Partikeldagarna 2018 (Lundmarksalen) + Discussion Session on the Swedish Input to the European Strategy of Particle Physics (Sal A)

Tuesday, October 16, 2018 - Thursday, October 18, 2018

Lund university

LUND UNIVERSITY

Book of Abstracts

Contents

Strategy overview 47 1

BSM 48 1

SM 49 1

Detectors 50 1

Heavy ions 51 1

Neutrinos 53 1

Accelerators 52 1

Discussions 54 2

Discussion of draft and key points 55 2

Deciphering the next supernova using neutrinos (12'+3') 15 2

The ESSnuSB neutrino beam and its accumulator (12'+3') 13 2

Complementarity in Dark Matter Searches (12'+3') 27 3

Lund ALICE summary (12'+3') 4 3

Color Matrix Element Corrections in Herwig (12'+3') 17 3

IR fitness of the effective potential in the $\hbar$-expansion (12'+3') 12 4

Cosmic Neutrinos from a Blazar (12'+3') 25 4

MAX IV - status and brief inside view (12'+3') 9 4

INSIGHTS: Learning to Learn (12'+3') 2 5

Freeze-out and freeze-in relic density for a light vector mediator (12'+3') 29 5

The Next Generation Radio Detector for Extermely High Energy Neutrinos (12'+3') 7 . . 5

Monitoring the energetic Universe with the ALTO gamma-ray observatory (12'+3') 30 . . 6

Insights on the particle acceleration at the core of Centaurus A (12'+3') 31 6

The SHIFT project (12'+3') 20 7

Tuning of Monte Carlo Event Generators (12'+3') 22 7

Building and test of ITk Strip modules (12'+3') 33 7

QCD multiplet bases with arbitrary parton ordering (12'+3') 18 8

A Search for Magnetic Monopoles with IceCube (12'+3') 21 8

Search for new physics with taus (12'+3') 8 8

Constraining EFT operators in the top sector (12'+3') 14 9

Space Charge Tracking in Accelerators (12'+3') 6 9

Consequences of a XENONnT/LZ signal for the LHC and thermal dark matter production (12'+3') 28 10

Summary of Swedish physics-analysis activities in ATLAS (20+5) 34 10

IUPAP report (15') 37 10

ECFA report (15') 38 10

High-school visits at CERN (15') 40 11

VR+RFI (20') 41 11

Discussion (10') 42 11

IPPOG report (15') 36 11

Council week (15') 39 11

The PTOLEMY dark matter and relic neutrino detection project (12'+3') 16 11

Charged Higgs searches in ATLAS (12'+3') 24 12

Combination of searches for Higgs boson pairs in pp collisions at 13 TeV with the ATLAS experiment (12'+3') 23 12

Optimization Procedure in the Search for Spin-0 Supersymmetric Partner of Top Quark Using 120 fb^{-1} of $\sqrt{s} = 13$ TeV pp Collisions using the ATLAS Detector (12'+3') 10 . 13

Results from a search for dijet resonances using only trigger-level jets at ATLAS (12'+3') 32 13

ACCU report (15') 35 14

Exploring sub-GeV Dark Matter with LDMX (12'+3') 3 14

Towards solving the proton spin puzzle (12'+3') 19 14

Electromagnetic finite size effects to the hadronic vacuum polarisation (12'+3') 11 15

Summary of Swedish upgrade activities in ATLAS (20+5) 45 15

CERN research plans from the accelerator perspective 44 15

Challenges in data processing and handling at the SKA telescope 43 16

Strategy overview 46 16

Discussion session / **47**

Strategy overview

Corresponding Author: milstead@fysik.su.se

Discussion session / **48**

BSM

Corresponding Authors: rikard.enberg@physics.uu.se, christian.ohm@cern.ch, caterina.doglioni@cern.ch

Discussion session / **49**

SM

Corresponding Authors: rebeca.gonzalez.suarez@cern.ch, leif.lonnblad@thep.lu.se

Discussion session / **50**

Detectors

Corresponding Authors: richard.brenner@cern.ch, blj@kth.se

Discussion session / **51**

Heavy ions

Corresponding Authors: david.silvermyr@gmail.com, leif.lonnblad@thep.lu.se, peter.christiansen@hep.lu.se

Discussion session / **53**

Neutrinos

Corresponding Authors: roman.pasechnik@fysast.uu.se, cfinley@fysik.su.se

Discussion session / **52**

Accelerators

Corresponding Authors: tord.johan.carl.ekelof@cern.ch, roger.ruber@cern.ch

Discussion session / **54**

Discussions

Discussion session / **55**

Discussion of draft and key points

Partikeldagarna 2018 / **15**

Deciphering the next supernova using neutrinos (12'+3')

Author: Erin O'Sullivan[1]

[1] *Stockholm University*

Corresponding Author: eosullivan.queens@gmail.com

Supernovae are the spectacular end in the lives of massive stars. Neutrinos are an important player in the explosion and account for 99% of the explosion energy. IceCube, a detector embedded in the ice at the South Pole, will make a precision measurement of the neutrino rate from the next galactic supernova. This measurement will give us an unprecedented look at the inner structure of the exploding star. Future detectors, such as Hyper-Kamiokande, will give even more details of the explosion, such as the neutrino energies and supernova direction, and will allow us to see more distant supernovae. This talk will discuss what physics we expect to extract using neutrinos detected in current and next-generation detectors from the next galactic supernova, as well as future prospects to measure many distant supernovae.

Partikeldagarna 2018 / **13**

The ESSnuSB neutrino beam and its accumulator (12'+3')

Authors: Ye Zou[1]; Tord Johan Carl Ekelof[2]

[1] *Department of Physics and Astronomy, Uppsala University*

[2] *Uppsala University (SE)*

Corresponding Authors: ye.zou@cern.ch, tord.johan.carl.ekelof@cern.ch

The 2.0 GeV, 5 MW proton linac for the European Spallation Source, ESS, will have the capacity to send extra pulses to a neutrino target, giving an excellent opportunity to produce an unprecedented high performance neutrino beam, the ESS neutrino Super Beam, ESSnuSB. The proton pulse power for the neutrino target can be as high as 5 MW, which will be the world's most powerful neutrino source, while the linac structure does not have to be changed too much. Due to the limitation of the neutrino target focusing system, the pulse duration will need to be as short as a few microseconds. An accumulator ring is needed to compress the 2.86 ms pulses from the ESS linac for 3 orders of magnitude, while maintaining the pulse intensity up to 1.1E10^15. One of the main challenges of this accumulator ring is the injection of the particles due to very high beam intensity. The injection method currently used in the design is H- stripping and painting. Some alternative methods like two-plane direct proton injection is investigated as well. Different pulse schemes and beam distributions are studied in order to make sure that the beam properties meet the requirements for the extraction region, the transfer line and the target system as well. The 4-target station is designed to mitigate

the total beam power for each target and different configurations of beam switchyard are designed. An overview of the plans for how the ESSnuSB neutrino beam facility will be constructed will be introduced, including the linac upgrade and the target station, but that the main subject will be the design of the accumulator.

Partikeldagarna 2018 / **27**

Complementarity in Dark Matter Searches (12'+3')

Author: Catena Riccardo[1]

[1] *Chalmers University of Technology*

Corresponding Author: catena@chalmers.se

I will report on recent research activities conducted at Chalmers in the field of dark matter particle phenomenology. The dark matter particle phenomenology group at Chalmers performs research on the complementarity of different dark matter search strategies in order to maximise the amount of information which can be extracted from the outcome of present and future dark matter search experiments. For example, our group has shown that the hypothetical discovery of dark matter in one of the upcoming runs of direct detection experiments such as XENONnT or LZ could be combined with the collider searches for dark matter to gain insights into the dark matter particle spin. Of particular interest in this area are monojet and dijet searches at the Run 3 of the LHC. We study their phenomenology in the framework of simplified models, and use non-relativistic effective operators as far as the modelling of direct detection signals is concerned. We are also interested in the combined interpretation of dark matter searches at direct detection experiments and neutrino telescopes. We pursue our research benefiting from interactions with the Chalmers' Nuclear Theory and Particle Phenomenology groups. Furthermore, we collaborate with the XENON group in Stockholm within the SweDCube network, and with other experiments in astroparticle physics, including IceCube and CRESST.

Partikeldagarna 2018 / **4**

Lund ALICE summary (12'+3')

Authors: Peter Christiansen[1]; David Silvermyr[1]

[1] *Lund University (SE)*

Corresponding Authors: david.silvermyr@gmail.com, peter.christiansen@hep.lu.se

Summary of activities in the Lund ALICE group.

Partikeldagarna 2018 / **17**

Color Matrix Element Corrections in Herwig (12'+3')

Authors: Malin Sjodahl[1]; Johan Thorén[1]

[1] *Lund University*

Corresponding Authors: johan.thoren@thep.lu.se, malin.sjodahl@thep.lu.se

We investigate the effects of keeping the full color structure for parton emissions in parton showers for both LEP and LHC. This is done within the Herwig 7 dipole shower. The subleading Nc terms are included as color matrix element corrections to the splitting kernels by evolving an amplitude-level density operator and correcting the radiation pattern for each parton multiplicity, up to a fixed number of full color emissions, after which a standard leading color shower takes over. Our results are compared to data for both LEP and LHC observables. Typically we find percent level corrections for hard perturbative dynamics, although the corrections occasionally exceed 10%. On soft physics we find significantly larger effects.

Partikeldagarna 2018 / **12**

IR fitness of the effective potential in the $\hbar$-expansion (12'+3')

Authors: Andreas Ekstedt[1]; Johan Löfgren[1]

[1] *Uppsala university*

Corresponding Authors: johan.lofgren@physics.uu.se, andreas.ekstedt@physics.uu.se

Perturbative calculations of the effective potential evaluated at a broken minimum, V_{min}, are plagued by difficulties. Even though this quantity is physical, it is not straightforward to get a finite and gauge invariant result. In fact, the methods proposed to deal with these two issues are orthogonal in their approaches. Gauge dependence is dealt with through the $\hbar$-expansion, which establishes and maintains a strict loop-order separation of terms. On the other hand, IR divergences seems to require a resummation, which mixes the different loop orders. In this talk i discuss these methods for Fermi gauge Abelian Higgs at 2 loops. I discuss why the resummation procedure is not capable of removing all divergences. I show how the $\hbar$-expansion is able to deal with both the issues of IR divergences and gauge dependence.

Partikeldagarna 2018 / **25**

Cosmic Neutrinos from a Blazar (12'+3')

Author: Chad Finley[None]

Corresponding Author: cfinley@fysik.su.se

This summer IceCube announced the first evidence of a cosmic source of high-energy neutrinos. A rare, high-energy neutrino event detected on 2017 Sept. 22 was reported by IceCube in a public alert that led to extensive follow-up observations across the electromagnetic spectrum. A tantalizing association was found with a blazar, an active galaxy where one of the jets from the central black hole is pointed in our direction. Subsequent analysis of archival IceCube data revealed further evidence that the blazar had a previous episode of neutrino emission. These results may for the first time identify a long-sought accelerator of high-energy cosmic rays.

Partikeldagarna 2018 / **9**

MAX IV - status and brief inside view (12'+3')

Author: Bernhard Meirose[1]

[1] *MAX IV*

Corresponding Author: bernhard.meirose@maxiv.lu.se

The MAX IV Laboratory in Lund is the largest and most ambitious Swedish investment in national research infrastructure. Hosted by Lund University, MAX IV is the brightest source of x-rays worldwide. In this talk I give a brief overview of the status of the laboratory, giving also an inside view of the daily work that is done to keep the linear accelerator and storage rings running 24 hours a day, seven days a week. I conclude with a quick glance at current and future opportunities at the facility.

Partikeldagarna 2018 / **2**

INSIGHTS: Learning to Learn (12'+3')

Corresponding Author: n.s@cern.ch

INSIGHTS (International Training Network of Statistics for High Energy Physics and Society) is an Innovative Training Network (ITN) designed to train a group of PhD students in statistical methods and machine learning. Application of these techniques to particle physics and to things such as finance and decision making is also a key part of the network. This brief talk gives an introduction to the INSIGHTS network from a newly participating PhD student, and will encompass the main aims and structure of the network, elaborate on the techniques being studied, and showcase some of the foreseen examples of application of these techniques.

Partikeldagarna 2018 / **29**

Freeze-out and freeze-in relic density for a light vector mediator (12'+3')

Author: Isabelle John[1]

[1] *Lund University*

In collider experiments, such as the Large Hadron Collider (LHC), an unknown particle could be produced from a pair of quarks in proton-proton collisions. In simplified dark matter (DM) models, this particle could then decay either into WIMP (Weakly-Interacting Massive Particles) dark matter or into Standard Model (SM) particles, acting as a mediator between ordinary matter and dark matter. From such a simplified model, we consider a light mediator Z' (m_Z' < 300 GeV) and test different scenarios of the couplings to dark matter and Standard Model matter of this mediator to see the impact these changes have on the relic density of dark matter, using MadDM and micrOMEGAs for the calculations. The today observable abundance of dark matter can be achieved through different mechanisms, such as freeze-out and freeze-in. In the freeze-out scenario, the initial dark matter abundance is high and decreases due to annihilation and decay processes as the universe cools down. Conversely, in the freeze-in case, there is only a small amount of dark matter initially, and more dark matter is produced as the universe evolves. Additionally to investigating the relic density from the freeze-out production of dark matter, we use the freeze-in module in micrOMEGAs to calculate the relic density for even smaller couplings to dark matter and Standard Model matter.

Partikeldagarna 2018 / **7**

The Next Generation Radio Detector for Extermely High Energy Neutrinos (12'+3')

Author: Allan Hallgren[1]

[1] *Uppsala University*

Corresponding Author: allan.hallgren@physics.uu.se

Neutrinos in the Energy range above 10 PeV will provides important information on very high energy processes in the universe and the origin of the highest energy Cosmic rays. Additionally neutrino properties can be studied. The detection of these neutrinos is challenging, a large volume of detector material needs to be monitored. The economically feasible method is detection of radio signals from Askaryan pulses formed in ice after neutrino interactions. Prototype work has been ongoing for several years, e.g. in the ARIANNA and ARA collaborations. These two collaborations are now preparing for a common large scale neutrino detector based on the in-ice radio technique. I will present the status of these plans.

Partikeldagarna 2018 / **30**

Monitoring the energetic Universe with the ALTO gamma-ray observatory (12'+3')

Authors: Yvonne Becherini[1]; Satyendra Thoudam[1]; Michael Punch[2]; Jean-Pierre Ernenwein[3]; Mohanraj Senniappan[1]; Tomas Bylund[1]

[1] *Linnaeus University*

[2] *APC/IN2P3/CNRS and Linnaeus University*

[3] *CPPM/IN2P3/CNRS*

Corresponding Authors: yvonne.becherini@lnu.se, satyendra.thoudam@lnu.se, ernenwein@cppm.in2p3.fr, mpunch.in2p3@gmail.c
tomas.bylund@lnu.se, mohanraj.senniappan@lnu.se

Imaging Atmospheric Cherenkov Telescopes together with the Fermi-LAT satellite have, in the last 15 years, unveiled how rich the Universe is in powerful mechanisms able to accelerate particles which then produce High Energy (HE) and Very High Energy (VHE) gamma-rays. Some of the gamma-ray emitting sources are found to be steady with respect to the sensitivity of the instruments, while many of them are found to be variable, and can be seen only when they are in a flaring state. In order to catch flaring gamma-ray sources with E>300 GeV, we propose the construction of ALTO, a wide-field of view gamma-ray observatory, which we aim to install in the Southern hemisphere at an altitude of about 5 km. I will present the status of the project, including the prototyping efforts.

Partikeldagarna 2018 / **31**

Insights on the particle acceleration at the core of Centaurus A (12'+3')

Author: Yvonne Becherini[1]

[1] *Linnaeus University*

Corresponding Author: yvonne.becherini@lnu.se

Centaurus A is the nearest radio-galaxy and an excellent laboratory to study the origin of particle acceleration responsible for the High-Energy (HE) and Very-High-Energy (VHE) gamma-ray emission in Active Galactic Nuclei. The H.E.S.S. and Fermi-LAT collaborations have together recently

published the most up-to-date Spectral Energy Distribution of its core emission. I will present these recent results and will discuss how will the HE and VHE gamma-ray emission from Centaurus A be studied in the upcoming years.

Partikeldagarna 2018 / **20**

The SHIFT project (12'+3')

Authors: Sara Strandberg[1]; Elin Bergeaas Kuutmann[2]; Gabriele Ferretti[3]; Rikard Enberg[4]; Joergen Sjoelin[1]; David Anthony Milstead[1]

[1] *Stockholm University (SE)*

[2] *Uppsala University (SE)*

[3] *Chalmers University, Gothenburg, Sweden*

[4] *Uppsala University*

Corresponding Authors: rikard.enberg@physics.uu.se, ferretti@chalmers.se, sjolin@fysik.su.se, elin.bergeaas.kuutmann@physics.uu.se, milstead@fysik.su.se, sara.strandberg@cern.ch

The presentation will summarize the scope and status of the SHIFT project, which is a collaboration between experimental and theoretical particle physicists at Chalmers, Stockholm and Uppsala. The focus is to search for top partners that can protect the mass of the Higgs boson from large quantum corrections. We study possible signatures of such top partners and search for them using data from the ATLAS experiment. We cover direct searches for top partners in supersymmetry and compositeness models as well as indirect searches via precision measurements of processes involving top quarks.

Partikeldagarna 2018 / **22**

Tuning of Monte Carlo Event Generators (12'+3')

Author: Leif Gellersen[1]

[1] *Lund University*

Corresponding Author: leif.gellersen@thep.lu.se

Monte Carlo Event Generators are important tools to understand the physics of particle colliders. They play a key role in both the analysis of data collected by experiments and the design of new colliders and detectors. Due to the complexity of particle collisions and the limited ability of perturbative QCD to describe the low energy behavior of partons, we need phenomenological models to provide a complete prediction of many observables. However, these models contain several a priori unknown or weakly constrained parameters. A systematic tuning of these parameters based on experimental data allows us to optimize the predictions of Monte Carlo Event Generators and refine our understanding of the relevant models. In this talk, I will give an overview and finish by discussing recent systematic studies of tuning.

Partikeldagarna 2018 / **33**

Building and test of ITk Strip modules (12'+3')

Author: Geoffrey Mullier[1]

[1] *Lund University (SE)*

Corresponding Author: geoffrey.mullier@cern.ch

The current Inner Detector (ID) of the ATLAS experiment, despite its excellent current performance, will not meet the harsh requirements of the High Luminosity-LHC upgrade. A newly designed inner detector Inner Tracker (ITk) composed uniquely of semi-silicon pixels and strip detectors will be installed from 2024 to 2026. This contribution summarizes the activities within the different institutes involved in the phase II upgrade of the Strip Tracker in Sweden and Scandinavia. An update on the current status of testing and prototyping is given as well as the outline of the production plans.

Partikeldagarna 2018 / **18**

QCD multiplet bases with arbitrary parton ordering (12'+3')

Authors: Johan Thorén[1]; Malin Sjodahl[1]

[1] *Lund University*

Corresponding Authors: malin.sjodahl@thep.lu.se, johan.thoren@thep.lu.se

We have developed an algorithm for recursively constructing orthogonal multiplet bases for the color space of QCD, for any order of partons and any Nc. The basis vectors can be used to calculate Wigner 6j coefficients. These coefficients offer a method of using multiplet bases without resorting to the explicit expressions of the basis vectors, which lead to a significant speed-up compared to other methods of treating full color structure.

Partikeldagarna 2018 / **21**

A Search for Magnetic Monopoles with IceCube (12'+3')

Author: Alexander Burgman[1]

[1] *Uppsala University*

Corresponding Author: alexander.burgman@physics.uu.se

Magnetic monopoles are predicted to exist in many extensions and unifications of the Standard Model of particle physics. A magnetic monopole passing through the IceCube detector array would be readily detected via its characteristic light output. In this talk I will report on the progress of the search for magnetic monopoles ongoing in the Uppsala University IceCube group.

Partikeldagarna 2018 / **8**

Search for new physics with taus (12'+3')

Author: Shi Qiu[1]

[1] *Lund University (SE)*

Corresponding Author: shi.qiu@cern.ch

The generation mechanism of neutrino mass is one of the major problems remained in the Standard Model. One of the possible solutions is to introduce exotic Higgs bosons which generate neutrino mass through the Seesaw mechanism. The SSDiLep group works on studying the doubly-charged Higgs bosons, predicted in a large variety of BSM models such as left-right symmetric model, Higgs triplet models and the little Higgs model. The unique characteristic of a doubly-charged Higgs boson is its decay product which always involves two particles of same charge. The lepton channel is particularly of interest for the SSDiLep group due to its low expected Standard Model background, especially at the region far away from the weak bosons resonance peaks. In previous studies with the consideration of two leptons (e and μ) resulting in three ways of combination for the final states, it was concluded that the limits on the mass of doubly-charged Higgs bosons with $Br(H_L^{\pm\pm} \rightarrow l^{\pm}l^{\pm}) = 100\%$ vary between 770 and 870 GeV for the $H_L^{\pm\pm}$ mass and between 660 and 760 GeV for the $H_R^{\pm\pm}$ mass. The limits for a branching ratio $Br(H_L^{\pm\pm} \rightarrow l^{\pm}l^{\pm}) > 10\%$ reduced to 450 GeV and 320 GeV for $H_L^{\pm\pm}$ and $H_R^{\pm\pm}$, respectively. One big improvement that can be made on the previous study is to include the third lepton tau into the analysis. Since tau is the heaviest particle of lepton family, it can decay into quarks leading to complicated background. Our current study on tau leptons focuses on the estimation of the background due to charge flip, which occurs when the detector correctly reconstructs the particle type but assigns it with a wrong electromagnetic charge. The data-driven likelihood charge flip estimation method is of particular interest and it was the method used on electrons in the last analysis by SSDiLep group. With a better estimation of the background, the desired same-sign lepton (particularly for tau) signals can be extracted.

Partikeldagarna 2018 / 14

Constraining EFT operators in the top sector (12'+3')

Author: Nabila Shaikh[None]

Corresponding Author: nabila.shaikh@cern.ch

The current model for particle physics, the SM, is very successful. However, there are many questions that are not answered by it and therefore the search for physics beyond the SM is one of the main focus of particle physicists. There are several searches for particular beyond the SM theories like supersymmetry. Experiments have unfortunately not found any of the new particles that are proposed by these theories. By assuming that new physics appears at a higher energy scale, we can use EFT to modify the SM interactions. With the LHC, we can study the couplings between the top quark and the neutral bosons, which has not be possible before. An appropriate framework for doing this is EFT. We are studying the associated production of a top quark pair and a W boson in order to constrain the EFT operators present in ttW.

Partikeldagarna 2018 / 6

Space Charge Tracking in Accelerators (12'+3')

Author: Benjamin Folsom[1]

[1] *European Spallation Source; Lund University*

Corresponding Author: benjamin.folsom@hep.lu.se

The interactions between charged particles are derived from the relativistic Lienard-Wiechert four-potential. This expression is usually broken into field components and solved statically (Coulombic). However, to study high-intensity, high-precision beams, one can to simulate bunch dynamics by incorporating the full potential into a Lorentz-covariant Hamiltonian.

Methods are shown for building an explicit (requiring no solvers), symplectic (ensuring long-term stability) integrator from such a Hamiltonian. A method is also shown which places particles on an extruded Archimedian-spiral coordinate system, which can reduce the number of calculation steps needed versus the typical rectilinear-mesh approach.

Partikeldagarna 2018 / **28**

Consequences of a XENONnT/LZ signal for the LHC and thermal dark matter production (12'+3')

Author: Martin Krauss[None]

Corresponding Author: martin.krauss@chalmers.se

The discovery of dark matter (DM) at XENONnT or LZ would place constraints on DM particle mass and coupling constants. It is interesting to ask when these constraints can be compatible with thermal production of DM. We address this question within the most general set of renormalizable models that preserve Lorentz and gauge symmetry, and that extend the standard model by one DM candidate of mass mDM and one particle of mass Mmed mediating DM-quark interactions. We find that for most of the models considered here, O(100) signal events at XENONnT/LZ and the DM thermal production are only compatible for resonant DM annihilations. Furthermore, we develop a method to forecast the outcome of the LHC Run 3 based on the same hypothetical detection of O(100) signal events at XENONnT. Applying our analysis to simulated data, we find that at the end of the LHC Run 3 only two mutually exclusive scenarios would be compatible with the detection of O(100) signal events at XENONnT, depending on the detection or lack of detection of a monojet signal. This would significantly narrow the range of possible dark matter–nucleon interactions. Finally, we want to give outlook on how this analysis can also be extended to inlcude dijet-searches for the mediator particle at the LHC.

Partikeldagarna 2018 / **34**

Summary of Swedish physics-analysis activities in ATLAS (20+5)

Author: Ruth Pottgen[1]

[1] *Lund University (SE)*

Corresponding Author: ruth.poettgen@cern.ch

Partikeldagarna 2018 / **37**

IUPAP report (15')

Author: Johan Rathsman[None]

Partikeldagarna 2018 / **38**

ECFA report (15')

Author: David Milstead[None]

Partikeldagarna 2018 / **40**

High-school visits at CERN (15’)

Authors: Emelie Sandved[None]; Linn Enroth[None]; Mats Persson[None]

Partikeldagarna 2018 / **41**

VR+RFI (20’)

Corresponding Author: per.karlsson@vr.se

Partikeldagarna 2018 / **42**

Discussion (10’)

Partikeldagarna 2018 / **36**

IPPOG report (15’)

Corresponding Author: jonas.strandberg@cern.ch

Partikeldagarna 2018 / **39**

Council week (15’)

Author: Kerstin Jon-And[None]

Partikeldagarna 2018 / **16**

The PTOLEMY dark matter and relic neutrino detection project (12’+3’)

Author: Carlos de los Heros[1]

Co-authors: Jan Conrad [2]; Alfredo Davide Ferella [3]; Jon Gudmundsson [3]

[1] *Uppsala University*

[2] *Stokcholm University*

[3] *Stockholm University*

Corresponding Authors: jon.gudmundsson@fysik.su.se, jan.conrad@cern.ch, cph@physics.uu.se, alfredo.ferella@fysik.su.se

The existence of relic neutrinos from the big bang is a well established fact in any cosmological model. Since they are expected to currently have an energy of a few milielectronvolts, their detection is a huge technological challenge. The PTOLEMY detector is a proposal to directly detect the cosmic neutrino background by looking at the very rare electrons emitted in the inverse beta decay of Tritium nuclei induced by relic neutrinos. An intermediate phase of the experiment aims also at using graphene for direct detection of light (~ MeV) dark matter particles, with unique directional sensitivity. We present the PTOLEMY concept and describe the first activities of the Swedish groups participating in this proof-of-concept experiment.

Partikeldagarna 2018 / **24**

Charged Higgs searches in ATLAS (12'+3')

Author: Max Fredrik Isacson[1]

[1] *Uppsala University (SE)*

Corresponding Author: max.isacson@cern.ch

It is universally accepted that the Standard Model (SM) is incomplete, and many models that describe physics Beyond the Standard Model (BSM) has by necessity an extended Higgs sector. The smallest extensions add one additional Higgs doublet to the one already present in the SM. These models are collectively called Two Higgs Doublet Models (2HDM). The scalar particle observed in 2012 is then understood to be one of two neutral scalar bosons described by the 2HDM, out of a total of 5 bosons. The remaining 3 are then a neutral pseudo-scalar and a pair of charged scalar bosons.

The observation of such a charged Higgs boson, $H^{\pm}$, would be convincing evidence of BSM physics and numerous direct searches has been carried out by both ATLAS and CMS. For charged Higgs masses below that of the top quark, the dominant decay is to a tau-lepton and a corresponding tau-neutrino. As the mass of the charged Higgs increases, the decay into a top- and a bottom-quark becomes kinematically allowed and quickly becomes the dominant channel. Thus these two decay modes naturally complement each other.

This talk presents the latest ATLAS results from the searches for a charged Higgs boson in the $\tau\nu$ and tb decay channels, using 36.1 fb^{-1} of proton-proton collision data collected during 2016 and 2017.

Partikeldagarna 2018 / **23**

Combination of searches for Higgs boson pairs in pp collisions at 13 TeV with the ATLAS experiment (12'+3')

Authors: Petar Bokan[1]; Arnaud Ferrari[2]

[1] *Uppsala University (SE), Georg-August-Universitaet Goettingen (DE)*

[2] *Uppsala University (SE)*

Corresponding Authors: arnaud.ferrari@physics.uu.se, petar.bokan@cern.ch

This report presents a combination of searches for Higgs boson pairs using up to 36.1 fb^{-1} of proton-proton collision data at a centre-of-mass energy $\sqrt{s} = 13$ TeV recorded with the ATLAS detector

at the LHC. The combination is performed using three analyses searching for the $HH \to b\bar{b}b\bar{b}$, $HH \to b\bar{b}\tau^+\tau^-$ and $HH \to b\bar{b}\gamma\gamma$ decay channels. Results are presented for both non-resonant and resonant Higgs boson pair production modes. The combined observed (expected) limit on the non-resonant Higgs boson pair cross-section is 0.22 pb (0.35 pb) at 95% confidence level, which corresponds to 6.7 (10.4) times the predicted Standard Model cross-section. The ratio of the Higgs boson self-coupling to its Standard Model expectation ($\kappa_\lambda = \lambda_{HHH}/\lambda^{\mathrm{SM}}_{HHH}$) is observed (expected) to be constrained at 95% confidence level to $-5.0 < \kappa_\lambda < 12.1$ ($-5.8 < \kappa_\lambda < 12.0$). Exclusion limits are also set on resonant Higgs boson pair production, probing a model with an extended Higgs sector based on two doublets, as well as a Randall-Sundrum bulk graviton model.

Partikeldagarna 2018 / **10**

Optimization Procedure in the Search for Spin-0 Supersymmetric Partner of Top Quark Using 120 fb^{-1} of $\sqrt{s} = 13$ TeV pp Collisions using the ATLAS Detector (12'+3')

Author: Stefio Yosse Andrean[1]

[1] *Stockholm University (SE)*

Corresponding Author: stefio.yosse.andrean@cern.ch

By offering a solution to the long-standing hierarchy problem, supersymmetry becomes one of the most searched extension to the Standard Model (SM) in the field of experimental high energy physics. Supersymmetry introduces each SM particle with a supersymmetric partner which has identical quantum number but a half-unit difference in spin. Supersymmetry can also answer the existence of dark matter, as the lightest supersymmetric particles is stable and interacts only by weak force, making it a good dark matter candidate.

Running on center of mass energy of $\sqrt{s} = 13$ TeV, the Large Hadron Collider (LHC) has the energy reach to access these supersymmetric particles. ATLAS is a multipurpose particle detector built in one of LHC's collision points, and was designed to identify every outgoing particles in a collision and measure their properties. The topic of the talk is the search for spin-0 supersymmetric partner of the top quark using the ATLAS detector at the Large Hadron Collider, focusing on a simplified model where the only light supersymmetric particles are the stop quark and the lightest neutralino.

In this presentation, an optimization procedure for various signal points is presented. The aim is to maximize search sensitivity in the region of high stop mass with low neutralino mass, and intermediate stop mass with high neutralino mass. The algorithm is tuned for full Run 2 data of 120 fb^{-1}, where sensitivity is expected to be much improved from the previous 36 fb^{-1} result. With this method, it is also possible to explore new region(s) in the parameter space and improve the overall exclusion. The result of this optimization procedure will be proposed as new signal regions for the analysis of the full ATLAS Run 2 dataset.

Partikeldagarna 2018 / **32**

Results from a search for dijet resonances using only trigger-level jets at ATLAS (12'+3')

Authors: Per Alexander Ekman[1]; William Kalderon[1]

[1] *Lund University (SE)*

Corresponding Authors: william.kalderon@cern.ch, per.alexander.ekman@cern.ch

The LHC delivers an unprecedented number of proton-proton collisions to its experiments. In kinematic regimes first studied by earlier generations of collider experiments, the limiting factor to more deeply probing for new physics can be the online and offline computing, and offline storage, requirements for the recording and analysis of this data. In this contribution, we describe a strategy that the ATLAS experiment employs to overcome these limitations and make the most of LHC data during Run-2 - a compact data stream involving trigger-level jets, recorded at a far higher rate than is possible for full event data. We discuss the challenges posed in the analysis of this data, collected in 2016, including the custom jet calibration developed. We also present the results of that analysis, demonstrating the competitiveness and complementarity with traditional data streams.

Partikeldagarna 2018 / **35**

ACCU report (15')

Corresponding Author: sara.strandberg@cern.ch

Partikeldagarna 2018 / **3**

Exploring sub-GeV Dark Matter with LDMX (12'+3')

Author: Lene Kristian Bryngemark[1]

[1] *Lund University (SE)*

Corresponding Author: lene.bryngemark@cern.ch

The origin and observed abundance of Dark Matter can be explained elegantly by the thermal freeze-out mechanism, leading to a preferred mass range for Dark Matter particles in the ~MeV-TeV region. The GeV-TeV mass range is being explored intensively by a variety of experiments searching for Weakly Interacting Massive Particles. The sub-GeV region, however, in which the masses of the building blocks of stable matter lie, is experimentally open territory. This mass range for particles and force carriers occurs naturally in Hidden Sector Dark Matter models. The Light Dark Matter eXperiment (LDMX) is a planned electron-beam fixed-target missing-momentum experiment that has uniquely broad and robust sensitivity to light Dark Matter in the sub-GeV range. This contribution will give an overview of the theoretical motivation, the main experimental challenges and how they are addressed, as well as projected sensitivities in comparison to other experiments.

Partikeldagarna 2018 / **19**

Towards solving the proton spin puzzle (12'+3')

Author: Gunnar Ingelman[None]

Co-author: Ekstedt, Ghaderi, Leupold

The fact that the spins of the quarks in the proton, as measured in deep inelastic lepton scattering, only add up to about 30% of the spin of the proton is still not understood after 30 years. We show that our newly developed model for the quark and gluon momentum distributions in the proton, based on quantum fluctuations of the proton into baryon-meson pairs convoluted with Gaussian momentum distributions of partons in hadrons, can essentially reproduce the data on the proton spin structure function g_1(x) and the associated spin asymmetry. A further improved description of the data is achieved by also including the relativistic correction of the Melosh transformation to the light-front formalism used in deep inelastic scattering. However, this does not fully resolve the spin puzzle, including also the neutron spin structure and the spin sum rules. These aspects can

also be accounted for by our few-parameter model if the conventional SU(6) flavor-spin symmetry is broken, giving new information on the non-perturbative bound-state nucleon.

Partikeldagarna 2018 / 11

Electromagnetic finite size effects to the hadronic vacuum polarisation (12'+3')

Authors: Andreas Jüttner[1]; Antonin Portelli[2]; James Harrison[1]; Johan Bijnens[3]; Nils Hermansson Truedsson[3]; P. A. Boyle[2]; Tadeusz Janowski[2]

[1] *University of Southampton*

[2] *University of Edinburgh*

[3] *Lund University*

Corresponding Author: nils.hermansson-truedsson@thep.lu.se

One of the most precisely measured quantities in particle physics is the anomalous magnetic moment $a_\mu = (g_\mu - 2)/2$, where g_μ is the deviation from the Dirac value $g_\mu = 2$. At present, there is roughly a $3\,\sigma$ discrepancy between the value of a_μ calculated in the Standard Model and that experimentally measured at Brookhaven, which could indicate physics beyond the Standard Model. In order to find out down whether or not this is the case, there is a new experiment at Fermilab, expected to have an improved value in the coming couple of years, as well as effort to improve the calculations of the various contributions to the theoretical value. One of the contributions to a_μ is from the hadronic vacuum polarisation (HVP) which in recent years can be calculated in finite volume (FV) on the lattice. The errors due to the FV approximation in such a calculation depend on the size of the lattice, and massive particles have exponentially suppressed effects, i.e. $\exp(-mL)$, whereas massless particles have power suppressed effects starting at some power of $1/mL$, so including QED on the lattice could potentially require a very large volume to have the errors under control. We have calculated the $1/mL$ expansion of the HVP at NLO in the the electromagnetic coupling in QED$_L$ and found it to start at $1/(mL)^3$, so that the NLO QED effects are negligible in ordinary lattice calculations. The analytical $1/mL$ expansion was compared numerically with lattice perturbation theory as well as lattice calculations and there is good agreement.

Authors: J. Bijnens, N. Hermansson Truedsson, T. Janowski, A. Portelli + (Lattice) P. A. Boyle, J. Harrison, A. Jüttner

Partikeldagarna 2018 / 45

Summary of Swedish upgrade activities in ATLAS (20+5)

Author: Christian Ohm[1]

[1] *KTH Royal Institute of Technology (SE)*

Corresponding Author: christian.ohm@cern.ch

44

CERN research plans from the accelerator perspective

Corresponding Author: ioannis.papaphilippou@cern.ch

43

Challenges in data processing and handling at the SKA telescope

Author: Anna Scaife[1]

[1] *University of Manchester*

46

Strategy overview