# 10th Edition of the Large Hadron Collider Physics Conference


# Report of Contributions

https://indico.cern.ch/e/1109611

Contribution ID: **511** Contribution code: **P-I** Type: **Talk**

# Prospects for non-conventional future experiments

*Tuesday 17 May 2022 13:30 (24 minutes)*

**Presenter:** BATELL, Brian Thomas (University of Pittsburgh (US))

**Session Classification:** Plenary I: Beyond the Standard Model - Feeble Interactions

Contribution ID: **512** Type: **Talk**

# Ideas and motivation for feebly-interacting sector

*Tuesday 17 May 2022 12:00 (24 minutes)*

**Presenter:** THAMM, Andrea (University of Melbourne (AU))

**Session Classification:** Plenary I: Beyond the Standard Model - Feeble Interactions

Contribution ID: **513** Type: **Talk**

# Searches with displaced particles

*Tuesday 17 May 2022 13:00 (24 minutes)*

**Presenter:** ESCALANTE DEL VALLE, Alberto (Austrian Academy of Sciences (AT))

**Session Classification:** Plenary I: Beyond the Standard Model - Feeble Interactions

Contribution ID: **514** Type: **Talk**

# Searches with prompt particles

*Tuesday 17 May 2022 12:30 (24 minutes)*

**Presenter:** WU, Yusheng (University of Science and Technology of China (CN))

**Session Classification:** Plenary I: Beyond the Standard Model - Feeble Interactions

Contribution ID: **515** Type: **Talk**

# Heavy ions theory

*Tuesday 17 May 2022 16:45 (24 minutes)*

**Presenter:** NORONHA-HOSTLER, Jacquelyn (University of Illinois Urbana Champaign)

**Session Classification:** Plenary II: Heavy Ions

Contribution ID: **516** Type: **not specified**

# Universality across system size

*Tuesday 17 May 2022 17:15 (24 minutes)*

**Presenter:** KRIZKOVA GAJDOSOVA, Katarina (CERN)

**Session Classification:** Plenary II: Heavy Ions

Contribution ID: **517** Type: **Talk**

# Quark-gluon plasma properties

*Tuesday 17 May 2022 17:45 (24 minutes)*

**Presenter:** KRINTIRAS, Georgios (The University of Kansas (US))

**Session Classification:** Plenary II: Heavy Ions

Contribution ID: **518** Type: **Talk**

# Quark-gluon plasma evolution and hadronization

*Tuesday 17 May 2022 18:15 (24 minutes)*

**Presenter:** COLAMARIA, Fabio (INFN, Sezione di Bari (IT))

**Session Classification:** Plenary II: Heavy Ions

Contribution ID: **519** Type: **Talk**

# Electroweak theory

*Wednesday 18 May 2022 16:00 (20 minutes)*

**Presenter:** WACKEROTH, Doreen (SUNY Buffalo)

**Session Classification:** Plenary IV: Electroweak & Higgs Physics

Contribution ID: **520** Type: **Talk**

# Electroweak precision measurements

*Wednesday 18 May 2022 16:24 (20 minutes)*

**Presenter:** XU, Menglin (University of Warwick (GB))

**Session Classification:** Plenary IV: Electroweak & Higgs Physics

Contribution ID: **521** Type: **Talk**

# Multiboson measurements

*Wednesday 18 May 2022 16:48 (20 minutes)*

**Presenter:** MEHTA, Ankita (University of Hamburg)

**Session Classification:** Plenary IV: Electroweak & Higgs Physics

Contribution ID: **522** Type: **not specified**

# VBF and VBS measurements

*Wednesday 18 May 2022 17:12 (20 minutes)*

**Presenter:** NIELSEN, Jason (University of California,Santa Cruz (US))

**Session Classification:** Plenary IV: Electroweak & Higgs Physics

Contribution ID: **523** Type: **Talk**

# Effective Field Theory (EW, Higgs & Top)

*Wednesday 18 May 2022 17:36 (20 minutes)*

**Presenter:** YOU, Tiann Tevong (Imperial College Sci., Tech. & Med. (GB))

**Session Classification:** Plenary IV: Electroweak & Higgs Physics

Contribution ID: **524** Type: **not specified**

# Heavy flavour theory

*Wednesday 18 May 2022 12:00 (24 minutes)*

**Presenter:** BLANKE, Monika (Karlsruhe Institute of Technology)

**Session Classification:** Plenary III: Flavour Physics

Contribution ID: **525** Type: **not specified**

# Rare decays

*Wednesday 18 May 2022 12:30 (24 minutes)*

**Presenter:** POLIKARPOV, Sergey

**Session Classification:** Plenary III: Flavour Physics

Contribution ID: **526** Type: **not specified**

# Test of lepton flavor universality

*Wednesday 18 May 2022 13:00 (24 minutes)*

**Presenter:** SIMI, Gabriele (Universita e INFN, Padova (IT))

**Session Classification:** Plenary III: Flavour Physics

Contribution ID: **527** Type: **not specified**

# CP violation and mixing in B and charm decays

*Wednesday 18 May 2022 13:30 (24 minutes)*

**Presenter:** OZCELIK, Ozlem (The University of Edinburgh (GB))

**Session Classification:** Plenary III: Flavour Physics

Contribution ID: **528** Type: **Talk**

# New ideas and signatures in electroweak-scale model building

*Thursday 19 May 2022 12:00 (24 minutes)*

**Presenter:** MURAYAMA, Hitoshi (University of California Berkeley (US))

**Session Classification:** Plenary V: Beyond the Standard Model - TeV Scale

Contribution ID: **529** Type: **Talk**

# Model building in relation to recent flavor anomalies

*Thursday 19 May 2022 12:30 (24 minutes)*

**Presenter:** GRELJO, Admir (Universitaet Bern (CH))

**Session Classification:** Plenary V: Beyond the Standard Model - TeV Scale

Contribution ID: **530** Type: **Talk**

# Heavy resonance searches

*Thursday 19 May 2022 13:00 (24 minutes)*

**Presenter:** CHEKANOV, Sergei (Argonne National Laboratory (US))

**Session Classification:** Plenary V: Beyond the Standard Model - TeV Scale

Contribution ID: **531** Type: **Talk**

# Non-resonant searches for new physics

*Thursday 19 May 2022 13:30 (24 minutes)*

**Presenter:** HATAKEYAMA, Kenichi (Baylor University (US))

**Session Classification:** Plenary V: Beyond the Standard Model - TeV Scale

Contribution ID: **532** Type: **Talk**

# Precision Higgs theory

*Wednesday 18 May 2022 18:00 (20 minutes)*

**Presenter:** HEINRICH, Gudrun (KIT)

**Session Classification:** Plenary IV: Electroweak & Higgs Physics

Contribution ID: **533** Type: **Talk**

# BSM Higgs theory

*Thursday 19 May 2022 16:15 (21 minutes)*

**Presenter:** GONÇALVES, Dorival (Oklahoma State University)

**Session Classification:** Plenary VI: Higgs & Top Physics

Contribution ID: **534** Type: **Talk**

# Precision Higgs experiment

*Wednesday 18 May 2022 18:24 (20 minutes)*

**Presenter:** KOENEKE, Karsten (Albert Ludwigs Universitaet Freiburg (DE))

**Session Classification:** Plenary IV: Electroweak & Higgs Physics

Contribution ID: **535** Type: **Talk**

# Rare & BSM Higgs experiment

*Thursday 19 May 2022 16:40 (21 minutes)*

**Presenter:** NOVAK, Andrzej (RWTH Aachen (DE))

**Session Classification:** Plenary VI: Higgs & Top Physics

Contribution ID: **536** Type: **Talk**

# Top theory

*Thursday 19 May 2022 17:05 (21 minutes)*

**Presenter:** FREDERIX, Rikkert (Lund University)

**Session Classification:** Plenary VI: Higgs & Top Physics

Contribution ID: **537** Type: **Talk**

# Top precision measurements

*Thursday 19 May 2022 17:30 (21 minutes)*

**Presenter:** GONZALEZ, Juan (Universidad de Oviedo (ES))

**Session Classification:** Plenary VI: Higgs & Top Physics

Contribution ID: **538** Type: **Talk**

# Top properties and tests in top quark decays

*Thursday 19 May 2022 17:55 (21 minutes)*

**Presenter:** OWEN, Mark Andrew (University of Glasgow (GB))

**Session Classification:** Plenary VI: Higgs & Top Physics

Contribution ID: **539** Type: **Talk**

# Rare production and decay processes

*Thursday 19 May 2022 18:20 (21 minutes)*

**Presenter:** CASTRO, Nuno (LIP and University of Minho (PT))

**Session Classification:** Plenary VI: Higgs & Top Physics

Contribution ID: **540** Type: **Talk**

# High-pt QCD theory

*Friday 20 May 2022 12:00 (20 minutes)*

**Presenter:** ZHU, Huaxing (ZJU - Zhejiang University (CN))

**Session Classification:** Plenary VII: QCD Physics

Contribution ID: **541** Type: **Talk**

# High-pt QCD measurements

*Friday 20 May 2022 12:24 (20 minutes)*

**Presenter:** LLORENTE MERINO, Javier (Simon Fraser University (CA))

**Session Classification:** Plenary VII: QCD Physics

Contribution ID: **542** Type: **Talk**

# Soft QCD theory

*Friday 20 May 2022 12:48 (20 minutes)*

**Presenter:** SJOSTRAND, Torbjorn (Lund University (SE))

**Session Classification:** Plenary VII: QCD Physics

Contribution ID: **543** Type: **Talk**

# Spectroscopy and hadronic structure measurements

*Friday 20 May 2022 13:36 (20 minutes)*

**Presenter:** SPADARO NORELLA, Elisabetta (Università degli Studi e INFN Milano (IT))

**Session Classification:** Plenary VII: QCD Physics

Contribution ID: **544** Type: **Talk**

# ALICE upgrades

*Friday 20 May 2022 14:15 (20 minutes)*

**Presenter:** URAS, Antonio (Centre National de la Recherche Scientifique (FR))

**Session Classification:** Plenary VIII: Upgrades and Future Projects

Contribution ID: **545** Type: **Talk**

# ATLAS upgrades

*Friday 20 May 2022 14:39 (20 minutes)*

**Presenter:** VARI, Riccardo (Sapienza Universita e INFN, Roma I (IT))

**Session Classification:** Plenary VIII: Upgrades and Future Projects

Contribution ID: **546** Type: **Talk**

# CMS upgrades

*Friday 20 May 2022 15:03 (20 minutes)*

**Presenter:** PASZTOR, Gabriella (Eötvös University, Budapest)

**Session Classification:** Plenary VIII: Upgrades and Future Projects

Contribution ID: **547** Type: **Talk**

# LHCb upgrades

*Friday 20 May 2022 15:27 (20 minutes)*

**Presenter:** COLLINS, Paula (CERN)

**Session Classification:** Plenary VIII: Upgrades and Future Projects

Contribution ID: **548** Type: **Talk**

# Physics at HL-LHC and future colliders

*Friday 20 May 2022 15:51 (20 minutes)*

**Presenter:** WANG, Liantao

**Session Classification:** Plenary VIII: Upgrades and Future Projects

Contribution ID: **549** Type: **Talk**

# Welcome

*Monday 16 May 2022 12:00 (5 minutes)*

**Presenter:** CHEN, Kai-Feng (National Taiwan University (TW))

**Session Classification:** Opening Plenary

Contribution ID: **550** Type: **Talk**

# Overall CERN view, status and plans

*Monday 16 May 2022 14:25 (20 minutes)*

**Presenter:** MNICH, Joachim Josef (CERN)

**Session Classification:** Opening Plenary

Contribution ID: **551** Type: **Talk**

# Status of the LHC

*Monday 16 May 2022 12:05 (20 minutes)*

**Presenter:** LAMONT, Mike (CERN)

**Session Classification:** Opening Plenary

Contribution ID: **552** Type: **Talk**

# CMS status and overview

*Monday 16 May 2022 12:30 (20 minutes)*

**Presenter:** OLSEN, Jim (Princeton University (US))

**Session Classification:** Opening Plenary

Contribution ID: **553** Type: **Talk**

# ATLAS status and overview

*Monday 16 May 2022 12:55 (20 minutes)*

**Presenter:** KADO, Marumi (Sapienza Universita e INFN, Roma I (IT))

**Session Classification:** Opening Plenary

Contribution ID: **554** Type: **Talk**

# LHCb status and overview

*Monday 16 May 2022 13:35 (20 minutes)*

**Presenters:** PALUTAN, Matteo (Unknown); PALUTAN, Matteo (INFN e Laboratori Nazionali di Frascati (IT))

**Session Classification:** Opening Plenary

Contribution ID: **555** Type: **Talk**

# ALICE status and overview

*Monday 16 May 2022 14:00 (20 minutes)*

**Presenter:** MUSA, Luciano (CERN)

**Session Classification:** Opening Plenary

Contribution ID: **556** Type: **Talk**

# Diversity, inclusion and outreach report

*Monday 16 May 2022 14:50 (10 minutes)*

**Presenter:** BERRY, Tracey (University of London (GB))

**Session Classification:** Opening Plenary

Contribution ID: **557** Type: **Talk**

# Report from the LHC experiments' young scientist forums

*Friday 20 May 2022 16:45 (10 minutes)*

**Presenter:** FLOR, Fernando Antonio (University of Houston (US))

**Session Classification:** Closing Plenary

Contribution ID: **558** Type: **Talk**

# LHCP International Advisory Committee report

*Friday 20 May 2022 16:30 (5 minutes)*

**Presenter:** BOSE, Tulika (University of Wisconsin Madison (US))

**Session Classification:** Closing Plenary

Contribution ID: **559** Type: **Talk**

# Poster award presentation

*Friday 20 May 2022 16:35 (10 minutes)*

**Presenter:** FIORINI, Luca (Univ. of Valencia and CSIC (ES))

**Session Classification:** Closing Plenary

Contribution ID: **560** Type: **Talk**

# Status and prospects for quantum computation (invited)

*Friday 20 May 2022 17:00 (30 minutes)*

**Presenter:** YEH, Ping (Google, Inc)

**Session Classification:** Closing Plenary

Contribution ID: **561** Type: **Talk**

# Experimental highlights from LHCP 2022

*Friday 20 May 2022 17:35 (30 minutes)*

**Presenter:** PEPE-ALTARELLI, Monica (CERN)

**Session Classification:** Closing Plenary

Contribution ID: **562** Type: **Talk**

# Theory perspective

*Friday 20 May 2022 18:10 (30 minutes)*

**Presenter:** CARENA LOPEZ, Marcela Silvia (Fermi National Accelerator Lab. (US))

**Session Classification:** Closing Plenary

Contribution ID: **563** Type: **not specified**

# Closing remarks

*Friday 20 May 2022 18:45 (5 minutes)*

**Presenters:** CHARLTON, Dave (University of Birmingham (GB)); RAHATLOU, Shahram (Sapienza Universita e INFN, Roma I (IT))

**Session Classification:** Closing Plenary

Contribution ID: **565** Type: **Theory poster**

# Muonic charged Higgs boson discovery channel at the LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

The ATLAS and CMS experiments have an ambitious search program for charged Higgs bosons. The two main searches for $H^{\pm}$ at the LHC have traditionally been performed in the $\tau\nu$ and $tb$ decay channels, as they provide the opportunity to probe complementary regions of the Minimal SuperSymmetric Model (MSSM) parameter space. Charged Higgs bosons may decay also to light quarks, $H^{\pm} \to cs/cb$, which represent an additional probe for the mass range below $m_t$. In this work, we focus on $H^{\pm} \to \mu\nu$ as an alternative channel in the context of two Higgs doublet model type III. We explored the prospect of looking $pp \to tbH^{\pm}$, followed by $H^{\pm} \to \mu\nu$ signal at the LHC. Such a scenario appears in 2HDM type-III where couplings of the charged Higgs are enhanced to $\mu\nu$. Almost all the experimental searches rely on the production and decay of the charged Higgs are taken into account. We show that for a such scenario, the above signal is dominant for most of the parameter space, and $H^{\pm} \to \mu\nu$ can be an excellent complementary search.

**Author:** Mr BOUKIDI, Mohammed (Cadi Ayyad University, Marrakech)

**Co-authors:** Prof. BENBRIK, Rachid (Cadi Ayyad University, Marrakech); Dr SEMLALI, Souad (School of Physics and Astronomy, University of Southampton); Prof. MANAUT, Bouzid (Sultan Moulay Slimane University); Prof. TAJ, Souad (Sultan Moulay Slimane University); OUCHEMHOU, Mohamed (Cadi Ayyad University, Marrakech)

**Presenter:** Mr BOUKIDI, Mohammed (Cadi Ayyad University, Marrakech)

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **566** Type: **Theory poster**

# Multi-partonic cascades in expanding medium

*Tuesday 17 May 2022 19:00 (1 hour)*

In this work, we introduce both gluon and quark degrees of freedom for describing the partonic cascades inside the medium. We present numerical solutions for the set of coupled evolution equations with splitting kernels calculated for the static, exponential and Bjorken expanding media to arrive at medium-modified parton spectra for quark and gluon initiated jets respectively. We discuss novel scaling features of the partonic spectra between different types of media. Next, we study the inclusive jet by including phenomenologically driven combinations of quark and gluon fractions inside a jet. In addition, we have also studied the effect of the nPDF as well as vacuum like emissions on the jet . Differences among the estimated values of quenching parameter for different types of medium expansions are noted. Next, the impact of the expansion of the medium on the rapidity dependence of the jet as well as jet $v_2$ are studied in detail. Finally, we present qualitative results comparing the sensitivity of the time for the onset of the quenching for the Bjorken profile on these observables. All the quantities calculated are compared with the recent ATLAS data.

**Authors:** SALGADO LOPEZ, Carlos Albert (Universidade de Santiago de Compostela (ES)); Mr ADHYA, Souvik Priyam (Institute of Nuclear Physics, Polish Academy of Sciences); TYWONIUK, Konrad (University of Bergen (NO)); SPOUSTA, Martin (Charles University)

**Presenter:** Mr ADHYA, Souvik Priyam (Institute of Nuclear Physics, Polish Academy of Sciences)

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **567** Type: **Theory poster**

# Extended relaxation time approximation and relativistic dissipative hydrodynamics

*Tuesday 17 May 2022 19:00 (1 hour)*

Development of a new framework for the derivation of order-by-order hydrodynamics from the Boltzmann equation is necessary as the widely used Anderson-Witting formalism leads to violation of fundamental conservation laws when the relaxation-time depends on particle energy, or in a hydrodynamic frame other than the Landau frame. We generalize an existing framework for the consistent derivation of relativistic dissipative hydrodynamics from the Boltzmann equation with an energy-dependent relaxation-time by extending the Anderson-Witting relaxation-time approximation. We argue that the present framework is compatible with conservation laws and derives first-order hydrodynamic equations in the landau frame. Further, we show that the transport coefficients, such as shear and bulk viscosity as well as charge and heat diffusion currents, have corrections due to the energy dependence of relaxation-time compared to what one obtains from the Anderson-Witting approximation of the collision term. The ratio of these transport coefficients are studied using a parametrized relaxation time, and several interesting scaling features are reported.

**Author:** Mrs DASH, Dipika (NISER, Bhubaneswar)

**Co-authors:** Mr BHADURY, Samapan (NISER, Bhubaneswar); Mr JAISWAL, Sunil (TIFR, Mumbai); Dr JAISWAL, Amaresh (NISER, Bhubaneswar)

**Presenter:** Mrs DASH, Dipika (NISER, Bhubaneswar)

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **569** Type: **Experimental poster**

# A new Scattering and Neutrino Detector at the LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

SND@LHC is a compact and stand-alone experiment to perform measurements with neutrinos produced at the LHC in a hitherto unexplored pseudo-rapidity region of 7.2 < ⊠ < 8.6, complementary to all the other experiments at the LHC. The experiment is located 480 m downstream of IP1 in the unused TI18 tunnel. The detector is composed of a hybrid system based on an 800 kg target mass of tungsten plates, interleaved with emulsion and electronic trackers, followed downstream by a calorimeter and a muon system. The configuration allows efficiently distinguishing between all three neutrino flavours, opening a unique opportunity to probe physics of heavy flavour production at the LHC in the region that is not accessible to ATLAS, CMS and LHCb. This region is of particular interest also for future circular colliders and for predictions of very high-energy atmospheric neutrinos. The detector concept is also well suited to searching for Feebly Interacting Particles via signatures of scattering in the detector target. The first phase aims at operating the detector throughout LHC Run 3 to collect a total of 150 $fb^{-1}$. The experiment was recently approved by the Research Board at CERN and its detector is being commissioned. A new era of collider neutrino physics is just starting.

**Author:** GRAVERINI, Elena (EPFL - Ecole Polytechnique Federale Lausanne (CH))

**Presenter:** DE SIMONE, Dario (University of Zurich (CH))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **570** Type: **not specified**

# Soft QCD experiment

*Friday 20 May 2022 13:12 (20 minutes)*

**Presenter:** OPPEDISANO, Chiara (Universita e INFN Torino (IT))

**Session Classification:** Plenary VII: QCD Physics

Contribution ID: **572** Type: **Theory poster**

# Lepton and quark mixing patterns with generalized $CP$ transformations

*Tuesday 17 May 2022 19:00 (1 hour)*

In this work, we have modified a scenario, originally proposed by Grimus and Lavoura, in order to obtain maximal values for atmospheric mixing angle and $CP$ violating Dirac phase of the lepton sector. To achieve this, we have employed $CP$ and some discrete symmetries in a type II seesaw model. In order to make predictions about neutrino mass ordering and the smallness of the reactor angle, we have obtained some conditions on the elements of the neutrino mass matrix of our model. Finally, within the framework of our model, we have studied quark masses and mixing pattern.

**Author:** GANGULY, Joy

**Co-author:** Dr HUNDI, Raghavendra Srikanth (Indian Institute of Technology Hyderabad)

**Presenter:** GANGULY, Joy

**Session Classification:** Poster Session I

**Track Classification:** Flavour Physics

Contribution ID: **573** Type: **Experimental poster**

# Prospects for dark boson searches via exotic Higgs decays in Run 3 and high luminosity era of the LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

We investigate the potential reach of a search for a long-lived dark vector boson, a dark $Z$ or $Z_D$, through exotic decays of the standard model (SM) Higgs boson $h$ into either $Z_D Z_D$ or $Z Z_D$. In addition, we study a decay of $h$ into two dark Higgs bosons $h_D h_D$. We consider the production of the SM Higgs boson at the large hadron collider (LHC) via gluon-gluon fusion and use production cross sections for Run 3 of the LHC (i.e., 14 TeV) calculated to a combination of next-to-next-to-next-to-leading order with QCD corrections (N$^3$LO QCD) and next-to-leading order with electroweak corrections (NLO EW) from the literature. The $Z_D$ production through the Higgs portal is completed via one of two mechanisms, kinetic mixing of $Z_D$ with the SM $Z$ boson and the mixing of $h_D$ with $h$. The branching fractions are calculated to NLO and scanned over the relevant mixing parameters and particle masses in Monte Carlo (MC) simulation using the {\textsc{MadGraph5}}_aMC@NLO v2.7.0 framework. We focus on a final state of multiple dimuon pairs, displaced up to \mbox{7500 mm}, where the muons can be reconstructed without vertex constraint using data from the ATLAS and CMS detectors to be collected in Run˜3 of the LHC. Integrated luminosities of 300 and 3000 fb$^{-1}$ for Run 3 and High Luminosity (HL), respectively, of the LHC are used for estimating the expected search sensitivity of the LHC to each decay mode. Finally, we investigate the decay lengths of $Z_D$ and $h_D$ in the detectors as well as kinematics of the displaced dimuons in the final state.

**Author:** ELKAFRAWY, Tamer (Florida Institute of Technology (US))

**Co-authors:** HOHLMANN, Marcus (Florida Institute of Technology (US)); RAHMANI, Mehdi (Florida Institute of Technology (US)); PADLEY, Paul (Rice University (US)); KAMON, Teruki (Texas A & M University (US)); KIM, Hyunyong (Texas A & M University (US))

**Presenter:** ELKAFRAWY, Tamer (Florida Institute of Technology (US))

**Session Classification:** Poster Session I

**Track Classification:** Feeble Interactions BSM

Contribution ID: **574** Type: **Theory poster**

# Light nuclei production with/without critical fluctuation

*Tuesday 17 May 2022 19:00 (1 hour)*

Light nuclei production is a hot research topic in heavy-ion collision at RHIC-BES. The observed non-monotonic behavior with the colliding energies[1,2] was declared to be related to the critical point of the QCD phase diagram[3,4]. In this talk, we focus on investigating the light nuclei production with and without critical fluctuations within the framework of the coalescence model.

In the first part [5], we derive the yield of light nuclei in terms of various orders of cumulants for the density distribution function by the implementation of the characteristic function of the phase space density without considering the critical fluctuations. We found that the leading terms of the phase-space cumulants in the yield of light nuclei share a similar form and could be canceled out in light nuclei ratio, whereas the higher-order ones (non-Gaussian shaped density profile) remain and play an important role in the interpretation of the behavior of light nuclei yield ratio.

In the second part [6], we introduce the static critical correlation contribution to the phase space density and derive the light nuclei production in terms of phase space cumulant. Because the leading terms of the phase-space cumulants in the yield of light nuclei share the similar form, we can construct a new light nuclei yield ratio, which is directly proportional to the critical contribution. By mapping the equation of state from the three-dimension Ising model, the new light nuclei yield ratio can describe the experiment measurements[1,2], which indicate the existence of QCD critical point and its effect on light nuclei production.

[1] H. Liu, D. Zhang, S. He, K.-j. Sun, N. Yu, and X. Luo, Phys. Lett. B 805, 135452 (2020).
[2] D. Zhang (STAR), JPS Conf. Proc. 32, 010069 (2020).
[3] E. Shuryak and J M.Torres-Rincon, Eur.Phys.J.A 56 (2020) 9,241.
[4] K.-j. Sun, F.Li and C.M.Ko, Phys.Lett.B 816 (2021) 136258.
[5] S.Wu, K.Murase, S.Tang and H.Song, in preparation.
[6] S.Wu, K.Murase, S.Zhao and H.Song, in preparation.

**Author:** WU, Shanjin

**Co-authors:** MURASE, Koichi (Yukawa Institute for Theoretical Physics, Kyoto University); SONG, Huichao

**Presenter:** WU, Shanjin

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **575** Type: **Theory poster**

# Spin magnetohydrodynamics

*Tuesday 17 May 2022 19:00 (1 hour)*

We extend the classical phase-space distribution function to include the spin and electromagnetic fields coupling and derive the modified constitutive relations for charge current, energy-momentum tensor, and spin tensor. Because of the coupling, the new tensors receive corrections to their perfect-fluid counterparts and make the background and spin fluid equations of motion communicate with each other. We investigate special cases which are relevant in high-energy heavy-ion collisions, including baryon free matter and large mass limit. Using Bjorken symmetries, we find that spin polarization increases with increasing magnetic field for an initially positive baryon chemical potential. The corrections derived in this framework may help to explain the splitting observed in Lambda hyperons spin polarization measurements.

**Author:** Mr SINGH, Rajeev (Institute of Nuclear Physics Polish Academy of Sciences)

**Presenter:** Mr SINGH, Rajeev (Institute of Nuclear Physics Polish Academy of Sciences)

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **576** Type: **Experimental poster**

# Constraining Deep Neural Network classifiers' systematic uncertainty via input feature space reduction

*Tuesday 17 May 2022 19:00 (1 hour)*

In current and future high-energy physics experiments, the sensitivity of selection-based analysis will increasingly depend on the choice of the set of high-level features determined for each collision. The complexity of event reconstruction algorithms has escalated in the last decade, and thousands of parameters are available for analysts. Deep Learning approaches are widely used to improve the selection performance in physics analysis.
In many cases, the development of the algorithm is based on a brute force approach where all the possible combinations of available neural network architectures are tested using all the available parameters. A crucial aspect is that the results from a model based on a large number of input variables are more difficult to explain and understand. This point becomes relevant for neural network models since they do not provide uncertainty estimation and are often treated as perfect tools, which they are not.

In this work, we show how using a sub-optimal set of input features can lead to higher systematic uncertainty associated with classifier predictions. We also present an approach to selecting an optimal set of features using ensemble learning algorithms. For this study, we considered the case of highly boosted di-jet resonances produced in $pp$ collisions decaying to two $b$-quarks to be selected against an overwhelming QCD background. Results from a Monte Carlo simulation with HEP pseudo-detectors are shown.

**Author:** Mr DI LUCA, Andrea (Universita degli Studi di Trento and INFN (IT))

**Presenter:** Mr DI LUCA, Andrea (Universita degli Studi di Trento and INFN (IT))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **577** Type: **not specified**

# Test talk 1

**Session Classification:** Electroweak Physics

Contribution ID: **578** Type: **Talk**

# Higgs decays to bosons at ATLAS and CMS

*Tuesday 17 May 2022 14:15 (17 minutes)*

**Presenter:** BASSO, Matthew (University of Toronto (CA))

**Session Classification:** Higgs Physics

Contribution ID: **579** Type: **not specified**

# CPV & mixing in beauty sector: experimental overview

*Monday 16 May 2022 15:15 (18 minutes)*

**Presenter:** JAKOUBEK, Tomas (Weizmann Institute of Science (IL))

**Session Classification:** Flavour Physics

Contribution ID: **580** Type: **not specified**

# CPV & mixing in beauty sector: theoretical overview

*Monday 16 May 2022 15:37 (18 minutes)*

**Presenter:** MALAMI, Eleftheria

**Session Classification:** Flavour Physics

Contribution ID: **581** Type: **not specified**

# CPV & mixing in charm sector: experimental overview

*Monday 16 May 2022 15:59 (18 minutes)*

**Presenter:** WILLIAMS, Mark Richard James (The University of Edinburgh (GB))

**Session Classification:** Flavour Physics

Contribution ID: **582** Type: **not specified**

# CPV & mixing in charm sector: theoretical overview

*Monday 16 May 2022 16:21 (18 minutes)*

**Presenter:** LENZ, Alexander (Siegen University)

**Session Classification:** Flavour Physics

Contribution ID: **583** Type: **not specified**

# Overview of rare decays of B mesons at LHC

*Tuesday 17 May 2022 14:38 (20 minutes)*

**Presenter:** NAYAK, Samarendra (Indian Institute of Technology Bhubaneswar)

**Session Classification:** Flavour Physics

Contribution ID: **584** Type: **not specified**

# Rare decays of B and D mesons at LHCb

*Tuesday 17 May 2022 15:01 (20 minutes)*

**Presenter:** AGAPOPOULOU, Christina (Centre National de la Recherche Scientifique (FR))

**Session Classification:** Flavour Physics

Contribution ID: **585** Type: **not specified**

# Lattice QCD: form factors for $b \to s\ell\ell$ and $b \to c\ell\nu$

*Tuesday 17 May 2022 14:15 (20 minutes)*

**Presenter:** MEINEL, Stefan (University of Arizona)

**Session Classification:** Flavour Physics

Contribution ID: **586** Type: **not specified**

# Searches for lepton-flavour violating decays (experimental overview)

*Tuesday 17 May 2022 15:24 (20 minutes)*

**Presenter:** SUN, Liang (Wuhan University (CN))

**Session Classification:** Flavour Physics

Contribution ID: **587** Type: **not specified**

# Recent results from the Belle II experiment

*Tuesday 17 May 2022 15:47 (20 minutes)*

**Presenter:** NISHIDA, Shohei

**Session Classification:** Flavour Physics

Contribution ID: **588** Type: **not specified**

# New ideas in rare decays $(b, c, s)$, proposals for new measurements

*Tuesday 17 May 2022 16:10 (20 minutes)*

**Presenter:** BORDONE, Marzia (CERN)

**Session Classification:** Flavour Physics

Contribution ID: **589** Type: **not specified**

# Experimental overview of semileptonic decays ($b \to c$, $b \to u$)

*Thursday 19 May 2022 14:15 (20 minutes)*

**Presenter:** GARCIA PARDINAS, Julian (Universita & INFN, Milano-Bicocca (IT))

**Session Classification:** Flavour Physics

Contribution ID: **590** Type: **not specified**

# Lifetime of the $B_c^+$ meson in relation to flavour anomalies

*Thursday 19 May 2022 15:26 (20 minutes)*

**Presenter:** GRINSTEIN, Benjamin (Univ. of California San Diego (US))

**Session Classification:** Flavour Physics

Contribution ID: **591** Type: **not specified**

# Status of the Cabibbo angle anomaly

*Thursday 19 May 2022 14:38 (20 minutes)*

**Presenter:** MANZARI, Claudio Andrea (University of Zurich (CH))

**Session Classification:** Flavour Physics

Contribution ID: **592** Type: **not specified**

# Status of the unitarity triangle and $V_{ub}, V_{cb}$

*Thursday 19 May 2022 15:01 (23 minutes)*

**Presenter:** BONA, Marcella (Queen Mary University of London (UK))

**Session Classification:** Flavour Physics

Contribution ID: **593** Type: **Experimental poster**

# Dedicated Triggers for Displaced Jets using Timing Information from Electromagnetic Calorimeter at HL-LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

In this paper, we study the prospect of ECAL barrel timing to develop triggers dedicated to long-lived particles decaying to jets at the level-1 of HL-LHC. We construct over 20 timing-based variables, and identify three of them which have better performances and are robust against increasing PU. We estimate the QCD prompt jet background rates accurately using the "stitching" procedure for varying thresholds defining our triggers and compute the signal efficiencies for different LLP scenarios for a permissible background rate. The trigger efficiencies can go up to $\mathcal{O}(80\%)$ for the most optimal trigger for pair-produced heavy LLPs having high decay lengths, which degrades with decreasing mass and decay length of the LLP. We also discuss the prospect of including the information of displaced L1 tracks to our triggers, which further improves the results, especially for LLPs characterised by lower decay lengths.

**Authors:** BHATTACHERJEE, BIPLOB (Indian Institute of Science); SOLANKI, Prabhat (Indian Institute of Science, Bengaluru, India); SENGUPTA, Rhitaja; GHOSH, Tapasi (IFIC, Valencia)

**Presenter:** SOLANKI, Prabhat (Indian Institute of Science, Bengaluru, India)

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **594** Type: **Theory poster**

# Long-Lived Light Mediators from Higgs boson Decay at HL-LHC, FCC-hh and a Proposal of Dedicated LLP Detectors for FCC-hh

*Tuesday 17 May 2022 19:00 (1 hour)*

We study the pair production of the long-lived mediator particles from the decay of the SM Higgs boson and their subsequent decay into standard model particles. We compute the projected sensitivity, both model-independently and with a minimal model, of using the muon spectrometer of the CMS detector at the HL-LHC experiment for ggF, VBF, and Vh production modes of the Higgs boson and various decay modes of the mediator particle, along with dedicated detectors for LLP searches like CODEX-b and MATHUSLA. Subsequently, we study the improvement with the FCC-hh detector at the 100 TeV collider experiment for such long-lived mediators, again focusing on the muon spectrometer. We propose dedicated LLP detector designs for the 100 TeV collider experiment, DELIGHT (\textbf{De}tector for \textbf{l}ong-l\textbf{i}ved particles at hi\textbf{gh} energy of 100 \textbf{T}eV), and study their sensitivities.

**Authors:** BHATTACHERJEE, BIPLOB (Indian Institute of Science); MATSUMOTO, Shigeki (Kavli IPMU); SENGUPTA, Rhitaja

**Presenter:** SENGUPTA, Rhitaja

**Session Classification:** Poster Session I

**Track Classification:** Feeble Interactions BSM

Contribution ID: **595** Type: **Theory poster**

# Constraining 3-3-1 Models at the LHC and Future Hadron Colliders

*Tuesday 17 May 2022 19:00 (1 hour)*

In this work, we derive lower mass bounds on the $Z'$ gauge boson based on the dilepton data from LHC with 13 TeV of center-of-mass energy, and forecast the sensitivity of the High-Luminosity-LHC with $L = 3000 fb^{-1}$, the High-Energy LHC with $\sqrt{s} = 27$˜TeV, and also at the Future Circular Collider with $\sqrt{s} = 100$˜TeV. We take into account the presence of exotic and invisible decays of the $Z'$ gauge boson to find a more conservative and robust limit, different from previous studies. We investigate the impact of these new decays channels for several benchmark models in the scope of two different 3-3-1 models. We found that in the most constraining cases, LHC with $139 fb^{-1}$ can impose $m_{Z'} > 4$˜TeV. Moreover, we forecast HL-LHC, HE-LHC, and FCC bounds that yield $m_{Z'} > 5.8$˜ TeV, $m_{Z'} > 9.9$˜TeV, and $m_{Z'} > 27$˜TeV, respectively. Lastly, put our findings into perspective with dark matter searches to show the region of parameter space where a dark matter candidate with the right relic density is possible.

**Authors:** Ms SÁNCHEZ VILLAMIZAR, Yoxara (IIP & DFTE - Federal University of Rio Grande do Norte (UFRN)); ALVES, Alexandre (Universidade Federal de São Paulo / UNIFESP); Ms OVIEDO-TORRES, Yohan; QUEIROZ, FARINALDO; KOVALENKO, Sergey (Universidad Andres Bello (CL)); Ms DUARTE, Laura

**Presenter:** Ms SÁNCHEZ VILLAMIZAR, Yoxara (IIP & DFTE - Federal University of Rio Grande do Norte (UFRN))

**Session Classification:** Poster Session I

**Track Classification:** TeV-Scale BSM

Contribution ID: **596** Type: **not specified**

# Low energy SUSY in light of current experiments

*Tuesday 17 May 2022 14:15 (15 minutes)*

**Presenter:** YANG, Jin Min

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **597** Type: **not specified**

# RPV Models Overview

*Tuesday 17 May 2022 14:33 (15 minutes)*

**Presenter:** NANGIA, Saurabh

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **598** Type: **not specified**

# EW SUSY searches at ATLAS and CMS (including charginos, neutralino and sleptons, soft susy)

*Tuesday 17 May 2022 14:51 (15 minutes)*

**Presenter:** APARO, Marco (University of Sussex (GB))

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **599** Type: **not specified**

# 3G SUSY searches at ATLAS and CMS (stop, sbottom, gluinos and squarsk if new result available)

*Tuesday 17 May 2022 15:09 (15 minutes)*

**Presenter:** KAMON, Teruki (Texas A & M University (US))

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **600** Type: **not specified**

# Searches for RPV SUSY in ATLAS, CMS and LHCb

*Tuesday 17 May 2022 15:27 (15 minutes)*

**Presenter:** KARMAKAR, Saikat (Tata Inst. of Fundamental Research (IN))

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **601** Type: **not specified**

# Non-minimal VLQ models

*Tuesday 17 May 2022 15:45 (15 minutes)*

**Presenter:** AGUILAR SAAVEDRA, Juan Antonio (Consejo Superior de Investigaciones Cientificas (CSIC) (ES))

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **602** Type: **not specified**

# Search for heavy particles decaying to 3rd generation quarks at CMS and ATLAS

*Tuesday 17 May 2022 16:03 (15 minutes)*

**Presenter:** ZHENG, Zhi (SLAC National Accelerator Laboratory (US))

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **603** Type: **not specified**

# Theoretical Overview on novel BSM models

*Thursday 19 May 2022 14:15 (17 minutes)*

**Presenter:** ARCADI, Giorgio

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **604** Type: **not specified**

# Non collider experiments results on Dark Matter

*Thursday 19 May 2022 14:32 (17 minutes)*

**Presenters:** D'IMPERIO, Giulia (Sapienza Universita e INFN, Roma I (IT)); D'IMPERIO, Giulia (Universita di Roma I 'La Sapienza'-Universita e INFN, Roma I)

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **605** Type: **not specified**

# Mono-X searches in ATLAS and CMS

*Thursday 19 May 2022 14:49 (17 minutes)*

**Presenter:** BRUERS, Ben (Deutsches Elektronen-Synchrotron (DE))

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **606** Type: **not specified**

# Search for low and high mass mediators in ATLAS and CMS (dilepton, dijet)

*Thursday 19 May 2022 15:06 (17 minutes)*

**Presenter:** SAOULIDOU, Niki (National and Kapodistrian University of Athens (GR))

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **607** Type: **not specified**

# Resonant and non resonant searches at ATLAS and CMS

*Thursday 19 May 2022 15:23 (17 minutes)*

**Presenter:** GHOSH, Saranya Samik (CERN)

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **608** Type: **not specified**

# ATLAS + CMS Searches for Di-/Tri-boson resonances

*Thursday 19 May 2022 15:40 (17 minutes)*

**Presenter:** ZOI, Irene (Fermi National Accelerator Lab. (US))

**Session Classification:** BSM 1 - TeV Scale

Contribution ID: **609** Type: **not specified**

# Theory overview on dark matter portals

*Monday 16 May 2022 17:00 (20 minutes)*

**Presenter:** KIM, Doojin (Texas A & M University (US))

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **610** Type: **not specified**

# Theory overview on dark showers

*Monday 16 May 2022 17:25 (20 minutes)*

**Presenter:** DESAI, Nishita (Tata Institute of Fundamental Research)

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **611** Type: **not specified**

# Searches for displaced jets at the LHC

*Monday 16 May 2022 17:50 (20 minutes)*

**Presenter:** DARWISH, Mohamed (University of Antwerp (BE))

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **612** Type: **not specified**

# Searches for displaced vertices at the LHC

*Monday 16 May 2022 18:15 (20 minutes)*

**Presenter:** HENRY, Louis (CERN)

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **613** Type: **not specified**

# Examining W, g-2, and DM anomalies with the NMSSM

*Wednesday 18 May 2022 14:37 (18 minutes)*

**Presenter:** TSAI, YUE-LIN (Purple Mountain Observatory, Chinese Academy of Sciences)

**Session Classification:** Joint Session 6

Contribution ID: **614** Type: **not specified**

# Searches for BSM in flavour (experiment: ATLAS, CMS, LHCb) - incl. B anomalies (perhaps g-2)

**Session Classification:** Joint Session 6

Contribution ID: **615** Type: **not specified**

# Direct searches at LHC in the context of B anomalies (exp: ATLAS, CMS, LHCb)

*Wednesday 18 May 2022 14:59 (18 minutes)*

**Presenters:** KAJOMOVITZ MUST, Enrique (Department of Physics); KAJOMOVITZ MUST, Enrique (Technion, Israel Institute of Technology)

**Session Classification:** Joint Session 6

Contribution ID: **616** Type: **not specified**

# TeV-scale BSM: models in context of flavour anomalies (theory)

*Wednesday 18 May 2022 14:15 (18 minutes)*

**Presenter:** SON, Minho (Korea Advanced Institute of Science and Technology)

**Session Classification:** Joint Session 6

Contribution ID: **617** Type: **not specified**

# Status of the FASER and SND@LHC experiments

*Tuesday 17 May 2022 14:40 (20 minutes)*

**Presenter:** LI, Ke (University of Washington (US))

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **618** Type: **not specified**

# Searches for light BSM in flavour decays (HNLs, FIP, etc –theory)

*Wednesday 18 May 2022 15:21 (18 minutes)*

**Presenter:** STAMOU, Emmanuel (TU Dortmund)

**Session Classification:** Joint Session 6

Contribution ID: **619** Type: **not specified**

# Status of the MATHUSLA, CODEX and ANUBIS experiments

*Tuesday 17 May 2022 14:15 (20 minutes)*

**Presenter:** HENRY, Louis (CERN)

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **620** Type: **not specified**

# Dedicated LLP experiments beyond the LHC

*Tuesday 17 May 2022 15:05 (20 minutes)*

**Presenter:** MOLINA BUENO, Laura (Univ. of Valencia and CSIC (ES))

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **621** Type: **not specified**

# Theory overview on millicharged particles and monopoles

*Tuesday 17 May 2022 15:30 (20 minutes)*

**Presenter:** TSAI, Yu-Dai (Fermilab)

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **622** Type: **not specified**

# Status of the MilliQan and MOEDAL experiments

*Tuesday 17 May 2022 15:55 (20 minutes)*

**Presenter:** CARRIGAN, Michael William (Ohio State University (US))

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **623** Type: **not specified**

# Theory overview on ALPs

*Thursday 19 May 2022 14:15 (20 minutes)*

**Presenter:** REDIGOLO, Diego (CERN-INFN Florence)

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **624** Type: **not specified**

# Searches for charged long-lived particles at the LHC

*Thursday 19 May 2022 14:40 (20 minutes)*

**Presenter:** OIDE, Hideyuki (Tokyo Institute of Technology (JP))

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **625** Type: **not specified**

# Searches for non-hadronic displaced objects not from a common vertex at the LHC

*Thursday 19 May 2022 15:05 (20 minutes)*

**Presenter:** SHAPIRO, Marjorie (Lawrence Berkeley National Lab. (US))

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **626** Type: **not specified**

# Prospects for LLPs searches at the LHC in Run 3 and HL-LHC

*Thursday 19 May 2022 15:30 (20 minutes)*

**Presenter:** SHCHUTSKA, Lesya (EPFL - Ecole Polytechnique Federale Lausanne (CH))

**Session Classification:** BSM 2 - Feeble Interactions

Contribution ID: **627** Type: **not specified**

# Searches for Dark Photons at LHC (full range mass) (ATLAS+CMS+LHCb)

*Monday 16 May 2022 15:15 (18 minutes)*

**Presenter:** MUKHERJEE, Swagata (Rheinisch Westfaelische Tech. Hoch. (DE))

**Session Classification:** Joint Session 1

Contribution ID: **628** Type: **not specified**

# Theory landscape of Heavy Neutral Leptons

*Monday 16 May 2022 15:37 (18 minutes)*

**Presenter:** RUIZ, Richard (Institute of Nuclear Physics (IFJ) PAN)

**Session Classification:** Joint Session 1

Contribution ID: **629** Type: **not specified**

# Searches for Heavy Neutral Leptons at LHC (ATLAS+CMS+LHCb)

*Monday 16 May 2022 15:59 (18 minutes)*

**Presenter:** LISTER, Alison (University of British Columbia (CA))

**Session Classification:** Joint Session 1

Contribution ID: **630** Type: **not specified**

# Dark matter searches complementarity and phase space coverage (ATLAS+CMS+LHCb)

*Monday 16 May 2022 16:21 (18 minutes)*

**Presenter:** BRANDT, Oleg (University of Cambridge (GB))

**Session Classification:** Joint Session 1

Contribution ID: **631** Type: **not specified**

# Di-Higgs production BSM models

*Monday 16 May 2022 17:00 (17 minutes)*

**Presenter:** ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

**Session Classification:** Joint Session 4

Contribution ID: **632** Type: **not specified**

# Gravitational Wave physics & Higgs

*Monday 16 May 2022 17:20 (17 minutes)*

**Presenter:** DORSCH, Glauber (Universidade Federal de Minas Gerais)

**Session Classification:** Joint Session 4

Contribution ID: **633** Type: **not specified**

# Exotic Higgs decays, incl. new scalars (ATLAS+CMS)

*Monday 16 May 2022 17:40 (17 minutes)*

**Presenter:** CARRATTA, Giuseppe (University and INFN, Bologna (IT))

**Session Classification:** Joint Session 4

Contribution ID: **634** Type: **not specified**

# Searches for Higgs boson decays to invisible particles in ATLAS and CMS

*Monday 16 May 2022 18:00 (17 minutes)*

**Presenters:** THOMAS, Laurent (Universite Libre de Bruxelles (BE)); THOMAS, Laurent (Universite Libre de Bruxelles (BE))

**Session Classification:** Joint Session 4

Contribution ID: **635** Type: **not specified**

# Searches for heavy resonances decaying to one or two Higgs bosons in CMS and ATLAS

*Monday 16 May 2022 18:20 (17 minutes)*

**Presenter:** SAKA, Halil (University of Cyprus (CY))

**Session Classification:** Joint Session 4

Contribution ID: **641** Type: **Talk**

# Single top production in association with a WZ pair at the LHC in the SMEFT

*Tuesday 17 May 2022 14:15 (20 minutes)*

**Presenter:** MIMASU, Ken (King's College London)

**Session Classification:** Top Physics

Contribution ID: **642** Type: **Talk**

# Single top production ATLAS+CMS

*Tuesday 17 May 2022 14:40 (20 minutes)*

**Presenter:** WENDLAND, Bjoern (Technische Universitaet Dortmund (DE))

**Session Classification:** Top Physics

Contribution ID: **643** Type: **Talk**

# EFT interpretation in top-quark sector ATLAS

*Tuesday 17 May 2022 15:05 (15 minutes)*

**Presenter:** LYSAK, Roman (Czech Academy of Sciences (CZ))

**Session Classification:** Top Physics

Contribution ID: **644** Type: **Talk**

# EFT interpretation in top-quark sector CMS

*Tuesday 17 May 2022 15:25 (15 minutes)*

**Presenter:** WILSON, Jon (Baylor University (US))

**Session Classification:** Top Physics

Contribution ID: **645** Type: **Talk**

# Flavor Changing Neutral Currents in top-quark decays ATLAS+CMS

*Tuesday 17 May 2022 15:45 (20 minutes)*

**Presenter:** CHEN, Xin (Tsinghua University (CN))

**Session Classification:** Top Physics

Contribution ID: **646** Type: **Talk**

# BSM searches in top-quark sector ATLAS+CMS

*Tuesday 17 May 2022 16:10 (15 minutes)*

**Presenter:** CHATTERJEE, Suman (Austrian Academy of Sciences (AT))

**Session Classification:** Top Physics

Contribution ID: **647** Type: **Talk**

# tt production CMS

*Monday 16 May 2022 17:00 (15 minutes)*

**Presenter:** PALENCIA CORTEZON, Jose Enrique (Universidad de Oviedo (ES))

**Session Classification:** Top Physics

Contribution ID: **648** Type: **Talk**

# tt production ATLAS

*Monday 16 May 2022 17:20 (15 minutes)*

**Presenter:** SERKIN, Leonid (INFN Gruppo Collegato di Udine and ICTP Trieste (IT))

**Session Classification:** Top Physics

Contribution ID: **649** Type: **not specified**

# B-hadron production in NNLO QCD: application to LHC tt events with leptonic decays

*Monday 16 May 2022 17:40 (20 minutes)*

**Presenter:** GENERET, Terry (RWTH Aachen University)

**Session Classification:** Top Physics

Contribution ID: **650** Type: **Talk**

# Hadronic production of ttZ in the POWHEG BOX framework

*Monday 16 May 2022 18:05 (15 minutes)*

**Presenter:** GHEZZI, Margherita (University of Tübingen)

**Session Classification:** Top Physics

Contribution ID: **651** Type: **Talk**

# Top-quark mass and properties ATLAS+CMS

*Monday 16 May 2022 18:25 (15 minutes)*

**Presenter:** WUCHTERL, Sebastian (Deutsches Elektronen-Synchrotron (DE))

**Session Classification:** Top Physics

Contribution ID: **652** Type: **Talk**

# Complete-NLO predictions for tt in association with at least one isolated photon

*Wednesday 18 May 2022 14:15 (20 minutes)*

**Presenter:** ZARO, Marco (Università degli Studi e INFN Milano (IT))

**Session Classification:** Top Physics

Contribution ID: **653** Type: **Talk**

# ttX/tX (X = anything but H) production CMS

*Wednesday 18 May 2022 14:40 (15 minutes)*

**Presenter:** VICO VILLALBA, Carlos (Universidad de Oviedo (ES))

**Session Classification:** Top Physics

Contribution ID: **654** Type: **Talk**

# ttX/tX (X = anything but H) production ATLAS

*Wednesday 18 May 2022 15:00 (15 minutes)*

**Presenter:** JOHNS, Kenneth (University of Arizona (US))

**Session Classification:** Top Physics

Contribution ID: **655** Type: **Talk**

# Off-shell modeling of ttbb at the LHC

*Wednesday 18 May 2022 15:20 (20 minutes)*

**Presenter:** KRAUS, Manfred (Florida State University)

**Session Classification:** Top Physics

Contribution ID: **656** Type: **Talk**

# Modeling uncertainties of ttW in multi-lepton channel

*Monday 16 May 2022 15:15 (15 minutes)*

**Presenter:** NASUFI, Jasmina (RWTH Aachen University)

**Session Classification:** Joint Session 3

Contribution ID: **657** Type: **Talk**

# Combined SMEFT interpretation of Higgs, diboson, and top quark data from the LHC

*Monday 16 May 2022 15:33 (15 minutes)*

**Presenter:** ROJO, Juan (VU Amsterdam and Nikhef)

**Session Classification:** Joint Session 3

Contribution ID: **658** Type: **Talk**

# ttH/tH production ATLAS

*Monday 16 May 2022 15:51 (15 minutes)*

**Presenter:** CARVALHO, Luisa (LIP (PT))

**Session Classification:** Joint Session 3

Contribution ID: **659** Type: **Talk**

# ttH/tH production CMS

*Monday 16 May 2022 16:09 (15 minutes)*

**Presenter:** GIRALDI, Angela (Deutsches Elektronen-Synchrotron (DE))

**Session Classification:** Joint Session 3

Contribution ID: **660** Type: **Talk**

# ttbb modeling for ttH ATLAS+CMS

*Monday 16 May 2022 16:27 (15 minutes)*

**Presenter:** BRAHIMI, Nihal (Tsung-Dao Lee Institute & Shanghai Jiao Tong University)

**Session Classification:** Joint Session 3

Contribution ID: **661** Type: **not specified**

# Theory on novel jet substructure techniques

*Tuesday 17 May 2022 14:15 (20 minutes)*

**Presenter:** LIU, Xiaohui

**Session Classification:** QCD

Contribution ID: **662** Type: **not specified**

# Boosted W/Z/H/top jets

*Tuesday 17 May 2022 14:40 (18 minutes)*

**Presenter:** ILIC, Nikolina (University of Toronto (CA))

**Session Classification:** QCD

Contribution ID: **663** Type: **not specified**

# Gluon/quark jet substructure

*Tuesday 17 May 2022 15:02 (18 minutes)*

**Presenter:** BANSAL, Sunil (Panjab University (IN))

**Session Classification:** QCD

Contribution ID: **664** Type: **not specified**

# Lund plane and reclustering

*Tuesday 17 May 2022 15:24 (18 minutes)*

**Presenter:** HAVENER, Laura Brittany (Yale University (US))

**Session Classification:** QCD

Contribution ID: **665** Type: **not specified**

# Heavy flavour jet substructure

**Session Classification:** QCD

Contribution ID: **666** Type: **not specified**

# Neutrinos at LHC with FASER(nu) and SND@LHC

*Tuesday 17 May 2022 15:46 (18 minutes)*

**Presenter:** BETANCOURT, Christopher (University of Zurich (CH))

**Session Classification:** QCD

Contribution ID: **667** Type: **not specified**

# PDF developments for Run 3 and HL-LHC

*Wednesday 18 May 2022 14:15 (20 minutes)*

**Presenter:** NADOLSKY, Pavel (Southern Methodist University)

**Session Classification:** QCD

Contribution ID: **668** Type: **not specified**

# Recent measurements sensitive to PDFs

*Wednesday 18 May 2022 14:39 (18 minutes)*

**Presenter:** HAN, Qundong (Central China Normal University CCNU (CN))

**Session Classification:** QCD

Contribution ID: **669** Type: **not specified**

# Recent measurements on small-x QCD and hadronisation

*Wednesday 18 May 2022 15:01 (18 minutes)*

**Presenter:** NOVITZKY, Norbert (University of Tsukuba (JP))

**Session Classification:** QCD

Contribution ID: **670** Type: **not specified**

# Odderon exchange from elastic scattering in pp and ppbar with TOTEM and D0

*Wednesday 18 May 2022 15:23 (18 minutes)*

**Presenter:** ROYON, Christophe (The University of Kansas (US))

**Session Classification:** QCD

Contribution ID: **671** Type: **not specified**

# Progress on precision QCD calculations

*Thursday 19 May 2022 14:15 (18 minutes)*

**Presenter:** PONCELET, Rene (Cambridge University)

**Session Classification:** QCD

Contribution ID: **672** Type: **not specified**

# V+jet measurements

*Thursday 19 May 2022 14:36 (18 minutes)*

**Presenter:** MIJUSKOVIC, Jelena (University of Montenegro (ME))

**Session Classification:** QCD

Contribution ID: **673** Type: **not specified**

# Inclusive jet + multijet + photon measurements

*Thursday 19 May 2022 14:57 (18 minutes)*

**Presenter:** SUNAR CERCI, Deniz (Adiyaman University (TR) - Istanbul University (TR))

**Session Classification:** QCD

Contribution ID: **674** Type: **not specified**

# Hadron-hadron QCD interactions with ALICE

*Thursday 19 May 2022 15:18 (18 minutes)*

**Presenter:** KORNAKOV, Georgy (Warsaw University of Technology (PL))

**Session Classification:** QCD

Contribution ID: **675** Type: **not specified**

# Precision QCD measurements with LHCb

*Thursday 19 May 2022 15:39 (18 minutes)*

**Presenter:** ZULIANI, Davide (Universita e INFN, Padova (IT))

**Session Classification:** QCD

Contribution ID: **676** Type: **not specified**

# Exotic hadrons at LHC (experiment)

*Monday 16 May 2022 17:00 (20 minutes)*

**Presenter:** GANDINI, Paolo (INFN Milano (IT))

**Session Classification:** Joint Session 5

Contribution ID: **677** Type: **not specified**

# Conventional hadrons at LHC (experiment)

**Session Classification:** Joint Session 6

Contribution ID: **678** Type: **not specified**

# Heavy-flavor production at LHC (experiment)

*Monday 16 May 2022 17:54 (20 minutes)*

**Presenter:** NORMAN, Jaime (University of Liverpool (GB))

**Session Classification:** Joint Session 5

Contribution ID: **679** Type: **not specified**

# Lattice QCD in hadron spectroscopy

*Monday 16 May 2022 17:26 (20 minutes)*

**Presenter:** PRELOVSEK, Sasa (Jozef Stefan Institute)

**Session Classification:** Joint Session 5

Contribution ID: **680** Type: **not specified**

# Heavy flavour production and polarisation (theory)

*Monday 16 May 2022 18:20 (20 minutes)*

**Presenter:** MA, Yan-Qing

**Session Classification:** Joint Session 5

Contribution ID: **681** Type: **not specified**

# Jet substructure in heavy ions (theory)

*Monday 16 May 2022 15:15 (15 minutes)*

**Presenter:** ONTOSO, Alba (IPhT)

**Session Classification:** Joint Session 2

Contribution ID: **682** Type: **not specified**

# Jet substructure in heavy ions (experiment)

*Monday 16 May 2022 15:33 (15 minutes)*

**Presenter:** RYBAR, Martin (Charles University (CZ))

**Session Classification:** Joint Session 2

Contribution ID: **683** Type: **not specified**

# Pileup mitigation and grooming (theory)

*Monday 16 May 2022 15:51 (15 minutes)*

**Presenter:** ALIPOUR-FARD, Samuel (Massachusetts Institute of Technology)

**Session Classification:** Joint Session 2

Contribution ID: **684** Type: **not specified**

# Modification of hadronization in heavy ions (Heavy and light flavour, cross experiments with emphases on large systems)

*Monday 16 May 2022 16:09 (15 minutes)*

**Presenter:** PRINO, Francesco (Universita e INFN Torino (IT))

**Session Classification:** Joint Session 2

Contribution ID: **685** Type: **not specified**

# Ultra-peripheral collisions (experiment)

*Monday 16 May 2022 16:27 (15 minutes)*

**Presenter:** DYNDAL, Mateusz (AGH UST Krakow)

**Session Classification:** Joint Session 2

Contribution ID: **686** Type: **Theory poster**

# Quarks and gluons in the Lund plane

*Tuesday 17 May 2022 19:00 (1 hour)*

Discriminating quark and gluon jets is a long-standing topic in collider phenomenology. In this paper, we address this question using the Lund jet plane substructure technique introduced in recent years. We present two complementary approaches: one where the quark/gluon likelihood ratio is computed analytically, to single-logarithmic accuracy, in perturbative QCD, and one where the Lund declusterings are used to train a neural network. For both approaches, we either consider only the primary Lund plane or the full clustering tree. The analytic and machine-learning discriminants are shown to be equivalent on a toy event sample resumming exactly leading collinear single logarithms, where the analytic calculation corresponds to the exact likelihood ratio. On a full Monte Carlo event sample, both approaches show a good discriminating power, with the machine-learning models usually being superior. We carry on a study in the asymptotic limit of large logarithm, allowing us to gain confidence that this superior performance comes from effects that are subleading in our analytic approach. We then compare our approach to other quark-gluon discriminants in the literature. Finally, we study the resilience of our quark-gluon discriminants against the
details of the event sample and observe that the analytic and machine-learning approaches show similar behaviour.

Reference:
[1] F. Dreyer, G. Soyez, A. Takacs, arXiv:2112.09140

**Authors:** TAKACS, Adam (University of Bergen); DREYER, Frederic Alexandre (University of Oxford); SOYEZ, Gregory (IPhT, CEA Saclay)

**Presenter:** TAKACS, Adam (University of Bergen)

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **687** Type: **Theory poster**

# Dynamically groomed jet radius in heavy-ion collisions

*Tuesday 17 May 2022 19:00 (1 hour)*

We explore the ability of a recently proposed jet substructure technique, Dynamical Grooming, to pin down the properties of the Quark-Gluon Plasma formed in ultra-relativistic heavy-ion collisions. In particular, we compute, both analytically and via Monte-Carlo simulations, the opening angle $\theta_g$ of the hardest splitting in the jet as defined by Dynamical Grooming. Our calculation, grounded in perturbative QCD, accounts for the factorization in time between vacuum-like and medium-induced processes in the double logarithmic approximation. We observe that the dominating scale in the $\theta_g$-distribution is the decoherence angle $\theta_c$ which characterises the resolution power of the medium to propagating color probes. This feature also persists in strong coupling models for jet quenching. We further propose for potential experimental measurements a suitable combination of the Dynamical Grooming condition and the jet radius that leads to a pQCD dominated observable with a very small sensitivity (≲10%) to medium response.

References:
[1] P. Caucal, A. Soto-Ontoso, A. Takacs, arXiv:2111.14768
[2] P. Caucal, A. Soto-Ontoso, A. Takacs, JHEP 07 (2021) 020

**Authors:** TAKACS, Adam (University of Bergen); ONTOSO, Alba (IPhT); CAUCAL, Paul (Brookhaven National Laboratory)

**Presenters:** TAKACS, Adam (University of Bergen); ONTOSO, Alba (IPhT); CAUCAL, Paul (Brookhaven National Laboratory)

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **688** Type: **Theory poster**

# Intermittency analysis of charged hadrons generated in Pb-Pb collisions at $\sqrt{s_{NN} = 2.76 TeV and 5.02 TeV using PYTHIA8/ Angantyr

*Tuesday 17 May 2022 19:00 (1 hour)*

The search for the QCD critical point (CP), and the study of quark-hadron phase transition (and vice-versa), at finite baryon density and high temperature, is the main task in contemporary relativistic heavy-ion collision experiments. Fluctuation analysis with global and local measures is the basic tool to achieve this goal. Local density fluctuations are directly related to the critical behaviour in QCD. These fluctuations in the phase space are expected to scale according to universal power-law in the vicinity of critical-point. A search for such power-law fluctuations within the frame-work of the intermittency method is ongoing to locate the critical point of the strongly interacting matter. This method is used to probe the behaviour of these fluctuations through the measurement of normalized factorial moments (NFMs) in ($\eta$, $\phi$) phase space. Observations and results from the intermittency analysis performed for generated charged hadrons in Pb+Pb collisions, at two different energies, using PYTHIA8/Angantyr for centrality as well as transverse momentum bin width dependence will be presented. We also made a comparison with published EPOS3 results at 2.76TeV.

**Authors:** GUPTA, Ramni (University of Jammu (IN)); Mr MALIK, Salman K (University of Jammu (IN))

**Presenter:** Mr MALIK, Salman K (University of Jammu (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **690** Type: **Theory poster**

# In medium properties of an axion within a 2+1 flavor Polyakov loop enhanced Nambu–Jona-Lasinio model

*Tuesday 17 May 2022 19:00 (1 hour)*

We estimate in medium properties of axion i.e., its mass and self-coupling within a three flavor Polyakov loop extended Nambu–Jona-Lasinio (PNJL) model with Kobayashi-Maskawa-t'Hooft determinant interaction. We also estimate the topological susceptibility of strong interaction within the same model. It is observed that (statistical) confinement effects simulated by Polyakov loop potential play an important role in the estimation of all these quantities, particularly, near the critical temperature. Both the mass and the self-coupling of the axion get correlated with the chiral and deconfinement transition. The results for all these quantities obtained within the PNJL model is compared with chiral perturbation theory, Nambu–Jona-Lasinio (NJL) model and lattice QCD simulation results wherever available. The results for properties of axions at finite baryon densities are also presented.

**Authors:** Dr ABHISHEK, Aman (Physical Research Laboratory, Navrangpura, Ahmedabad); Dr DAS, Arpan (Institute of Nuclear Physics Polish Academy of Sciences); Dr MISHRA, Hiranmaya (Physical Research Laboratory, Navrangpura, Ahmedabad, India); Dr MOHAPATRA, Ranjita K. (Department of Physics, Banki Autonomous College, Cuttack, India)

**Presenter:** Dr DAS, Arpan (Institute of Nuclear Physics Polish Academy of Sciences)

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **691** Type: **Talk**

# Physics at future e+e- colliders

*Thursday 19 May 2022 14:15 (20 minutes)*

**Presenter:** SIMON, Frank (Max-Planck-Institut fuer Physik)

**Session Classification:** Upgrades and Future Projects

Contribution ID: **692** Type: **Talk**

# Experiments at future e+e- colliders

*Thursday 19 May 2022 14:40 (20 minutes)*

**Presenter:** RUAN, Manqi (Chinese Academy of Sciences (CN))

**Session Classification:** Upgrades and Future Projects

Contribution ID: **693** Type: **Talk**

# Experiments at future hadron colliders

*Thursday 19 May 2022 15:05 (20 minutes)*

**Presenter:** ZABOROWSKA, Anna (CERN)

**Session Classification:** Upgrades and Future Projects

Contribution ID: **694** Type: **Talk**

# Physics at future hadron colliders

*Thursday 19 May 2022 15:30 (20 minutes)*

**Presenter:** GRAY, Heather (UC Berkeley/LBNL)

**Session Classification:** Upgrades and Future Projects

Contribution ID: **695** Type: **not specified**

# Nuclear PDFs (theory)

*Tuesday 17 May 2022 14:15 (22 minutes)*

**Presenter:** PAAKKINEN, Petja Kalle Matias (Helsinki Institute of Physics (FI))

**Session Classification:** Heavy Ions

Contribution ID: **696** Type: **not specified**

# Inclusive jet suppression (multi-experiment)

*Tuesday 17 May 2022 14:42 (22 minutes)*

**Presenter:** MAO, Yaxian (Central China Normal University CCNU (CN))

**Session Classification:** Heavy Ions

Contribution ID: **697** Type: **not specified**

# high-pT heavy-flavor, heavy-flavor jets (multi-experiment)

*Tuesday 17 May 2022 15:09 (22 minutes)*

**Presenter:** STAHL LEITON, Andre Govinda (CERN)

**Session Classification:** Heavy Ions

Contribution ID: **698** Type: **not specified**

# Monte Carlos in heavy ions

*Tuesday 17 May 2022 15:36 (22 minutes)*

**Presenter:** CAUCAL, Paul (Brookhaven National Laboratory)

**Session Classification:** Heavy Ions

Contribution ID: **699** Type: **not specified**

# Quarkonia (multi-experiment)

*Tuesday 17 May 2022 16:03 (22 minutes)*

**Presenter:** CARON, Robin (Centre National de la Recherche Scientifique (FR))

**Session Classification:** Heavy Ions

Contribution ID: **700** Type: **not specified**

# Hadron-hadron interactions and nuclei production

*Wednesday 18 May 2022 14:15 (15 minutes)*

**Presenter:** BALBINO, Alessandro (Politecnico and INFN di Torino (IT))

**Session Classification:** Heavy Ions

Contribution ID: **701** Type: **not specified**

# Recent flow results (multi-experiment)

*Wednesday 18 May 2022 14:33 (15 minutes)*

**Presenter:** TANG, Siyu (Central China Normal University CCNU (CN))

**Session Classification:** Heavy Ions

Contribution ID: **702** Type: **not specified**

# Recent heavy flavor flow results (multi-experiment)

*Wednesday 18 May 2022 14:51 (15 minutes)*

**Presenter:** STOJANOVIC, Milan (Purdue University (US))

**Session Classification:** Heavy Ions

Contribution ID: **703** Type: **not specified**

# Bayesian analysis

*Wednesday 18 May 2022 15:09 (15 minutes)*

**Presenter:** PAQUET, Jean-Francois (Duke University)

**Session Classification:** Heavy Ions

Contribution ID: **704** Type: **not specified**

# Heavy flavour production and fragmention in small systems(multi-experiment)

*Wednesday 18 May 2022 15:27 (15 minutes)*

**Presenter:** DURHAM, John Matthew (Los Alamos National Laboratory)

**Session Classification:** Heavy Ions

Contribution ID: **705** Type: **not specified**

# Collectivity in small systems (theory)

*Thursday 19 May 2022 14:15 (20 minutes)*

**Presenter:** SCHLICHTING, Soeren (Universität Bielefeld)

**Session Classification:** Heavy Ions

Contribution ID: **706** Type: **not specified**

# Soft hadron production and collectivity in small systems (multi-experiment)

*Thursday 19 May 2022 14:40 (20 minutes)*

**Presenter:** SEIDLITZ, Blair Daniel (University of Colorado Boulder (US))

**Session Classification:** Heavy Ions

Contribution ID: **707** Type: **not specified**

# Energy loss in small systems (theory)

*Thursday 19 May 2022 15:05 (20 minutes)*

**Presenter:** MAZELIAUSKAS, Aleksas (CERN)

**Session Classification:** Heavy Ions

Contribution ID: **708** Type: **not specified**

# SMOG results (experiment)

*Thursday 19 May 2022 15:30 (20 minutes)*

**Presenter:** NIEL, Elisabeth Maria (EPFL - Ecole Polytechnique Federale Lausanne (CH))

**Session Classification:** Heavy Ions

Contribution ID: **709** Type: **not specified**

# Strangeness tracking

*Monday 16 May 2022 15:15 (15 minutes)*

**Presenter:** DOBRIGKEIT CHINELLATO, David (University of Campinas UNICAMP (BR))

**Session Classification:** Performance and Tools

Contribution ID: **710** Type: **not specified**

# Lepton + Tracking

*Monday 16 May 2022 15:33 (15 minutes)*

**Presenter:** VAZQUEZ GOMEZ, Ricardo (University of Barcelona (ES))

**Session Classification:** Performance and Tools

Contribution ID: **711** Type: **not specified**

# Jet/MET + b/c tagging

*Monday 16 May 2022 15:51 (15 minutes)*

**Presenter:** KOMARAGIRI, Jyothsna Rani (Indian Institute of Science (IISc) (IN))

**Session Classification:** Performance and Tools

Contribution ID: **712** Type: **not specified**

# Direct online reconstruction

*Monday 16 May 2022 16:09 (15 minutes)*

**Presenter:** VAN VEGHEL, Maarten (University of Groningen (NL))

**Session Classification:** Performance and Tools

Contribution ID: **713** Type: **not specified**

# Triggering

*Monday 16 May 2022 16:27 (15 minutes)*

**Presenter:** RUIZ MARTINEZ, Arantxa (Univ. of Valencia and CSIC (ES))

**Session Classification:** Performance and Tools

Contribution ID: **714** Type: **not specified**

# ALICE experiment

*Monday 16 May 2022 17:00 (17 minutes)*

**Presenter:** KRYSHEN, Evgeny

**Session Classification:** Performance and Tools

Contribution ID: **715** Type: **not specified**

# ATLAS experiment

*Monday 16 May 2022 17:21 (17 minutes)*

**Presenter:** GOBLIRSCH-KOLB, Maximilian Emanuel (Brandeis University (US))

**Session Classification:** Performance and Tools

Contribution ID: **716** Type: **not specified**

# CMS experiment

*Monday 16 May 2022 17:42 (17 minutes)*

**Presenter:** CHENG, Tongguang (Beihang University (CN))

**Session Classification:** Performance and Tools

Contribution ID: **717** Type: **not specified**

# LHCb experiment

*Monday 16 May 2022 18:03 (17 minutes)*

**Presenter:** TOBIN, Mark (Chinese Academy of Sciences (CN))

**Session Classification:** Performance and Tools

Contribution ID: **718** Type: **not specified**

# Luminosity measurements of the LHC experiments

*Monday 16 May 2022 18:24 (17 minutes)*

**Presenter:** LAVICKA, Roman (FNSPE at CTU in Prague)

**Session Classification:** Performance and Tools

Contribution ID: **719** Type: **not specified**

# New developments in event generators (CANCELLED)

*Wednesday 18 May 2022 15:25 (15 minutes)*

**Presenter:** RE, Emanuele (Universita & INFN, Milano-Bicocca (IT))

**Session Classification:** Performance and Tools

Contribution ID: **720** Type: **not specified**

# GPUs online

*Wednesday 18 May 2022 14:33 (15 minutes)*

**Presenter:** CONCAS, Matteo (Yonsei University (KR))

**Session Classification:** Performance and Tools

Contribution ID: **721** Type: **not specified**

# New developments in fast simulation with machine learning

*Wednesday 18 May 2022 14:51 (15 minutes)*

**Presenter:** KRAUSE, Claudius (Rutgers University)

**Session Classification:** Performance and Tools

Contribution ID: **722** Type: **not specified**

# Software for analysis (general Python ecosystem, Coffea, analysis facilities [T2/T3])

*Wednesday 18 May 2022 14:15 (15 minutes)*

**Presenter:** BUHLER, Paul Alois (Stefan Meyer Institute for Subatomic Physics (SMI), Austrian Academy of Sciences (AT))

**Session Classification:** Performance and Tools

Contribution ID: **723** Type: **not specified**

# Machine learning for analysis/calibration

*Wednesday 18 May 2022 15:10 (15 minutes)*

**Presenter:** BUTTER, Anja

**Session Classification:** Performance and Tools

Contribution ID: **724** Type: **not specified**

# New developments in recasting

*Thursday 19 May 2022 14:15 (15 minutes)*

**Presenter:** KRAML, Sabine (LPSC Grenoble)

**Session Classification:** Performance and Tools

Contribution ID: **725** Type: **not specified**

# Boosted algorithms for searches

*Thursday 19 May 2022 14:33 (15 minutes)*

**Presenter:** LI, Congqiao (Peking University (CN))

**Session Classification:** Performance and Tools

Contribution ID: **726** Type: **not specified**

# Online/offline development for LLP

*Thursday 19 May 2022 14:51 (15 minutes)*

**Presenter:** USACHOV, Andrii (Nikhef National institute for subatomic physics (NL))

**Session Classification:** Performance and Tools

Contribution ID: **727** Type: **not specified**

# New developments in anomaly detection and model independent searches for new physics with machine learning

*Thursday 19 May 2022 15:09 (15 minutes)*

**Presenter:** NACHMAN, Ben (Lawrence Berkeley National Lab. (US))

**Session Classification:** Performance and Tools

Contribution ID: **728** Type: **not specified**

# EFTs and machine learning

*Thursday 19 May 2022 15:27 (15 minutes)*

**Presenter:** UBIALI, Maria

**Session Classification:** Performance and Tools

Contribution ID: **729** Type: **not specified**

# Precision measurements of the weak mixing angle and the W boson mass

*Monday 16 May 2022 15:15 (17 minutes)*

LHCb+ATLAS+CMS

**Presenter:** VESTERINEN, Mika Anton (University of Warwick (GB))

**Session Classification:** Electroweak Physics

Contribution ID: **730** Type: **not specified**

# Single boson production

*Monday 16 May 2022 15:37 (17 minutes)*

LHCb+ATLAS+CMS

**Presenter:** MOUREAUX, Louis (Hamburg University (DE))

**Session Classification:** Electroweak Physics

Contribution ID: **731** Type: **not specified**

# Overview of mixed EW-QCD corrections for Drell-Yan

*Monday 16 May 2022 15:59 (17 minutes)*

**Presenters:** BUCCIONI, Federico; BUCCIONI, Federico (University of Zurich)

**Session Classification:** Electroweak Physics

Contribution ID: **732** Type: **not specified**

# Electroweak input schemes

*Monday 16 May 2022 16:21 (17 minutes)*

**Presenter:** CHIESA, Mauro (University of Pavia)

**Session Classification:** Electroweak Physics

Contribution ID: **733** Type: **not specified**

# Diboson overview

*Monday 16 May 2022 17:22 (17 minutes)*

**Presenter:** LEVIN, Andrew Michael (Peking University (CN))

**Session Classification:** Electroweak Physics

Contribution ID: **734** Type: **not specified**

# Triboson overview

*Monday 16 May 2022 17:44 (17 minutes)*

**Presenter:** AN, Ying (Peking University (CN))

**Session Classification:** Electroweak Physics

Contribution ID: **735** Type: **not specified**

# Theory overview of diboson and triboson

*Monday 16 May 2022 17:00 (17 minutes)*

**Presenters:** SCHOENHERR, Marek (Technische Universitaet Dresden (DE)); SCHOENHERR, Marek (University of Durham); SCHOENHERR, Marek (University of Durham (GB))

**Session Classification:** Electroweak Physics

Contribution ID: **736** Type: **not specified**

# Experimental overview of EWK EFT

*Monday 16 May 2022 18:06 (17 minutes)*

ATLAS+CMS

**Presenter:** SOLDATOV , Evgeny

**Session Classification:** Electroweak Physics

Contribution ID: **737** Type: **not specified**

# Theory overview of EFT in the electroweak sector

*Monday 16 May 2022 18:28 (17 minutes)*

**Presenters:** GOMEZ AMBROSIO, Raquel (Milano Bicocca); GOMEZ AMBROSIO, Raquel (Durham university)

**Session Classification:** Electroweak Physics

Contribution ID: **738** Type: **not specified**

# Experimental overview of VBS

*Wednesday 18 May 2022 14:15 (17 minutes)*

ATLAS

**Presenter:** XU, Lailin (University of Science and Technology of China (CN))

**Session Classification:** Electroweak Physics

Contribution ID: **739** Type: **not specified**

# Experimental overview of VBS

*Wednesday 18 May 2022 14:37 (17 minutes)*

CMS

**Presenter:** PENG, Jing (Peking University (CN))

**Session Classification:** Electroweak Physics

Contribution ID: **740** Type: **not specified**

# Overview of polarisation measurements

*Wednesday 18 May 2022 14:59 (17 minutes)*

ATLAS+CMS

**Presenter:** MANJARRES, Joany (Technische Universitaet Dresden (DE))

**Session Classification:** Electroweak Physics

Contribution ID: **741** Type: **not specified**

# Theoretical overview of VBS

*Wednesday 18 May 2022 15:21 (17 minutes)*

**Presenters:** JAEGER, Barbara; JAGER, Barbara

**Session Classification:** Electroweak Physics

Contribution ID: **742** Type: **Talk**

# Calorimetry towards high-granularity at LHC experiments

*Monday 16 May 2022 15:15 (18 minutes)*

**Presenter:** PAGANIS, Stathes (National Taiwan University)

**Session Classification:** Upgrades and Future Projects

Contribution ID: **743** Type: **not specified**

# Tracker upgrades at LHC experimentds

*Monday 16 May 2022 15:37 (18 minutes)*

**Presenter:** BEOLE, Stefania Maria (Universita e INFN Torino (IT))

**Session Classification:** Upgrades and Future Projects

Contribution ID: **744** Type: **not specified**

# Upgrades on timing and PID detectors in LHC experiments

*Monday 16 May 2022 15:59 (18 minutes)*

**Presenter:** GEERTSEMA, Robbert Erik (Nikhef National institute for subatomic physics (NL))

**Session Classification:** Upgrades and Future Projects

Contribution ID: **745** Type: **Talk**

# Trigger upgrades at LHC experiments

*Monday 16 May 2022 16:21 (18 minutes)*

**Presenter:** CERRI, Alex (University of Sussex (GB))

**Session Classification:** Upgrades and Future Projects

Contribution ID: **746** Type: **Talk**

# Future e+e- and hadron colliders

*Monday 16 May 2022 17:42 (17 minutes)*

**Presenter:** GAO, Jie

**Session Classification:** Upgrades and Future Projects

Contribution ID: **747** Type: **Talk**

# Physics at muon colliders

*Monday 16 May 2022 17:21 (17 minutes)*

**Presenters:** LIU, Zhen; LIU, Zhen (University of Minnesota (US))

**Session Classification:** Upgrades and Future Projects

Contribution ID: **748** Type: **Talk**

# Experiments at muon colliders

*Monday 16 May 2022 18:03 (17 minutes)*

**Presenter:** JINDARIANI, Sergo (Fermi National Accelerator Lab. (US))

**Session Classification:** Upgrades and Future Projects

Contribution ID: **749** Type: **Talk**

# Heavy-ion programme for Run 5 and 6 at the LHC

*Monday 16 May 2022 17:00 (17 minutes)*

**Presenter:** FABBIETTI, Laura (Technische Universitat Munchen (DE))

**Session Classification:** Upgrades and Future Projects

Contribution ID: **750** Type: **Talk**

# The TOTEM, CMS PPS and LHCf Run 3 upgrades

*Monday 16 May 2022 18:24 (17 minutes)*

**Presenter:** GARCIA FUENTES, Francisco Ignacio (Helsinki Institute of Physics (FI))

**Session Classification:** Upgrades and Future Projects

Contribution ID: **751** Type: **Theory poster**

# Rare Higgs Decays in the Standard Model

*Tuesday 17 May 2022 19:00 (1 hour)*

After the discovery of Higgs boson by the ATLAS and CMS Collaborations, a new era of the precise determination of the properties of this new particle has begun. In recent years, experimental searches for rare Higgs decays, like $h \to V\gamma$ ($V$ denotes vector mesons $\rho$, $\phi$, $J/\psi$ and $\Upsilon$ etc.) and $h \to VV(V = J/\Psi, \Upsilon)$ have been performed at the LHC.

Motivated by the above experimental studies, we have presented the theoretical analysis of rare processes, including Higgs decays into lepton pair plus one light hadron and decays into a pair of heavy vector quarkonia, in the standard model (SM). Higgs couplings to gauge bosons and Yukawa couplings play interesting roles in these decays. Our calculation shows that branching ratios of $h \to VV$ are around $10^{-10}$, which are far below the current experimental upper bounds. For lepton pair plus a light hadron final states, their branching ratios are predicted to be in the range of $10^{-8} \sim 10^{-5}$. We have also analyzed the differential dilepton invariant mass and angular distributions of these three-body decays, which may provide interesting information on short-distance dynamics. Due to the small SM branching ratios, it will be in general challenging to search for these rare processes, however, experimental studies of them may be helpful both to increase our understanding of the properties of SM Higgs boson and to potentially probe the novel Higgs dynamics in new physics scenarios.

This poster is mostly based on references:
1. D.-N. Gao and X. Gong, PLB 817 (2021) 136348, arXiv:2103.03050[hep-ph].
2. D.-N. Gao and X. Gong, arXiv:2203.00514[hep-ph].

**Authors:** GONG, Xi; GAO, Dao-Neng

**Presenter:** GONG, Xi

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **752** Type: **Theory poster**

# W-boson angular coefficients at LHC at high precision

*Tuesday 17 May 2022 19:00 (1 hour)*

The spin structure of the weak gauge bosons produced at non-zero transverse momentum at proton-proton colliders leads to a parametrization of the cross section of the Drell-Yan process by a set of eight angular coefficients. These coefficients have been measured for the Z-boson by various experiments. The W-boson mass measurement at the LHC relies in part on precise knowledge of the W-boson angular coefficients, which currently is based on extrapolation from and theory comparison to the Z-boson coefficient measurements. We present predictions for the dominant W-boson coefficients for the first time at fixed-order NNLO QCD+NLO EW, differentially in the vector boson transverse momentum and rapidity. The mixed NNLO QCD and electroweak predictions presented for the W-boson coefficients provide at present the most precise predictions available for these observables for finite-pT W-boson production, and enables on the one hand a more accurate measurement of the W-boson mass, as well as a guideline for future measurements of these angular observables.

**Authors:** PELLEN, Mathieu (Albert-Ludwigs-Universität Freiburg); PONCELET, Rene (University of Cambridge); POPESCU, Andrei (University of Cambridge); VITOS, Timea

**Presenter:** VITOS, Timea

**Session Classification:** Poster Session I

**Track Classification:** Electroweak Physics

Contribution ID: **753** Type: **Theory poster**

# Charge and heat transport coefficients of a hot and dense QCD matter in the presence of a weak magnetic field

*Tuesday 17 May 2022 19:00 (1 hour)*

We have explored the effect of weak magnetic field on the transport of charge and heat in hot and dense QCD matter by calculating their response functions, such as electrical conductivity ($\sigma_{\rm el}$), Hall conductivity ($\sigma_{\rm H}$), thermal conductivity ($\kappa_0$) and Hall-type thermal conductivity ($\kappa_1$) in kinetic theory approach. The interactions among partons have been subsumed through their thermal masses. It is found that, $\sigma_{\rm el}$ and $\kappa_0$ decrease, and $\sigma_{\rm H}$ and $\kappa_1$ increase in the presence of weak magnetic field, whereas the emergence of finite chemical potential enhances these transport coefficients. The effects of weak magnetic field and finite chemical potential on aforesaid transport coefficients are more noticeable at low temperatures. On the other hand, at high temperatures, they have only a mild dependence on magnetic field and chemical potential. We have observed that the finite chemical potential further extends the lifetime of magnetic field. This study sheds light on the understanding of the effects of weak magnetic field and finite chemical potential on the local equilibrium through the Knudsen number, the elliptic flow, and the interplay between charge and heat transport coefficients through the Wiedemann-Franz law. The components of the Knudsen number in the weakly magnetized hot and dense QCD matter remain much below unity. Thus, the separation between the macroscopic and microscopic length scales is sufficient for the medium to remain in its local equilibrium state. Further, we have found that the elliptic flow gets increased due to the weak magnetic field and becomes decreased due to the finite chemical potential. Furthermore, the components of the Lorenz number are observed to be strongly affected by the finite chemical potential than by the weak magnetic field. With the increase of temperature, the components of the Lorenz number increase, thus confirming the violation of the Wiedemann-Franz law for the hot and dense QCD matter in an ambience of weak magnetic field.

**Author:** RATH, Shubhalaxmi (Indian Institute of Technology Bombay)

**Co-author:** Prof. DASH, Sadhana (Indian Institute of Technology Bombay)

**Presenter:** RATH, Shubhalaxmi (Indian Institute of Technology Bombay)

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **754** Type: **Theory poster**

# Hint of pion condensation in proton-proton collisions at the LHC using non-extensive Tsallis statistics

*Tuesday 17 May 2022 19:00 (1 hour)*

A study is performed on the possible Bose-Einstein Condensation (BEC) of pions in proton-proton (pp) collisions at $\sqrt{s}$ = 7 TeV at the Large Hadron Collider. To have a better and clear understanding, the results of pp systems have been contrasted with the systems produced in Pb-Pb collisions. We studied the temperature and final state multiplicity dependence of the number of particles in the pion condensates. A wide range of multiplicity is considered, covering the hadronic and heavy-ion collisions, using experimental transverse momentum spectra inputs. We observe a clear dominancy of non-extensive parameter q, which measures the degree of non-equilibrium, on the critical temperature and number of particles in the pion condensates.

**Author:** SAHU, Dushmanta (Indian Institute of Technology Indore (IN))

**Co-authors:** Mr PRADHAN, Anil Kumar; SAHOO, Raghunath (Indian Institute of Technology Indore (IN)); DEB, Suman (Indian Institute of Technology Indore (IN))

**Presenter:** SAHU, Dushmanta (Indian Institute of Technology Indore (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **755** Type: **Talk**

# Higgs decays to 3rd generation fermions at ATLAS and CMS

*Tuesday 17 May 2022 14:35 (17 minutes)*

**Presenter:** MUKHERJEE, Soumya (Tata Inst. of Fundamental Research (IN))

**Session Classification:** Higgs Physics

Contribution ID: **756** Type: **Talk**

# Higgs rare decays at ATLAS and CMS

*Tuesday 17 May 2022 14:55 (17 minutes)*

**Presenter:** DORDEVIC, Milos (Vinca Institute, University of Belgrade)

**Session Classification:** Higgs Physics

Contribution ID: **757** Type: **Talk**

# Improved understanding of off-shell effects in gg->4l

*Tuesday 17 May 2022 15:15 (17 minutes)*

**Presenters:** FERRARIO RAVASIO, Silvia; FERRARIO RAVASIO , Silvia (University of Oxford)

**Session Classification:** Higgs Physics

Contribution ID: **758** Type: **Talk**

# Differential signature of Higgs production from vector-boson fusion

*Tuesday 17 May 2022 15:35 (17 minutes)*

**Presenter:** CHEN, Xuan (University of Zürich)

**Session Classification:** Higgs Physics

Contribution ID: **759** Type: **Talk**

# Higgs properties (CP, mass, width,..) at ATLAS and CMS

*Tuesday 17 May 2022 15:55 (17 minutes)*

**Presenter:** DAVIS, Jeffrey (Johns Hopkins University (US))

**Session Classification:** Higgs Physics

Contribution ID: **760** Type: **Talk**

# Higgs fiducial and differential measurements at ATLAS and CMS

*Wednesday 18 May 2022 14:15 (17 minutes)*

**Presenter:** LUCIO ALVES, Fabio Lucio (Nanjing University (CN))

**Session Classification:** Higgs Physics

Contribution ID: **761** Type: **Talk**

# Higgs-charm coupling constraints at ATLAS and CMS

*Wednesday 18 May 2022 14:35 (17 minutes)*

**Presenter:** DU PREE, Tristan Arnoldus (Nikhef National institute for subatomic physics (NL))

**Session Classification:** Higgs Physics

Contribution ID: **762** Type: **Talk**

# Higgs coupling combination at ATLAS and CMS

*Wednesday 18 May 2022 14:55 (17 minutes)*

**Presenter:** TALIERCIO, Angela (Universite Catholique de Louvain (UCL) (BE))

**Session Classification:** Higgs Physics

Contribution ID: **763** Type: **Talk**

# Exact top-quark mass effects in gluon-fusion Higgs boson production at NNLO

*Wednesday 18 May 2022 15:15 (17 minutes)*

**Presenter:** NIGGETIEDT, Marco (RWTH Aachen)

**Session Classification:** Higgs Physics

Contribution ID: **764** Type: **not specified**

# Extra discussion time

*Wednesday 18 May 2022 15:35 (10 minutes)*

**Session Classification:** Higgs Physics

Contribution ID: **765** Type: **not specified**

# Extra discussion time

*Tuesday 17 May 2022 16:15 (15 minutes)*

**Session Classification:** Higgs Physics

Contribution ID: **766** Type: **Talk**

# Higgs EFT theory

*Thursday 19 May 2022 14:15 (17 minutes)*

**Presenter:** MARTIN, Adam (University of Notre Dame)

**Session Classification:** Higgs Physics

Contribution ID: **767** Type: **Talk**

# Higgs EFT results at ATLAS and CMS

*Thursday 19 May 2022 14:35 (17 minutes)*

**Presenter:** SCIANDRA, Andrea (University of California,Santa Cruz (US))

**Session Classification:** Higgs Physics

Contribution ID: **768** Type: **Talk**

# HH production theory

*Thursday 19 May 2022 14:55 (17 minutes)*

**Presenter:** KONG, Kyoungchul (KC) (Univesity of Kansas)

**Session Classification:** Higgs Physics

Contribution ID: **769** Type: **Talk**

# Higgs self-coupling at ATLAS

*Thursday 19 May 2022 15:15 (15 minutes)*

**Presenter:** D'ERAMO, Louis (Northern Illinois University)

**Session Classification:** Higgs Physics

Contribution ID: **770** Type: **Talk**

# Higgs self-coupling at CMS

*Thursday 19 May 2022 15:33 (15 minutes)*

**Presenter:** ZUOLO, Davide (Universita & INFN, Milano-Bicocca (IT))

**Session Classification:** Higgs Physics

Contribution ID: **771** Type: **not specified**

# Extra discussion time

*Thursday 19 May 2022 15:51 (9 minutes)*

**Session Classification:** Higgs Physics

Contribution ID: **773** Type: **Theory poster**

# Leveraging universality of jet taggers through transfer learning

*Tuesday 17 May 2022 19:00 (1 hour)*

A significant challenge in the tagging of boosted objects via machine-learning technology is the prohibitive computational cost associated with training sophisticated models. Nevertheless, the universality of QCD suggests that a large amount of the information learnt in the training is common to different physical signals and experimental setups. In this article, we explore the use of transfer learning techniques to develop fast and data-efficient jet taggers that leverage such universality. We consider the graph neural networks LundNet and ParticleNet, and introduce two prescriptions to transfer an existing tagger into a new signal based either on fine-tuning all the weights of a model or alternatively on freezing a fraction of them. In the case of W-boson and top-quark tagging, we find that one can obtain reliable taggers using an order of magnitude less data with a corresponding speed-up of the training process. Moreover, while keeping the size of the training data set fixed, we observe a speed-up of the training by up to a factor of three. This offers a promising avenue to facilitate the use of such tools in collider physics experiments.

**Authors:** Dr DREYER, Frederic Alexandre (University of Oxford); MONNI, Pier Francesco (CERN); GRABARCZYK, Radoslaw Piotr

**Presenters:** Dr DREYER, Frederic Alexandre (University of Oxford); MONNI, Pier Francesco (CERN); GRABARCZYK, Radoslaw Piotr

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **774** Type: **Theory poster**

# Intrinsic quantum mechanics behind the Standard Model? - predictions in the baryon and Higgs sectors

*Tuesday 17 May 2022 19:00 (1 hour)*

I introduce quantum mechanics on an intrinsic configuration space for baryons, the Lie group U(3), which carries the three gauge groups of the standard model of particle physics as subgroups SU(3), SU(2) and U(1). The strong and electroweak interactions become related via the Higgs mechanism. I namely settle the electroweak energy scale by the neutron to proton decay where both sectors are involved through quark flavour changes. Predictions of neutral pentaquark resonances reachable at LHCb follow in the baryon sector as does an accurate expression in the electroweak sector for the Higgs mass (yielding 125.095(14) GeV) and predictions on the couplings of the Higgs to itself and to the gauge bosons with signal strengths deviating by the presence of the up-down quark mixing matrix element. The intrinsic view means that quantum fields are generated by the momentum form on intrinsic wavefunctions and local gauge transformations in laboratory space equate translations in the intrinsic configuration space which may be likened to a generalised spin space. Further insight is gained for the Cabibbo and Weinberg angles expressed in traces of u and d flavour quark generators.

Key references:
EPL 102 (2013) 42002, Int. J. Mod. Phys. A 30 (2015) 1550078, EPL 124 (2018) 31001, EPL 125 (2019) 41001, EPL 133 (2021) 31001. See also arXiv:2007.02936.

**Author:** Mr TRINHAMMER, Ole Lynnerup (Technical University of Denmark)

**Presenter:** Mr TRINHAMMER, Ole Lynnerup (Technical University of Denmark)

**Session Classification:** Poster Session I

**Track Classification:** Electroweak Physics

Contribution ID: **775** Type: **Theory poster**

# Theoretical analysis of $B^0 \to \phi\ell^+\ell^-$ decay

*Tuesday 17 May 2022 19:00 (1 hour)*

In the Standard Model (SM), the $b \to s$ and $b \to d$ flavor-changing neutral currents (FCNC), being loop-induced, are standard experimental channels for testing the SM precisely and searching for possible physics beyond the SM. Purely annihilation decays of $B$-mesons are of significant interest as in the SM they are extremely suppressed and New Physics effects can increase substantially their decay widths. Radiative and semileptonic decays with the $\phi$-meson production, being a subject of experimental searches at the LHC and KEKB, are typical examples of annihilation-type processes. One of the well-known experimental results on these decays is the upper limit on the radiative decay, $calB(B^0 \to \phi\gamma) < 10^{-7}$, obtained by the Belle collaboration in 2016 [Z. King, et al., Belle Collab., Phys. Rev. D. (2016) 93]. Early this year, the LHCb collaboration obtained the upper limit on its semileptonic counterpart, $calB(B^0 \to \phi\mu^+\mu^-) < 3.2 \times 10^{-9}$ [R. Aaij, et al., LHCb Collab., arxiv:2201.10167]. Here, we consider the annihilation-type semileptonic $B^0 \to \phi\ell^+\ell^-$ decay, where $\ell$ is a charged lepton, and present SM theoretical predictions for the branching fraction based on the effective electroweak Hamiltonian approach for the $b \to d\ell^+\ell^-$ transitions.

**Authors:** Dr PARKHOMENKO, Alexander (P. G. Demidov Yaroslavl State University); PARNOVA, Irina

**Presenter:** PARNOVA, Irina

**Session Classification:** Poster Session I

**Track Classification:** Flavour Physics

Contribution ID: **776** Type: **Theory poster**

# Investigation of the right-handed vector current via unbinned angular analysis of $B \to D^*(D\pi)\ell\nu_\ell$

*Tuesday 17 May 2022 19:00 (1 hour)*

We perform a sensitivity study of an unbinned angular analysis of the $B \to D^*(D\pi)\ell\nu_\ell$ decay, including the contributions from the right-handed vector current. We show that the angular observable can constrain very strongly the right-handed vector current without the intervention of the yet unsolved $V_{cb}$ puzzle.

**Authors:** LU, Cai-Dian (IHEP, Beijing); KOU, Emi (LAL-IN2P3); HUANG, Zhuoran (APCTP); TANG, Ru-Ying (IHEP)

**Presenter:** HUANG, Zhuoran (APCTP)

**Session Classification:** Poster Session I

**Track Classification:** Flavour Physics

Contribution ID: **777** Type: **Experimental poster**

# ”Particle physics for babies”: outreach for the youngest audience

*Tuesday 17 May 2022 19:00 (1 hour)*

Particle physics is a field which is full of striking visuals: from Feynman diagrams to event displays, there is no shortage of colourful high-contrast shapes and designs to capture the imagination. Can these visuals be used to reach out to budding scientists from their very earliest days? This talk will describe the development of the “Particle Physics for Babies” children’s book, a concept imagined by a first-time dad/physicist who wanted to find a way to communicate his physics passion to his newborn daughter. The book was co-developed with the ATLAS outreach team and the International Particle Physics Outreach Group, and has grown to include downloadable captions which allow parents to explain the images in the book to their children or grandchildren with confidence, allowing science to be part of a new child’s universe from day 0.

**Author:** Dr CORPE, Louie Dartmoor (CERN)

**Presenter:** Dr CORPE, Louie Dartmoor (CERN)

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **778** Type: **Theory poster**

# A Deep Learning Based Estimator for Elliptic Flow in Heavy Ion Collisions

*Tuesday 17 May 2022 19:00 (1 hour)*

Deep Learning (DL) is one of the most popular Machine Learning models in the High Energy Physics (HEP) community and has been applied to solve numerous problems for decades. The ability of the DL model to learn unique patterns and correlations from data to map highly complex non-linear functions is a matter of interest. Such features of the DL model could be used to explore the hidden physics laws that govern particle production, anisotropic flow, spectra, etc., in heavy-ion collisions. This work sheds light on the possible use of the DL techniques such as the feed-forward Deep Neural Network (DNN) based estimator to predict the elliptic flow ($v_2$) in heavy-ion collisions at RHIC and LHC energies. A novel method is used to process the track level information as input to the DNN model. The model is trained with Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV minimum bias simulated events with AMPT event generator. The trained model is successfully applied to estimate centrality dependence of $v_2$ for both LHC and RHIC energies. The proposed model is quite successful in predicting the transverse momentum ($p_{\rm T}$) dependence of $v_2$ as well. A noise sensitivity test is performed to estimate the systematic uncertainty of this method. Results of the DNN estimator are compared to both simulation and experiment, which concludes the robustness and prediction accuracy of the model.

Reference: N. Mallick, S. Prasad, A. N. Mishra, R. Sahoo and G. G. Barnaf\"oldi, [arXiv:2203.01246 [hep-ph]].

**Authors:** Mr MALLICK, Neelkamal (Indian Institute of Technology Indore); PRASAD, Suraj (Indian Institute of Technology Indore (IN)); MISHRA, Aditya Nath (Wigner Research Centre for Physics Budapest, Hungary); SAHOO, Raghunath (Indian Institute of Technology Indore (IN)); BARNAFOLDI, Gergely (Hungarian Academy of Sciences (HU))

**Presenter:** Mr MALLICK, Neelkamal (Indian Institute of Technology Indore)

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **779** Type: **Experimental poster**

# Searching for an eco-friendly gas mixture for the ALICE Resistive Plate Chambers

*Tuesday 17 May 2022 19:00 (1 hour)*

Resistive Plate Chambers (RPCs) are gaseous detectors with parallel plate geometry and resistive electrodes, widely employed at the LHC. In ALICE (A Large Hadron Collider Experiment) 72 RPCs are installed in the forward muon spectrometer and provide muon identification.

The ALICE RPCs are operated with a mixture of 89.7% $C_2H_2F_4$, 10% i-$C_4H_{10}$ and 0.3% $SF_6$. $C_2H_2F_4$ and $SF_6$ are fluorinated greenhouse gases (F-gases) with a high Global Warming Potential (GWP). New European Union regulations have imposed a progressive phase-down of the production and usage of F-gases, aiming to cut down their emission by two thirds in 2030 with respect to 2014.

Even though research activities are excluded from these regulations, the F-gases phase-down will inevitably increase their price and CERN is also aiming to cut down on its emissions. For these reasons it is crucial to find a more eco-friendly gas mixture for RPCs by the LHC long shutdown 3, foreseen in 2026. Since $C_2H_2F_4$ is the main contributor to the mixture's GWP an extensive R&D process has started to replace it with tetrafluoropropene ($C_3H_2F_4$), due to its chemical similarity with $C_2H_2F_4$ and its low GWP (around 7). Laboratory studies have shown promising results in terms of detector performance and the next step is to study the long term behavior of RPCs operated with these new gas mixtures (aging studies). Since this is a subject of interest for all the LHC experiments, a collaboration, ECOgas@GIF++, was setup to carry out joint studies. Among others,
small-size, ALICE-like RPCs were installed at the Gamma Irradiation Facility at CERN, where they are exposed to a strong radiation field, coming from a 14 TBq $^{137}$Cs source, which allows one to simulate many years of operation in a relatively short time. The facility also provides a muon beam in specific times of the year, which can be used to study the detector performance (e.g. efficiency and cluster size) during and after irradiation.

This poster will report the current status of the measurements, focusing on the preliminary results of the irradiation campaign and of beam tests carried out in 2021.

**Author:** Mr QUAGLIA, Luca (CERN, University and INFN Torino)

**Co-authors:** ALICE COLLABORATION; ECOGAS@GIF++ COLLABORATION

**Presenter:** Mr QUAGLIA, Luca (CERN, University and INFN Torino)

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **780** Type: **Experimental poster**

# Measurement of the forward η meson production cross section in p-p collisions at √s=13 TeV with the LHCf Arm2 detector

*Tuesday 17 May 2022 19:00 (1 hour)*

The LHC forward (LHCf) is a unique experiment designed on purpose to measure neutral particle production spectra in the forward region to provide high energy data for the tuning of the hadronic interaction models used by ground-based cosmic rays experiments, thanks to the excellent performance of this experimental apparatus, composed by two sampling calorimeters, called Arm1 and Arm2, located at about $\pm 140$ m from the LHC interaction point 1 (IP1), at zero-degree angle.

In this talk we would like to present the data analysis strategy and preliminary results for the measurement of $\eta$ meson differential cross section as function of the Feynman $x_F$ variable , measured in p-p collisions at $\sqrt{s} = 13$ TeV with the Arm2 detector, and compared with the predictions of four widely used hadronic interaction models. The importance of this observation is relied to the fact that the strange quark contribution is one of the parameters characterizing the different models, thus differences in this parameter induce a large discrepancy on the expected $\eta$ production cross section.

**Authors:** TRICOMI, Alessia (Universita e INFN, Catania (IT)); TIBERIO, Alessio (Universita e INFN, Firenze (IT)); BERTI, Eugenio (Universita e INFN, Firenze (IT)); PIPARO, Giuseppe (Università e INFN, Catania (IT)); MENJO, Hiroaki (Nagoya University (JP)); KASAHARA, Katsuaki; OHASHI, Ken (Nagoya University (JP)); YOSHIDA, Kenji (Shibaura Institute of Technology (JP)); D'ALESSANDRO, Lel (Universita e INFN, Firenze (IT)); BONECHI, Lorenzo (Universita e INFN, Firenze (IT)); BONGI, Massimo (Universita e INFN, Firenze (IT)); HAGUENAUER, Maurice (EPFL - Ecole Polytechnique Federale Lausanne (CH)); KONDO, Moe (Nagoya University (JP)); SCARINGELLA, Monica (INFN Firenze (IT)); SAKURAI, Nobuyuki (Nagoya University (JP)); ADRIANI, Oscar (Universita e INFN, Firenze (IT)); PAPINI, Pauro (INFN, Firenze (IT)); BETTI, Pietro (Universita e INFN, Firenze (IT)); DETTI, Sebastiano (Universita e INFN, Firenze (IT)); RICCIARINI, Sergio Bruno (Universita e INFN, Firenze (IT)); TORII, Shoji (Waseda University (JP)); TAMURA, Tadashi (Kanagawa University (JP)); SAKO, Takashi (University of Tokyo (JP)); TURNER, William C (Lawrence Berkeley Laboratory); MURAKI, Yasushi (STE-laboratory, Nagoya University (JP)); ITOW, Yoshitaka (Nagoya University (JP)); SHIMIZU, Yuki (JAXA); MATSUBARA, Yutaka (Nagoya University)

**Presenter:** PIPARO, Giuseppe (Università e INFN, Catania (IT))

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **781** Type: **Theory poster**

# Probing phenomenological models implemented in PYTHIA8

*Tuesday 17 May 2022 19:00 (1 hour)*

PYTHIA is a highly successful and well-established Monte Carlo event generator, different options of selected physics models offered by PYTHIA8 are investigated using best fit to the Minimum Bias published data by ATLAS. These models include a new scenario for Multiparton Interactions (MPI), impact parameter dependence, and color reconnection choices. MPI should be switched on to get reasonable results for hadron-hadron collision data. It is observed that the double Gaussian option in impact parameter dependence is favored by data as compared to other options provided by PYTHIA8. Without the color reconnection model, the Pt spectrum is too soft. This study is quite intriguing to observe the impact of different model options on the description of selected observables.

**Author:** FIRDOUS, Nameeqa (GIFT University Gujranwala Pakistan)

**Co-author:** Mr JUNAID, Malik (University of Innsbruck)

**Presenter:** FIRDOUS, Nameeqa (GIFT University Gujranwala Pakistan)

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **782** Type: **Theory poster**

# New tunes of PYTHIA8 to the Minimum Bias data at 13TeV using different PDF sets

*Tuesday 17 May 2022 19:00 (1 hour)*

PYTHIA8 simulates a number of physics aspects by implementing several models along with theory, these models have many free parameters that need to be tweaked for the best description of data. In this study, we use PYTHIS8.2 for the simulation of Multiparton Interactions using different PDF sets from LAHPDF6. Altogether five parameters were selected for the final tune depending on their sensitivity to the selected observables at 13TeV published by ATLAS Collaboration. Simulated experimental analysis data is obtained using the Rivet analysis toolkit. These tunes are substantial improvements on existing standard choices and describe the selected data reasonably well. Tuning results are also compared with the default tunes in PYTHIA8.2.

**Author:** FIRDOUS, Nameeqa (GIFT University Gujranwala Pakistan)

**Co-author:** Mr JUNAID, Malik (University of Innsbruck)

**Presenter:** FIRDOUS, Nameeqa (GIFT University Gujranwala Pakistan)

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **784** Type: **Experimental poster**

# Precision Timing with the CMS MTD Barrel Timing Layer for HL-LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

The MIP Timing Detector (MTD) is a new sub-detector planned for the Compact Muon Solenoid (CMS) experiment at CERN, aimed at maintaining the excellent particle identification and reconstruction efficiency of the CMS detector during the High Luminosity LHC (HL-LHC) era. The MTD will provide new and unique capabilities to CMS by measuring the time-of-arrival of minimum ionizing particles with a resolution of 30-40 ps for MIP signals at a rate of 2.5 Mhit/s per channel at the beginning of HL-LHC operation. The precision time information provided by the MTD will reduce the effects of the high levels of pileup expected at the HL-LHC by enabling the use of 4D reconstruction algorithms. The central barrel timing layer (BTL) of the MTD uses a sensor technology consisting of LYSO:Ce scintillating crystal bars coupled to SiPMs, one at each end of the bar, read out with TOFHIR ASICs for the front-end. We present an overview of the MTD BTL design and show test beam results demonstrating the achievement of the target time resolution of about 30 ps.

**Author:** CMS, Collaboration

**Presenter:** DERVAN, John (Northeastern University (US))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **785** Type: **Experimental poster**

# Reduction of high voltage discharge in GEM detectors for the ME0 station of the CMS forward muon system

*Tuesday 17 May 2022 19:00 (1 hour)*

The Phase 2 upgrade of the CMS muon spectrometer will include the installation of three new muon stations based on Gas Electron Multiplier (GEM) technology. One of the three stations, ME0, will increase the acceptance for muon detection in the region $2.03 < |\eta| < 2.82$ where there is a high radiation background. When triple-GEM detectors, including ME0, operate at high gain, there are occasional discharges within the transfer gaps that are likely followed by less-common secondary discharges, and may cause irreversible damage to the detector. ME0 has the advantage of using double-segmented GEM foils that help lower the probability of high voltage discharges, and in turn, protect the detector and maintain high detection efficiency. To optimize the ME0 design, we studied the performance of several configurations of GEM foil design and high voltage filters regarding discharge propagation, rate capability, and crosstalk.

**Authors:** MOHAMED, Salwa (ENHEP Egyptian Network of High Energy Physics (EG)); ELKAFRAWY, Tamer (Florida Institute of Technology (US)); MERLIN, Jeremie Alexandre (INFN-Bari)

**Presenter:** MOHAMED, Salwa (ENHEP Egyptian Network of High Energy Physics (EG))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **786** Type: **Experimental poster**

# Measurement of ψ(2S) production as a function of charged-particle multiplicity in pp collisions at √s =13 TeV and p–Pb collisions at √sNN = 8.16 TeV with ALICE at the LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

Quarkonia are bound states of heavy quark–antiquark pairs. Due to their large mass, heavy quarks production mechanism takes place at hard scales of QCD, while the formation of the bound states involves soft QCD scales. Quarkonia are therefore sensitive to both perturbative and non-perturbative aspects of QCD.
In addition, their measurement in p–Pb collisions provides information on cold nuclear matter effects, such as nuclear shadowing or interaction with comoving particles.
Recent measurements reveal that $J/\psi$ yields increase with charged-particle multiplicity in pp and p–Pb collisions at the LHC. Different mechanisms were proposed to explain this observation. One of them is the influence of multiple parton interactions in the initial state of the collision. Measurements of the excited charmonium states, e.g $\psi(2S)$, as a function of charged-particle multiplicity are essential to disentangle the impact of possible final-state effects.

This poster presents the measurement of charmonium yields in pp collisions at $\sqrt{s}$ = 13 TeV and p–Pb collisions at $\sqrt{s_{\rm NN}}$ = 8.16 TeV as a function of charged-particle multiplicity, measured at central rapidity ($|\eta| < 1.0$). $J/\psi$ and $\psi(2S)$ are reconstructed in their dimuon decays within $2.5 < y_{\rm cms} < 4.0$ for pp collisions, $2.03 < y_{\rm cms} < 3.53$ and $-4.46 < y_{\rm cms} < -2.96$ for p–Pb collisions. Both charmonia yields and charged-particle multiplicity are normalised to their corresponding average values. The charmonium excited-to-ground state ratio is also shown. Results are compared with model calculations.

**Author:** TORK, Theraa (Université Paris-Saclay (FR))

**Presenter:** TORK, Theraa (Université Paris-Saclay (FR))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **787** Type: **Experimental poster**

# Measurements of ψ(2S) production in Pb–Pb collisions with ALICE at the LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

Quantum Chromodynamics predicts the existence of dense and hot nuclear matter which is described in terms of a deconfined medium of quarks and gluons, known as quark-gluon plasma (QGP). High energy density and temperature can be reached by colliding heavy-ions at ultra-relativistic energies, enabling the study of the QGP in the laboratory. The ALICE detector at the LHC was designed to study the properties of such deconfined medium. Quarkonia are sensitive probes of the QGP, in particular, the study of their production in Pb–Pb collisions normalized to the corresponding one in pp collisions at the same energy and scaled by the number of nucleon-nucleon collisions, known as nuclear modification factor, can shed light on the properties of the QGP. In the presence of a QGP medium, the charmonium yield would be suppressed due to color Debye screening and dissociation. Due to its larger size and weaker binding energy, the ψ(2S) is expected to be more suppressed in the medium compared to the J/ψ. However, the magnitude of the J/ψ suppression at LHC energies is smaller than that observed at lower energies at SPS and RHIC, indicating thereby that charmonium (re)generation via the re)combination of charm and anticharm-quarks, happening either in medium or at the phase boundary, plays an important role at LHC energies. The ψ(2S) production relative to J/ψ represents one possible discriminator between the two different regeneration scenarios. Due to its smaller production cross-section and branching ratio to the dilepton decay channel, the ψ(2S) measurement is more challenging as compared to the J/ψ one. The combined Run 2 data sets of ALICE allows one to extract the ψ(2S) signal over the full centrality range, in Pb–Pb collisions at √s_NN = 5.02 TeV at forward rapidity with the muon spectrometer.

In this poster, we report the ψ(2S) nuclear modification factor and ψ(2S)-to-J/ψ double ratio in Pb–Pb collisions at √s_NN = 5.02 TeV as a function of centrality and transverse momentum, using a new pp reference measured at the same energy with improved precision. All the measurements are compared with theoretical predictions.

**Author:** HUSHNUD, Hushnud (Saha Institute of Nuclear Physics)

**Presenter:** HUSHNUD, Hushnud (Saha Institute of Nuclear Physics)

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **788** Type: **Experimental poster**

# Searches for supersymmetry in hadronic final states with the CMS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

Results from the CMS experiment are presented for searches for supersymmetric particles with decays to hadronic final states. The searches use proton-proton collision data with luminosity up to 137 fb-1 recorded by the CMS detector at center of mass energy 13 TeV during the LHC Run 2.

**Author:** MISHRA, Tribeni (National Institute of Science Education and Research (NISER) (IN))

**Presenter:** MISHRA, Tribeni (National Institute of Science Education and Research (NISER) (IN))

**Session Classification:** Poster Session I

**Track Classification:** TeV-Scale BSM

Contribution ID: **789** Type: **Experimental poster**

# Measurement and QCD analysis of double-differential inclusive jet cross sections at 13 TeV

*Tuesday 17 May 2022 19:00 (1 hour)*

A measurement of the inclusive jet production in proton-proton collisions at the LHC at $\sqrt{s} = 13$ TeV is presented. The double-differential cross sections are measured as a function of the jet transverse momentum $p_{\mathrm{T}}$ and the absolute jet rapidity $\|y|$. The anti-$k_{\mathrm{T}}$ clustering algorithm is used with distance parameter of 0.4 (0.7) in a phase space region with jet $p_{\mathrm{T}}$ from 97 GeV up to 3.1 TeV and $|y| < 2.0$. Data collected with the CMS detector are used, corresponding to an integrated luminosity of 36.3 fb$^{-1}$ (33.5 fb$^{-1}$). The measurement is used in a comprehensive QCD analysis at next-to-next-to-leading order, which results in significant improvement in the accuracy of the parton distributions in the proton. Simultaneously, the value of the strong coupling constant at the Z boson mass is extracted as $\alpha_S(m_{\mathrm{Z}}) = 0.1170 \pm 0.0019$. For the first time, these data are used in a standard model effective field theory analysis at next-to-leading order, where parton distributions and the QCD parameters are extracted simultaneously with imposed constraints on the Wilson coefficient $c_1$ of 4-quark contact interactions.

**Authors:** LIPKA, Katerina (Deutsches Elektronen-Synchrotron (DE)); MAKELA, Toni (Deutsches Elektronen-Synchrotron (DE))

**Presenter:** MAKELA, Toni (Deutsches Elektronen-Synchrotron (DE))

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **790** Type: **Experimental poster**

# Heavy flavor jet tagging algorithm developments at CMS for HL-LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

The rich physics program at the high luminosity LHC (HL-LHC) requires all final state particles to be reconstructed with good accuracy. However, it also poses formidable challenge of dealing with very high pile up. Different identification algorithms need to be upgraded along with the detectors to improve the overall event reconstruction in such a hostile collision environment. The new timing device in the proposed CMS detector at the HL-LHC allows for the construction of timing observables at the track-level as well as at the jet-level. This information when given as inputs to the deep neural networks, have a potential to improve the existing algorithms used for heavy flavor (HF) jet tagging. In this poster, the latest developments on the studies for HF jet tagging performance at the HL-LHC are presented.

**Author:** Mr PFEFFER, Emanuel (KIT - Karlsruhe Institute of Technology (DE))

**Co-author:** NEUKUM, Max (KIT - Karlsruhe Institute of Technology (DE))

**Presenter:** Mr PFEFFER, Emanuel (KIT - Karlsruhe Institute of Technology (DE))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **791** Type: **Experimental poster**

# Measurement of the top quark pole mass using ttbar+jet events in the dilepton final state at 13 TeV

*Tuesday 17 May 2022 19:00 (1 hour)*

A measurement of the top quark pole mass in events where the top quark-antiquark pair is produced in association with one additional jet is presented. This analysis is performed using proton-proton collision data at 13 TeV collected by the CMS experiment at the CERN LHC in 2016, corresponding to a total integrated luminosity of 36.3 fb−1. Events with two opposite charge leptons in the final state (ee, $\mu\mu$, e$\mu$) are analyzed. Using multivariate analysis techniques based on Machine Learning, the reconstruction of the main observable and the event selection are optimized. The production cross section is measured as a function of the invariant of the $t\bar{t}$+jet system invariant mass at parton-level, using a maximum likelihood unfolding method. The top quark pole mass is then obtained from a chi-squared fit of the theory predictions at next-to-leading order precision to the data.

**Author:** WUCHTERL, Sebastian (Deutsches Elektronen-Synchrotron (DE))

**Presenter:** WUCHTERL, Sebastian (Deutsches Elektronen-Synchrotron (DE))

**Session Classification:** Poster Session I

**Track Classification:** Top Physics

Contribution ID: **792** Type: **Experimental poster**

# QuarkNet in LHC Education and Outreach

*Tuesday 17 May 2022 19:00 (1 hour)*

QuarkNet is a U.S. program for professional development of high school teachers. In QuarkNet, teachers deepen their understanding of physics, pedagogy, and how to engage students through the use of authentic data from a diverse set of contemporary particle physics experiments. The LHC figures prominently in these efforts. QuarkNet promotes and manages International Particle Physics Masterclasses with Fermilab-moderated videoconferences, has partnered with physicists to develop and maintain the CMS masterclass used worldwide, and has created new masterclass opportunities such as World Wide Data Day. QuarkNet makes these masterclasses available not only in the U.S. but also throughout the world. These international collaborations enrich the teachers and students involved. QuarkNet teachers also participate in LHC Data Workshops and similar opportunities. QuarkNet staff and select teachers are currently building short masterclasses and workshops for the 10th anniversary of the discovery of the Higgs.

**Authors:** CECIRE, Kenneth William (University of Notre Dame (US)); GLOVER, Marla (Purdue University); WADNESS, Michael (Medford High School); WOOD, Shane (Mounds View Public Schools / University of Notre Dame ); MCCAULEY, Thomas (University of Notre Dame (US))

**Presenters:** CECIRE, Kenneth William (University of Notre Dame (US)); GLOVER, Marla (Purdue University); WADNESS, Michael (Medford High School); WOOD, Shane (Mounds View Public Schools / University of Notre Dame ); MCCAULEY, Thomas (University of Notre Dame (US))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **794** Type: **Experimental poster**

# Sharing ATLAS Science: communicating to the public

*Tuesday 17 May 2022 19:00 (1 hour)*

Communicating the science and achievements of the ATLAS Experiment is a core objective of the ATLAS Collaboration. This talk will explore the range of communication strategies adopted in ATLAS communications, with particular focus on how these have been impacted by the COVID-19 pandemic. In particular, an overview of ATLAS'digital communication platforms will be given – with focus on social media, YouTube and Virtual Visits –and the effect on target audiences evaluated with best practices are shared.

**Presenter:** MORENO LLACER, Maria (Univ. of Valencia and CSIC (ES))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **795** Type: **Experimental poster**

# ATLAS Open Data: developing education and outreach resources from research data

*Tuesday 17 May 2022 19:00 (1 hour)*

The ATLAS Open Data project aims to deliver open-access resources for education and outreach in High Energy Physics using real data recorded by the ATLAS detector. The Open Data release so far has resulted in the release of a substantial amount of data from 8 TeV and 13 TeV collisions in an easily-accessible format and supported by dedicated software and documentation to allow its fruitful use by users at a range of experience levels. To maximise the value of the data, software, and documentation resources provided ATLAS has developed initiatives and promotes stakeholder engagement in the creation of these materials through on-site and remote training schemes such as high-school work experience and summer schools programs, university projects and PhDs qualification tasks. We present examples of how multiple training programs inside and outside CERN have helped and continue to help development the ATLAS Open Data project, lessons learnt, impacts, and future goals.

**Presenter:** MORAIS SILVA GONCALO, Ricardo Jose (LIP - Laboratorio de Instrumentação e Física Experimental de Partículas (PT))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **796** Type: **Experimental poster**

# Educational Printables: from colouring books to cheat & fact sheets

*Tuesday 17 May 2022 19:00 (1 hour)*

The ATLAS Collaboration has developed a variety of printables for education and outreach activities. We present two ATLAS Colouring Books, the ATLAS Fact Sheets, the ATLAS Physics Cheat Sheets, and ATLAS Activity Sheets. These materials are intended to cover key topics of the work done by the ATLAS Collaboration and the physics behind the experiment for a broad audience of all ages and levels of experience. In addition, there is ongoing work in translating these documents to different languages, with one of the colouring books already available in 18 languages. These printables are prepared to complement the information found in all ATLAS digital channels, they are particularly useful in outreach events and in the classroom. We present these resources, our experiences in the creation of them, their use, feedback received, and plans for the future.

**Presenter:** BUXBAUM, Valerie (California State University (US))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **797** Type: **Experimental poster**

# ATLAS Virtual Visits: Bringing the world to our detector

*Tuesday 17 May 2022 19:00 (1 hour)*

The Virtual Visit service run by the ATLAS Collaboration has been active since 2010. The ATLAS Collaboration has used this popular and effective method to bring the excitement of scientific exploration and discovery into classrooms and other public places around the world. The programme, which uses a combination of video conferencing, webcasts, and video recording to communicate with remote audiences, has already reached tens of thousands of viewers, in a large number of languages, from tens of countries across all continents. We present a summary of the ATLAS Virtual Visit service that is currently in use –including a new booking system and hand-held video conference setup from the ATLAS cavern –and present a new system that is being installed in the ATLAS Visitors Centre and in ATLAS cavern. In addition, we show the reach of the programme over the last few years.

**Presenter:** LE BOULICAUT, Elise Maria (Duke University (US))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **798** Type: **Experimental poster**

# A new ATLAS Visitor Centre

*Tuesday 17 May 2022 19:00 (1 hour)*

The ATLAS Visitor Centre at CERN is a guided exhibition space that has been welcoming visitors from around the world since 2009. In a recent effort, ATLAS has reinvented the whole exhibition, replacing the original installation with a completely new exhibition. This contribution will highlight the basic concept behind the new exhibition, introduce its main components along with details on their implementation and hint at the process of getting from an idea to the final implementation. This contribution will also present some of the efforts to make the exhibition more inclusive and accessible to a wider and more diverse audience.

**Presenter:** MEHLHASE, Sascha (LMU Munich)

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **799** Type: **Experimental poster**

# Increasing Multilingualism in ATLAS' Science Communication

*Tuesday 17 May 2022 19:00 (1 hour)*

Despite modern particle physics being an international endeavour, the vast majority of its educational material is only published in English. By making material available in other languages, physicists can make in-roads with new audiences –especially those very young or very old –in their home countries. The ATLAS Collaboration has published colouring books, a teaching guide, activity sheets, fact sheets and cheat sheets aimed at communicating science to a non-expert audience. An effort is underway to translate this content into as many languages as possible, taking advantage of the countless multilingual members of the collaboration. Currently all of this content is available in at least two languages other than English, with the ATLAS Colouring Book being the one available in the most languages (19 so far). The reach of this multilingual content is presented.

**Presenter:** RODRIGUEZ VERA, Ana Maria (York University (CA))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **800** Type: **Experimental poster**

# Evolution of Regional, Age and Gender Demographics in the ATLAS Collaboration

*Tuesday 17 May 2022 19:00 (1 hour)*

The ATLAS Collaboration consists of more than 5000 members, from over 100 different countries. Regional, age and gender demographics of the collaboration are presented, including the time evolution over the lifetime of the experiment. In particular, the relative fraction of women is discussed, including their share of contributions, recognition and positions of responsibility, including showing how these depend on other demographic measures.

**Presenter:** PACEY, Holly (University of Cambridge (GB))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **801** Type: **Theory poster**

# Investigating New Physics Models with Signature of Same-Sign Diboson$\not{E}_T$

*Tuesday 17 May 2022 19:00 (1 hour)*

We investigate the prospect of searching for new physics via the novel signature of same-sign diboson + $\not{E}_T$ at current and future LHC. We study three new physics models: (i) natural SUSY models, (ii) type-III seesaw model and (iii) type-II seesaw/Georgi-Machacek model. In the first two class of models, this signature arises due to the presence of a singly-charged particle which has lifetime long enough to escape detection, while in the third model this signature originates resonantly from a doubly-charged particle produced along with two forward jets that, most likely, would escape detection. We analyze in great detail the discovery prospects of the signal in these three classes of models in the current as well as the upcoming runs of the LHC (such as HL-LHC, HE-LHC and FCC-hh) by showing a distinction among these scenarios.

**Authors:** Prof. CHIANG, Cheng-Wei (Department of Physics, National Taiwan University, Taipei, Taiwan 10617, R.O.C., Physics Division, National Center for Theoretical Sciences, Taipei, Taiwan 10617, R.O.C.); SENGUPTA, Dibyashree; Dr JANA, Sudip (Max-Planck-Institut f{\"u}r Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany)

**Presenter:** SENGUPTA, Dibyashree

**Session Classification:** Poster Session I

**Track Classification:** Feeble Interactions BSM

Contribution ID: **802** Type: **Experimental poster**

# ATLAS Roman Pots at LHC Run 3 - Detector Status

*Tuesday 17 May 2022 19:00 (1 hour)*

ALFA and AFP detectors are being prepared to take data during Run 3. ALFA underwent refurbishment whereas AFP, among other upgrades, was equipped with new solution for Time-of-Flight system, so-called Out-of-Vacuum solution. AFP Silicon Tracker is equipped with new modules and ToF, after various testbeams, seems to achieved desired resolution with high efficiency.

**Presenter:** STASZEWSKI, Rafał (IFJ PAN Cracow (PL))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **803** Type: **Experimental poster**

# Developing a production database for the High Granularity Timing Detector for ATLAS Phase-II upgrade

*Tuesday 17 May 2022 19:00 (1 hour)*

The increase of the particle flux (pile-up) with luminosities of L ⊠ 7.5 × 10ˆ34cmˆ−2sˆ−1 is one of the main experimental challenges for the HL-LHC physics program. A powerful new way to mitigate the effects of pileup is to use high-precision timing information to distinguish between collisions occurring close in space but well-separated in time. A High-Granularity Timing Detector, based on low gain avalanche detector technology, is therefore proposed in front of the LAr end-cap calorimeters for pile-up mitigation and for luminosity measurement. It will cover the pseudo-rapidity range from 2.4 to 4.0. Two silicon sensors double-sided layers will provide precision timing information for MIPs with a resolution better than 30 ps per track in order to assign each particle to the correct vertex. About an order of ten thousand silicon sensor modules will be produced. The module production to be carried out at several sites, will involve the assembly of many components that are produced by various vendors. The history of the production of these components, their quality control checks and tests are to be tracked and recorded. This poster presents the work that concerns the development of a production database that store these information. The development of applications that are used for uploading and retrieving of data from the database, and a user interface for interacting with the database are presented too.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** AIT TAMLIHAT, Malak (Universite Mohammed V (MA))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **804** Type: **Experimental poster**

# Physics and performance of the High Granularity Timing Detector

*Tuesday 17 May 2022 19:00 (1 hour)*

The expected increase in particle flux in the high-luminosity phase of the LHC (HL-LHC), with an instantaneous luminosity that can reach L ≈ 7.5 × 10ˆ34cmˆ−2sˆ−1, will have a significant impact on the pile-upwith potentially 200 interactions per bunch crossing. The performances of electrons and photons, as well as those of jets and missing transverse energy, will be strongly degraded in the end-cap and at the forward region of the detector, where the granularity of the electromagnetic calorimeter is coarser and the momentum resolution of the Inner Tracker(ITk) is poorer. In order to mitigate the pile-up contamination coming from this high luminosity, a High Granularity Timing Detector (HGTD) is proposed in front of the LAr end-cap calorimeters, covering the pseudorapidity region between 2.4 and 4.0. The high granularity and the highprecision timing information will allow to improve the pile-up reduction. It will also improve the forward objects reconstruction, and complement the performance of the updated ITk in the forward region of ATLAS detector. This leads to an amelioration in the jet and lepton reconstruction performances.The ability of the HGTD detector to improve the pile-up jet rejection and the lepton isolation efficiency within the forward region in addition to the physics and performance results is going to be presented.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** BENDEBBA, Fatima (Universite Hassan II, Ain Chock (MA))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **805** Type: **Experimental poster**

# Development of the USTC LGAD sensors for the ATLAS HGTD upgrade

*Tuesday 17 May 2022 19:00 (1 hour)*

The Low Gain Avalanche Detector (LGAD) technology is proposed for the ATLAS High Granularity Timing Detector (HGTD) towards the High-Luminosity Large Hadron Collider (HL-LHC). The USTC-IME v2.0 and v2.1 LGAD sensors are designed by the University of Science and Technology of China (USTC) and fabricated by the Institute of Microelectronics of the Chinese Academy of Science (IME, CAS). Various designs with different peripheral structures and gain layer implantation are realized in the production. The IV/CV electrical characterization, charge collection and timing resolution measurements are carried out with Sr-90 beta source and test-beam are performed on the single-pad test structures and large arrays, both before and after the neutron irradiation at JSI. The results show that the USTC-IME-v2.1 sensors, of which the carbon implantation is well optimized, can provide collected charge of more than 4 fC and time resolution better than 70 ps at appropriate bias voltage even with the radiation fluence up to 2.5 × 10ˆ15 cmˆ−2 1 MeV neutron equivalent, which satisfies the requirements of the HGTD.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** ZHENG, Xiangxuan (University of Science and Technology of China (CN))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **806** Type: **Experimental poster**

# ATLAS LAr Calorimeter Commissioning for LHC Run-3

*Tuesday 17 May 2022 19:00 (1 hour)*

The Liquid Argon Calorimeters are employed by ATLAS for all electromagnetic calorimetry in the pseudo-rapidity region |η| < 3.2, and for hadronic and forward calorimetry in the region from |η| = 1.5 to |η| = 4.9. They also provide inputs to the first level of the ATLAS trigger. After successful period of data taking during the LHC Run-2 between 2015 and 2018 the ATLAS detector entered into the a long period of shutdown. In 2022 the LHC will restart and the Run-3 period should see an increase of luminosity and pile-up up to 80 interaction per bunch crossing.

To cope with this harsher conditions, a new trigger readout path has been installed during the long shutdown. This new path should improve significantly the triggering performances on electromagnetic objects. This will be achieved by increasing the granularity of the objects available at trigger level by up to a factor of ten.

The installation of this new trigger readout chain required also the update of the legacy system. More than 1500 boards of the precision readout have been extracted from the ATLAS pit, refurbished and re-installed. The legacy analog trigger readout that will remain during the LHC Run-3 as a backup of the new digital trigger system has also been updated.

For the new system 124 new on-detector boards have been added. Those boards that are operating in a radiative environment are digitizing the calorimeter trigger signals at 40MHz. The digital signal is sent to the off-detector system and processed online to provide the measured energy value for each unit of readout. In total up to 31Tbps are analyzed by the processing system and more than 62Tbps are generated for downstream reconstruction. To minimize the triggering latency the processing system had to be installed underground. The limited available space imposed a very compact hardware structure. To achieve a compact system, large FPGAs with high throughput have been mounted on ATCA mezzanines cards. In total no more than 3 ATCA shelves are used to process the signal from approximately 34000 channels. Given that modern technologies have been used compared to the previous system, all the monitoring and control infrastructure is being adapted and commissioned as well.

This contribution will present the challenges of the installation, the commissioning and the milestones still to be completed towards the full operation of both the legacy and the new readout paths for the LHC Run-3.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** PIAZZA, Federica (Università degli Studi e INFN Milano (IT))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **807** Type: **Experimental poster**

# Development of the ATLAS Liquid Argon Calorimeter Readout Electronics for the HL-LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

A new era of hadron collisions will start around 2028 with the High-Luminosity LHC, that will allow to collect ten times more data that what has been collected so far at the LHC. This is possible thanks to a higher instantaneous luminosity and higher number of collisions per bunch crossing.

To meet the new trigger and data acquisition requirements and withstand the high expected radiation doses at the High-Luminosity LHC, the ATLAS Liquid Argon Calorimeter readout electronics will be upgraded. The triangular calorimeter signals are amplified and shaped by analogue electronics over a dynamic range of 16 bits, with low noise and excellent linearity. Developments of low-power preamplifiers and shapers to meet these requirements are ongoing in 130nm CMOS technology. In order to digitize the analogue signals on two gains after shaping, a radiation-hard, low-power 40 MHz 14-bit ADCs is being developed using a pipeline+SAR architecture in 65nm CMOS. The characterization of the prototypes of these on-detector components is promising and will likely fulfill all the requirements.

The signals will be sent at 40MHz to the off-detector electronics, where FPGAs connected through high-speed links will perform energy and time reconstruction through the application of corrections and digital filtering. Reduced data are then sent with low latency to the first-level trigger-system, while the full data are buffered until the reception of the trigger decision signal. If an event is triggered, the full data is sent to the ATLAS readout system. The data-processing, control, and timing functions will be realized with dedicated boards using the ATCA technology.

The results of tests of prototypes of the on-detector components will be presented. The design of the off-detector boards along with the performance of the first prototypes will be discussed. In addition, the architecture of the firmware and processing algorithms will be shown.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** SHROFF, Maheyer Jamshed (University of Victoria (CA))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **809** Type: **Experimental poster**

# Upgrade of ATLAS Hadronic Tile Calorimeter for the High Luminosity LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

The Tile Calorimeter (TileCal) is a sampling hadronic calorimeter covering the central region of the ATLAS experiment, with steel as absorber and plastic scintillators as active medium. The High-Luminosity phase of LHC, delivering five times the LHC nominal instantaneous luminosity, is expected to begin in 2029. TileCal will require new electronics to meet the requirements of a 1 MHz trigger, higher ambient radiation, and to ensure better performance under high pile-up conditions. Both the on- and off-detector TileCal electronics will be replaced during the shutdown of 2026-2028. PMT signals from every TileCal cell will be digitized and sent directly to the back-end electronics, where the signals are reconstructed, stored, and sent to the first level of trigger at a rate of 40 MHz. This will provide better precision of the calorimeter signals used by the trigger system and will allow the development of more complex trigger algorithms. The modular front-end electronics feature radiation-tolerant commercial off-the-shelf components and redundant design to minimise single points of failure. The timing, control and communication interface with the off-detector electronics is implemented with modern Field Programmable Gate Arrays (FPGAs) and high speed fibre optic links running up to 9.6 Gb/s. The TileCal upgrade program has included extensive R&D and test beam studies. A Demonstrator module with reverse compatibility with the existing system was inserted in ATLAS in August 2019 for testing in actual detector conditions. The ongoing developments for on- and off-detector systems, together with expected performance characteristics and results of test-beam campaigns with the electronics prototypes will be discussed.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** NKADIMENG, Edward Khomotso (University of the Witwatersrand (ZA))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **810** Type: **Experimental poster**

# Upgrade of the ATLAS Luminosity Monitor for HL-LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

The ATLAS physics program for HL-LHC assumes that luminosity will be measured with a precision of at least 1%, the proton-proton collision rate being as large as 200 interactions per bunch crossing. In order to reach this goal, ATLAS will have several luminosity monitors. Among them, LUCID-3 will be one of the few with enough acceptance to measure absolute luminosity during van der Meer scans, when the proton-proton collision rate goes down to 10-4 interactions per bunch crossing.
The baseline LUCID-3 detector consists of photomultipliers (PMTs) placed close to the proton beam pipe in a highly radioactive environment. The sensitive area of the detector is the PMT window acting as Cherenkov radiator. The position of the detector is such that the acceptance is sufficiently high in vdM runs and sufficiently low in physics runs in order to avoid hit saturation, even at the highest collision rates. The same detector principle was used during Run-2 to provide the official ATLAS luminosity measurement at LHC.
An alternative option is based on the usage of radiation hard optical fibers acting both as Cherenkov radiators and light-guides, routing light towards PMTs located in a less radioactive area.
The PMT gain will be continuously monitored with a 207Bi radioactive source deposited on the PMT window. In the case of the fiber detector, LED light will be injected directly on the PMT, and simultaneously through the fibers, in order to monitor the deterioration of the fiber light transmission.
Prototypes of both detectors are installed at LHC and will be operational during Run-3. They will be presented together with the first results, if available.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** LINDON, Jack (University of Alberta (CA))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **811** Type: **Experimental poster**

# Study of the correlation between the construction parameters of the MM readout boards and performance of the Micromegas detectors

*Tuesday 17 May 2022 19:00 (1 hour)*

The ATLAS experiment is being upgraded to take advantage of the improved running conditions foreseen for the Run 3 and High Luminosity LHC operation phase. Part of this upgrade consists in removing the original Small Wheels located in the Muon Spectrometer, and replacing them with two New Small Wheels (NSWs). The exploited technologies for the upgrade are Small-Strips Thin Gap Chambers (sTGC) and MicroMegas (MM). The readout boards of the MicroMegas detectors, before being installed in the final detector, underwent a detailed QA/QC at CERN, during which many construction parameters were measured and stored in databases. Then, the boards have been mounted in Double Wedges and moved to BB5 integration site at CERN, where their final performance and operation have been validated with cosmic rays. Studies of the correlation between several construction parameters of the MM readout boards, as minimum resistance, surface resistivity, pillar height, and operational parameters, as maximum reachable HV per sector, are presented.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** GRECO, Matteo (INFN Lecce e Universita del Salento (IT))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **812** Type: **Experimental poster**

# The Control System of the New Small Wheel Electronics for the ATLAS experiment

*Tuesday 17 May 2022 19:00 (1 hour)*

The present ATLAS Small Wheel Muon detector will be replaced with a New Small Wheel(NSW) detector in order to cope up with the future LHC runs of high luminosity.One crucial part of the integration procedure concerns the validation of the electronics for a system with more than 2.1 M electronic channels.The readout chain is based on optical link technology connecting the backend to the front-end electronics via the FELIX, which is a newly developed system that will serve as the next generation readout driver for ATLAS.For the configuration, calibration and monitoring path the various electronics boards are supplied with the GBT-SCA ASIC and its purpose is to distribute control and monitoring signals to the electronics.Due to its complexity,NSW electronics requires the development of a sophisticated Control System.The use of such a system is necessary to allow the electronics to function consistently, safely and as a seamless interface to all sub-detectors and the technical infrastructure of the experiment.The central system handles the transition between the probe's possible operating states while ensuring continuous monitoring and archiving of the system's operating parameters.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** TZANIS, Polyneikis (National Technical Univ. of Athens (GR))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **813** Type: **Experimental poster**

# The ATLAS New Small Wheel Simulation and Reconstruction Software and Detector Performance Studies

*Tuesday 17 May 2022 19:00 (1 hour)*

After successfully completing the phase-I upgrades during the long-shutdown 2 of LHC, the ATLAS detector is now ready to take Run3 collision data, with several upgrades implemented. The most important and challenging being in the Muon Spectrometer, where the two forward inner muon stations have been replaced with the New Small Wheels (NSW) equipped with two completely new detector technologies: the small strips Thin Gap Chambers (sTGC) and the Micromegas (MM).

Following the enormous effort for the construction, commissioning and installation of the NSW, the muon software required extensive revisions and new implementations, as well as migration to new multi thread approach. The new detectors have been fully integrated into the software. The detectors response is simulated and compared with real data from cosmic ray's test benches and test-beams. Nominal geometries, misalignments, and deformations, as well as other possible deviations from nominal operating conditions resulted from the detectors validation studies, have been implemented for a realistic study of final performances.

The simulation of both sTGC and MM trigger was implemented, and performance evaluated in different configurations, with and without background, serving as a crucial input for the optimization and hardware implementation of the trigger logic. Full muon reconstruction performance studies are performed and all the software tools, including dedicated data format, are now ready for early data-taking detector commissioning, and for physics analyses.

After an overview of the software implementation and the adopted strategies for simulations and reconstruction, a summary of the studies carried out will be presented.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** CARNESALE, Maria (Sapienza Universita e INFN, Roma I (IT))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **814** Type: **Experimental poster**

# Status of the CSM FPGA Irradiation Test for the HL-LHC ATLAS Muon Spectrometer Upgrade

*Tuesday 17 May 2022 19:00 (1 hour)*

The increased radiation environment and data rate for the High Luminosity Large Hadron Collider (HL-LHC) require upgrades to the readout electronics for the Muon Spectrometer ( MS ) electronics. In this talk, I will present the status of the irradiation studies for the chamber service module (CSM). The CSM is a custom-built front-end electronics board and is responsible for multiplexing data read out from on-detector electronics as well as passing configuration information to them. An important component of the CSM is a Field-programmable gate array (FPGA), specifically using the FPGA Artix7 xc7a35T, is responsible for fanout of configuration and control information for 18 mezzanine cards. The Artix-7 is a commercial component with a history of meeting our radiation specifications. The specific model used in the CSM was first tested for the Single Event Effects (SEE) at LANSCE. The model was tested in a radiation hard environment with an average flux 10ˆ3 higher than ATLAS (6.02E+3 n/cm2/s vs 1.3E+6 n/cm2/s). Results show that the SEE test approximately had 3 years of ATLAS in comparison with 1.9E+11n/cm2/y fluence (MDT CSM Requirement). One CSM board on average has approximately 9 errors in 3 years of ATLAS Run. The CSM was next tested for the Total Ionization Dose (TID) at BNL. The model was tested at a dose rate 7.675 kRad/hr. Results show that the total dose of all four irradiated test boards exceeded more than 3x the ATLAS RTC requirement of 10kRad dose.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT)); GUHIT, Jem Aizen Mendiola (University of Michigan (US))

**Co-authors:** XIAO, Xiong (University of Michigan (US)); SCHWARZ, Thomas Andrew (University of Michigan (US)); HU, Xueye (University of Michigan (US)); GUO, Yuxiang

**Presenter:** GUHIT, Jem Aizen Mendiola (University of Michigan (US))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **815** Type: **Experimental poster**

# Event Filter Tracking for the Upgrade of the ATLAS Trigger and Data Acquisition System

*Tuesday 17 May 2022 19:00 (1 hour)*

This submission describes revised plans for Event Filter Tracking in the upgrade of the ATLAS Trigger and Data Acquisition system for the high pileup environment of the High-Luminosity Large Hadron Collider (HL-LHC). The new Event Filter Tracking system is a flexible, heterogeneous commercial system consisting of CPU cores and possibly accelerators (e.g., FPGAs or GPUs) to perform the compute-intensive Inner Tracker charged particle reconstruction. Demonstrators based on commodity components have been developed to support the proposed architecture: a software-based fast tracking demonstrator, an FPGA-based demonstrator, and a GPU-based demonstrator. Areas of study are highlighted in view of a final system for HL-LHC running.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** AHUJA, Sudha (Royal Holloway, University of London (GB))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **816** Type: **Experimental poster**

# Performance of ATLAS Forward Proton Detector during LHC Run 2

*Tuesday 17 May 2022 19:00 (1 hour)*

Since its installation in 2016, AFP took data during standard (low-beta, *high-μ) and special (low-beta*, low-μ) LHC fills. Performance of tracking and time-of-flight systems as well as studies of trigger performance and detector alignment will be discussed.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** ERLAND, Paula Agnieszka (Polish Academy of Sciences (PL))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **817** Type: **Experimental poster**

# Performance and calibration of the ATLAS Tile Calorimeter

*Tuesday 17 May 2022 19:00 (1 hour)*

The Tile Calorimeter (TileCal) is a sampling hadronic calorimeter covering the central region of the ATLAS experiment, with steel as absorber and plastic scintillators as active medium. The scintillators are read-out by the wavelength shifting fibres coupled to the photomultiplier tubes (PMTs). The analogue signals from the PMTs are amplified, shaped, digitized by sampling the signal every 25 ns and stored on detector until a trigger decision is received. The TileCal front-end electronics reads out the signals produced by about 10000 channels measuring energies ranging from about 30 MeV to about 2 TeV. Each stage of the signal production from scintillation light to the signal reconstruction is monitored and calibrated. During LHC Run-2, high-momentum isolated muons have been used to study and validate the electromagnetic scale, while hadronic response has been probed with isolated hadrons. The calorimeter time resolution has been studied with multi-jet events. A summary of the performance results, including the calibration, stability, absolute energy scale, uniformity and time resolution, will be presented.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** ANDREAN, Stefio Yosse (Stockholm University (SE))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **818** Type: **Experimental poster**

# Studies of the long term stability of track selection criteria for the ATLAS track counting luminosity measurement

*Tuesday 17 May 2022 19:00 (1 hour)*

A precise measurement of the luminosity is an essential part of the ATLAS physics program and is of particular importance to cross-section measurements, where it can be one of the largest systematic uncertainties. The track-counting method is one of several approaches used within ATLAS to compute the luminosity and involves counting the number of charged-particle tracks reconstructed in the Inner Detector. The average number of tracks scales linearly with the number of simultaneous proton-proton interactions, μ, per bunch-crossing, and can therefore be used to measure the luminosity.

This poster presents studies of the long term stability of the track-counting luminosity measurement in the LHC Run 2. Different track selection criteria are studied and are compared on a run-by-run basis, providing insights on changing detector conditions and beam configurations throughout each data-taking year. In addition, events from Z—>μμ decays are used to test the efficiency of the track selections and to study the stability over time.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** MCLACHLAN, Thomas Christopher (Deutsches Elektronen-Synchrotron (DE))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **819** Type: **Experimental poster**

# A Tool for Calculation of the Radiation Parameters on the Early Stage of Simulation Geometry Development in CATIA

*Tuesday 17 May 2022 19:00 (1 hour)*

The simulation is being used to produce artificial events for physics analyses. In the ATLAS experiment at LHC CERN, Geneva, Switzerland, simulation is carried out on the GEANT4 platform. The GEANT4 uses geometry descriptions as an input for the modelling of the propagation of the particles in the material. Adding CATIA (Computer-Aided Three-dimensional Interactive Application) CAD application into simulation infrastructure brings an opportunity for the early study of the detector geometry for precise simulation. Paper describes a method of calculation of X_0/λ radiation parameters for the CATIA native geometry descriptions. The core part is the so-called scanner function, enabling the generation of the control points on the geometry, where the calculations will carry out. The algorithm contains as well, the initial transformations of geometries before scanning and output interfaces with the standard applications Root and Excel

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT)); TSUTSKIRIDZE, Niko (Georgian Technical University (GE)); KEKELIA, Besik (Ivane Javakhishvili Tbilisi State University (GE)); SOLODKOV, Sanya (Institute for High Energy Physics of NRC Kurchatov Institute (RU)); ON BEHALF OF THE ATLAS COLLABORATION; SURMAVA, Archil (Georgian Technical University (GE)); SHARMAZANASHVILI, Alexander (Georgian Technical University (GE)); Mrs VASHAKIDZE, Salome (Georgian Technical University)

**Presenter:** SHARMAZANASHVILI, Alexander (Georgian Technical University (GE))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **821** Type: **Theory poster**

# First inverse moments of heavy-hadron distribution amplitudes

*Tuesday 17 May 2022 19:00 (1 hour)*

Heavy-quark symmetry (HQS), despite being approximate, allows to relate dynamically many hadron systems. In the HQS-limit heavy mesons and doubly-heavy baryons are very similar as their dynamics is determined by a light quark moving in a color field of a static source. As in the meson case, matrix elements of non-local interpolation currents between the baryon state and vacuum are determined by light-cone distribution amplitudes (LCDAs). The first inverse moment of the leading twist $B$-meson distribution amplitude is a hadronic parameter needed for an accurate theoretical description of $B$-meson exclusive decays. It is quite natural that a similar moment of doubly-heavy baryon is of importance in exclusive doubly-heavy baryons' decays. We obtain HQET sum rules for the first inverse moment based on the correlation functions containing nonlocal heavy-light operator of the doubly-heavy baryon and its local interpolating current. Numerical estimates of this moment are presented.

**Author:** SHUKHTINA, Alisa

**Co-author:** PARKHOMENKO, Alexander (P.G. Demidov Yaroslavl State University, Yaroslavl, Russia)

**Presenter:** SHUKHTINA, Alisa

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **822** Type: **Experimental poster**

# The performance of the ATLAS Inner Detector tracking trigger in high pileup collisions at 13 TeV at the Large Hadron Collider (Run-2) and plans for Run-3

*Tuesday 17 May 2022 19:00 (1 hour)*

The performance of the Inner Detector tracking trigger of the ATLAS experiment at the LHC is evaluated for the data taking period of Run-2 (2015-2018). The Inner Detector tracking was used for the muon, electron, tau and b-jet triggers, and its high performance is essential for a wide variety of ATLAS physics programs such as many precision measurements of the Standard Model and searches for new physics. The detailed efficiencies and resolutions of the trigger in a wide range of physics signatures are presented for the Run 2 data. From the upcoming Run-3, starting in 2022, the application of Inner Detector tracking in the trigger is planned to be significantly expanded, in particular full-detector tracking will be utilized for hadronic signatures (such as jets and missing transverse energy triggers) for the first time. To meet computing resource limitation, various improvements, including machine-learning based track seeding, have been developed.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** HUANG, Zuchen (University of Manchester)

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **823** Type: **Experimental poster**

# The new ATLAS triggers for long-lived particles that leave unconventional signature in the tracking detectors

*Tuesday 17 May 2022 19:00 (1 hour)*

The Large Hadron Collider (LHC) is the world's highest energy particle accelerator, providing ultimately unique opportunities of directly searching for new physics Beyond the Standard Model (BSM). Massive long-lived particles (LLPs), which are absent in the Standard Model, can occur in many well-motivated theories of physics BSM. These new massive LLPs can decay into other particles away from the LHC collision point, resulting in unusual experimental signatures and hence requiring customized and complex experimental techniques to identify them. Previously, the ATLAS experiment did not have dedicated triggers to explicitly identify massive LLPs decaying in the inner tracking detectors using tracking information. To enhance the sensitivity of searches, a series of new triggers customized for various unconventional tracking signatures, such as "displaced" tracks and short tracks which "disappear" within the tracking detector, have been developed and will be utilized in the upcoming Run-3 data taking starting from 2022. The development of these triggers and their expected performance will be presented.

**Authors:** ATLAS, Collaboration; ZHU, Junjie (University of Michigan (US)); LEONE, Sandra (Universita & INFN Pisa (IT))

**Presenter:** KERRIDGE, Benjamin Philip (University of Warwick (GB))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **825** Type: **Experimental poster**

# The Muon Trigger of the ATLAS experiment: performance and improvements for Run 3

*Tuesday 17 May 2022 19:00 (1 hour)*

Events with muons in the final state are fundamental for detecting a large variety of physics processes in the ATLAS Experiment, including both high precision Standard Model measurements and new physics searches. For this purpose, the ATLAS Muon Trigger has been designed and developed into two levels: a hardware based system (Level-1) and a software based reconstruction (High Level Trigger). They have been optimized to keep the trigger rate as low as possible while maintaining a high efficiency, despite the increased particle rates and pile-up conditions at the LHC. An overview of the muon triggering strategies will be provided, showing the performance in Run 2 data of both Level 1 and High Level Trigger. The most recent improvements implemented for Run 3 will also be presented.

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**Presenter:** DROBAC, Alec (Tufts University (US))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **826** Type: **Experimental poster**

# ATLAS Trigger system for Run 3

*Tuesday 17 May 2022 19:00 (1 hour)*

The ATLAS Trigger in Run 3 is expected to record on average around 1.7 kHz of primary 13.6 TeV physics data, along with a substantial additional rate of delayed data (to be reconstructed at a later date) and trigger-level-analysis data, surpassing the instantaneous data volumes collected during Run 2.

Events will be selected based on physics signatures such as the presence of energetic leptons, photons, jets or large missing energy. New in the Level 1 (L1) trigger are the New Small Wheel and BIS78 chambers, in combination with new L1Muon endcap sector logic and MUCTPI. In addition, a new L1Calo system based around eFEX, jFEX and gFEX systems for egamma, tau, jets and missing energy will be under commissioning in 2022. In the High Level Trigger, the ATLAS physics menu was re-implemented from scratch using a new multi-threaded framework.

We will present first results from the early phases of commissioning the Run 3 trigger in 2022. We will describe the ATLAS Run 3 trigger menu, and how it differs from Run 2. Exploring how rate, bandwidth, and CPU constraints are integrated into the menu. Improvements made during the run to react to changing LHC conditions and data taking scenarios will be discussed and we will conclude with an outlook on how the trigger menu will evolve with the continued commissioning on the new L1 systems.

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**Presenter:** MERLASSINO, Claudia (University of Oxford (GB))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **827** Type: **Experimental poster**

# Multiplicity dependence of intra-jet properties in small collision systems with ALICE

*Tuesday 17 May 2022 19:00 (1 hour)*

Measurements of jet fragmentation and jet properties in pp collisions provide a test of perturbative quantum chromodynamics (pQCD) and form a baseline for similar measurements in heavy ion (A-A) collisions. In addition, jet measurements in p-A collisions are sensitive to cold nuclear matter effects. Recent studies of high-multiplicity final states of small collision systems exhibit signatures of collective effects that could be associated with hot and dense, color-deconfined QCD matter, which is known to be formed in collisions of heavier nuclei. The modification of the jet fragmentation pattern and jet properties is expected in the presence of such QCD matter. Measurements of jet fragmentation patterns and other jet properties in p-A collisions are needed in order to establish whether deconfined QCD matter is indeed generated in such small systems. In this contribution we report recent ALICE measurements of charged-particle jet properties, including mean charged-constituent multiplicity and fragmentation distribution for leading jets, in minimum bias p-Pb collisions at $\sqrt{s}$ = 5.02 TeV and minimum bias pp collisions at $\sqrt{s}$ = 13 TeV. In addition, the multiplicity dependence of these jet properties in pp collisions at $\sqrt{s}$ = 13 TeV will also be presented. Results will be compared with theoretical model predictions.

**Author:** DAS, Prottoy (Bose Institute (IN))

**Presenter:** DAS, Prottoy (Bose Institute (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **828** Type: **Experimental poster**

# Multiplicity-dependent study of $\Lambda(1520)$ resonance production in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV with ALICE

*Tuesday 17 May 2022 19:00 (1 hour)*

Hadronic resonances are effective tools for studying the hadronic phase in ultra-relativistic heavy-ion collisions. In fact, their lifetime is comparable to the hadronic phase and resonances are sensitive to the hadronic phase effects such as rescattering and regeneration processes which might affect the resonance yields and shape of the transverse momentum spectra. $\Lambda(1520)$ has a lifetime of around 13 fm/$c$, which lies in between the lifetimes of $K^*$ and $\phi$ resonances. The resonance to stable particle yield ratios can be used to study the properties of the hadronic phase. Recently, ALICE observed the suppression of the $\Lambda(1520)/\Lambda$ ratio in Pb–Pb collisions at $\sqrt{s_{\rm NN}}$ = 2.76 TeV as a function of centrality. It is therefore interesting to investigate the multiplicity-dependent study of $\Lambda(1520)/\Lambda$ ratio for pp collisions, since this can serve as a baseline for heavy-ion collisions.

In this contribution, we present new results on the measurement of the baryonic resonance $\Lambda(1520)$ as a function of the charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 5.02 and 13 TeV. The transverse momentum spectrum, the integrated yield $(\mathrm{d}N/\mathrm{d}y)$, the mean transverse momentum $(\langle p_{\rm T}\rangle)$ and the $\Lambda(1520)/\Lambda$ yield ratio will be presented as a function of the charged-particle multiplicity.

**Author:** PADHAN, Sonali (IIT- Indian Institute of Technology (IN))

**Presenter:** PADHAN, Sonali (IIT- Indian Institute of Technology (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **829** Type: **Theory poster**

# Prediction for global properties in O+O collisions at $\sqrt{s_{NN}}$ = 7 TeV using AMPT model

*Tuesday 17 May 2022 19:00 (1 hour)*

Extensive studies at the Large Hadron Collider (LHC), CERN and Relativistic Heavy Ion Collider (RHIC), Brookhaven National Laboratory (BNL) on heavy-ion collisions such as Pb+Pb and Au+Au collisions have helped us understand the existence of Quark-Gluon Plasma (QGP) and study its properties in detail. Recent QGP-like signatures were observed in high-multiplicity proton+proton (pp) collisions. There has been intense research to understand the possible formation of QGP-droplets in small collision systems. However, to fill the gap between pp high-multiplicity and p+Pb collisions, small-ion collisions such as O+O collisions are anticipated in the upcoming run at the LHC. In such nuclear collisions, the nuclear charge density distribution inside the nucleus is a crucial parameter and affects almost every aspect of the outcomes. A three-parameter Fermi distribution (3pF) also known as the Woods-Saxon (WS) distribution is commonly used for heavier nuclei. However, for a doubly magic Oxygen nucleus, several studies replace the charge density profile from 3pF to be Harmonic-Oscillator (HO) type. In this work, we have implemented both of these density profiles in the 16O nucleus using a multiphase phase transport (AMPT) model. We report the results of global properties such as Bjorken energy density, squared speed of sound, particle ratios, kinetic freeze-out parameters and elliptic flow in O+O collisions at $\sqrt{s_{NN}}$ = 7 TeV from AMPT model for both WS and HO density profiles. This study would be a testimony for the studied global observables in O+O collisions with respect to a difference in the charge density profile when confronted with experimental observations from the LHC.

References: D Behera, N Mallick, S Tripathy, S Prasad, A N Mishra, R Sahoo, arXiv:2110.04016v1

**Authors:** BEHERA, Debadatta (Indian Institute of Technology Indore (IN)); MALLICK, Neelkamal (Indian Institute of Technology Indore); TRIPATHY, Sushanta (INFN, Bologna (IT)); PRASAD, Suraj (Indian Institute of Technology Indore (IN)); MISHRA, Aditya Nath (Wigner Research Centre for Physics Budapest, Hungary); SAHOO, Raghunath (Indian Institute of Technology Indore (IN))

**Presenters:** BEHERA, Debadatta (Indian Institute of Technology Indore (IN)); SAHOO, Raghunath (Indian Institute of Technology Indore (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **830** Type: **Experimental poster**

# Measurement prospects for di-Higgs production in the HH to bbyy channel with the ATLAS experiment at the HL-LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

We present a prospect study on di-Higgs production in the HH to bbyy decay channel with the ATLAS experiment at the High Luminosity LHC (HL-LHC). The results are obtained by extrapolating the results from the Run 2 measurement, with 139/fb of data at a center-of-mass energy of 13 TeV, to the conditions expected at the HL-LHC. While there is no sign of di-Higgs production with the current LHC dataset, the much higher luminosity (3000/fb) and energy (14 TeV) at the HL-LHC will enable a much better measurement of this important process. We describe in detail the extrapolation process and assumptions, and multiple scenarios for the treatment of systematic uncertainties at the HL-LHC are considered. Under the baseline systematic uncertainty scenario, the extrapolated precision on the Standard Model di-Higgs signal strength measurement is 50%, corresponding to a significance of 2.2 sigma. The extrapolated 1 sigma confidence interval from a measurement of kLambda, the trilinear Higgs boson self-coupling modifier, is [0.3, 1.9].
Other comments

**Authors:** WANG, Alex Zeng (University of Wisconsin Madison (US)); KORN, Andreas (University College London (GB))

**Presenter:** WANG, Alex Zeng (University of Wisconsin Madison (US))

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **831** Type: **Experimental poster**

# Projected sensitivity of Higgs boson pair production combining the bbyy and bbtautau decay channels at the HL-LHC with the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

A combination of projection studies of non-resonant Higgs boson pair production is performed in the $bb\gamma\gamma$ and $bb\tau\tau$ decay channels with the ATLAS detector, assuming 3000/fb of proton-proton collision data at a center-of-mass energy of $\sqrt{s} = 14$ TeV at the HL-LHC. The projected results are based on extrapolations of the Run 2 analyses conducted with 139/fb data at $\sqrt{s} = 13$TeV. In addition to the increased luminosity and center-of-mass energy at the HL-LHC, both experimental and theoretical systematic uncertainties are expected to be reduced relative to their Run 2 values. The projected results are expressed in terms of the significance for the observation of the Standard Model Higgs boson pair production, and the constraint on Higgs boson trilinear self-coupling modifier kLambda.

**Authors:** CHENG, Alkaid (University of Wisconsin Madison (US)); KORN, Andreas (University College London (GB))

**Presenter:** CHENG, Alkaid (University of Wisconsin Madison (US))

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **832** Type: **Experimental poster**

# Novel broad-mass search for new scalar particles in FCNC top quark decays using the full Run 2 data of the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

No analysis in ATLAS or CMS has so far searched for FCNC decays of top quarks into a new scalar (X) in a broad mass range probing branching ratios below $10^{-3}$. In the case of the Higgs boson, branching ratios $t \rightarrow Hu/c$ are predicted within the SM to be of about $O(10^{-17})/O(10^{-15})$. Several beyond-SM theoretical models predict new particles and enhanced branching ratios. In particular, simple SM extensions involve the Froggatt-Nielsen mechanism, which introduces a scalar field with flavour charge, the so-called flavon, featuring flavour violating interactions. Using the full Run 2 data, ATLAS has performed a search for a scalar of a mass in the range between 20 and 160 GeV and decaying into a pair of bottom quarks. In order to distinguish signal from background, a feed-forward neural network that uses kinematic variables together with various invariant masses of pairs of b-jets is used in the fits for the various mass hypotheses. The method, strategy and preliminary results for both FCNC decays $t \rightarrow cX$ and $t \rightarrow uX$ will be presented.

**Authors:** SALVADOR SALAS, Adrian (The Barcelona Institute of Science and Technology (BIST) (ES)); KORN, Andreas (University College London (GB))

**Presenter:** SALVADOR SALAS, Adrian (The Barcelona Institute of Science and Technology (BIST) (ES))

**Session Classification:** Poster Session I

**Track Classification:** Top Physics

Contribution ID: **833** Type: **Experimental poster**

# Search for resonant pair production of Higgs bosons in the 4b final state using 139/fb of sqrt(s) = 13 TeV pp collision data with the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

A search for resonant Higgs boson pair production in the 4b final state is presented. The analysis uses up to 139/fb of pp collision data at $\sqrt(s) = 13$ TeV collected with the ATLAS detector. The analysis is divided into two categories, targeting Higgs boson decays which are reconstructed as pairs of jets or as single large-radius jets. Two benchmark signal models are considered: a scalar resonance and a spin-2 graviton, both of which are produced via gluon-gluon fusion. The observed data are consistent with Standard Model predictions. Upper limits are set on the production cross section times branching ratio of a new resonance in the mass range from 251 GeV to 5 TeV.

**Authors:** KORN, Andreas (University College London (GB)); ZHANG, Rui (University of Wisconsin Madison (US))

**Presenter:** ZHANG, Rui (University of Wisconsin Madison (US))

**Session Classification:** Poster Session I

**Track Classification:** TeV-Scale BSM

Contribution ID: **835** Type: **Experimental poster**

# Search for the Higgs boson decaying to a pair of muons in pp collisions at 13 TeV with the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

The dimuon decay of the Higgs boson is the most promising process for probing the Yukawa couplings to the second generation fermions at the Large Hadron Collider (LHC). In this poster, we present a search for this important process using the data corresponding to an integrated luminosity of $139 fb^{-1}$ collected with the ATLAS detector in pp collisions at $\sqrt{s} = 13$ TeV at the LHC. Events are divided into several regions using boosted decision trees to target different production modes of the Higgs boson. The measured signal strength (defined as the ratio of the observed signal yield to the one expected in the Standard Model) is μ=1.2±0.6. The observed (expected) significance over the background-only hypothesis for a Higgs boson with a mass of 125.09 GeV is 2.0σ (1.7σ).

**Authors:** KORN, Andreas (University College London (GB)); CHAN, Jay (University of Wisconsin Madison (US))

**Presenter:** CHAN, Jay (University of Wisconsin Madison (US))

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **836** Type: **Experimental poster**

# Probing the CP nature of the top-Higgs Yukawa coupling in ttH and tH events with H⟶bb using the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

Within the Standard Model (SM) the Higgs boson is predicted to be a scalar particle ($J^{CP} = 0^{++}$). However, simple extensions to the SM, such as the Higgs characterisation model, allow for CP-odd couplings of the Higgs to other particles. Such modifications to the coupling can be probed by studying the Yukawa interaction of the Higgs with fermions. The modification the Lagrangian for the interaction is expressed as $\mathcal{L}_t tH = -\ _t y_{t\bar{t}}(+i_5)_t$, where $y_t$ is the SM Yukawa coupling strength, $_t$ is the coupling strength modifier, α is the CP mixing angle, ϕ the Higgs field and $_t$ &$\bar{}_t$ are the top-quark spinor fields. This work measures the coupling strength modifier and CP mixing angle of the interaction. The analysis targets events where a Higgs boson is produced in association with a pair of top-quarks (ttH) or with a single top-quark (tH) in the H⟶bb decay channel. This is the first time that the CP properties have been measured in this channel. To do this 139 $\mathrm{fb}^{-1}$ of data, collected by the ATLAS detector during Run 2 with a centre of mass energy of √s=13 TeV, is utilised. Within the analysis events are split into two different channels based on the decays of the top-quarks, utilising events with either 1 or 2 leptons. To determine the values of the coupling strength and mixing angle the analysis makes use of the CP-sensitive angular variables $b_4(t,\bar{t})$ and $b_2^{t\bar{t}H}(t,\bar{t})$. Additionally, techniques such as Boosted Decision Trees (BDTs) are used to separate signal from background, allowing for the definition of signal enriched regions. Results are obtained from a profile likelihood fit to data giving best fit values of $= 11\ ^{+55}_{-77}$ and $_t = 0.83^{+0.30}_{-0.46}$. These results disfavor a purely CP-odd coupling at 1.2σ significance and complement results obtained in the H⟶γγ decay channel.

**Authors:** KORN, Andreas (University College London (GB)); LAWRENCE, Zak (University of Manchester (GB))

**Presenter:** LAWRENCE, Zak (University of Manchester (GB))

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **837** Type: **Experimental poster**

# Proton parton distribution functions using ATLAS data

*Tuesday 17 May 2022 19:00 (1 hour)*

Precise knowledge of proton parton distribution functions is a crucial element of accurate predictions of both Standard Model and Beyond Standard Model physics at hadron colliders such as the LHC. We present a PDF fit at next-to-next-to-leading order in QCD demonstrating the constraining power of a diverse range of ATLAS measurements, in combination with deep-inelastic scattering data from HERA, on the parton distributions within the proton. Careful consideration is made of the correlation of systematic uncertainties within and between the ATLAS datasets. The resulting set of parton distribution functions, named ATLASpdf21, is evaluated for two choices of chi2 tolerance and compared to a range of global PDF fits.

**Authors:** KORN, Andreas (University College London (GB)); CONROY, Eimear Isobel (University of Oxford (GB))

**Presenter:** CONROY, Eimear Isobel (University of Oxford (GB))

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **839** Type: **Experimental poster**

# Exclusive dilepton production in ultraperipheral Pb+Pb collisions in ATLAS

*Tuesday 17 May 2022 19:00 (1 hour)*

Relativistic heavy-ion beams at the LHC are accompanied by a large flux of equivalent photons, leading to multiple photon-induced processes. One of the most basic processes, originating from the photon-photon interactions, is the exclusive production of lepton pairs. This poster presents new measurements of exclusive dielectron and dimuon production performed by the ATLAS Collaboration, using the data from ultraperipheral lead-lead collisions at $\sqrt{s_{NN}} = 5.02\,\mathrm{TeV}$. The differential cross-sections as a function of several dilepton variables were measured in the inclusive sample, and for dielectron pairs also under the requirement of no activity in the forward direction. The results are compared with predictions from STARlight and SuperChic MC generators.

**Authors:** OGRODNIK, Agnieszka Ewa (AGH University of Science and Technology (PL)); KORN, Andreas (University College London (GB))

**Presenter:** OGRODNIK, Agnieszka Ewa (AGH University of Science and Technology (PL))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **840** Type: **Experimental poster**

# Measurement of high-pt electron performance in proton-lead collisions in the ATLAS experiment

*Tuesday 17 May 2022 19:00 (1 hour)*

lectrons constitute an essential component of final states from the leptonic decay channels of W and Z bosons. Their reconstruction and identification are especially challenging in heavy-ion collisions due to high detector occupancy. Therefore, the evaluation of electron performance is crucial for precision measurements of properties of quark-gluon plasma produced in heavy-ion collisions at the LHC energies. The poster will present the measurement of electron reconstruction, identification, isolation, and trigger efficiencies in proton-lead collisions collected at 8.16 TeV in 2016. The tag and probe method will be used to derive electron efficiencies in data and MC simulation independently, and the results will be compared.

**Authors:** KORN, Andreas (University College London (GB)); POTEPA, Patrycja Anna (AGH University of Science and Technology (PL))

**Presenter:** POTEPA, Patrycja Anna (AGH University of Science and Technology (PL))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **841** Type: **Experimental poster**

# Search for electroweak production of supersymmetric sleptons and charginos with the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

A new search for the electroweak production of supersymmetric particles decaying into two leptons with missing transverse momentum is presented. Assuming R-parity conservation, two simplified models are considered: direct pair production of sleptons decaying into the lightest neutralinos through leptons of the Standard Model (SM) and direct pair production of the lightest charginos decaying into the lightest neutralinos through W bosons of the SM. The analysis targets phase space regions where the difference in mass between the slepton or the lightest chargino and the lightest neutralino is close to or below the mass of the W boson. Such regions with compressed mass spectra have not been covered by any searches conducted so far due to the low cross section of the supersymmetric signal. Therefore, improved analysis strategies are crucial to separate the supersymmetric signal from the SM backgrounds. A search for an excess of same-flavour lepton pairs in opposite-sign lepton events is made in the direct slepton pair production analysis while a multivariate approach using gradient boosted decision trees is exploited in the chargino pair production analysis and considering both the same-flavour and different-flavour channels. No significant excesses over the expected background are observed using proton-proton collisions data collected by the ATLAS experiment at 13 TeV and exclusion limits at 95% confidence level are set for each considered model. Exclusion limits are also set for selectrons and smuons separately and portions of the region excluded by the search of smuons pair production are expected to be compatible with the muon g-2 anomaly for small tan(beta) values.

**Authors:** KORN, Andreas (University College London (GB)); BALLABENE, Eric (Università degli Studi e INFN Milano (IT))

**Presenter:** BALLABENE, Eric (Università degli Studi e INFN Milano (IT))

**Session Classification:** Poster Session I

**Track Classification:** TeV-Scale BSM

Contribution ID: **842** Type: **Experimental poster**

# Improved track reconstruction for prompt and long-lived particles in ATLAS for the LHC Run 3

*Tuesday 17 May 2022 19:00 (1 hour)*

In preparation for LHC Run 3, ATLAS completed a major effort to improve the track reconstruction performance for prompt and long-lived particles. Resource consumption was halved while expanding the charged-particle reconstruction capacity. Large-radius track (LRT) reconstruction, targeting long-lived particles (LLP), was optimized to run in all events expanding the potential phase-space of LLP searches. The detector alignment precision was improved to avoid limiting factors for precision measurements of Standard Model processes. Mixture density networks and simulating radiation damage effects improved the position estimate of charged particles overlapping in the ATLAS pixel detector, bolstering downstream algorithms' performance. The ACTS package was integrated into the ATLAS software suite and is responsible for primary vertex reconstruction. The talk will highlight the above achievements and report on the readiness of the ATLAS detector for Run 3 collisions.

**Author:** KORN, Andreas (University College London (GB))

**Presenter:** VESSELLA, Makayla (University of Massachusetts (US))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **843** Type: **Experimental poster**

# Search for Dark Matter produced in association with a Standard Model Higgs boson decaying to b-quarks using the full Run 2 collision data with the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

This poster presents a search for Dark Matter produced in association with a Higgs boson decaying to b-quarks using the data corresponding to an integrated luminosity of 139/fb collected with the ATLAS detector in pp collisions at $\sqrt{s} = 13\,\mathrm{TeV}$ at the Large Hadron Collider. The targeted Events typically contain large missing transverse momentum and either two b-tagged small-radius jets or a single large-radius jet associated with two b-tagged subjects. No significant deviation from Standard Model expectations is observed. The results are interpreted in two benchmark models with two Higgs doublets extended by either a heavy vector boson $Z'$ or a pseudoscalar singlet $a$ and which provide a dark matter candidate $\chi$. Significant improvements in sensitivity have been achieved with respect to previous results owing to optimized event selections as well as advances in the object identification, such as the use of the likelihood-based significance of the missing transverse energy and variable-radius track jets. In the case of the Two-Higgs-Doublet model with an additional vector boson
$Z$ , the observed limits extend up to a $Z$ mass of 3.1 TeV at 95 % confidence level for a mass of 100 GeV for the Dark Matter candidate. For the Two-Higgs-Doublet model with an additional pseudoscalar $a$, masses of $a$ are excluded up to 520 GeV and 240 GeV for tanβ = 1 and tanβ = 10 and a Dark Matter mass of 10 GeV, respectively. In addition, limits on the visible cross sections are set and range from to 0.05 fb to 3.26 fb, depending on the missing transverse momentum and b-quark jet multiplicity requirements.

**Authors:** KORN, Andreas (University College London (GB)); CHAN, Jay (University of Wisconsin Madison (US))

**Presenter:** CHAN, Jay (University of Wisconsin Madison (US))

**Session Classification:** Poster Session I

**Track Classification:** Feeble Interactions BSM

Contribution ID: **844** Type: **Experimental poster**

# Search for neutral long-lived particles decaying into displaced jets in the ATLAS calorimeter

*Tuesday 17 May 2022 19:00 (1 hour)*

New long-lived particles are a feature of many extensions to the Standard Model, and their unique detector signatures may elude searches for promptly decaying particles. An analysis of data collected in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector at the Large Hadron Collider is described, focusing on identifying jets produced by neutral long-lived particles decaying to Standard Model fermions within the ATLAS calorimeter. This analysis considers benchmark hidden sector models of neutral long-lived scalars with masses between 5 GeV and 475 GeV pair-produced by decays of mediators with masses between 60 GeV and 1000 GeV. A deep neural network is used to predict whether candidate jets were produced by a long-lived particle decay, QCD multijets, or beam-induced background, and an adversarial training is applied to minimize the impact of Monte Carlo mismodeling. A boosted decision tree is then used to discriminate between signal and background events based on the per-jet neural network outputs and event-level variables. The results of this analysis are presented using the full Run 2 (2015-2018) data set, corresponding to an integrated luminosity of 139/fb. No significant excess is observed, and upper limits are set for these signal models.

**Authors:** KORN, Andreas (University College London (GB)); PROFFITT, Mason (University of Washington (US))

**Presenter:** PROFFITT, Mason (University of Washington (US))

**Session Classification:** Poster Session I

**Track Classification:** Feeble Interactions BSM

Contribution ID: **845** Type: **Experimental poster**

# Search for Heavy (pseudo)Higgs boson A/H produced in association with a top-antitop quark pair leading to the final state with four top quarks in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

Four top-quark production, a rare process in the Standard Model (SM) with a cross-section around 12 fb, is one of the heaviest final states produced at the LHC, and it is naturally sensitive to physics beyond the Standard Model (BSM). A data excess is observed with twice of the expectation. A follow-up analysis is the search for Heavy (pseudo)Higgs boson A/H produced in association with a top-antitop quark pair leading to the final state with four top quarks. The data analyzed correspond to an integrated luminosity of 139 $\mathrm{fb}^{-1}$. In this poster, the four top-quark decay final states containing either a pair of same-sign leptons or multi-lepton (SSML) are considered. To enhance the search sensitivity, a mass-parameterized BDT is introduced to discriminate the BSM signal against the irreducible SM four-top and other dominant SM backgrounds. Observed and expected upper bounds on the production cross-section of A/H are derived in the mass range from 400 GeV to 1000 GeV.

**Author:** KORN, Andreas (University College London (GB))

**Presenter:** HUANG, Shuhui (University of Hong Kong (HK))

**Session Classification:** Poster Session I

**Track Classification:** TeV-Scale BSM

Contribution ID: **846** Type: **Experimental poster**

# Long-lived dark photons at ATLAS: a search for unconventional signatures at the LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

Long-lived particles represent a well motivated approach for beyond-Standard Model (SM) physics searches. An interesting scenario is the one in which light vector mediators (dark photons), weakly coupled to the SM photon, can be produced by an exotic decay of the SM Higgs boson and decay back to SM particles after travelling a macroscopic distance. This study presents a search for light, neutral long-lived particles decaying in collimated jet-like structures containing pairs of leptons or quarks (Dark-Photon-Jets, DPJs). The search is performed on 139 $\mathrm{fb}^{-1}$ of pp collision data at $\sqrt{s}$ = 13 TeV collected during the Run-2. Both the gluon-gluon fusion (ggF) and associated production with a W boson are considered for the Higgs production and dark photon decays are identified, among the overwhelming QCD and non-collision background, thanks to a selection involving dedicated triggers and deep-learning classifiers. The results obtained are interpreted in the context of simplified long-lived particle models such as the Hidden Abelian Higgs Model (HAHM) and the Falkowsk-Ruderma-Volansky-Zupan (FRVZ) model.

**Authors:** KORN, Andreas (University College London (GB)); LONGARINI, Iacopo (Sapienza Universita e INFN, Roma I (IT))

**Presenter:** LONGARINI, Iacopo (Sapienza Universita e INFN, Roma I (IT))

**Session Classification:** Poster Session I

**Track Classification:** Feeble Interactions BSM

Contribution ID: **847** Type: **Experimental poster**

# Search for single production of a vector-like T quark decaying into a Higgs boson and top quark with fully hadronic final states using the ATLAS detector

*Tuesday 17 May 2022 19:00 (1 hour)*

A search is made for a vector-like $T$ quark decaying into a Higgs boson and a top quark in 13 TeV proton-proton collisions using the ATLAS detector at the Large Hadron Collider with a data sample corresponding to an integrated luminosity of $139\ ^{-1}$. The all-hadronic decay modes $H \to b\bar{b}$ and $t \to bW \to bq\bar{q}'$ are reconstructed as large-radius jets and identified using tagging algorithms. Improvements in background estimation, signal discrimination, and a larger data sample, contribute to an improvement in sensitivity over previous all-hadronic searches. No significant excess is observed above the background, so limits are set on the production cross-section of a singlet $T$ quark at 95\% confidence level, depending on the mass, $m_T$, and coupling, $_T$, of the vector-like $T$ quark to Standard Model particles. This search targets a mass range between 1.0 to 2.3 TeV, and a coupling value between 0.1 to 1.6, expanding the phase space of previous searches. In the considered mass range, the upper limit on the allowed coupling values increases with $m_T$ from a minimum value of 0.35 for $1.07 m_T 1.4$ TeV up to 1.6 for $m_T = 2.3$ TeV.

**Authors:** KORN, Andreas (University College London (GB)); FOO, Joel Hengwei (University of Toronto (CA))

**Presenter:** FOO, Joel Hengwei (University of Toronto (CA))

**Session Classification:** Poster Session I

**Track Classification:** TeV-Scale BSM

Contribution ID: **848** Type: **Experimental poster**

# Two New Developments on the Statistical Treatment of Flavour Tagging Uncertainties in ATLAS

*Tuesday 17 May 2022 19:00 (1 hour)*

The identification of jets containing b-hadrons, b-tagging, is critical for many ATLAS physics analyses. Its performance is measured in data and the simulation is corrected through simulation-to-data scale factors. However, such measurement only covers a certain jet $p_T$ range, so the b-tagging performance at higher $p_T$ must be evaluated via a simulation-based extrapolation method. This work considers a widely used scheme, the "pseudo-continuous" working points, which constitutes a flexible way to apply a set of different b-tagging requirements within the same ATLAS physics analysis. A brief introduction is given to this scheme and the corresponding simulation-based extrapolation to high $p_T$ jets is presented for the first time. In addition, a new statistical tool, denoted as "eigenvector recomposition", is developed to allow for the correct combination of analyses relying on different b-tagging setups. It correlates common systematic uncertainties related with b-tagging in a mathematically solid way. Its application in the combination of the "boosted" and "resolved" $VH(H \to bb)$ analyses is shown as an example.

**Authors:** KORN, Andreas (University College London (GB)); KE, Yan (Stony Brook University (US))

**Presenter:** KE, Yan (Stony Brook University (US))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **849** Type: **Experimental poster**

# Measurement of the b -tagging efficiency using multijet events in ATLAS

*Tuesday 17 May 2022 19:00 (1 hour)*

The identification of jets containing b-hadrons, b-tagging, plays an important role in many physics analyses in ATLAS. Several different machine learning algorithms have been deployed for the purpose of b-tagging. These tagging algorithms are trained using Monte-Carlo simulation samples, as such their performance in data must be measured. The b-tagging efficiencies (epsilon_b) have been measured in data using $t\bar{t}$ events in the past and this work presents the measurements in multijet events using data collected by the ATLAS detector at $\sqrt{s} = 13$ TeV for the first time. This offers several key advantages over the ttbar based calibrations, including a higher precision at low jet $p_T$ and an ability to perform measurements of epsilon_b at significantly higher jet $p_T$. Two approaches are applied and for both a profile likelihood fit is performed to extract the number of b-jets in samples passing and failing a given b-tagging requirement. The b-jets yields are then used to determine epsilon_b in data and from that scale factors to the efficiency measured in MC. The two approaches differ primarily in the discriminating variable used in the fit. At low jet $p_T$ the variable $p_{T\,rel}$ is used, while for high jet $p_T$ the signed impact parameter significance is used. Both calibrations give measurements of the scale factors as a function of the jet $p_T$.

**Authors:** KORN, Andreas (University College London (GB)); VECCHIO, Valentina (University of Manchester)

**Presenter:** VECCHIO, Valentina (University of Manchester)

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **850** Type: **Experimental poster**

# New ATLAS b-tagging Algorithm for Run3

*Tuesday 17 May 2022 19:00 (1 hour)*

The identification of jets containing b-hadrons (b-jets) is essential to many aspects of the ATLAS physics programme. Multivariate algorithms responsible for establishing the jet's flavour are developed by the ATLAS Collaboration, exploiting the distinct properties and correlations of charged particle tracks within the jet and reconstructed secondary vertices. The higher pileup conditions and the growing interest for searches in the high transverse momentum regime necessitate the development of improved algorithms using state-of-the-art machine learning techniques. Recent developments in track-based tagging introduced the Deep Impact Parameter Sets (DIPS) tagger, a neural network based on the Deep Sets architecture. It exploits the permutation invariance of track features in the network training and makes use of correlations among the tracks. Consequentially, an improved performance in the identification of b-jets compared to established approaches is observed. The performance of the novel DIPS tagger is evaluated using simulated data. This poster reviews the current state-of-the-art of jet flavour tagging algorithms used by the ATLAS Collaboration.

**Authors:** FROCH, Alexander (Albert Ludwigs Universitaet Freiburg (DE)); KORN, Andreas (University College London (GB))

**Presenter:** FROCH, Alexander (Albert Ludwigs Universitaet Freiburg (DE))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **851** Type: **Experimental poster**

# Measurement of differential cross sections for the production of top quark pairs and of additional jets in pp collisions at $\sqrt{s} = 13$ TeV

*Tuesday 17 May 2022 19:00 (1 hour)*

Differential cross sections for top quark pair ($t\bar{t}$) production are measured in proton-proton collisions at a centre-of-mass energy of 13 TeV using a sample of events containing two oppositely charged leptons. The data were recorded with the CMS detector at the LHC and correspond to an integrated luminosity of 138 fbˆ{−1}. Differential cross sections are measured as functions of kinematic observables of the $t\bar{t}$ system, the top quark and antiquark and their decay products, and the number of additional jets in the event not originating from the $t\bar{t}$ decay. These cross sections are measured as function of one, two, or three variables and are presented at the parton and particle levels. The measurements are compared to standard model predictions of Monte Carlo event generators with next-to-leading-order accuracy in quantum chromodynamics (QCD) at matrix-element level interfaced to parton showers. Some of the measurements are also confronted with predictions beyond next-to-leading-order precision in QCD. The nominal predictions from all calculations, neglecting theoretical uncertainties, do not describe well several of the measured cross sections, and the deviations are found to be largest for the multi-differential cross sections.

**Authors:** PETERSEN, Henriette Aarup (Deutsches Elektronen-Synchrotron (DE)); ALDAYA MARTIN, Maria (DESY); SAVITSKYI, Mykola (Deutsches Elektronen-Synchrotron (DE)); BEHNKE, Olaf (DESY); SOSA, Rafael (Deutsches Elektronen-Synchrotron (DE)); WUCHTERL, Sebastian (Deutsches Elektronen-Synchrotron (DE)); AMOROSO, Simone (Deutsches Elektronen-Synchrotron (DE))

**Presenter:** PETERSEN, Henriette Aarup (Deutsches Elektronen-Synchrotron (DE))

**Session Classification:** Poster Session I

**Track Classification:** Top Physics

Contribution ID: **852** Type: **Experimental poster**

# The High-Level Trigger for the CMS Phase-2 Upgrade

*Tuesday 17 May 2022 19:00 (1 hour)*

The High-Luminosity LHC (HL-LHC) will usher a new era in high-energy physics. The HL-LHC experimental conditions entail an instantaneous luminosity of up to 75 Hz/nb and up to 200 simultaneous collisions per bunch crossing (pileup). To cope with those conditions, the CMS detector will undergo a series of improvements, in what is known as the Phase-2 upgrade. In particular, the upgrade of the Data Acquisition and of the High-Level Trigger (DAQ-HLT) will have to address a much higher event rate and more complex events. In this talk, we will discuss the aspects of the HLT upgrade, detailing the development of the online reconstruction, the construction, characterisation and timing/rate measurement of a simplified HLT menu, the role of heterogeneous architectures in the HLT and the plan of work and milestones until the beginning of Phase-2.

**Author:** TOMEI FERNANDEZ, Thiago (UNESP - Universidade Estadual Paulista (BR))

**Presenter:** TOMEI FERNANDEZ, Thiago (UNESP - Universidade Estadual Paulista (BR))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **854** Type: **Theory poster**

# Insight into the magnetic response of hadron gas using non-extensive statistics

*Tuesday 17 May 2022 19:00 (1 hour)*

Non-central heavy-ion collisions at ultra-relativistic energies are unique in generating magnetic fields of the most significant strength in the laboratory. The fields produced at the early stages of the collision could affect the properties of Quantum Chromodynamics (QCD) matter formed in the heavy-ion collisions. Moreover, this transient magnetic field can also affect the thermodynamic and transport properties of the final state dynamics of the system. In this work, we investigated the thermodynamic properties such as energy density, entropy density, pressure, and speed of sound of a hadron gas in the presence of an external static magnetic field using thermodynamically consistent non-extensive Tsallis statistics. Further, the magnetization of such a system is also studied. This analysis reveals an interplay of the diamagnetic and paramagnetic nature of the system in the presence of the external magnetic field of varying strength for non-central heavy-ion collisions as one goes from RHIC to the LHC energies.

**Authors:** SAHU, Dushmanta (Indian Institute of Technology Indore (IN)); Mr PRADHAN, Girija Sankar (IIT Indore); DEB, Suman (Indian Institute of Technology Indore (IN))

**Presenter:** Mr PRADHAN, Girija Sankar (IIT Indore)

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **856** Type: **Experimental poster**

# Event shape and multiplicity dependence of K*(892)$^{\pm}$ production at mid-rapidity in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE at the LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

Short-lived resonances can probe strongly interacting matter produced in high-energy heavy-ion collisions. In particular, K*(892)$^{\pm}$ is important because of its very short lifetime (around 4 fm/c), comparable to the partonic plasma phase. Also, its short lifetime can be used to study the rescattering and regeneration effects in the hadronic phase. An event shape observable like transverse spherocity is sensitive to hard and soft processes. Such an observable can be used as a tool to categorize pp collisions into isotropic (dominated by soft QCD) and jetty (dominated by hard QCD) events. This work presents the latest developments in K*(892)$^{\pm}$ analysis as a function of event multiplicity and transverse spherocity using pp collisions at $\sqrt{s}$ = 13 TeV collected by ALICE. The results obtained in this analysis will be compared to those obtained for other light-flavor hadrons. The $p_T$-differential ratio of K*(892)$^{\pm}$ yields to those of long-lived stable hadrons in the same multiplicity and transverse spherocity intervals will also be presented.

**Author:** DEB, Suman (Indian Institute of Technology Indore (IN))

**Presenter:** DEB, Suman (Indian Institute of Technology Indore (IN))

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **857** Type: **Experimental poster**

# Measurement of $R_2(\Delta\eta, \Delta\varphi)$ and $P_2(\Delta\eta, \Delta\varphi)$ correlation functions in pp collisions at $\sqrt{s}$ = 13˜TeV using ALICE data

*Tuesday 17 May 2022 19:00 (1 hour)*

Two-particle normalized cumulants of particle number correlations ($R_2$) and transverse momentum correlations ($P_2$) measured as a function of relative pseudorapidity and azimuthal angle difference $(\Delta\eta, \Delta\varphi)$ provide key information about particle production mechanism, diffusivity, charge and momentum conservation in high-energy collisions. To complement the recent ALICE measurements in Pb–Pb collisions, as well as for better understanding of the jet contribution and nature of collectivity in small systems, we measure these observables in pp collisions at $\sqrt{s}$ = 13 TeV with similar kinematic range, $0.2 < p_{\mathrm{T}} \leq 2.0$ GeV/$c$. The near-side and away-side correlation structures of $R_2$ and $P_2$ are qualitatively similar, but differ quantitatively. Additionally, a significantly narrower near-side peak is observed for $P_2$ as compared to $R_2$ for both charge-independent and charge-dependent combinations like in the recently published ALICE results in p–Pb and Pb–Pb collisions. Being sensitive to the interplay between underlying event and mini-jets in pp collisions, these results not only establish a baseline for heavy-ion collisions but also allow one to understand better signals which resemble collective effects in small systems.

**Author:** SAHOO, Baidyanath (IIT- Indian Institute of Technology (IN))

**Presenter:** SAHOO, Baidyanath (IIT- Indian Institute of Technology (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **858** Type: **Experimental poster**

# Transverse Spherocity and Multiplicity Dependence of $R_2$ and $P_2$ Correlation Functions in pp Collisions at $\sqrt{s}$ = 7 TeV Using PYTHIA8

*Tuesday 17 May 2022 19:00 (1 hour)*

Event shape observables such as transverse spherocity($S_0$) have evolved as a powerful tool to separate soft and hard contributions in an event in small collision systems. To understand this phenomenon, we used two-particle differential-number correlation functions, $R_2$, and transverse momentum correlation functions, $P_2$, of charged particles produced in pp collisions at the LHC center-of-mass energy $\sqrt{s}$ = 7 TeV with the PYTHIA8 model. The $\Delta\varphi$-dependance of these correlation functions in different multiplicity and $S_0$ classes are discussed . We find that these correlation functions exhibit different shapes and sizes in both near-side(NS) and away-side(AS) with multiplicity and $S_0$ classes. We see a strong correlation in the NS and AS of these correlation functions for low-$S_0$(jetty-like), which become weaker for high-$S_0$(isotropic). In addition, mean-$p_{\mathrm{T}}$ of charged particles for low-$S_0$, high-$S_0$ and $S_0$-integrated are discussed. Finally, it was observed that $S_0$ should be a good observable as compared to multiplicity to disentangle jetty and isotropic events in a small collision system.

**Author:** SAHOO, Baidyanath (IIT- Indian Institute of Technology (IN))

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**Presenter:** SAHOO, Baidyanath (IIT- Indian Institute of Technology (IN))

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **859** Type: **Theory poster**

# Transverse spherocity dependence of global observables in heavy-ion collisions at the LHC using AMPT model

*Tuesday 17 May 2022 19:00 (1 hour)*

Transverse spherocity is a tool that separates events based on geometrical shapes, i.e., jetty and isotropic events. Transverse spherocity based studies are widely understood in small systems like proton-proton (pp) collisions in simulations and experiments, but it is yet to be explored in heavy-ion collisions. In this work, we attempt to study different global observables in heavy-ion collisions such as squared speed of sound, Bjorken energy density and kinetic freeze-out properties for different centrality classes as a function of transverse spherocity. This study has been carried out using a multi-phase transport model (AMPT) in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV. Contrary to pp collisions where jetty events are dominated, heavy-ion collisions are found to be dominated by isotropic events. Squared speed of sound and Bjorken energy density are found to be insensitive to transverse spherocity. In contrast, kinetic freeze-out properties such as transverse radial flow velocity and kinetic-freezeout temperature are found to be susceptive to transverse spherocity.

Reference: S. Prasad, N. Mallick, D. Behera, R. Sahoo and S. Tripathy, Sci. Rep. 12, 3917 (2022).

**Authors:** Mr PRASAD, Suraj (Indian Institute of Technology Indore (IN)); MALLICK, Neelkamal (Indian Institute of Technology Indore); BEHERA, Debadatta (Indian Institute of Technology Indore (IN)); SAHOO, Raghunath (Indian Institute of Technology Indore (IN)); TRIPATHY, Sushanta (INFN, Bologna (IT))

**Presenter:** Mr PRASAD, Suraj (Indian Institute of Technology Indore (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **860** Type: **Theory poster**

# Fluid properties of hadron gas produced in relativistic collisions of pp and AA

*Tuesday 17 May 2022 19:00 (1 hour)*

The applicability of hydrodynamics to study the space-time evolution of hadronic matter produced in relativistic heavy-ion collisions is one of the outstanding issues. The hadronic matter may be produced initially in the hadronic phase or may appear after a quark-gluon plasma phase produced initially revert to hadronic matter through a phase transition. The Knudsen number ($Kn$) can be used as an indicator of the degree of thermalization in the system. In this study, we obtain the variation of $Kn$ to study the degree of thermalization in an excluded volume hadron resonance gas model. $Kn$ along with other parameters like Reynolds number ($Re$) and Mach number ($Ma$) give insights into the nature of the flow in the system. The dependence of these dimensionless parameters on system size and baryonic chemical potential ($\mu_B$) are studied. The obtained values of the parameters ($Kn << 1$, $Ma$ 1 and $Re >> 1$) indicate the occurrence of compressible inviscid flows at high temperatures close to the QCD phase transition region ($T$ 150—170 MeV). The degree of thermalization of hadron gas estimated is comparable over different system sizes, indicating the applicability of hydrodynamics in interpreting the results from high multiplicity pp to heavy-ion collisions.

Reference: R. Scaria, D. Sahu, C. R. Singh, R. Sahoo and J. Alam, [arXiv:2201.08096 [hep-ph]].

**Authors:** SCARIA, Ronald; SAHU, Dushmanta (Indian Institute of Technology Indore (IN)); SINGH, Captain Rituraj; SAHOO, Raghunath (Indian Institute of Technology Indore (IN)); Prof. ALAM, Jan-e (Variable Energy Cyclotron Centre)

**Presenter:** SCARIA, Ronald

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **861** Type: **Theory poster**

# Identical-particle (pion and kaon) femtoscopy in Pb−−Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV with Therminator2 modeled with (3+1)D viscous hydrodynamics

*Tuesday 17 May 2022 19:00 (1 hour)*

Femtoscopy is a technique that can be used to measure the space-time characteristics of the particle-emitting source created in heavy-ion collisions using momentum correlations between two particles. In this report, the two-pion and two-kaon femtoscopic correlations for Pb−−Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV within the framework of (3+1)D viscous hydrodynamics combined with THERMINATOR 2 code for statistical hadronization. The femtoscopic radii or the source size for pions and kaons are estimated as a function of pair transverse momentum and centrality in all three pair directions. The radii seems to be decreasing with pair transverse momentum and transverse mass for all centralities which signals to the presence of strong collectivity in the system. Moreover, an effective scaling of radii with pair transverse mass was observed for both pion and kaons.

**Author:** CHAKRABORTY, Pritam (IITB- Indian Institute of Technology Bombay (IN))

**Co-authors:** PANDEY, Ashutosh Kumar (University of Tsukuba (JP)); DASH, Sadhana (IIT- Indian Institute of Technology (IN))

**Presenter:** CHAKRABORTY, Pritam (IITB- Indian Institute of Technology Bombay (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **862** Type: **Experimental poster**

# Energy and momentum-dependent studies of $\mathrm{R}_2(\Delta\eta, \Delta\varphi)$ and $\mathrm{P}_2(\Delta\eta, \Delta\varphi)$ correlation functions in p−p collisions using color reconnection and rope hadronization models

*Tuesday 17 May 2022 19:00 (1 hour)*

Color-reconnection (CR) mechanism used in PYTHIA8 has been reported to describe collective-like effects in small systems, such as mass-dependent growth in $\langle p_{\mathrm{T}} \rangle$ as a function of multiplicity, enhanced baryon production over meson at intermediate $p_{\mathrm{T}}$, etc., similar to those observed in heavy-ion collisions. Color-reconnection (CR) and rope-hadronization (RH) development in PYTHIA8 have aided in a better understanding of the small system. We measure charge-independent (CI) and charge-dependent (CD) two-particle differential number correlation functions, $\mathrm{R}_2(\ \eta,\ \varphi)$, and transverse momentum correlation functions, $\mathrm{P}_2(\ \eta,\ \varphi)$, of charged particles produced in $pp$ collisions at the LHC centre-of-mass energies $\sqrt{s}$ = 2.76 TeV, 7 TeV and 13 TeV with the PYTHIA8 model. For inclusive charged hadrons ($h^{\pm}$) in three distinct transverse momentum ($p_{\mathrm{T}}$) ranges, PYTHIA8 predictions for $\mathrm{R}_2$ and $\mathrm{P}_2$ correlation functions with full azimuthal coverage in the pseudorapidity range $|\eta| < 1.0$ are shown. The strengths and shapes of $\mathrm{R}_2$ and $\mathrm{P}_2$ correlation functions are reported for various combinations of CR and RH to study particle production mechanisms in small systems. Additionally, for a better understanding of angular ordering and jet properties implemented in the PYTHIA8 model, $\Delta\eta$ and $\Delta\varphi$ dependence of $\mathrm{R}_2$ and $\mathrm{P}_2$ are compared. The evolution of near-side width of these correlation functions for different transverse momentum and energies is shown.

**Author:** Mr BAURI, Dibakar (IIT- Indian Institute of Technology (IN))

**Co-authors:** Mr SAHOO, Baidyanath (IIT- Indian Institute of Technology (IN)); CHAKRABORTY, Pritam (IITB- Indian Institute of Technology Bombay (IN)); NANDI, Basanta Kumar (IIT- Indian Institute of Technology (IN)); DASH, Sadhana (IIT- Indian Institute of Technology (IN))

**Presenter:** Mr BAURI, Dibakar (IIT- Indian Institute of Technology (IN))

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **863** Type: **Theory poster**

# Scaling properties of charged particles generated in Xe-Xe collisions at √s_N N = 5.44 TeV using AMPT Model

*Tuesday 17 May 2022 19:00 (1 hour)*

At critical point a system undergoing phase transition is characterized by large fluctuations in the observables. Fluctuation study is thus one of the important techniques to explore phases of the QCD matter and to search for the critical end point of hadron-quark or quark-hadron phase boundary. Scaling properties of the multiplicity fluctuations of hadrons produced in the high energy heavy ion collisions may reveal the features of quark-hadron phase transition and also the particle production mechanism. Using scaling exponent obtained from the normalized factorial moments of the number of charged hadrons in the two dimensional ($\eta$, $\phi$) phase space, the system created in these collisions can be characterized quantitatively. Within the framework of Ginzburg-Landau (GL) formalism
for second order phase transition and for the two-dimensional Ising model simulated for quark-hadron phase transition a universal value of scaling exponent ($\nu$) is obtained as $1.316 \pm 0.012$. Here we will present observations and results from the analysis performed for charged particle multiplicity distributions obtained from Xe-Xe collisions at $\sqrt{s_{NN}} = 5.44$ TeV with the string melting mode of the AMPT model. Observations, results on the behaviour of the normalized factorial moments and the dependence of the scaling exponent on the transverse momentum bin width will be presented.

**Authors:** GUPTA, Ramni (University of Jammu (IN)); BANOO, Zarina (University of Jammu (IN))

**Presenter:** BANOO, Zarina (University of Jammu (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **864** Type: **Experimental poster**

# Study of resonance's properties in heavy-ion collisions using angular hadron-resonance correletions in ALICE experiment.

*Tuesday 17 May 2022 19:00 (1 hour)*

Hadronic resonances can act as useful probes to examine the hadronic phase in ultra-relativistic heavy-ion collisions. In addition, high $p_T$ resonances could probe not only the hadronic phase but also the partonic phase if they are created very early in jet fragmentation. Hadron-resonance angular correlations could help to preferentially select high transverse momentum resonances coming from the jet or out of the jet region.
In this analysis, the $K^{*0}(892)$ and $\phi(1020)$ production in and out of jets are studied by exploiting their angular correlation with respect to the highest transverse momentum particle, used as a proxy for the jet axis. A first look at the method using data from lead-lead collisions at $\sqrt{s_{\rm NN}}$= 5.02 TeV will be presented.

**Author:** JAKUBCINOVA, Zuzana (Pavol Jozef Safarik University (SK))

**Presenter:** JAKUBCINOVA, Zuzana (Pavol Jozef Safarik University (SK))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **865** Type: **Theory poster**

# CP-violating anomalous interactions at Large Hadron Collider

*Tuesday 17 May 2022 19:00 (1 hour)*

In this study, we explore the effects of CP-violating anomalous interactions of the top-quark through the semileptonic decay modes of the top-quark arising due to pair-production of $t\bar{t}$ at the Large Hadron Collider. Predictions on the LHC sensitivities of the coupling strength to such CP-violating interactions would be discussed for the 13 TeV LHC data and for the future hadron collider with 14 TeV energy.

**Author:** Ms TIWARI, Apurba (Aligarh Muslim University)

**Co-author:** Dr GUPTA, Sudhir (Aligarh Muslim University)

**Presenter:** Ms TIWARI, Apurba (Aligarh Muslim University)

**Session Classification:** Poster Session I

**Track Classification:** Top Physics

Contribution ID: **866** Type: **Theory poster**

# Transverse spherocity and multiplicity dependent study of various higher order moments of $\langle p_{\mathrm{T}} \rangle$ distribution in pp collisions using PYTHIA8

*Tuesday 17 May 2022 19:00 (1 hour)*

The event-by-event fluctuations of the average transverse momentum, $\langle p_{\mathrm{T}} \rangle$, are studied as a function of transverse spherocity and average multiplicity in p−p collisions using PYTHIA8 event generator at $\sqrt{s} = 7$ TeV and 13 TeV. We compared the results for different spherocity classes to understand the contribution from the underlying events. Also, the energy dependence and the effect of different color reconnection and rope hadronisation models on the observables are investigated. The fluctuations studies are sensitive to the properties of phase transition from hadron gas to QGP in heavy-ion collisions. The investigation of such fluctuations in pp collision would serve as a baseline to understand the heavy-ion collisions.

**Author:** ROY, Subhadeep (IIT- Indian Institute of Technology (IN))

**Co-authors:** DASH, Sadhana (IIT- Indian Institute of Technology (IN)); TRIPATHY, Tulika (IIT- Indian Institute of Technology (IN))

**Presenter:** ROY, Subhadeep (IIT- Indian Institute of Technology (IN))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **867** Type: **Experimental poster**

# Nuclear modification factors of prompt and non-prompt J/ψ in Pb–Pb collisions at √ sNN= 5.02 TeV at midrapidity with ALICE

*Tuesday 17 May 2022 19:00 (1 hour)*

Heavy quarks are considered excellent probes to study the properties of the state of matter where quarks and gluons are deconfined, known as quark-gluon plasma (QGP). The QGP is expected to be formed in ultrarelativistic nuclear collisions. Non-prompt J/$\psi$ measurements are important to investigate the parton energy loss in the hot medium and its quark mass dependence, as they provide additional constraints to extract heavy-quark diffusion coefficients from experimental data. In addition, the prompt J/$\psi$ production provides a direct comparison with models that include (re-)generation, which is found to be the dominant production mechanism at low transverse momentum ($p_{\rm T}$) and in central collisions at the LHC. ALICE has unique tracking and particle identification capabilities down to very low momentum at midrapidity ($|y| < 0.9$), enabling the separation of prompt and non-prompt J/$\psi$ down to $p_{\rm T} \sim 1.5$ GeV/$c$ in Pb−Pb collisions. In this contribution, recent ALICE results on nuclear modification factors ($R_{\rm AA}$) of prompt and non-prompt J/$\psi$, reconstructed at midrapidity in the dielectron decay channel, as a function of $p_{\rm T}$ and centrality will be presented and compared with theoretical predictions. Presented results are obtained by analyzing data from Pb−Pb collisions collected at $\sqrt{s_{\rm NN}}$ = 5.02 TeV during the LHC Run 2. Moreover, results will be compared with similar LHC measurements, available at higher $p_{\rm T}$.

**Author:** Mr SHARMA, Himanshu (Polish Academy of Sciences (PL))

**Presenter:** Mr SHARMA, Himanshu (Polish Academy of Sciences (PL))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **868** Type: **Theory poster**

# CP-Violating Invariants in the SMEFT

*Tuesday 17 May 2022 19:00 (1 hour)*

In the Standard Model, CP violation in the Electroweak sector is parametrized by the Jarlskog Invariant. This is the order parameter of CP-violation, in the sense that it vanishes iff CP is conserved. When higher dimensional operators are allowed, and the Standard Model Effective Field Theory is constructed, numerous new sources for CP violation can appear. However, the description of CP violation as a collective effect, present in the SM, is inherited by its Effective extension.
Here, I argue that such a behaviour has to be captured, at dimension 6, by flavor invariant, CP violating objects, linear in the Wilson coefficients. Such a description ensures that CP violation in the SMEFT is treated in a basis independent manner. In particular, I claim these are the objects that have to vanish, together with the SM Jarlskog Invariant, for CP to be conserved, and viceversa. Different assuptions on the flavor structure of the SMEFT operators lead to invariants with different relative importance. A consistent way to address this issue in our framework is presented.

**Authors:** GROJEAN, Christophe (DESY (Hamburg) and Humboldt University (Berlin)); GENDY ABD EL SAYED, Emanuele; RUDERMAN, Joshua (Princeton University); BONNEFOY, Quentin (DESY)

**Presenter:** GENDY ABD EL SAYED, Emanuele

**Session Classification:** Poster Session I

**Track Classification:** Flavour Physics

Contribution ID: **869** Type: **Experimental poster**

# Determination of the strong-coupling constant from the Z-boson transverse-momentum distribution

*Tuesday 17 May 2022 19:00 (1 hour)*

The strong force is the least known fundamental force of nature, and the effort of precisely measuring its coupling constant has a long history of at least 30 years. This contribution presents a new experimental method for determining the strong-coupling constant from the Sudakov region of the transverse-momentum distribution of Z bosons produced in hadron collisions through the Drell-Yan process. The analysis is based on predictions at third order in perturbative QCD,and employs a measurement performed in proton-proton collisions with the CDF experiment. The determined value of the strong coupling at the reference scale corresponding to the $Z$-boson mass is $\alpha_S(m_Z) = 0.1185^{+0.0014}_{-0.0015}$. This is the most precise determination achieved so far at a hadron collider. The application of this methodology at the LHC has the potential to reach sub-percent precision.

**Authors:** FERRERA, Giancarlo (Università degli Studi e INFN Milano (IT)); CAMARDA, Stefano (CERN); SCHOTT, Matthias (CERN / University of Mainz)

**Presenter:** CAMARDA, Stefano (CERN)

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **870** Type: **Experimental poster**

# ME0 second generation prototype chamber characterization for CMS phase II upgrade in the Muon forward region

*Tuesday 17 May 2022 19:00 (1 hour)*

The CMS experiment is a general-purpose detector installed in Large Hadron collider. During the High Luminosity LHC (HL-LHC) phase, it expects 10 times higher luminosity than actual LHC operation regime. Forward region of Muon system of CMS will be equipped with 3 additional triple GEM based muon stations. ME0 is the innermost layer of this tree stations which will be installed right behind the new endcap calorimeter; it will be exposed to a background particle fluxes up to 150 kHz/cm2. Recent R&D for rate capability and gain drop study brought the changing of the original GEM foils High Voltage segmentation direction. Second-generation prototype is segmented in radial direction different from the previous horizontal segmentation of GE11 and GE2/1. This study will present mainly the results of characterization of new ME0 prototype module which include the mechanical design of second-generation prototype, segmentation simulation study results, assembling process, gas tightness, HV stability test, energy spectrum, effective gain result and Its response uniformity results. This module fully characterized, as above, will be installed in GIF++ facility for high background irradiation tests and beam test studies; its initial experimental setup is also presented.

**Author:** KIM, Mi Ran (Sungkyunkwan University (KR))

**Co-authors:** BIANCO, Michele (CERN); FIORINA, Davide (Universita & INFN Pavia); FALLAVOLLITA, Francesco (CERN); MERLIN, Jeremie Alexandre (INFN-Bari)

**Presenter:** KIM, Mi Ran (Sungkyunkwan University (KR))

**Session Classification:** Poster Session I

**Track Classification:** Upgrade & Future Projects

Contribution ID: **871** Type: **Theory poster**

# Virtual QCD Corrections to gg->ZH via a Transverse Momentum Expansion

*Tuesday 17 May 2022 19:00 (1 hour)*

The associated production of a Higgs and a Z boson at the LHC receives an important contribution from the gluon-initiated channel $gg \to ZH$. Currently, exact analytic results for the NLO QCD corrections to this partonic process are not known, due to the presence of top-quark-mediated two-loop box diagrams in the virtual contribution. The inclusion of the gluon-initiated component at NLO would reduce the theoretical uncertainties of the hadronic process $pp \to ZH$, which also affect the determination of the $H \to b\bar{b}$ decay.

In this poster I will present the calculation of the virtual QCD corrections to $gg \to ZH$ using an analytic approximation, based on the expansion of the amplitude in terms of a small transverse momentum of the final-state particles. This method provides an approximation of the virtual corrections with an accuracy below the percent level for center-of-mass energies up to ~750 GeV, which contribute to ~98% of the hadronic cross section at the LHC. I will also report on the recent combination of these results with the ones obtained from a complementary approach, which is based on the expansion of the amplitude in the high-energy limit. When the results of both expansions are improved using Padé approximants, their combination provides accurate results over the whole phase space.

**Authors:** DEGRASSI, Giuseppe (Universita degli Studi e INFN Roma Tre); ALASFAR, Lina; BELLAFRONTE, Luigi; VITTI, Marco; GIARDINO, Pier Paolo; GROEBER, Ramona (Università di Padova and INFN, Sezione di Padova)

**Presenter:** VITTI, Marco

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **872** Type: **Theory poster**

# p –> e+ gamma in LCSR framework

*Tuesday 17 May 2022 19:00 (1 hour)*

Proton decay is a baryon number violating process and hence is forbidden in the Standard Model (SM). Baryon number violation is expected to be an important criteria to explain the matter anti-matter asymmetry of the universe. Any detection of the proton decay will serve as a direct evidence of physics beyond the SM. In SMEFT, proton decay is possible via baryon number violating dimension six operators.
In this work, we have considered the proton decay to a positron and a photon, which is expected to be an experomentally cleaner channel because of less nuclear absorption. The gauge invariant amplitude of this process involves two form factors (FFs). We present these FFs in the framework of light cone sum rules (LCSR).

**Authors:** BANSAL, Anshika (Physical Research Laboratory, Ahmedabad); Prof. MAHAJAN, Namit (Physical Research Laboratory, Ahmedabad)

**Presenter:** BANSAL, Anshika (Physical Research Laboratory, Ahmedabad)

**Session Classification:** Poster Session I

**Track Classification:** Flavour Physics

Contribution ID: **873** Type: **Experimental poster**

# Measurement of heavy-flavor production in the high-mass dimuon spectrum in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE

*Tuesday 17 May 2022 19:00 (1 hour)*

Heavy-quark production in nuclear collisions is an important tool to access the properties and evolution of a deconfined state of nuclear matter known as quark-gluon plasma. Studies of these probes in pp collisions, besides serving as a reference process, represent a powerful tool for testing various aspects of QCD. An analysis technique that was little explored until now at LHC energies is the analysis of the high-mass region of the dilepton invariant mass spectrum ($m_{\mu\mu} > m_{J/\Psi}$), which is significantly populated by the semileptonic decays of hadrons pairs containing charm and beauty quarks.

In the context of this analysis, studies based on Monte Carlo event generators, such as PYTHIA8, are crucial to reproduce the invariant mass and transverse momentum spectra of muon pairs from heavy-flavour decays, separately for charm and beauty hadrons.

In addition, dedicated Monte Carlo simulations are important to study the contribution from the semileptonic decays of light-flavour hadrons, in particular $\pi$ and $K$, which represent the main background source of this analysis.

The goal of the analysis presented in this poster is a first comparison between the mass spectrum measured by ALICE in pp collisions at $\sqrt{s}$ = 13 TeV, based on an integrated luminosity $\mathcal{L}_{int}$ of $\sim 25$ pb$^{-1}$, and the prediction of the PYTHIA8 calculations. The study will be carried out in the rapidity region 2.5 < $y$ < 4.0, which corresponds to the coverage of the ALICE muon spectrometer.

In further detail, in this poster, I will present the status of the analysis for what concerns the simulation chain and the prospects for the extraction of the heavy-quark pair cross-sections. In particular, I will discuss the fitting technique necessary to disentangle the contributions coming from charm, beauty, and light-flavours hadrons, respectively.

**Author:** PENNISI, Michele (Universita e INFN Torino (IT))

**Presenter:** PENNISI, Michele (Universita e INFN Torino (IT))

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **874** Type: **Theory poster**

# Pair charged Higgs productions at NLO in e+ e- collider within the Inert Doublet model .

*Tuesday 17 May 2022 19:00 (1 hour)*

We investigate the full electro-weak one-loop radiative correction to the $e^+e^- \to H^+H^-$ within the Inert Higgs Doublet Model (IHDM), at the future Higgs factory such as the ILC, CLIC, CEPC. After taken account of the theoretical and experimental constraints such as LEP, LHC and Dark matter constraints. The calculations are performed using FeynArts/FormCalc to compute the one-loop weak corrections and using Feynman Diagram Calculation (FDC) to calculate the QED contribution to the next leading order cross section, in three energies of collisions 250, 500 and 1000 GeV, by observing the $e^+e^- \to H^+H^-$ process, the detection of the new physics of IHDM can be directly done because of the large production rate and the corrections are significant

**Author:** Mr ABOUABID, Hamza (Université Abdelmalek Essaadi)

**Co-authors:** ARHRIB, Abdesslam (Université Abdelmalek Essaadi); Prof. EL FALAKI, Jaouad (Ibn Zohr University); Prof. BIN, gong (Theory Division, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, China); Prof. YAN, Qishu (School of Physics Sciences, University of Chinese Academy of Sciences, Beijing 100049, China); Dr XIE, Wenhai (School of Physics Sciences, University of Chinese Academy of Sciences, Beijing 100049, China.)

**Presenter:** Mr ABOUABID, Hamza (Université Abdelmalek Essaadi)

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **875** Type: **Experimental poster**

# Probing the hadronic phase of large hadronizing system through the study of the Λ(1520) resonance with ALICE at the LHC

*Tuesday 17 May 2022 19:00 (1 hour)*

The measurement of hadronic resonance production in heavy-ion collisions at the LHC has led to the observation of a prolonged hadronic phase after hadronisation. Due to their short lifetimes, resonances experience the competing effects of regeneration and rescattering of the decay products in the hadronic medium. Studying how the experimentally measured yields are affected by these processes can extend the current understanding of the properties of the hadronic phase and the mechanisms that determine the shape of particle transverse momentum spectra.

New preliminary results on the production of the Λ(1520) resonance measured in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with the ALICE detector at the LHC are presented in this contribution. These results are compared with those from a set of hadronic resonances with a lifetime span of 1 to 46 fm/c such as ρ(770)0, K*(892)0, $\Sigma(1385)^{\pm}$, Ξ(1530)0 and Φ(1020) measured by the ALICE experiment. The spectral shapes, mean pT and particle ratios are compared with the Blast-Wave, MUSIC with a SMASH afterburner and statistical hadronisation model predictions.

**Author:** Dr AGRAWAL, Neelima (Universita e INFN, Bologna (IT))

**Presenter:** Dr AGRAWAL, Neelima (Universita e INFN, Bologna (IT))

**Session Classification:** Poster Session I

**Track Classification:** Heavy Ions

Contribution ID: **876** Type: **Theory poster**

# A novel experimental search channel for very light Higgses in the Type-I 2HDM

*Tuesday 17 May 2022 19:00 (1 hour)*

We present a reinterpretation study of existing results from the CMS Collaboration, specifically, searches for light BSM Higgs pairs produced in the chain decay $pp \to H_{\rm SM} \to hh(AA)$ into a variety of final states, in the context of the CP-conserving 2-Higgs Doublet Model (2HDM) Type-I. Through this, we test the LHC sensitivity to a possible new signature, $pp \to H_{SM} \to ZA \to ZZh$, with $ZZ \to jj\mu^+\mu^-$ and $h_{SM} \to b\bar{b}$. We perform a systematic scan over the 2HDM Type-I parameter space, by taking into account all available theoretical and experimental constraints, in order to find a region with a potentially visible signal. We investigate the significance of it through a full Monte Carlo simulation down to the detector level. We show that such a signal is an alternative promising channel to standard four-body searches for light BSM Higgses at the LHC with an integrated luminosity of $L = 300/\text{fb}$.

**Authors:** Prof. C. H. SHEPHERD-THEMISTOCLEOUS (Rutherford Appleton laboratory, UK); SOUAD, Semlali (University of Southampton); SOUAD, Semlali (LPHEA, Faculté des sciences, Semlalia, Marrakech); Prof. MORETTI, Stefano (School of Physics and Astronomy, University of Southampton)

**Presenters:** SOUAD, Semlali (University of Southampton); SOUAD, Semlali (LPHEA, Faculté des sciences, Semlalia, Marrakech)

**Session Classification:** Poster Session I

**Track Classification:** Higgs Physics

Contribution ID: **877** Type: **Theory poster**

# Long lived NMSSM : Analysing some long-lived NSLP signatures in the NMSSM

*Tuesday 17 May 2022 19:00 (1 hour)*

We analyze NMSSM scenarios containing a singlino LSP dark matter. By systematically considering several NLSP compositions, we identify and classify regions of parameter space where NLSP exhibits a long lifetime due to suppressed couplings and leads to a displaced vertex signature at the colliders. We furthermore construct viable production and decay processes at the HL-LHC to search for such displaced vertices. We illustrate a strategy to neglect the SM background with some benchmark scenarios for this type of signal.

**Authors:** DE, Amandip; ADHIKARY, Amit; BHATTACHERJEE, BIPLOB (Indian Institute of Science); BARMAN, Rahool Kumar (Oklahoma State University); GODBOLE, Rohini Madhusudan (Indian Institute of science (IN)); KULKARNI, Suchita (University of Graz)

**Presenter:** DE, Amandip

**Session Classification:** Poster Session I

**Track Classification:** Feeble Interactions BSM

Contribution ID: **878** Type: **Experimental poster**

# Crowdfunding your outreach project

*Tuesday 17 May 2022 19:00 (1 hour)*

In recent years, crowdfunding platforms have gained popularity as a way to raise funds for various endeavors. This poster discusses the use of crowdfunding as a non-traditional way to finance physics outreach projects. Such tools can provide much needed flexibility to projects and serve as a platform to spread the word about your project. The poster is based on first-hand experience using such tools and includes a discussion of important advise and common pitfalls.

**Authors:** VEATCH, Jason Robert (California State University (US)); STOLPOVSKIY, Mikhail (Geneva University)

**Presenters:** VEATCH, Jason Robert (California State University (US)); STOLPOVSKIY, Mikhail (Geneva University)

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **880** Type: **Experimental poster**

# Point Cloud Deep Learning Methods for Pion Reconstruction in the ATLAS Detector

*Tuesday 17 May 2022 19:00 (1 hour)*

Reconstructing the type and energy of isolated pions from the ATLAS calorimeters is a key step in the hadronic reconstruction. The baseline methods for local hadronic calibration were optimized early in the lifetime of the ATLAS experiment. Recently, image-based deep learning techniques demonstrated significant improvements over the performance over these traditional techniques. We present an extension of that work using point cloud methods that do not require calorimeter clusters or particle tracks to be projected onto a fixed and regular grid. Instead, transformer, deep sets, and graph neural network architectures are used to process calorimeter clusters and particle tracks as point clouds. We demonstrate the performance of these new approaches as an important step towards a full deep learning-based low-level hadronic reconstruction.

**Authors:** KORN, Andreas (University College London (GB)); PETTEE, Mariel (Lawrence Berkeley National Lab. (US))

**Presenter:** PETTEE, Mariel (Lawrence Berkeley National Lab. (US))

**Session Classification:** Poster Session I

**Track Classification:** Performance and Tools

Contribution ID: **881** Type: **Talk**

# Outreach during pandemic at CERN

*Wednesday 18 May 2022 14:15 (17 minutes)*

**Presenter:** NAYAK, Tapan (CERN, Geneva and NISER, Bhubaneswar)

**Session Classification:** Outreach, Diversity and Education

Contribution ID: **882** Type: **Talk**

# Particle physics educational activities in times of pandemic

*Wednesday 18 May 2022 14:37 (17 minutes)*

**Presenter:** SHAW, Kate (University of Sussex (GB))

**Session Classification:** Outreach, Diversity and Education

Contribution ID: **883** Type: **not specified**

# The African School of Fundamental Physics and Applications from the point of view of education

*Wednesday 18 May 2022 14:59 (17 minutes)*

**Presenter:** KA, Oumar (Cheikh Anta Diop University)

**Session Classification:** Outreach, Diversity and Education

Contribution ID: **884** Type: **not specified**

# Building the High Energy Network –for the benefit of its members and the Lab

*Wednesday 18 May 2022 15:21 (17 minutes)*

**Presenter:** BRAY, Rachel (CERN)

**Session Classification:** Outreach, Diversity and Education

Contribution ID: **885** Type: **not specified**

# Monitoring and promotion of diversity in the Asian landscape

*Monday 16 May 2022 17:00 (17 minutes)*

**Presenter:** GOSWAMI, Srubabati (Physical Research Laboraotory)

**Session Classification:** Outreach, Diversity and Education

Contribution ID: **886** Type: **not specified**

# Diversity activities in theory

*Monday 16 May 2022 17:22 (17 minutes)*

**Presenter:** TAYLOR, Marika (University of Southampton, UK)

**Session Classification:** Outreach, Diversity and Education

Contribution ID: **887** Type: **not specified**

# Diversity monitoring at the LHC and small experiments

*Monday 16 May 2022 18:06 (17 minutes)*

**Presenter:** BEN HAIM, Eli (Centre National de la Recherche Scientifique (FR))

**Session Classification:** Outreach, Diversity and Education

Contribution ID: **888** Type: **not specified**

# Inclusion of the visually impaired community with Tactile Collider

*Monday 16 May 2022 17:44 (17 minutes)*

**Presenter:** APPLEBY, Robert Barrie (University of Manchester (GB))

**Session Classification:** Outreach, Diversity and Education

Contribution ID: **889** Type: **Experimental poster**

# Outreach Modules for a New Particle Search Using the ATLAS Forward Proton Detector and Higgs Boson Physics

*Tuesday 17 May 2022 19:00 (1 hour)*

We present two modules as part of the Czech Particle Physics Project (CPPP). These are intended as learning tools in masterclasses aimed at high-school students (aged 15 to 18). The first module is dedicated to the detection of an Axion-Like-Particle (ALP) using the ATLAS Forward Proton (AFP) detector. The second module focuses on the reconstruction of the Higgs boson mass using the Higgs boson golden channel with four leptons in the final state. The modules can be accessed at the following link: http://cern.ch/cppp.

**Author:** SOPCZAK, Andre (Czech Technical University in Prague (CZ))

**Presenter:** SOPCZAK, Andre (Czech Technical University in Prague (CZ))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **890** Type: **Experimental poster**

# Implementation of a Portal Dedicated to Higgs Bosons for Experts and the General Public

*Tuesday 17 May 2022 19:00 (1 hour)*

The implementation of a web portal dedicated to Higgs boson research is presented. A database is created with more than 1000 relevant articles using CERN Document Server API and web scraping methods. The database is automatically updated when new results on the Higgs boson become available. Using natural language processing, the articles are categorised according to properties of the Higgs boson and other criteria. The process of designing and implementing the Higgs Boson Portal (HBP) is described in detail. The components of the HBP are deployed to CERN Web Services using the OpenShift cloud platform. The web portal is operational and freely accessible on http://cern.ch/higgs.

**Author:** SOPCZAK, Andre (Czech Technical University in Prague (CZ))

**Presenter:** SOPCZAK, Andre (Czech Technical University in Prague (CZ))

**Session Classification:** Poster Session I

**Track Classification:** Outreach, Diversity and Education

Contribution ID: **892** Type: **Experimental poster**

# Prospects of the LHCf operation in 2022

*Tuesday 17 May 2022 19:00 (1 hour)*

LHC forward (LHCf) experiment measures forward neutral particles to improve hadronic interaction models adopted in cosmic-ray air shower simulations. This summer, we plan to have a data taking in proton-proton collisions. We expect ten times larger statistics than the previous operation in 2015 which allows us to measure pi0 and eta mesons more precisely. Moreover, we plan to have a joint operation with the ATLAS Zero degree calorimeter in this operation.
Improvements in energy resolution for hadrons are expected by the joint operation and allow us to select the one-pion exchange process. In this talk, we present the prospects of the next LHCf operation.

**Author:** OHASHI, Ken (Nagoya University (JP))

**Presenter:** OHASHI, Ken (Nagoya University (JP))

**Session Classification:** Poster Session I

**Track Classification:** QCD Physics

Contribution ID: **893** Type: **Experimental poster**

# AtlFast3: the next generation of fast simulation in ATLAS

AtlFast3 is the next generation of high precision fast simulation in ATLAS that is being deployed by the collaboration and will replace AtlFastII, the fast simulation tool that was successfully used until now. AtlFast3 combines a parametrization-based Fast Calorimeter Simulation and a new machine-learning based Fast Calorimeter Simulation based on Generative Adversarial Networks (GANs). The new fast simulation improves the accuracy of simulating objects used in analyses when compared to Geant4, with a focus on those that were poorly modelled in AtlFastII. In particular, the simulation of jets of particles reconstructed with large radii and the detailed description of their substructure, are significantly improved in Atlfast3. Additionally the agreement between AtlFast3 and Geant4 is improved for high momentum ⊠-leptons. The modelling and performance are evaluated on events produced at 13 TeV centre-of-mass energy in the Run-2 data-taking conditions.

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