



University of Venda
Creating Future Leaders

Welcome to the Sixth HEPP Workshop

University of Venda, Jan 29th-31st 2020





Home

Welcome to the South African scientific collaboration with CERN

Upcoming Event: [Ten Years of SA-CERN Celebration November 19-21 2018](#)

The SA-CERN programme is a national programme funded by the [Department of Science and Technology](#) and the [National Research Foundation](#) to provide South African researchers, students, engineers and technicians with an opportunity to participate in the world's premier and largest international research facility at [CERN](#)



<http://sa-cern.tlabs.ac.za>

SA-CERN celebrated its 10th anniversary this coming November 19th-21st

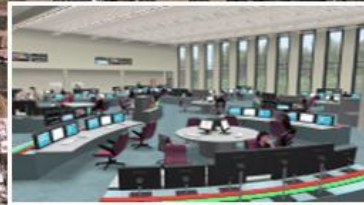
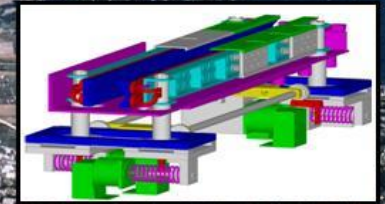
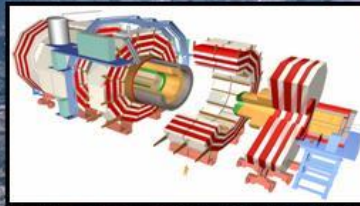
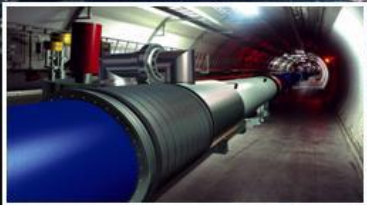
Presenting at the event plans for the next 10 years including continued expansion of the effort in the area of technology transfer and innovation.

iThemba LABS is the host of the SA-CERN program



The Large Hadron Collider

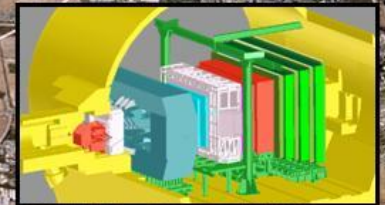
SA's contribution
ALICE
ATLAS
ISOLDE
Theory



ALICE

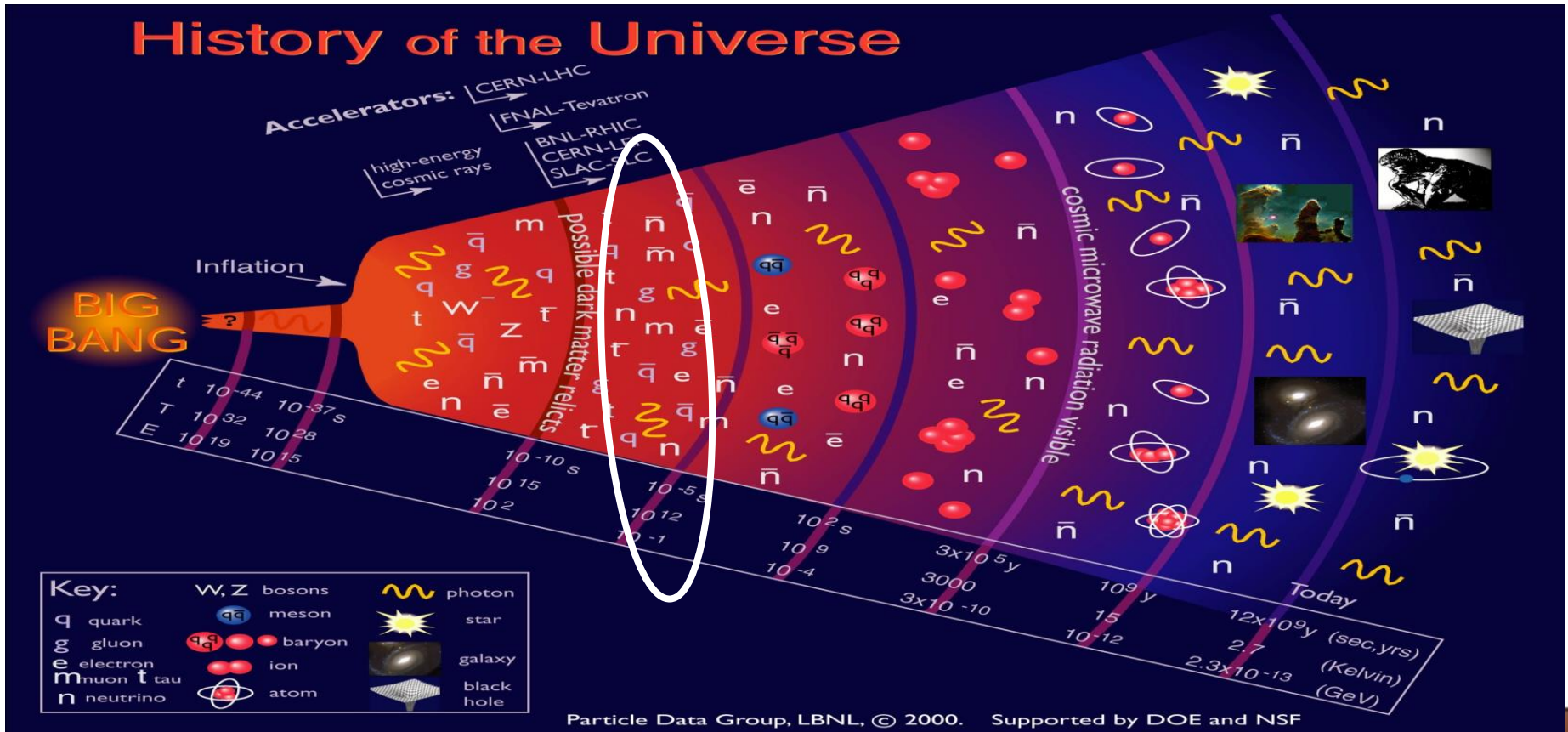


ATLAS



Physics with Heavy Ions

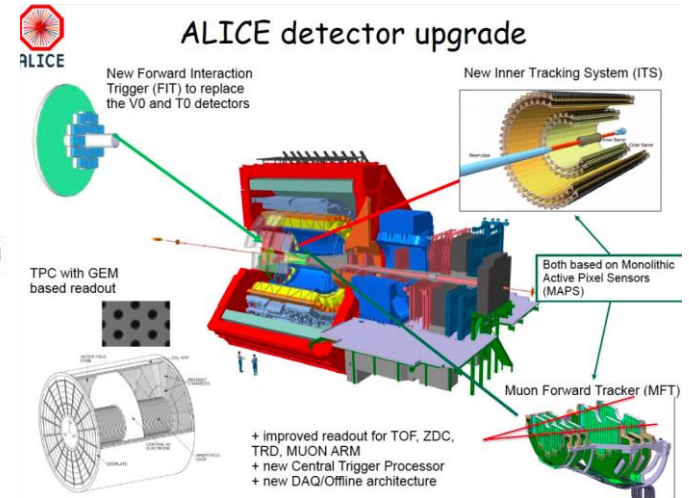
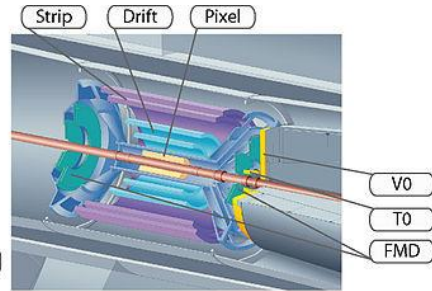
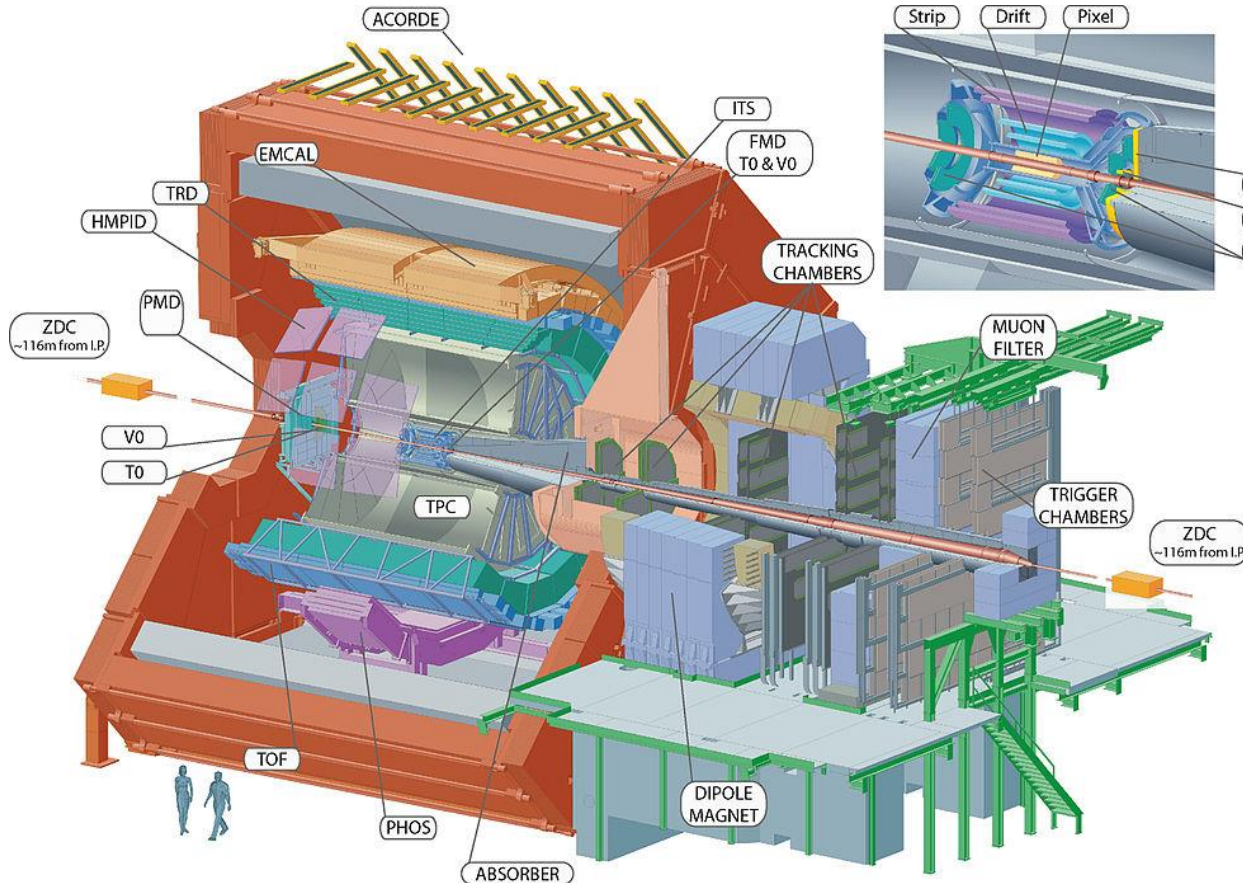
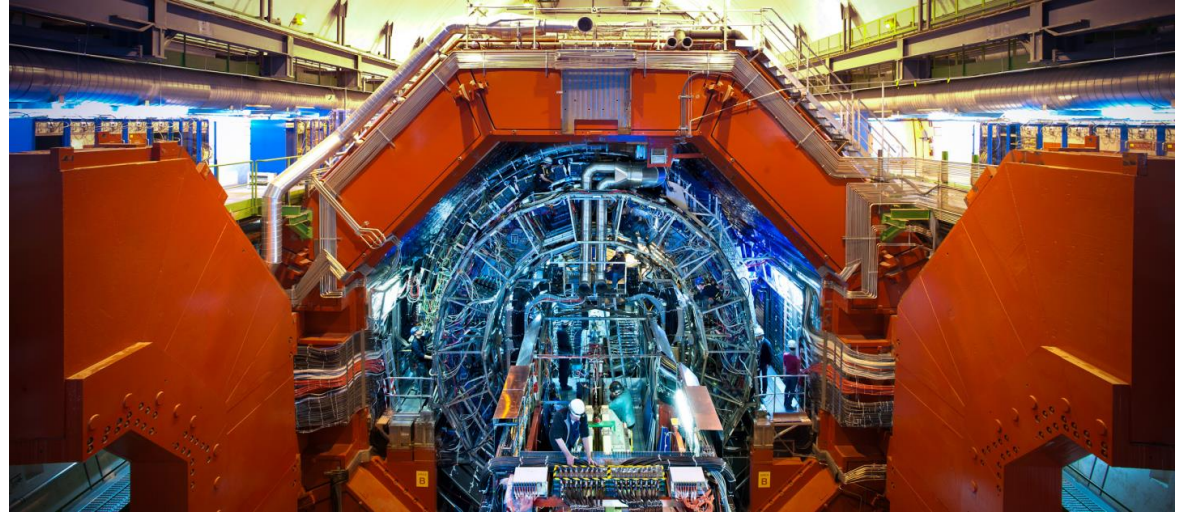
In the early stages of the Universe; Quarks and gluons were reaming freely



As the universe cooled down, they got confined and have remained imprisoned ever since...



Heavy Ion Collisions with the ALICE Detector





ALICE

Z. Buthelezi

A surprise: Observation of elliptic flow and other effects first seen in heavy-ion collisions also in pp and p-Pb collisions

- Puzzle: is QGP in small systems?
- But no jet quenching seen in small systems
- Ongoing discussion

Quest:

- study of particle production mechanisms in different collisions systems
 - Which mechanisms involved?
- Possible connection between hard and soft processes
 - Production at QGP freeze-out
 - Role of hadronic re-scattering phase
 - Hadronization at high- p_T

Are We happy with the SM?

- ❑ **The SM as it is does not solve a number of fundamental questions/problems**
 - ❑ **Quadratic divergences of the Higgs mass**
 - **Higgs mass grows with scale of new physics**
 - ❑ **Does not explain the origin of the neutrino mass**
 - ❑ **Does not explain dark matter in the universe**
 - ❑ **Does not explain dark energy in the universe**
 - **The universe expanding at an accelerated rate**
 - ❑ **How about gravity?**
 - ❑ **Unification of fundamental interactions**
 - ❑ **Why three generations?**
 - ❑ **Etc...**

Multi-lepton anomalies in p-p collisions

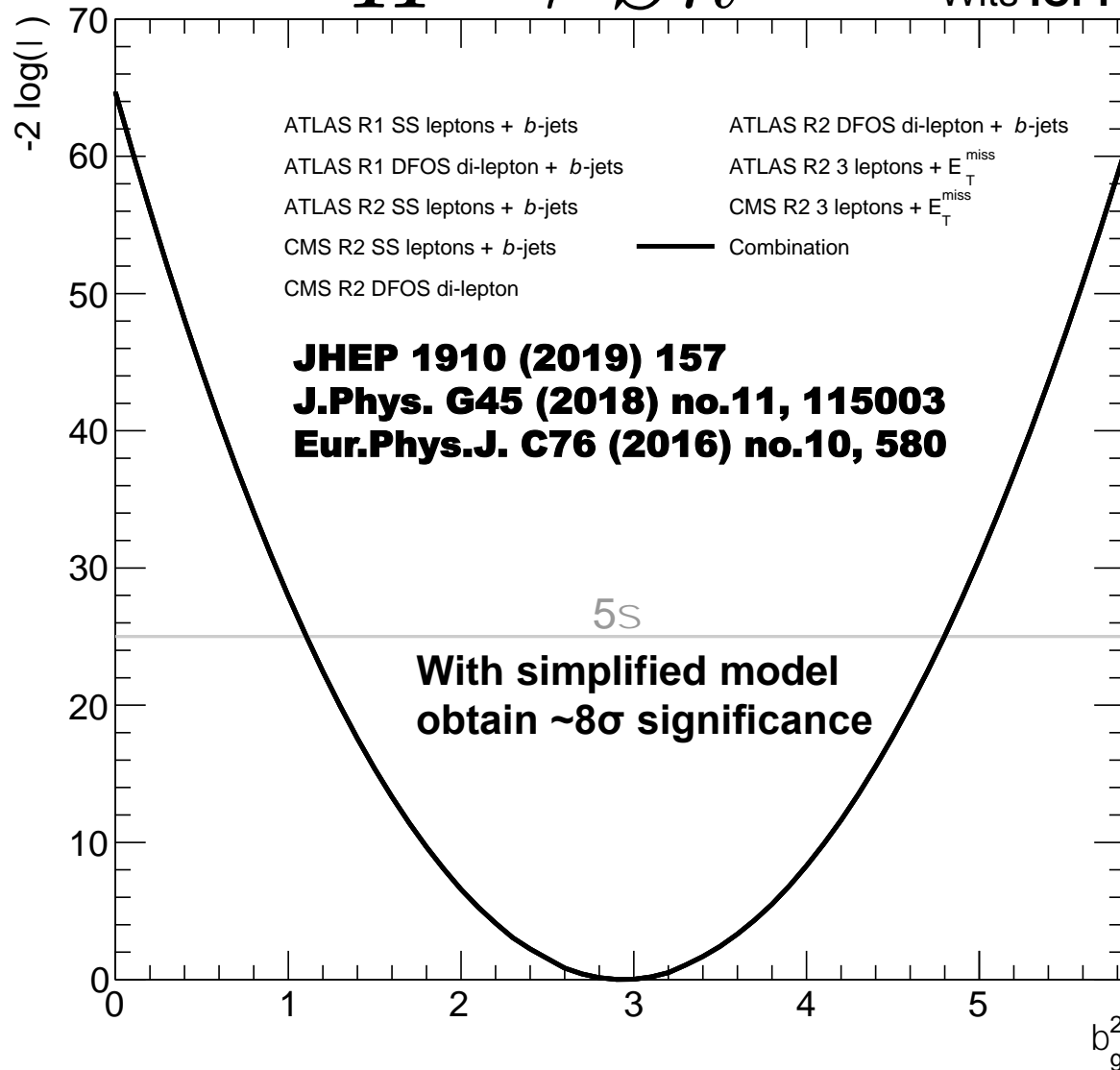
Implications for LHC and future colliders

Connection with anomalies in Astro-Physics?



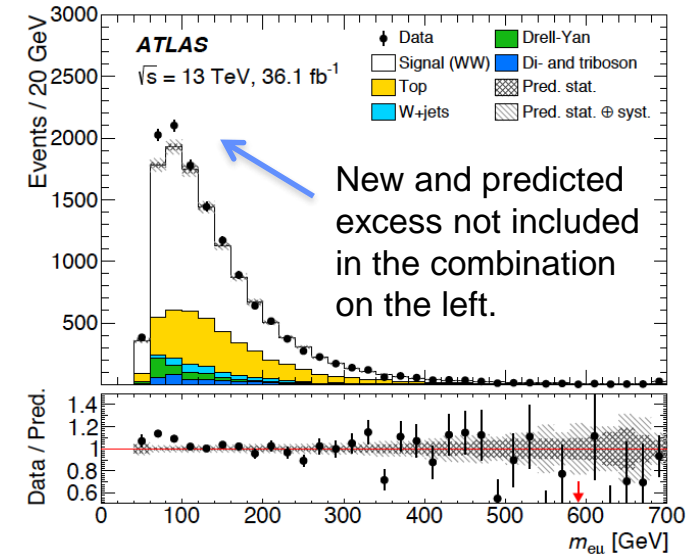
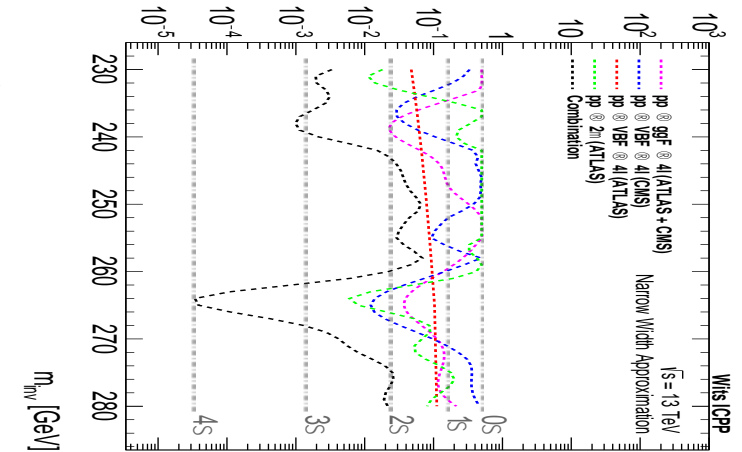
$$H \rightarrow Sh$$

Wits ICPP



$$H \rightarrow 4\ell, 2\mu$$

Local p_0



Is the SM breaking down through the leptonic sector?

□ **Apparent violation of lepton flavor conservation in B-meson decays**

$$R_{D^{(*)}} = \frac{\mathcal{B}(\bar{B} \rightarrow D^{(*)} \tau \bar{\nu})}{\mathcal{B}(\bar{B} \rightarrow D^{(*)} \ell \bar{\nu})}$$

$$R_K = \frac{\mathcal{B}(B^+ \rightarrow K^+ \mu^+ \mu^-)}{\mathcal{B}(B^+ \rightarrow K^+ e^+ e^-)}$$

□ **Anomalous magnetic moment of the muon (also electron?)**

$$R_{K^*} = \frac{\mathcal{B}(B^0 \rightarrow K^{*0} \mu^+ \mu^-)}{\mathcal{B}(B^0 \rightarrow K^{*0} e^+ e^-)}$$

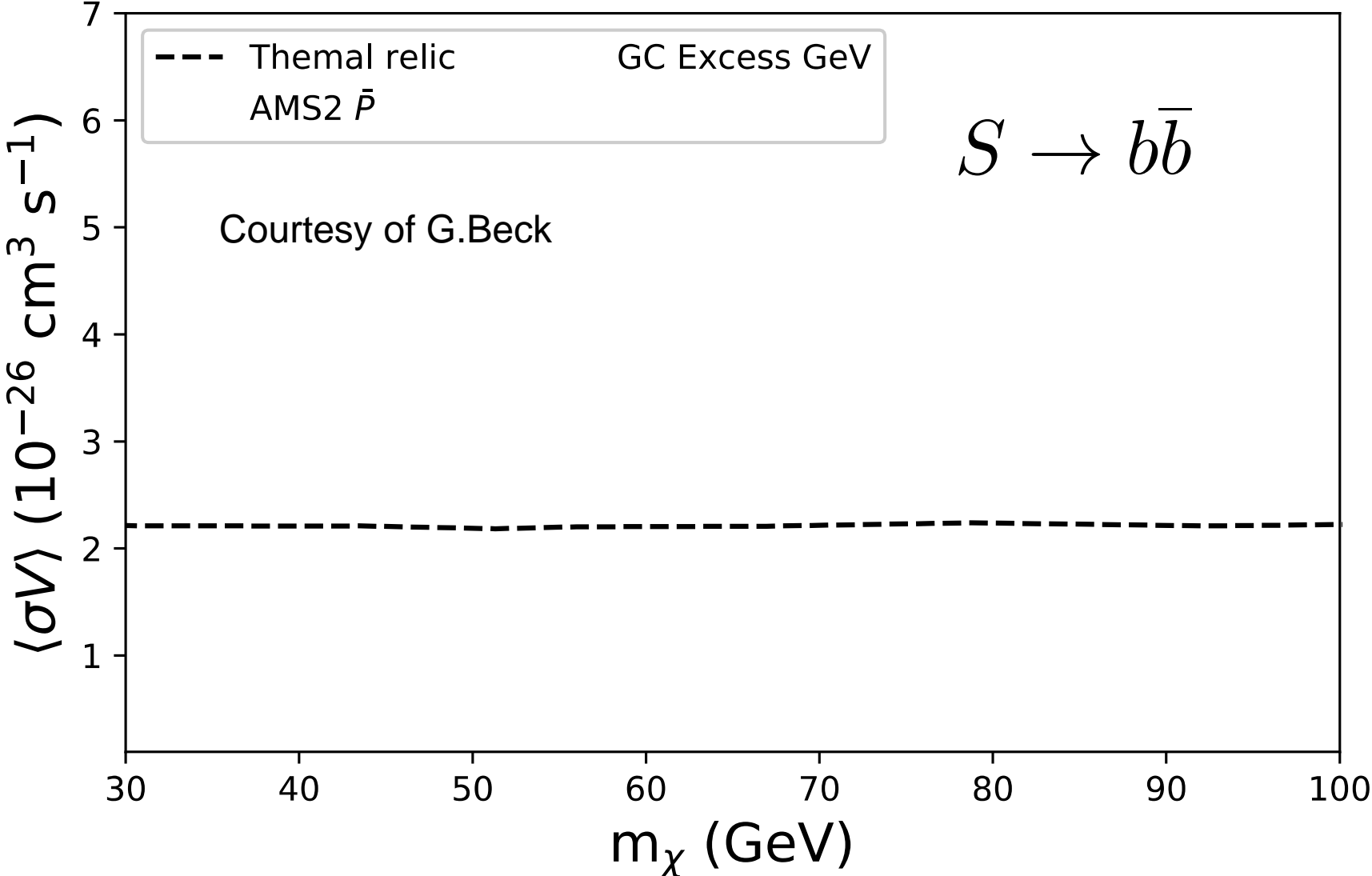
$$\vec{\mu} = g \frac{e}{2m} \vec{s}$$

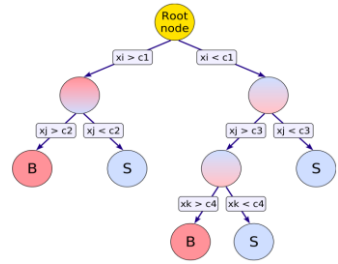
□ **Multi-lepton anomalies in p-p collisions at the LHC (see above)**

□ **Electron neutrino appearance at MiniBooNE/LSND**

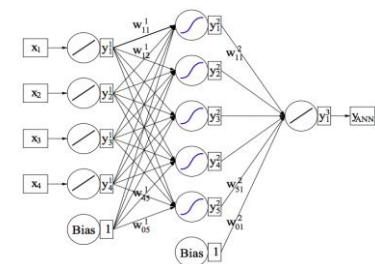
**How about
Astro-Physics?**

Excesses in Astro-Physics consistent with DM annihilation into not so heavy mediators. Includes leptophilic excesses, such as positron rise in PAMELA/AMS02. Consequences for MeerKat/SKA, KM3NeT



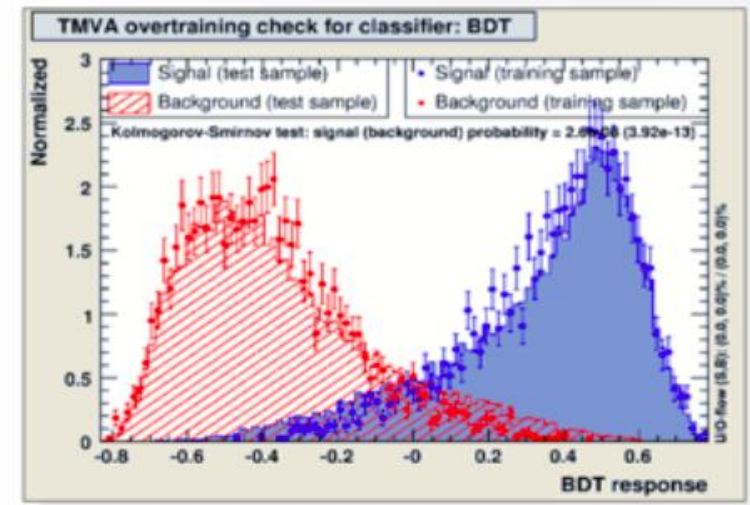
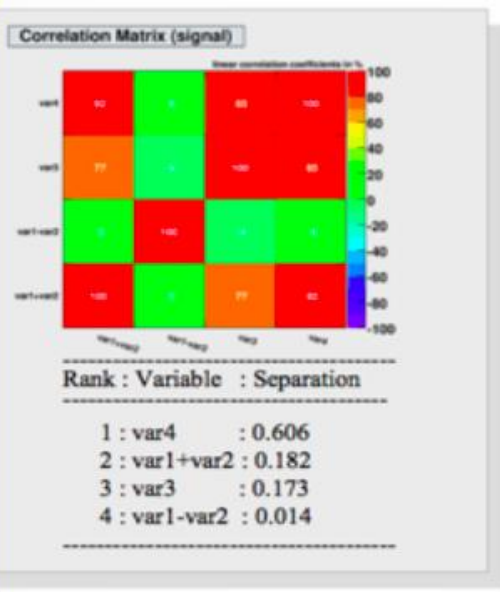


Machine Learning



TMVA Plotting Macros

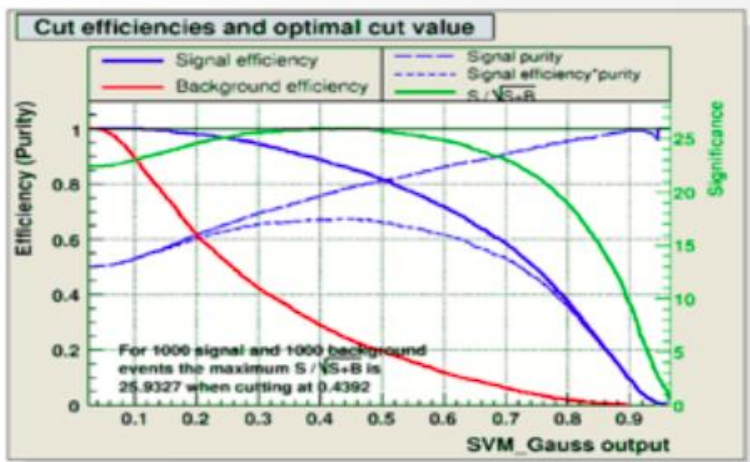
- (1a) Input Variables
- (1b) Decorrelated Input Variables
- (1c) PCA-transformed Input Variables
- (2a) Input Variable Correlations (scatter profiles)
- (2b) Decorrelated Input Variable Correlations (scatter profiles)
- (2c) PCA-transformed Input Variable Correlations (scatter profiles)
- (3) Input Variable Linear Correlation Coefficients
- (4a) Classifier Output Distributions
- (4b) Classifier Output Distributions for Training and Test Samples
- (4c) Classifier Probability Distributions
- (4d) Classifier Rarity Distributions
- (5a) Classifier Cut Efficiencies
- (5b) Classifier Background Rejection vs Signal Efficiency (ROC curve)
- (6) Likelihood Reference Distributions
- (7a) Network Architecture
- (7b) Network Convergence Test
- (8) Decision Trees
- (9) PDFs of Classifiers
- (10) Rule Ensemble Importance Plots
- (11) Cut



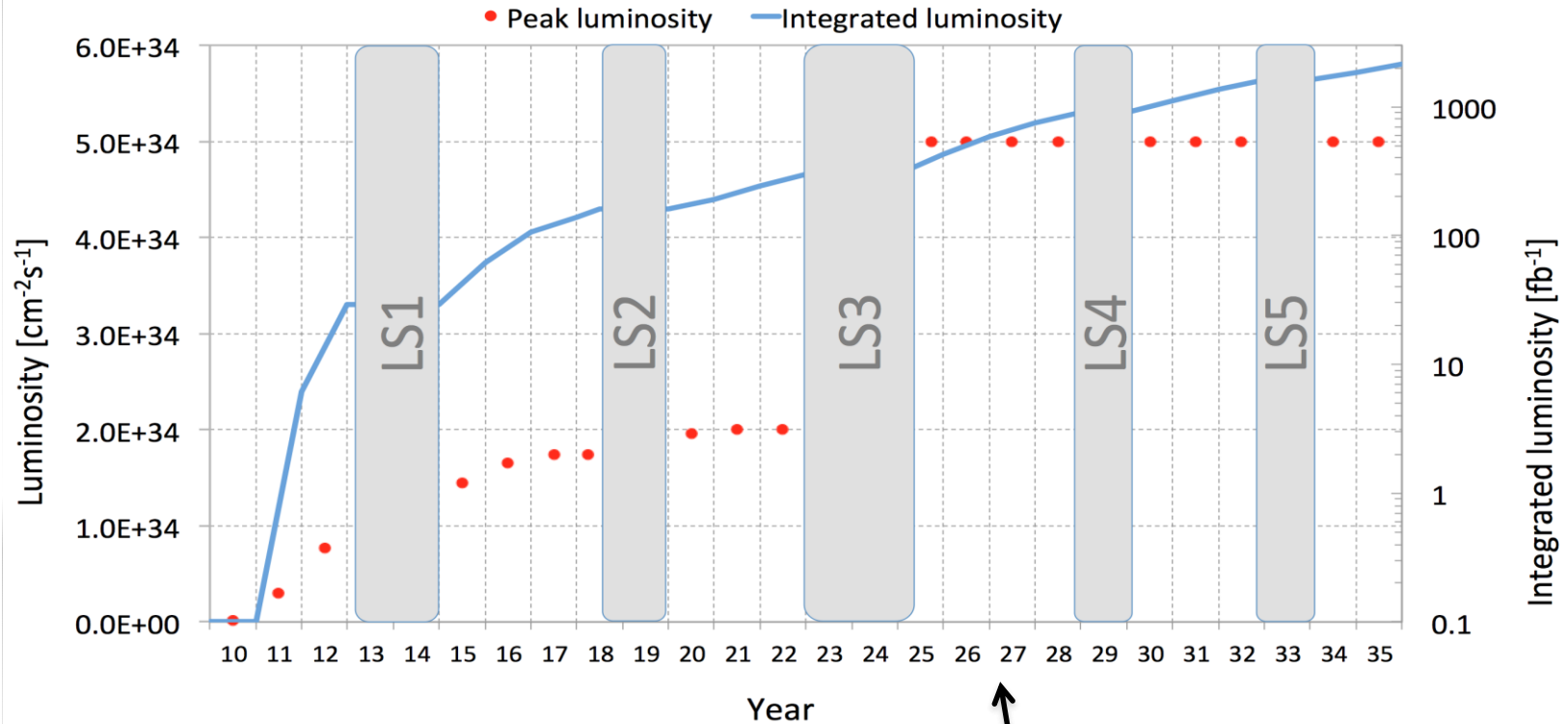
average no. of nodes before/after pruning: 4193 / 968

MLP Convergence Test

Training Sample | Test sample



2010 - 2035

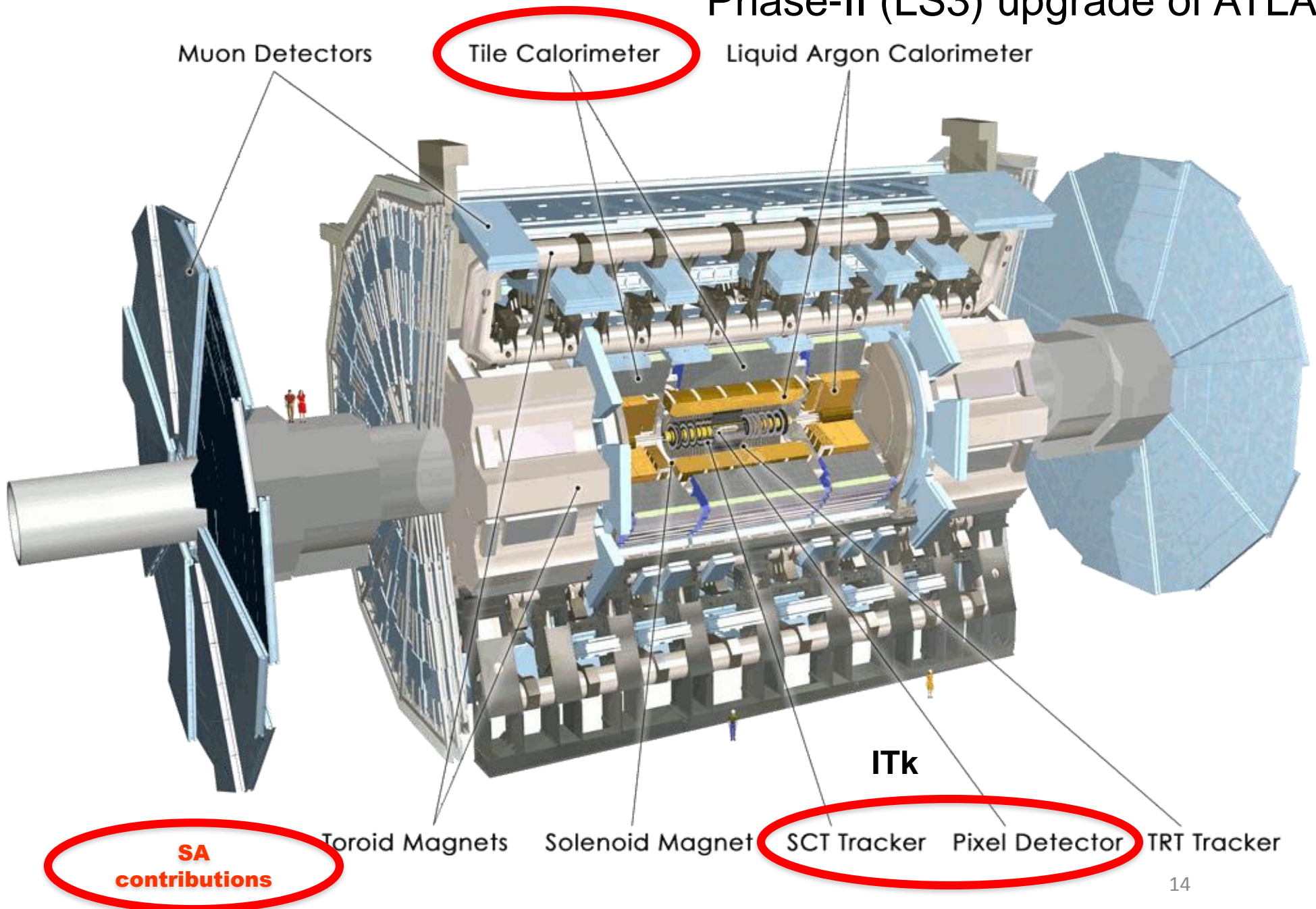


Phase-II upgrade has been postponed to 25-27

3

Plans for next ten years include: contributing to the upgrade of the detectors, expanding the student body and our technology transfer and innovation efforts.

Phase-II (LS3) upgrade of ATLAS



**SA
contributions**

Tech Transfer and Relations with Industry

❑ Technology Innovation Platform

❑ Presentation by Prof. Papka

❑ Application of Classroom Fundamentals in Industry

❑ Presentation by Rinae Nnduvheni (Deloitte)

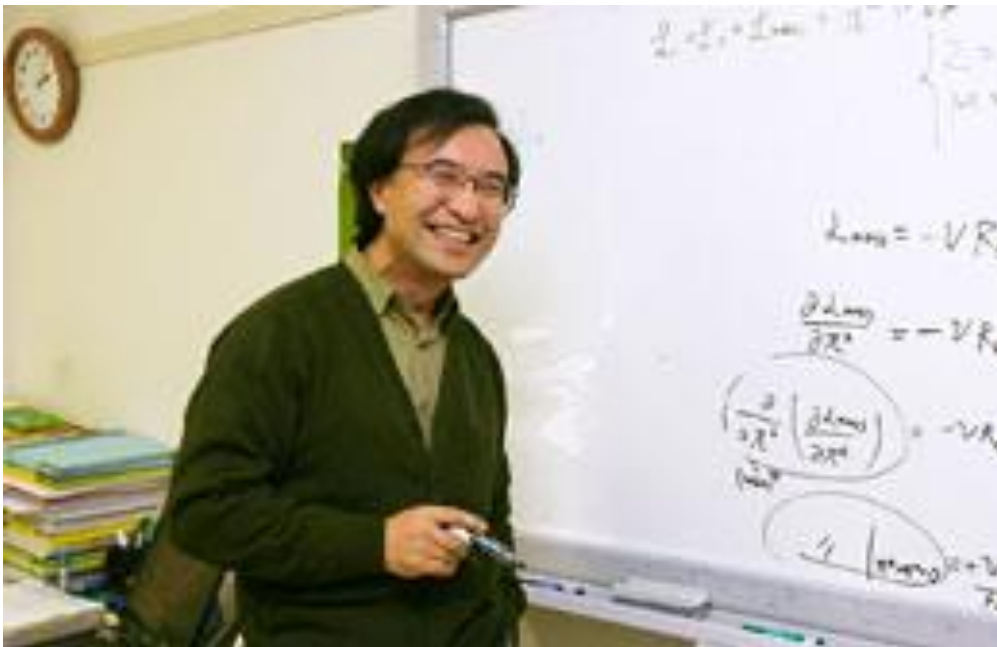
❑ Bridging the Gap between Industry and Academia

❑ Presentation by Dingane Hlaluku (IBM)

Structure of the Workshop

Distinguished Foreign Lecturers

Prof. Kaoru Hagiwara



Prof. Benjamin Fuks



	29 Jan 2020	30 Jan 2020	31 Jan 2020
AM	08:45 Session I (until 12:00) ()	09:00 Session III (until 12:30) ()	09:00 Session V (until 12:30) ()
	09:00 Greetings from the DVC Academic - Prof. J.E. Crafford (University of Venda) ()	09:00 Standard Model of Particle Physics III and IV - Prof. Kaoru Hagiwara (KEK) ()	09:00 New Physics Simulations at Colliders II - Benjamin Fuks (Centre National de la Recherche Scientifique (FR)) ()
	09:15 Greetings from the Dean of the Faculty of Sciences - Prof. N. Potgieter (University of Venda) ()	10:30 --- Tea/Coffee ---	09:45 Heavy Ion Physics II - William Alexander Horowitz (University of Cape Town (ZA)) ()
	09:30 Greetings from the Head of the School of Physics - Dr Eric Maluta (University of Venda) ()	11:00 New Physics Simulations at Colliders I - Benjamin Fuks (Centre National de la Recherche Scientifique (FR)) ()	10:30 --- Tea/Coffee ---
	09:45 Overview and goals of the workshop - Alan Stanley Cornell (University of Johannesburg (ZA)) Bruce Mellado Garcia (University of the Witwatersrand) ()	11:45 Heavy Ion Physics I - William Alexander Horowitz (University of Cape Town (ZA)) ()	11:00 The Technology and Innovation Platform - Paul Papka (Stellenbosch University) ()
	10:15 --- Tea/Coffee Break ---		11:45 Application of classroom fundamentals in industry - Mr Rinae Nnduvheni (Deloitte) ()
	10:30 The Standard Model of Particle Physics I and II - Prof. Kaoru Hagiwara (KEK) ()		
PM	12:00 --- Lunch ---	12:30 --- Lunch ---	12:30 --- Lunch ---
	13:30 Session II (until 17:30) ()	14:00 Session IV (until 17:35) ()	14:00 Session VI (until 17:45) ()
	13:30 Fluctuating Open Heavy Flavour Energy Loss in a Strongly Coupled Plasma with Observables from RHIC and the LHC - Mr Blessed Blessed Ngwenya (University of Cape Town) William Horowitz (University of Cape Town) ()	14:00 BSM searches using SM measurements! - Deepak Kar (University of the Witwatersrand (ZA)) ()	14:00 Visualising Event Data from the Transition Radiation Detector in ALICE at CERN - Sameshan Perumal (University of Cape Town (ZA)) ()
	13:45 A step-by-step analysis of the Equilibration of Hadron matter from the microscopic model - Mr Thendo Emmanuel Nemakhavhani (UJ) ()	14:20 Implementing a robust anti-QCD tagger with mass de-correlated jet image data - Mr Kokotla Rapetsoa (University of Venda (ZA)) ()	14:15 Gamma Irradiation of possible photocathode materials - Joyful Elma Mdhuli (University of the Witwatersrand (ZA)) ()
	14:00 Computation of the effective potential in the gauge-Higgs unification models - Alan Stanley Cornell (University of Johannesburg (ZA)) ()	14:35 Application of a novel Machine Learning approach for the search of heavy resonances with topological features at the LHC - Salah-Eddine Dahbi (University of the Witwatersrand (ZA)) ()	14:30 Assembly, quality checks and installation of the scintillator detector modules for phase I upgrade of the Tile Calorimeter of the ATLAS experiment - Gaogalaibe Mokgatitwane (University of the Witwatersrand (ZA)) ()
	14:20 Searches for a ubiquitous U(1) pseudo-scalar at future lepton colliders - Ms Lara Mason (University of Johannesburg/IPNL) ()	14:50 Testing the search for new resonances in the di-photon channel with topological requirements on the production of the Standard Model Higgs boson at the LHC - Mr Nalamotse Joshua Choma (University of the Witwatersrand (ZA)) ()	14:45 CONTRIBUTIONS TO THE DEVELOPMENT OF THE OFF-DETECTOR ELECTRONICS FOR THE PHASE-II UPGRADE OF THE ATLAS TILE CALORIMETER - Mpho Gift Doctor Gololo (University of the Witwatersrand (ZA)) ()
	14:35 Measuring the tWZ process with full Run-II ATLAS data - Benjamin William Warren (University of Cape Town (ZA)) ()	15:05 An Alternative to Monte Carlo Generators with Deep Generative Models - Mr Thabang Lebese (University of the Witwatersrand (ZA)) ()	15:00 Development of high speed electronics for the off-detector readout of the Tile Calorimeter of the ATLAS detector - Mr Daniel Edwards (University of the Witwatersrand) ()
	14:50 --- Tea/Coffee ---	15:20 Applications of Weakly-Supervised Machine Learning Techniques in the Search for New Bosons Focusing on Dilepton Final States at the ATLAS Experiment. - Mr Benjamin Lieberman (University of the Witwatersrand (ZA)) ()	15:15 DAQ software implementation in the TileCal ALTI Module - Mr Humphry Tiou (University of the Witwatersrand (ZA)) ()
	15:20 Top Tagging Using Spatial Distribution of Subjets - Ms Danielle Wilson (University of the Witwatersrand) ()	15:35 --- Tea/Coffee ---	15:30 --- Tea/Coffee ---
	15:35 Constraining Stealth SUSY with illuminated fat jets at the LHC - Marvin Flores (University of the Witwatersrand (ZA)) ()	16:05 Searching for heavy scalar resonances in the LHC run 2 dataset in the $SZ\gamma\gamma$ final states using machine learning techniques. - Ntsoko Phuti Raphepha (University of the Witwatersrand (ZA)) ()	16:00 Low Voltage Power Supply production, hardware upgrade and testing for the ATLAS TileCal Front-End Electronics system - Mr Edward Khomotso Nkadmeng (University of the Witwatersrand (ZA)) ()
	15:50 Dark Matter Search using Semi-visible jets - Sukanya Sinha (University of Witwatersrand) ()	16:20 Application of Machine Learning to satellite data - Mr Ayanda Thwala (University of Eswatini) ()	16:15 Characterization and Functionality of Burn-in station for the ATLAS Tile Calorimeter Low Voltage Power Supplies. - Thabo James Lepota (University of the Witwatersrand (ZA)) ()
	16:05 Electrons in Dense environment in ATLAS - Lawrence Davou Christopher (University of the Witwatersrand (ZA)) ()	16:35 Search for a resonance decaying into two photons in association with $b\bar{b}$ jets - Esra Mohammed Shrif (University of the Witwatersrand (ZA)) ()	16:30 Testing of new low-voltage power supplies for the ATLAS tile-calorimeter front-end electronics - Ryan Peter Mckenzie (University of the Witwatersrand (ZA)) ()
	16:20 Implications of the anomalous production of leptons at the LHC - Bruce Mellado Garcia (University of the Witwatersrand) ()	16:50 Background determination of the control region of the $S\gamma\gamma$ signal at the ATLAS detector - Mr Abdulazem Fadol Mohammed (Chinese Academy of Sciences (CN)) ()	16:45 Heat Transfer Improvement of a Thermal Interface Material for Heat Sink Applications Using Carbon Nanospheres. - Othmane Mouane ()
	16:40 The anomalous production of multi-leptons and its impact on the measurement of W production at the LHC - Yesenia Hernandez Jimenez (University of the Witwatersrand (ZA)) ()		17:00 Bridging the gap between industry and academia - Mr Dingane Hlaluku (IBM) ()
	16:55 An exploration of the anomalous $t\bar{t}$ rate at the LHC - Stefan von Buddenbrock (University of the Witwatersrand (ZA)) ()		

Proceedings due **March 1st 2020**

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Thank you for contributing your paper to the proceedings of the [High Energy Particle Physics Workshop \(HEPPW2015\)](#).

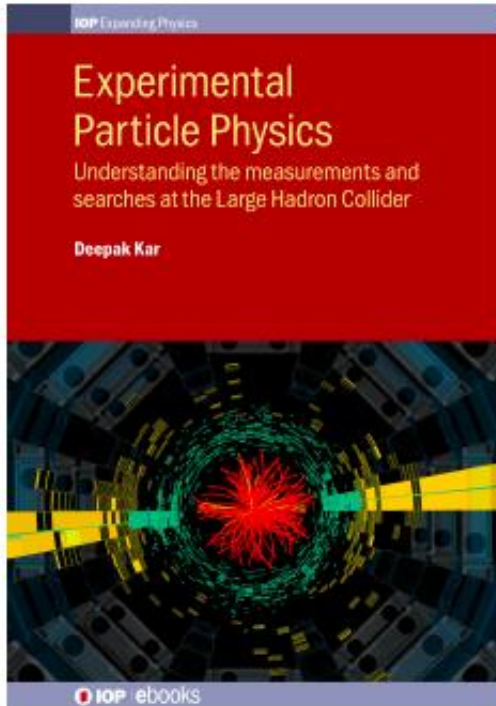
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The URL of your paper is

<http://dx.doi.org/10.1088/1742-6596/645/1/012027>

The book!



Particle physics book for beginners in the field, published by Institute of Physics, UK



Book launch held on 4th October

