High Energy Particle Physics Workshop 2015

Report of Contributions

https://indico.cern.ch/e/367368

Contribution ID: **0** Type: **not specified**

DVC research

Wednesday 11 February 2015 09:00 (10 minutes)

Presenter: Prof. VILAKAZI, Zeblon (University of Witwatersrand)

Contribution ID: **1** Type: **not specified**

Welcome from the Head of the School of Physics

Wednesday 11 February 2015 09:20 (15 minutes)

Presenter: Prof. CARTER, John (University of Witwatersrand)

Contribution ID: **2** Type: **not specified**

Introduction and structure of the workshop

Wednesday 11 February 2015 09:35 (10 minutes)

Presenters: CORNELL, Alan; MELLADO GARCIA, Bruce (University of the Witwatersrand)

Contribution ID: **3** Type: **not specified**

Overview of iThemba facilities

Wednesday 11 February 2015 09:45 (45 minutes)

Presenter: MULLINS, Simon (iThemba LABS)

Contribution ID: **4** Type: **not specified**

Heavy Ion Theory

Wednesday 11 February 2015 11:00 (45 minutes)

Presenter: AZWINNDINI, Muronga (University of Johannesburg)

Contribution ID: **5** Type: **not specified**

Heavy Ion Experiment

Wednesday 11 February 2015 11:45 (45 minutes)

Presenter: DIETEL, Tom (University of Cape Town (ZA))

Contribution ID: **6** Type: **not specified**

Jets of light hadrons via AdS/CFT correspondence

Wednesday 11 February 2015 13:30 (20 minutes)

The spectacular measurements from the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC) provide compelling evidence that the matter produced in heavy ion collision is a deconfined state of QCD, Quark-Gluon Plasma (QGP), at temperatures above ˜160 MeV which appears to be nearly perfect, with an extremely low viscosity-to-entropy ratio η/s ˜ 1/4π.
Within this expanding fireball, jets are produced which probes the QGP. Analysis the energy loss of these energetic partons as they travel throw QGP may reveal extremely valuable information about the dynamics of the plasma and exhibit distinctive properties such as jet-quenching.
The "AdS/CFT correspondence"which imposes the duality between the gauge theory and gravity is a novel tool provides valuable insight into the strongly coupled plasma. The most important result of AdS/CFT is calculating the value of shear viscosity to entropy density ratio which is in remarkable agreement with the hydrodynamics predictions.
We study the energy loss rate of light quarks via AdS/CFT correspondence in both static and expanding plasma. In the hope of making contact with QGP physics, we propose a novel jet prescription based on the separation of hard and soft modes in the dual theory and test the AdS/CFT approach with the latest light hadron suppression data from CMS.

Presenter: MORAD, Razieh (University of Cape Town)

Contribution ID: **7** Type: **not specified**

Using a Classical Gluon Cascade to study the Equilibration of a Gluon-Plasma

Wednesday 11 February 2015 13:50 (20 minutes)

Using a classical gluon cascade, we study the thermalisation of a gluon-plasma in a homogeneous box by considering the time evolution of the entropy, and in particular how the thermalisation time depends on the strong coupling constant. We then partition the volume into cells with a linearly increasing temperature gradient in one direction, and homogeneous/isotropic in the other two directions. We allow the gluons to stream in one direction in order to study how they then evolve spatially. We examine cases with and without collisions. We study the entropy as well as the flow-velocity in the z-direction and find that the system initially has a flow which dissipates over time as the gluons become distributed homogeneously throughout the box.

Presenter: MCCONNEL, R (University of Cape Town)

Contribution ID: **8** Type: **not specified**

Short path length and running coupling pQCD corrections to energy loss in the QGP

Wednesday 11 February 2015 14:10 (20 minutes)

In the heavy ion experiments at RHIC and the LHC, a state of matter known as the quark-gluon plasma (QGP) has been produced. The so-called 'hard particles', or particles with very high momentum that are produced as a consequence of the asymptotic freedom of QCD, can be used as tomographic probes of the QGP. We will study the way in which energy is dissipated in this QGP by calculating, in pQCD, corrections to the well-known energy loss formulae for short path lengths. This is necessary to address the discovery at the LHC that shockingly small systems appear to be exhibiting collective behaviour. We will also attempt to incorporate the running-coupling corrections to existing calculations in order to realise a quantitative theoretical understanding of energy loss processes.

Presenter: KOLBE, Isobel (University of Cape Town)

Contribution ID: **9** Type: **not specified**

Sibaliso Mhlanga

Contribution ID: **10** Type: **not specified**

Review of jet reconstruction algorithms

Wednesday 11 February 2015 14:50 (20 minutes)

Accurate jet reconstruction is necessary for understanding the link between free partons and the collimated “jets” of colourless particles they hadronise into. This link will shed light on the properties of the partons. I shall present a review of various jet reconstruction algorithms, namely Kt, anti-Kt, Cambridge/Aachen, Iterative cones and SIScone, highlighting their strengths and weaknesses. An application with data may also be presented

Presenter: ATKIN, Ryan (UKZN)

Contribution ID: **11** Type: **not specified**

Theoretical overview of pp collision physics results

Thursday 12 February 2015 09:00 (45 minutes)

Presenter: CORNELL, Alan

Contribution ID: **12** Type: **not specified**

Review of ATLAS Physics Results

Thursday 12 February 2015 09:45 (45 minutes)

Presenter: KAR, Deepak (University of Glasgow (GB))

Contribution ID: **13** Type: **not specified**

The discovery of the Standard Model Higgs boson and its properties

Thursday 12 February 2015 11:00 (20 minutes)

The observation of the Higgs boson with the ATLAS detector in 2012 was a major achievement for science. This essay is aimed at understanding the relevance of the Higgs boson in the Standard Model and analysing the experimental observation of the particle. The dataset used in the experiment had an integrated luminosity of about 25 fb−1 at the centre-of-mass energy of √s = 8 TeV. To understand how the ATLAS detector works to identify a particle, the Z ⟶ e−e+ decay is used as an illustration. The Z boson mass is measured to be mZ = 91.53 ± 0.12 GeV/c2 with the width of ΓZ = 3.56 ± 0.89 GeV/c2. The Higgs boson analysis is done using only the data from the H ⟶ γγ channel. The results are examined in a statistical test with two hypotheses. The statistical results show the presence of a particle at 126 GeV/c2.

Presenter: THUSINI, Xolisile Octavia (University of Cape Town)

Contribution ID: **14** Type: **not specified**

Measurement of the Higgs Boson Transverse Momentum and its Sensitivity to New Physics Beyond the Standard Model

Thursday 12 February 2015 12:00 (20 minutes)

Using the Standard Model of particle physics (SM) to model the interactions between fundamental particles, simulations of processes resulting in the production of Higgs bosons were done for different centre of mass energies of the CERN Large Hadron Collider (LHC). The results from these simulations were then compared to actual data obtained at the ATLAS and CMS experiments and it was found that there is an excess of transvers momentum in the actual results above the simulation results. One hypothesis, which explains this excess transverse momentum, is that a Beyond Standard Model Pseudo scalar boson is being produced, which then decays into a dark matter particle and a SM-like Higgs Boson. Thus, the emission of the dark matter particle would give the Higgs Boson more transverse momentum than predicted by the SM. This was loosely modeled by simulating the production of a heavier than SM Higgs boson which would represent the Beyond Standard Model Pseudo scalar boson. By doing this it was found that as the running centre of mass energies at the CERN LHC was increased the total production cross-section for the Pseudo scalar boson increased faster than that for the SM Higgs boson. This tells us that if this hypothesis is correct we would expect a greater Higgs boson production cross-section to be seen at the LHC in 2015 when the centre of mass energy increases. The measurement of the transverse momentum spectrum of the Higgs boson is sensitive to physics beyond the SM, in particular to the production of Dark matter.

Presenter: GOSSMAN, David (University of the Witwatersrand)

Contribution ID: **15** Type: **not specified**

Measurement of the Higgs Boson Transverse Momentum in the Di-photon Channel with the ATLAS detector

Thursday 12 February 2015 11:40 (20 minutes)

The Standard Model (SM) of particle physics, with the discovery of the Higgs boson, is a complete model of the known fundamental particles and their interactions. The data taken in the 2012 run was then compared to the Monte Carlo and an excess has been found in the Higgs transverse momentum in the di-photon and ZZ decay channels. A possible explanation is a beyond the SM pseudo scalar boson is being produced which would then decay into a dark matter particle and a Higgs Boson that looks like the current SM. This dark matter particle would provide the Higgs with excess momentum which may account for the discrepancy observed. A first attempt at modelling the production of the heavier than the SM Higgs (or Pseudo scalar boson) showed that as the centre of mass energies increase the production cross-section of the Pseudo scalar increased faster than the SM Higgs boson. This indicates that if the hypothesis is true then we should expect greater Higgs boson productions during the 2015 run at higher centre of mass energies. A better understanding of the observed excess is needed before any further conclusions can be made.

Presenter: REED, Robert Graham (University of the Witwatersrand (ZA))

Contribution ID: **16** Type: **not specified**

Measurement of the properties of Higgs boson in two photon final state in ATLAS

Thursday 12 February 2015 11:20 (20 minutes)

The measurements of the Higgs bosonproperties are performed in Higgs decaying into two photons channel after the discovery. The gluon-gluon fusion, the vector boson fusion, the Higgs production in association with a W or Z boson or a top-quark pair are measured in this final state. The multivariate analysis (MVA) method is applied to extract the Higgs boson in the vector boson fusion enriched category to enhance the signal significance. The couplings of the each production modes are measured using 20.3\,fb^{-1} 2012 data taken at $\sqrt{s}$\,=\,8\,TeV and 4.5\,fb^{-1} 2011 data taken at $\sqrt{s}$\,=\,7\,TeV in the ATLAS detector. No significant deviations from the predictions of the Standard Model are found.

The measurements of the fiducial and differential cross sections are performed for Higgs boson production using 2012 data in this final state as well. The distribution of several kinematic variables of the two photons and jets are studied. The observed signals are extracted from the data and unfolded to the truth level. The results are compared with the several theoretical Higgs boson production mechanisms.

Presenter: RUAN, Xifeng (University of the Witwatersrand (ZA))

Contribution ID: **17** Type: **not specified**

Higgs Production through Gluon Fusion and Plausible Dark Matter Studies

Thursday 12 February 2015 12:20 (20 minutes)

The Standard Model of particle physics is, so far, the best description of elementary particle dynamics and interactions. However, while it explains many of the phenomena we observe in experiment, there are shortcomings. It is therefore essential for particle physicists to have a clear understanding of the theory which makes up the Standard Model, as well as possible additions to the Standard Model which better explain experimental anomalies. In terms of theory, a gluon fusion loop diagram has been evaluated in an attempt to find an analytic form of its partonic cross section. In terms of exploring physics beyond the Standard Model, a minimal Z′ model has been tested as a dark matter candidate in pp collisions. Computational studies of this model show that a Z′ having a mass of ~ 100GeV could be considered as a dark matter candidate, although further study is needed to gain a deeper understanding of this.

Presenter: VON BUDDENBROCK, Stefan Erich (University of the Witwatersrand (ZA))

Contribution ID: **18** Type: **not specified**

Understanding the Higgs Boson with the Large Hadron Electron Collider

Wednesday 11 February 2015 16:40 (20 minutes)

The Large Hadron Electron Collider (LHeC) at the European Laboratory, CERN, is expected to collide electrons and protons at high energy. Studies pertaining to the feasibility of observing the Higgs boson in this environment were reported in the Conceptual Design Report. Here the effect of decreasing the electron energy in an ep collision to find the optimal, economic electron energy for the study of the Higgs boson in the future LHeC is studied. Two production mechanisms are studied: one with and the other without the production of the Higgs boson in an ep collision. The electron energy was varied between 10 GeV and 100 GeV in increments of 10 GeV. This project' s results showed that using electron energies between 40 GeV and 60 GeV would be sufficient to measure the properties of the Higgs boson without compromising on the validity of obtained results.

Presenter: ESTEVES, Jonathan (University of Witwatersrand)

Contribution ID: **19** Type: **not specified**

Single Top and Double Higgs Boson Production in ep Collisions

Wednesday 11 February 2015 16:20 (20 minutes)

In this talk I am going to present some studies on the prospects of single top quark production at the LHeC and double-Higgs production at the FCC-he. In particular we are investigating the tbW couplings via single top quark production with the introduction of possible anomalous Lorentz structure and the sensitivity of Higgs-self-coupling (λ) through double Higgs production. The studies are performed with 60 GeV electron colliding with 7 (50) TeV proton for LHeC (FCC-he). The single top quark studies has been done at parton level and we find the sensitivity of the anomalous coupling at 95% C.L, considering 10-1% of systematics. The double Higgs boson production has been studied with speculated detector parameters and the sensitivity of λ estimated via the cross section study around the Standard Model Higgs-self-coupling strength (λ_{SM}) considering 5% systematical error in signal and backgrounds.

Presenter: KUMAR, Mukesh (University of the Witwatersrand (ZA))

Contribution ID: **20** Type: **not specified**

Finite time calculations for hard parton production relevant to the QGP

Wednesday 11 February 2015 14:30 (20 minutes)

AdS/CFT computations have been used to describe the energy loss of QCD-like particles moving through a strongly coupled plasma, but little is understood regarding the initial conditions of these jets.

We use the Schwinger-Keldysh finite-time formalism applied to an interacting scalar field theory to derive a perturbative expression for the energy momentum tensor associated with hard particle production. This is used as a foundational model to study jet production in the QGP.

Presenter: MEIRING, Ben (University of Cape Town)

Contribution ID: **21** Type: **not specified**

Results of the search for an A boson decaying to Zh, with an lltautau final state, in pp collisions at 8 TeV centre of mass energy recorded with the ATLAS experiment

Thursday 12 February 2015 15:00 (20 minutes)

The neutral CP-dd boson A is predicted by many models with an extended Higgs sector. Searching for the A boson in the sensitive Zh decay, where h is assumed to be the LHC discovered Higgs boson, within the mass range of 220-1000 GeV offers a gateway to find physics beyond the Standard Model. A search for a gluon-fusion-produced A in the decay to Zh, with a final state of two light leptons and two tau leptons, is conducted with 20.3 fbˆ(-1) of proton-proton collision data at 8 TeV CME. The data driven background estimations, background reduction techniques and systematic uncertainty calculations are presented. Upper limits on the cross section times branching ratio of the A boson decaying to lltautau are set for various 2 Higgs Doublet Model (2HDM) scenarios. Where no excess is observed, exclusion limits are set on ranges of the 2HDM phase-space.

Presenter: HAMITY, Guillermo Nicolas (University of the Witwatersrand (ZA))

Contribution ID: **22** Type: **not specified**

Simulation of microscopic black-hole production at the LHC

Wednesday 11 February 2015 15:40 (20 minutes)

Modern theories suggest that microscopic black-hole might form as particle collision remnants in modern particle colliders. A remarkable consequence of quantum mechanics is that these black-holes should decay rapidly into a shower of particles. While it is clear that the particle and energy signatures of such a shower should be distinguishable from other processes of particles collisions, the actual signatures of such decays are not fully understood. Simulations are needed to study such decay signatures. In this presentation, current work on building a catalogue of black-hole emission spectra is summarised and the usefulness of such a catalogue in identifying decay processes of microscopic black-holes produced at modern particle colliders is discussed. Then, the decay signatures generated by a previous generation simulator and a novel simulator are compared in the context of current collider black-hole event searches.

Presenter: Mr CARLSON, Warren Anthony (University of the Witwatersrand)

Contribution ID: **23** Type: **not specified**

Quasi-normal Modes for Spin 3/2 Fields

Wednesday 11 February 2015 16:00 (20 minutes)

This paper aims to calculate the quasi normal modes for spin-3/2 fields of black holes, since spin-3/2 fields can be thought of as vector fields whose components are spinors we can use Camporesi and Higuchi's results as a starting point. This project will then determine the stability of micro ultra-spinning black holes. We will then use this information to calculate the emission spectrum of a micro spinning black holes. Since it has been theorised that during collisions at the LHC micro black holes are formed, we hope to use the results of this to paper to detect these black holes.

Presenter: HARMSEN, Gerhard (University of Witwatersrand)

Contribution ID: **24** Type: **not specified**

Large AT without Dessert

Thursday 12 February 2015 14:40 (20 minutes)

Even if the unification and supersymmetry breaking scales are around 10ˆ6 to 10ˆ{9} TeV, a large A_t coupling may be entirely generated at low energies through RGE evolution in the 5D MSSM. Independent of the precise details of supersymmetry breaking, we take advantage of power law running in five dimensions and a compactification scale in the 10-10ˆ3 TeV range to show how the gluino mass may drive a large enough A_t to achieve the required 125.5 GeV Higgs mass. This also allows for sub-TeV stops, possibly observable at the LHC, and preserving GUT unification, thereby resulting in improved naturalness properties with respect to the four dimensional MSSM. The results apply also to models of "split families" in which the first and second generation matter fields are in the bulk and the third is on the boundary, which may assist in the generation of light stops whilst satisfying collider constraints on the first two generations of squarks.

Presenter: ABDALGABAR, Ammar (University of Witwatersrand)

Contribution ID: **25** Type: **not specified**

Performance of missing transverse momentum reconstruction in ATLAS studied in proton-proton collisions in 2012 at 8 TeV

Thursday 12 February 2015 14:20 (20 minutes)

The missing transverse energy plays a really important role in reconstructing events produced at hadron colliders. Undetectable particles, such as neutrinos, pass through the matter with a negligible probability of interaction. Hence, no direct evidence of them can be measured in a general purpose detector, as ATLAS. However, the total momenta in the transverse plane to the beam axis has to be conserved and computed. In particular, it is used in searches for the Standard Model Higgs boson channels, such as: H->WW, H->ZZ and H->tautau. The benefit of using this conservation law is that an energy imbalance may signal the presence of such undetectable particles. Therefore, it becomes also a powerful tool for new physics searches at the Large Hadron Collider, such as Supper Symmetry and Extra Dimensions. The performance of the missing transverse momentum reconstruction in the ATLAS detector is evaluated using data collected in 2012 in proton-proton collisions at a centre-of-mass energy of 8 TeV. An optimised reconstruction and calibration of missing transverse momentum is used and the effects arising from additional proton-proton interactions superimposed on the hard physics process are suppressed with various methods. Results are shown for a data sample corresponding to an integrated luminosity of about 20 fb-1 and for events with different topologies with or without a genuine missing transverse momentum due to undetected particles. Estimates of the systematic uncertainty on the missing transverse momentum measurement are also presented.

Presenter: MARCH RUIZ, Luis (University of the Witwatersrand (ZA))

Contribution ID: **26** Type: **not specified**

Measurement of exclusive γγ → μ+μ− events in the ATLAS Experiment

Thursday 12 February 2015 15:20 (20 minutes)

measurement was made of the exclusive production of muon pairs in 4.5 fb−1 of ATLAS data collected at a centre of mass energy of 7 TeV. Exclusive interactions in this context occur when two charged hadrons interact via photon exchange and escape the interaction intact while at the same time creating particle anti-particle pair. This work will search for exclusive interactions in proton-proton collisions creating a muon anti-muon pair. We are considering di-muon production due to the accuracy with which muons can be tracked by the ATLAS detector. At high luminosities in the LHC, on the order of 20 interactions per beam crossing are to be expected. This pile-up of interactions creates a significant challenge by inducing a large amount of background which must be disentangled from the signal. In previous experiments exclusive interactions were measured in events with no pile-up. As the LHC reaches higher luminosities, such events become negligibly rare and thus a way of finding these events even in the presence of pile-up is essential. Exclusive production is a process well described by Quantum Electrodynamics and as such measuring the cross-section allows for a precise test of the Standard Model.

Presenter: SCHENCK, Ferdinand Wilhelm (University of Cape Town (ZA))

Contribution ID: **27** Type: **not specified**

Radiation hardness of plastic scintillators for the Tile Calorimeter of the ATLAS detector

Thursday 12 February 2015 16:10 (20 minutes)

The Tile Calorimeter of the ATLAS detector, is a hadronic calorimeter responsible for detecting hadrons as well as accommodating for the missing transverse energy that result from the p-p collisions within the LHC. Plastic scintillators form an integral component of this calorimeter due to their ability to undergo prompt fluorescence when exposed to ionising particles. The scintillators employed are specifically chosen for their properties of high optical transmission and fast rise and decay time which enables efficient data capture since fast signal pulses can be generated.
The main draw-back of plastic scintillators however is their susceptibility to radiation damage. The damage caused by radiation exposure reduces the scintillation light yield and introduces an error into the time-of flight data acquired. During Run 1 of the LHC data taking period, plastic scintillators employed within the GAP region between the Tile Calorimeter's central and extended barrels sustained a significant amount of damage. With operational beam energy set to increase in successive data taking periods to come, these scintillators will be exposed to a much harsher radiation environment.
In lieu of the 2018 planned upgrade when the gap scintillators will be replaced, a comparative study was conducted into the radiation hardness of several grades of plastic scintillators available on the market. In this talk, I present an analysis on the damage undergone by several polyvinyl toluene and polystyrene based scintillators which have been subjected to 6 MeV proton irradiation using the tandem accelerator of iThemba LABS, Gauteng. The degradation in scintillation light yield as well as light transmission is assessed for doses ranging between 800 kGy to 80 MGy, and a Raman characterisation of the change to bonding structure is presented.

Presenter: JIVAN, Harshna (University of the Witwatersrand (ZA))

Contribution ID: **28** Type: **not specified**

Studying the Radiation Damage of Plastic Scintillators using EPR

Thursday 12 February 2015 16:30 (20 minutes)

In an attempt to understand the effects of ionizing radiation on various scintillation plastics, a number of studies are currently under way with a hope that favourable properties of scintillator plastics, such as high light output and fast decay time, can be optimized. In this investigation, MBTS irradiated plastics that were situated on the TileCal of the ATLAS detector at CERN were sent to the University of Witwatersrand where they were prepared for electron paramagnetic resonance (EPR) and nuclear magnetic resonance (NMR) analysis. EPR spectroscopy allows for the study of unpaired electrons and protons within these scintillators and offers a deeper insight into the organic or inorganic free radicals present. Furthermore, a computational approach will be taken using density functional theory (DFT) to isolate the optically active molecule and reproduce the EPR and NMR results seen. These techniques will used to validate the assumption that dangling bonds in the plastics were as a result of ionizing radiation damage caused in the testing phase. Three plastics, EJ200, EJ208, and EJ260 were used in this investigation as well as one Dubna scintillator plastic. These samples were irradiated at the iThemba Labs in Gauteng. The Dubna samples that were irradiated on the TileCal detector were compared to the un-irradiated samples as well as irradiated and un-irradiated Eljen samples. EPR experimental results show that damage to the plastics reduced the amount of paramagnetic centres seen and that new peaks form from new paramagnetic species formed due to irradiation and, over time, certain bonds would re-form within the plastics and further investigation is required to understand this effect.

Presenter: PELWAN, Chad Dean (University of the Witwatersrand (ZA))

Contribution ID: **29** Type: **not specified**

Study of Radiation Hardness of Plastic Scintillators for the Upgrade of the Tile Calorimeter of the ATLAS detector

Thursday 12 February 2015 16:50 (20 minutes)

The influence of radiation on the light transmittance of plastic scintillators was studied experimentally. The high optical transmittance property of plastic scintillators makes them essential in the effective functioning of the tile calorimeter of the ATLAS detector at CERN. This significant role played by the scintillators makes this research imperative in the movement towards the upgrade of the tile calorimeter. The radiation damage of three polyvinyl toluene (PVT) based plastic scintillators was studied, namely, EJ-200, EJ-208 and EJ-260, all manufactured and provided to us by ELJEN technology. In addition, polystyrene (PS) based scintillators were also scrutinised in this study, namely, Dubna, Protvino and Bicron. All the samples were irradiated using a 6MeV proton beam at doses of 80MG, 25MG, 8MG and 0.8MG. The radiation process was planned and mimicked by doing simulations using a SRIM program. In addition, transmission spectra for the irradiated and unirradiated samples of each grade were obtained and observed. From observation and data analysis it was found that the PS based plastic scintillators experienced more radiation damage in comparison to the PVT based scintillators. Furthermore, among the PVT based scintillators, the experimental data showed that EJ 208 was the least affected by the radiation as it displayed the least transmission loss as well as showed the commendable annealing abilities over a short period of time. In addition, it was found that EJ 200 showed the second least transmission loss and the fastest annealing abilities over a short period of time. On the other hand, EJ 260 experienced the most amount of radiation damage.

Presenter: LIAO, Shell-May (University of the Witwatersrand)

Contribution ID: **30** Type: **not specified**

(CANCELLED) A study of radiation damage in the on—detector electronics of the ATLAS detector using a (p,n) nuclear reaction in the Van Der Graf tandem linear accelerator at iThemba LABS, Gauteng

Thursday 12 February 2015 17:10 (20 minutes)

Semiconductor materials, such as silicon (Si) and germanium (Ge) form an important part in modern electronics. From these materials, far—reaching electronic devices, transistors and diodes for instance have been realized. The application of these devices span a wide spectrum, from domestic to research (in particle accelerators and detectors, such as the large hadron collider (LHC) and ATLAS, respectively). Particle accelerators are usually areas of considerable doses of nuclear radiation. This means the on—detector electronics of the ATLAS are constantly subjected to high doses of nuclear radiation from the proton—proton collisions at the LHC. Because interaction of nuclear radiation with matter can change the: mechanical, electrical and chemical properties of a material, thereby affecting the long—term performance of the on—detector electronics, transistors, for instance, it is important that a detailed understanding of the performance parameters of the on—detector electronics measured against various nuclear radiation dose and energy exposures is established. In this paper, we propose a method to study the effects of large radiation dose damage on the ATLAS on—detector electronics. We will recreate the radiation conditions at the ATLAS using neutrons generated through suitable quasi mono—energetic neutron sources, using the 7Li(p,n)7Be nuclear reaction or the more prolific source from the 9Be(p,n)9B nuclear reaction in the tandem accelerator facility at iThemba LABS, Gauteng. Together with this reaction, a Monte—Carlo program, such as MCNP will be used to establish a detailed understanding of neutron damage in specific semiconductor structures.

Presenter: KHUMALO, Thokozani (University of the Witwatersrand)

Contribution ID: **31** Type: **not specified**

Design of a new front-end electronics test bench for the upgraded ATLAS detector's Tile Calorimeter

Friday 13 February 2015 09:00 (20 minutes)

The Large Hadron Collider (LHC) is scheduled to be upgraded in the year 2022, in order to increase its instantaneous luminosity. The High Luminosity LHC, also referred to as upgrade Phase-II, means an inevitable complete re-design of the read-out electronics in the Tile Calorimeter of the ATLAS detector, in which the completed new read-out architecture is expected to have the front-end electronics transmit full digitized information of the full detector to the back-end electronics system. The back-end system will provide digital calibrated information with greater precision and granularity to the first level trigger, thereby resulting in improved trigger efficiencies. In Phase II, the current MobiDICK4 test bench will be replaced by the next generation test bench for the TileCal super-drawers, the new Prometeo (A Portable ReadOut ModulE for Tilecal ElectrOnics). The Prometeo's prototype is being assembled by the University of the Witwatersrand and installed at CERN for further developing, tuning and tests. A presentation will be made on the overall design of the Prometeo, and how it fits into the Tile Calorimeter electronics upgrade.

Presenter: KUREBA, Chamunorwa Oscar (University of the Witwatersrand (ZA))

Contribution ID: **32** Type: **not specified**

Development and Testing of a High Data Throughput ADC Board for the Prometeo Portable Test-bench System for the Certification of the ATLAS Tile Hadronic Calorimeter

Friday 13 February 2015 09:20 (20 minutes)

M. Spoor

The LHC has been undergoing its first long shut down (LS1) in preparation for the Phase–II upgrade scheduled for 2024. Once upgraded the LHC will begin its high Luminosity Phase, increasing the beam luminosity by a factor of 5 to 7. The upgrade requires a redesign of the electronics systems of the ATLAS tile hadronic calorimeter (TileCal) and thus a hybrid demonstrator system is in development to act as a validation of the new read-out architecture. A new stand-alone test-bench system used for the certification of the ATLAS TileCal is also in the process of being developed for the Phase-II upgrade of LHC in 2024. The Prometeo (A Portable ReadOut ModulE for Tilecal ElectrOnics) test-bench is planned to replace the current generation Mobidick 4 system, improving portability, expanding its functions as well as being compatible with the new TileCal Hybrid demonstrator. The design provides all the functionalities needed to assess the certification procedure of a single mini-draw of the TileCal. At the centre of each Prometeo system lies a Xilinx Virtex-7 FPGA which can be accessed through Ethernet via IPbus. Fibre optic connections provide communication with the front end electronics. A HV board delivers high voltage signals to turn on the gain of the PMTs, while a LED driver is used to provide fast pulses to trigger the PMTs. A new ADC board is currently being developed and tested for the Prometeo system. The prototype was based on the original Mobidick system which used two 8 channel 12-bit ADCs to sample differential analog signals coming from the trigger towers. The sampled data is serialised and sent to the FPGA via an FMC expansion port at a data rate of 640 Mbps. The ADC board including the firmware was designed and assembled by the University of Witwatersrand. The design is currently in its testing phase and next generation prototype is will be sent for fabrication at the end of February 2015.

Presenter: SPOOR, Matthew (University of the Witwatersrand (ZA))

Contribution ID: **33** Type: **not specified**

PGAS in-memory data processing for the Processing Unit of the Upgraded Electronics of the Tile Calorimeter of the ATLAS Detector

Friday 13 February 2015 10:00 (20 minutes)

Advances in new technologies, high speed and more accurate instrumentation for data acquisition have given rise to the accumulation of massively large amount of data typically referred to as Big-Data. The ATLAS detector, operated at the Large Hadron Collider (LHC) records proton-proton collisions at CERN every 50ns resulting in a sustained data flow up to Pb/s.
The upgraded Tile Calorimeter of the ATLAS experiment will, sustain about 5PB/s of digital throughput. These massive data rates require extremely fast data capture and processing. Although there has been a steady increase in the processing speed of CPU/GPGPU assembled for high performance computing, the rate of data input and output, even under parallel I/O, has not kept up with the general increase in computing speeds. The problem then is whether one can implement an I/O subsystem infrastructure capable of meeting the computational speeds of the advanced computing systems at the petascale and exascale level.
We propose a system architecture that leverages the Partitioned Global Address Space (PGAS) model of computing to maintain an in-memory data-store for the Processing Unit (PU) of the upgraded electronics of the Tile Calorimeter for high throughput data processing. The physical memory of the PUs are aggregated into a large global logical address space using RDMA- capable interconnects such as PCI-Express to enhance data processing throughput. The technique allows for seamless addition of global memory for high throughput data processing based on the memory requirements of the data stream being processed. Research challenges being addressed concern memory-to-memory data copying, fault-tolerance, as well as optimisations for high throughput data processing.

Presenter: OHENE-KWOFIE, Daniel (University of the Witwatersrand (ZA))

Contribution ID: **34** Type: **not specified**

Optimal Filtering on ARM for ATLAS Tile Calorimeter Front-End Processing

Friday 13 February 2015 09:40 (20 minutes)

Modern Big Science projects such as the Large Hadron Collider at CERN generate enormous amounts of raw data which presents a serious computing challenge. After planned upgrades in 2022, the data output from the ATLAS Tile Calorimeter will increase by 200 times to over 40 Tb/s! Advanced and characteristically expensive Digital Signal Processors (DSPs) and Field Programmable Gate Arrays (FPGAs) are currently used to process this quantity of data.
It is proposed that a cost-effective, high data throughput Processing Unit (PU) can be developed by using several ARM processors in a cluster configuration to allow aggregated processing performance and data throughput while maintaining minimal software design difficulty for the end-user. ARM is a cost effective and energy efficient alternative CPU architecture to the long established x86 architecture.
This PU could be used for a variety of high-level algorithms on the high data throughput raw data. An Optimal Filtering algorithm has been implemented in C++ and several ARM platforms have been tested. Optimal Filtering is currently used in the ATLAS Tile Calorimeter front-end for basic energy reconstruction and is currently implemented on DSPs.

Presenter: COX, Mitchell Arij (University of the Witwatersrand (ZA))

Contribution ID: **35** Type: **not specified**

Atlas Nightly on Arm

Friday 13 February 2015 11:10 (20 minutes)

The ATLAS software framework (ATHENA) is large and dynamic, comprised of around 6.5 million lines of code. It is built in the NICOS system which uses tools and scripts located and tuned for the LXPLUS and AFS systems. Furthermore, the constraints placed on the hardware that the software is based is limiting. A local build of ATHENA is somewhat difficult on a traditional computer and even more difficult on an ARM based CPU. With the sudden interest in ARM processors for large scale high energy physics computing, a new system needs to be implemented to build ATHENA versions for ARM, on ARM. This letter serves to introduce a new build framework called Atlas Nightly on ARM (ANA). This new framework implements patches to suit the ARM architecture with the goal of a final ATHENA version for ARM.

Presenter: SMITH, Joshua Wyatt (University of Cape Town (ZA))

Contribution ID: **36** Type: **not specified**

The Data Acquisition system for a fixed target experiment at the NICA complex at JINR and its connection to the ATLAS TileCal readout electronics

Friday 13 February 2015 11:30 (20 minutes)

Today's large-scale science projects have been always encountered challenges in processing large data flow from the experiments, the ATLAS detector records proton-proton collisions provided by the LHC at CERN every 50 ns which results in a total data flow of 10 Pb/s, the SKA is a radio telescope consisting of several thousand antennae, the data rates from the individual antenna at SKA results in a total data flow of up to 9 Pb/s. These data must be reduced to the science data product for further analysis, thus a very fast decisions need to be executed, to modify this large amounts of data at high rates. The capabilities required to support this scale of data movement is involving development and improvement of high-throughput electronics. The upgraded LHC will provide collisions at rates that will be at least 10 times higher than those of today due to the luminosity increasing by a factor of ten at 2022, however, this will require a complete redesign of the read-out electronics (ROD) in the Tile-calorimeter (TileCal) of the ATLAS experiment. The ROD system is a high-throughput system, it is capable of handling large data throughputs and to apply advanced operations at high rates, ROD system are functionally decomposed in two building blocks: the Field Programmable Gate Arrays (FPGA) and Digital Signal Processors (DSP). The aim of this work is to have a look at the ROD architecture for the fixed target experiment at the NICA complex at JINR, by compiling the data-flow requirements of all the subcomponents. Furthermore, the FPGAs boards characteristics to control, triggering and data acquisition will be described in order to define the data acquisition system (DAQ) with maximum readout efficiency, no dead time and data selection and compression.

Presenter: TOMIWA, Kehinde Gbenga (University of the Witwatersrand (ZA))

Contribution ID: **37** Type: **not specified**

Using GPGPU to Increase Accessibility and Efficiency in LHC Computational Systems

Friday 13 February 2015 10:50 (20 minutes)

After the 2022 upgrades, the ATLAS detector will be generating raw data at a rate of about 40 TB/s. The ATLAS triggering system thus presents an opportunity to explore the use of general-purpose computing on graphics processing units (GPGPU). GPUs could be used in both first and high level triggering (HLT) systems; in the former to reduce power consumption and increase event selection accuracy, and in the latter to implement existing algorithms more efficiently and to implement novel algorithms not implementable in traditional CPU farms. Moreover, GPUs can be programmed in C/C++, making them more accessible as compared to FPGAs. Currently, research into the viability of an ARM-based processing unit (PU) is being conducted at Wits. The introduction of GPUs into this PU could increase its computing capabilities. Upstream, the use of GPUs could enable the use of increasingly complex algorithms in the HLT system to increase its ability to find physical events of interest. This project will consider how GPUs can best be utilised as a subsystem of ATLAS in terms of power and computing efficiency.

Presenter: SACKS, Marc (University of Witwatersrand)

Contribution ID: **38** Type: **not specified**

Using GPGPU to Increase Accessibility and Efficiency in LHC Computational Systems, Sacks

Contribution ID: **39** Type: **not specified**

An Integration Framework Tool for ATCA's in the ATLAS Detector Control System

Friday 13 February 2015 11:50 (20 minutes)

ATLAS is a general-purpose detector at the Large Hadron Collider at CERN, Switzerland. The current Detector Control System (DCS) consists of a highly distributed system running over many servers using the SCADA product called PVSS OA. The DCS provides multiple functionality such as automated control procedures, efficient error recognition with handling, managing communication with external systems and synchronization with the ATLAS data acquisition system. For the Phase-II upgrade in 2022 the current Versa Module Eurocards will be replaced by the new Advanced Telecommunications Computing Architecture (ATCA) chassis. This chassis provides a new protocol, of which, has not been used in ATLAS and a new strategy is required to integrate the ATCA into the DCS. This contribution describes the ATCA framework tools and how it uses a new protocol in conjunction with WinCC OA to seamlessly integrate the ATCA into the DCS.

Presenter: REED, Robert Graham (University of the Witwatersrand (ZA))

Contribution ID: **40** Type: **not specified**

Missing PT reconstruction at ATLAS

Thursday 12 February 2015 14:00 (20 minutes)

Presenter: LEE, Claire (University of Johannesburg (ZA))

Contribution ID: **41** Type: **not specified**

Welcome from the SAIP

Wednesday 11 February 2015 09:10 (10 minutes)

Presenter: Dr GLEDHILL, Igle (CSIR)