The 3rd African Conference on Fundamental and Applied Physics (ACP2023)

Monday, 25 September 2023 - Saturday, 30 September 2023

Protea Hotel King George

Book of Abstracts

Contents

1

Hurwitz Zeta function and its application in condence matter physics.

Author: Bouzenada Abdelmalek[1]

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Abstract Category:

Particle Physics

2

Contribution of the UV-visible hair fluorescence spectrometry in Systemic Lupus Erythematosus (SLE) : Diagnosis and follow-up

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Abstract Category:

Medical Physics

4

OPTIMIZATION OF THE AMOUNT OF FERROELECTRIC INORGANIC PEROVSKITE NANOPARTICLES FOR HIGH EFFICIENCY INDOOR PHOTOVOLTAIC CELLS

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Abstract Category:

Energy

Parallel Session 1 / 5

Assessment of cystamine's radioprotective ability under high dose-rate irradiation: a Monte Carlo multi-track chemistry simulation study

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This contribution was presented as poster instead

The biological effects of radiation to healthy organs surrounding tumour target volumes are a fundamental dose-limiting restriction in radiotherapy (RT). To protect healthy organs from ionizing radiation, and to reduce morbidity or mortality, various radioprotectors agents have been used. The clinical involvements of these radioprotective agents have emerged as promising medications with antitumor effect. However, the conventional radiotherapy treatment and cure are still limited by acute or chronic toxicities to normal tissue. Recently, a fundamentally different paradigm of radiation therapy based on delivering radiation at ultra-high dose rates has emerged. Although FLASH radiotherapy appears to significantly improve the therapeutic ratio of cancer treatment, the protection of surrounding healthy tissue has nevertheless not been shown to be complete. It would therefore be expected that the combination of cystamine with FLASH-RT would further improve the therapeutic ratio of cancer cure. This study aims to investigate the radical-scavenging properties of cystamine by examining the behavior of this compound with respect to the primary species produced in the radiolysis of the Fricke dosimeter under various dose-rate irradiation conditions. The radiolytic oxidation of Fe2+ ions to Fe3+ was used as a measure of the radioprotective ability of cystamine as a function of dose rate. Our simulations revealed that cystamine provides a greater tissue protection at pulsed (FLASH) dose rates compared to conventional radiotherapy (RT) irradiation

Key words: cystamine, radioprotector, antioxidant, aerated ferrous sulfate (Fricke) dosimeter, water radiolysis, high-energy protons, Ultra-High Dose-Rate, Monte Carlo multi-track chemistry simulation, reaction scheme, competition kinetics, radiation chemical yields (G values), FLASH radiotherapy, nuclear power plant accident, nuclear weapons deployment, nuclear/radiological.

Abstract Category:

Medical Physics

7

Machine-generated radiation dose assessment for common computed tomography examination in Komfo Anokye Teaching Hospital, Kumasi, Ghana.

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Abstract Category:

Medical Physics

9

Hybrid Renewable Energy System Optimization: Combining Complimentary Solar PV, Wind and Battery Storage Integrated with Marine Energy

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Abstract Category:

Energy

10

Isolation and Characterisation of High Grade Nanosilicon from Coastal Landform in Ilaje Local Government Area of Ondo State, Nigeria

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Abstract Category:

Materials Physics

13

Elaboration and characterization of silicon nanostructures for photovoltaic application

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Abstract Category:

Energy

14

Performance of the local reconstruction algorithms for the CMS hadron calorimeter in Run 2 data

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Abstract Category:

Instrumentaions & Detectors

15

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN MATERIALS SCIENCE

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Abstract Category:

Materials Physics

19

Hyperfine spin splittings, decay and radiative transitions of S-waves bottomonium in the non-relativistic quark model

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Abstract Category:

Particle Physics

20

Quark confinement in Schwarzchild-like space-time with a metric generated by a non-gravitational Yukawa-like strong field.

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Abstract Category:

Particle Physics

Parallel Session 1 / 23

Performance of a Bifacial Solar Module Under Different Backgrounds

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Bifacial Photovoltaic (BPV) is a rapidly growing technology that has the potential to increase electricity production while taking up less space compared to conventional modules and due to this, they have attracted significant attention in recent years. Apparently, little study has been conducted on these types of modules, notably on the use of reflecting surfaces to improve backside production, which in this case receives low irradiance. This paper reports on a section of my research conducted on the rooftop of the Department of Physics at the University of Nairobi's Chiromo Campus in Kenya. This study examines the influence of various backgrounds on the performance of a bifacial solar module. Two solar modules were mounted back-to-back to create a double-sided solar module (bifacial solar cell configuration), with one module facing the sky (front side) and the other facing the ground (back side). The module was kept at about 1.2 m and inclined at about 300 to the horizontal facing north orientation. Beneath the module, various backgrounds were used in turns while parameters like solar irradiance, module temperature, current, and voltage values were recorded. Solar irradiance was measured using an HT304N reference cell fixed alongside the back module and connected to an irradiance meter. Current-Voltage values of the solar module were obtained using a current-voltage (I-V) solar analyzer. The effect of a reflective background on the module's performance was investigated using Metallized polyethylene terephthalate, (MPET), normal galvanized iron sheet, and mylar windshield sunshade as reflectors. Data collection was done daily between 12 pm and 1 pm East African Time, EAT at an interval of 2 minutes. Data analysis and visualization were done using Python and Origin software. The results confirmed that using reflective backgrounds greatly increases the power output of the bifacial solar module. Metalized polyethylene terephthalate, MPET reflectors produced the most irradiance of the tested three reflector samples, followed by the Mylar sunshade and finally iron sheet. MPET increased irradiance by 84.62%, Mylar by 77.21%, and iron sheets by 22.95%. Moreover, due to its high reflectivity, the MPET reflector was recommended for usage as a reflecting surface.

Keywords: Bifacial, solar module, background irradiance, performance

Reference

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Abstract Category:

Energy

24

Ceramic Water Filters Impregnated with Silver Nanoparticles for the Removal of Lead and Chromium Ions from Water

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Abstract Category:

Materials Physics

Parallel Session 2 / 25

Cosmic web topology and the characteristics of dark matter subhaloes

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The cosmic web, a complex network of thin walls, elongated filaments, and dense clusters enclosing empty voids, provides a map of the universe's dark matter density distribution. Dark matter halos are structures that form and grow due to the gravitational instability caused by initial density perturbations in the cosmic field, vary in their characteristics, such as mass and contained galaxies, depending on their location within the cosmic web. A complete, statistical description of the abundance of dark matter haloes down to the level of subhaloes can be obtained by accurately describing the conditional subhalo mass function, which gives the number of subhaloes that reside in a parent halo. By studying the effect of the cosmic web environment on subhalo properties, like subhalo velocity function, radial distribution, and others including subhalo mass function, we can gain insights

into the impact of location in the cosmic web environment on parent haloes and the galaxies they contain. Although there is some evidence that the features of dark matter halos differ based on their cosmic web location, understanding the relationship between the properties of dark matter subhalos and their cosmic web location remains elusive. In this study, we explore the subhalo mass function, velocity function, radial distribution, and other intrinsic properties of dark matter subhalos through zoom-in N-body simulations. Our findings highlight the influence of parent halo properties and cosmic web location on subhalo properties, shedding light on the connection between the cosmic web and dark matter subhalos.

Abstract Category:

Astrophysics & Cosmology

Parallel Session 1 / 27

Production of heavy flavours via semi-muonic decays using Monte Carlo Simulations

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The purpose of the ALICE Experiment is to study the properties of a hot, dense state of matter called the quark gluon plasma (QGP), produced in nucleus-nucleus collisions, in which quarks and gluons are deconfined. Proton-proton collisions serve as source of baseline measurements that support studies for the more complex nucleus-nucleus collisions as well as to test quantum chromodynamics (QCD) based theoretical models. Our work studies the decays of heavy-flavour quarks and their hadrons in the semi-muonic decay channel at forward rapidity ($-4 < \eta < -2.5$). Heavy quarks are produced in the early stages of collisions with high momentum transfer and short formation time. Their flavour is conserved in strong interactions, thus allowing us to use them as probes of the QGP. They also help to give us insight into the quark-gluon composition of protons.

Monte Carlo simulation is an important tool for the study of heavy quark production at the ALICE experiment. It is a powerful way to test the accuracy of the standard model - particularly quantum chromodynamics - by benchmarking simulated data with real world data collected by the ALICE detector. We conducted two sets of simulations of proton-proton collisions at forward rapidity in the ALICE detector. The results are compared to real world collision data collected by ALICE, at $\sqrt{s}$ = 5.02 TeV and $\sqrt{s}$ = 13 TeV at the LHC. To perform our comparisons, we computed the transverse momentum differential cross sections as well as the η-differential cross sections from each of the data sets.

Abstract Category:

Particle Physics

29

MEASUREMENT OF RADON AND RADON EXHALATION RATES IN SOIL SAMPLES FROM THE TRADITIONAL MAIN HALLS IN THE UNIVERSITY OF GHANA CAMPUS USING THE SEALED-CAN TECHNIQUE

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Abstract Category:

Nuclear Physics

31

808 nm Laser irradiated upconversion nanoparticle coated with antimony shell for bioimaging and photothermal therapy in vitro

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Abstract Category:

Materials Physics

32

From Pixels to Insights: Earth Observation Data and Applications in Earth Physics Research

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Abstract Category:

Earth Physics

33

FOURIER SYNTHESIS IMAGING OF KAT-7 RESPONSE TO RADIO WAVES VIA SIMULATION

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Abstract Category:

Astrophysics & Cosmology

Parallel Session 1 / 34

Indoor radon and ambient equivalent dose measurements using a locally manufactured low-cost smart electronic device and validation with reference instruments

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This work reports the realization of a low-cost smart electronic device for Gamma ionizing radiation monitoring and its implementation in real-time external ambient dose rate detection and indoor radon tracing. The device is developed according to the principle of nuclear signal processing in order to obtain the standard radiation protection signal (a slow positive logic pulses) and calibrated in the presence of Cesium (137Cs). The device uses a ZP 1200 Geiger-Müller (GM) tube detector, low-cost components namely the microcontroller board, the DHT11 temperature (T) and relative humidity (RH) sensor and XBee-based Internet of Things (IoT) wireless transmission modules. The environmental radiation monitoring and nuclear security developed device is also low energy consumption, easily deployable in the field (in-situ), adapted for real-time measurements and data transmission to a remote-controller PC.

A first comparative analysis of the data obtained from the developed survey meter was carried out with those of an in-situ gamma spectrometry chain (outdoor reference method) previously used at the same place and under the same conditions in Yaoundé-Cameroon. This analysis gave an acceptable mean value of 64.30 nGy/h, of the developed device, compared to 50.67 nGy/h of the gamma spectrometer. The indoor reference device measures radon concentration, temperature, and relative humidity in indoor spaces. Typically, the developed device also provides data of atmospheric parameters (T, RH) and the ambient dose equivalent rate. From this ambient dose equivalent rate (in µSv/h), radon activity concentration (in Bq/m3) is deducted using standard and recognized conversion coefficients. The coefficients vary according to the ambient radiation strength and are ranging from 5500 to 8900 (Bq/m3)/(µSv/h). The developed device and the indoor reference instrument were exposed during one month in several dwellings in the city of Yaoundé, and periodic average values of 27.51 ℃ (developed device) and 26.19 ℃ (RadonEye) for temperature, 74.10 % (developed device) and 73.00 % (RadonEye) for relative humidity, and 1499.19 Bq/m3 (developed device) and 1464.91 Bq/m3 (RadonEye) of cumulated radon activity concentrations, for a 24 hours exposure period were evaluated. Statistical analyzes carried out on the results of these two devices provide a linear regression coefficient of R2 = 0.9978. This shows a good agreement between the data of the developed device and the reference instrument RadonEye. The prototype thus developed is simple, precise, and made for Environmental radiation protection.

Keywords: Radiation monitoring, radon tracing, smart electronic device, Internet of Things (IoT), Geiger-Müller (GM) tube detector, temperature and relative humidity sensor

Abstract Category:

Instrumentaions & Detectors

35

Short GRBs and MGF pulse fitting and spectral analysis

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Abstract Category:

Astrophysics & Cosmology

36

Stochastic Perturbation of Convective Parameterization Schemes in RegCM4

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Abstract Category:

Earth Physics

Nuclear and Particle Physics / **37**

The Quest for Physics Beyond the Standard Model

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The Standard Model (SM) of particle physics is an impressive framework, but it has limitations. This talk explores the search for Physics Beyond the Standard Model (BSM). We discuss the shortcomings

of the SM, such as the hierarchy problem, non-vanishing neutrino masses and dark matter. We delve into theories like Supersymmetry and GUTs, examining their predictions and experimental implications.

Abstract Category:

Particle Physics

38

First-principles calculations study of electronic structure, opto-electronic, vibrational analysis, linear and nonlinear optical properties of eosin b (4',5'-dibromo-2',7'-dinitro-3-oxo-3Hspiro[2-benzofuran-1,9'-xanthene]-3',6'-diolate)

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Abstract Category:

Young Physicists Forum

40

Artificial intelligence and machine learning for security purposes

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Abstract Category:

Computing & 4IR

41

MECHANICAL BEHAVIOR SIMULATIONS OF NANOWIRES IN PHOTOVOLTAIC APPLICATIONS

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Abstract Category:

Materials Physics

43

Quantum machine learning simulations of photosynthetic light harvesting

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Abstract Category:

Optics & Photonics

44

Study of Interference Effects in $^{9}Be(^{23}Al\ ,^{22}Mg)$X Breakup Reaction at 40-100 MeV/n Beam Energy

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Abstract Category:

Nuclear Physics

45

Search for Dark Matter with 2HDM+a in pp collisions at s = 13 TeV with the ATLAS detector

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Abstract Category:

Particle Physics

46

Nuclear physics interpretation of the universality of elemental abundances

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Abstract Category:

Nuclear Physics

Renewable energies & Energy Efficiency / **47**

Transition from Biomass to Sustainable Green Energy Storage Devices

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Energy as a commodity is facing a global crisis due to its high demand and consumption in all areas, overuse of fossil fuels is also causing environmental problems such as global warming and depletion of the ozone layer. To solve this problem, researchers have been interested on developing efficient, sustainable, and clean energy storage systems to boost the use of renewable energy. We report on green and ecofriendly biomass derived devices for energy storage applications. From our results on activated carbon nanostructures from peanut shell waste using different porosity-enhancing agents, an asymmetric supercapacitor device was assembled in a neutral electrolyte (2.5 M KNO3) at a cell voltage of 1.8 V, which yielded 224.3 F g−1 specific capacitance at a specific current of 1 A g−1 with a corresponding specific energy of 25.2 W h kg−1 and 0.9 kW kg−1 of specific power. To enhance the performance of the device, ex-situ nitrogen-doped porous carbon was synthesized and investigated in the same electrolyte. The fabricated device exhibited a 251.2 F g-1 of specific capacitance at a gravimetric current of 1 A g-1) at a wide cell voltage of 2.0 V. A specific energy of 35 Wh kg-1 with a corresponding specific power of 1 kW kg-1 at 1 A g-1 was obtained. For future development of environmentally friendly and sustainable electrode materials, we developed sustainable binary vanadium pentoxide carbon graphene foam composites (V2O5@C-R2HS/GF) using a green method. The device showed high specific energy and specific power values of 55 W h kg−1 and 707 W kg−1, respectively, at a specific current of 1 A g−1. The device presented a good stability test showing 99% capacity retention up to 10000 cycles confirmed by the floating time up to 150 h with specific energy an increase of 23.6% after the first 10 h.

Keywords: Biomass, Energy Storage, Supercapacitors, Energy and Power densities

Abstract Category:

Energy

Parallel Session 2 / **49**

X-Ray and Terahertz Source Based on Energy Recovery Linac.

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This research study introduces an innovative design concept named BriXSinO, which aims to generate high repetition rate THz and X-ray synchronized radiation pulses. The proposed BriXSinO system incorporates an Energy Recovery Linac (ERL) based on Superconducting cavities (SC), operating in Continuous Wave mode (CW), and remarkably sustaining MW-class beam power with only 100 kW active power dissipation. The ERL effectively drives a Free-Electron Laser (FEL) Oscillator and an Inverse Compton scattering (ICS) source, both of which are extensively evaluated for their performance in single and dual-color operation scenarios. Through meticulous start-to-end simulations, the scheme's capabilities are thoroughly assessed, particularly focusing on wavelengths of interest within the 10-50 μm (6-30 THz) and 3-0.05 A range. The significant implications of these findings lie in the advancement of medical applications
and cutting-edge applied research.

Abstract Category:

Accelerators

Accelerators & Light Sources / 50

Challenges of 4th generation accelerator-based light sources

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Accelerator-based light sources have become fundamental tools for research in matter physics, medicine, cultural heritage and industry. They span the wavelength range from THz to gamma rays through many and diverse accelerator configurations. The working principles of two families of light sources, synchrotrons and free-electron lasers, are recalled. Technical and physical challenges of their next generation are elucidated, with a focus on nowadays worldwide efforts towards unprecedented level of brilliance and degree of coherence.

Abstract Category:

Light Sources

Parallel Session 2 / 51

Long-term protection of thermal quantum correlations and their role in enhancing quantum teleportation protocol

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Abstract Category:

Women in Physics

Nuclear and Particle Physics / **53**

Neutrinos as a Window into New Physics beyond the Standard Model

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The discovery of neutrino oscillation has provided arguably the most compelling evidence for Physics beyond the Standard Model. Their observed small masses hint at Physics at a very high energy scale, and thus offer a unique window into the theory that underlies the Standard Model of Particle Physics. In this talk, I will review the current state of neutrino physics. I will describe possible new physics where the observed pattern of neutrino masses can arise. I will elucidate how neutrinos may be the key in the generation of the observed cosmological matter-antimatter asymmetry of the Universe.

Abstract Category:

Particle Physics

55

Dynamics of exciton polaron in microtubule

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Abstract Category:

Biophysics

Plasma Physics / **56**

Nonlinear electrostatic fluctuations in the Earth's magnetosphere

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Large-amplitude electrostatic solitary waves (ESWs) associated with asymmetric magnetic reconnection at the Earth's magnetopause are studied in a four-component plasma composed of a mixture of the magnetosheath and magnetosphere plasma of a cold, warm and hot electron populations, and background ions. The species are modeled as adiabatic fluids except for the hot electrons which have a kinetic vortex-like velocity distribution. Using the Sagdeev pseudopotential technique, for the plasma parameters recorded by the Magnetospheric Multiscale (MMS) mission in the magnetosheath side of the ion diffusion region, existence regime of the nonlinear electrostatic solitary wave structures is obtained. The results agree with the magnetosheath electrostatic waves having amplitudes of 100s mV/m and frequencies up to 3.2 kHz observed by the MMS.

Abstract Category:

Fluid & Plasma Physics

58

Structural and electrical characterizations of Sn/Zr co-doped Barium titanate perovskite ceramic

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Abstract Category:

Materials Physics

Parallel Session 1 / **60**

Production measurements of heavy-quarks in pp collisions at 13 TeV with the ALICE detector.

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Heavy-flavour production measurements in pp collisions are important tools to test theoretical models based on pertubative quantum chromodymanics (pQCD) and to investigate the heavy-quark hadronization mechanisms. In ALICE, heavy quarks are measured via the hadronic and electronic decay channels at central rapidity (|η|<0.9), and via the muon decay channels at forward |η|<0.9), and via the muon decay channels at forward<0.9), and via the muon decay channels at forward), and via the muon decay channels at forwardη|<0.9), and via the muon decay channels at forward rapidity (-4< <-2.5).).η|<0.9), and via the muon decay channels at forward rapidity (-4< <-2.5).

In this contribution, the production cross-sections measurements of leptons from heavy-flavour hadron decays are presented and compared to pertubative quantum chromodymanics (pQCD) theoretical calculations. The latest measurements of D0, D+,D +*+ and D+s mesons together with the measurements of Λ +c , Ξ0,+c , Σ0,++c and the measurement of Ω0c baryons performed with the ALICE detector at midrapidity in pp collisions at √s = 13 TeV are also presented. Measurements of charm-baryon production are crucial to study the charm-quark hadronization mechanisms in a partonic rich environment like the one produced in pp collisions at the LHC energies.

Abstract Category:

Particle Physics

Accelerators & Light Sources / 61

Developing an African Inverse Compton Scattering source of advanced X-rays as an incubator on the path towards the African Light Source

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Inverse Compton Scattering sources are becoming world-wide user facilities delivering advanced X-ray beams to applications in the medical, cultural heritage, material studies and nuclear photonics / photo-nuclear physics fields. ICS delivering up to 300 keV X-rays are compact, cheaper and easier to operate that large scale storage-ring based light sources. Although the performances of ICS in terms of fluxes and brilliances are definitely lower than synchrotron light sources, at least for photon energies below 150 keV, these machines can be located and operated inside University Campus, and their cost is limited in the range 10-20 M$ (depending on the maximum X-ray energy required). Nevertheless, designing, building and putting a ICS into operation (with electron beam energies in the 50-200 MeV range) implies the development of an accelerator team acquiring expertise in several involved key technologies, like RF, electronics, lasers, vacuum, diagnostics, control systems, alignment, beam-lines, X-ray detectors, radio-protection, ancillary equipments, beam dynamics/simulations, that are also fundamental for any large scale accelerator like GeV-class electron storage rings. Therefore, developing a ICS source inside an African University Campus (or equivalent laboratory) can be the first step towards the ambitious goal of building the African Light Source (AfLS). This small scale first step, in principle sustainable by a single African country, can be the incubator facilitating a build-up of a pan-African endeavour towards the AfLS.

Abstract Category:

Accelerators

Parallel Session 2 / 62

Topological Stars and Gravity

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In this talk, I will discuss aspects of microscopic degrees of freedom of gravity and the physical motivation of quantum gravity. While the generic states are quantum mechanical, our goal will be to understand a class of them that are coherent enough to admit classical descriptions in Einstein gravity. The existence of these state require topological structures in spacetime that follow from the dynamics of compact extra dimensions. They behave as ultra-compact objects, dubbed topological stars, which can also model microscopic degrees of freedom of black holes. I will discuss why it is interesting to understand such objects in a new age of black hole astrophysics, and various aspects of their observational properties.

Abstract Category:

Particle Physics

63

FABRICATION AND CHARACTERISATION OF DYE-SENSITISED SOLAR CELLS USING GRAPHENE OXIDE-TiO2 AS COUNTER ELECTRODE

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Abstract Category:

Materials Physics

Parallel Session 2 / 64

The Mu2e experiment and its electromagnetic calorimeter

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The Mu2e experiment at Fermilab searches for the neutrino-less conversion of a negative muon into an electron, with a distinctive signature of a mono-energetic electron with energy of 104.967 MeV. Mu2e aims to improve by four orders of magnitude with respect to the current best limit.

The calorimeter plays an important role to provide excellent particle identification capabilities and an online trigger filter while improving the track reconstruction capabilities, asking for 10% energy resolution and 500 ps timing resolution for 100 Mev electrons. It consists of two disks, each one made by 674 un-doped CsI crystals, read out by two large area UV-extended SiPMs.

In this talk, we present the status of construction and the QC performed on the produced crystals and photosensors, the development of the rad-hard electronics and the most important results of the irradiation tests done on the different components from crystals to SIPMs and electronics. Irradiation has been carried out with ionising doses, neutrons and protons.

A large calorimeter prototype (dubbed Module-0) has been tested with an electron beam between 60 and 120 MeV at different impact angles and the obtained results are reported. A full vertical slice test with the final electronics is in progress on Module-0 at the Frascati Cosmic Rays test setup. Stability of response and calibration results are shown.

Production of electronics is ongoing.We summarize the QC in progress on the analog/digital electronics and on the integrated SIPM+FEE units. Construction of the mechanical parts are completed and the two calorimeter disks are being assembled. We describe the Ongoing assembly procedures and Commissioning plans.

Abstract Category:

Instrumentaions & Detectors

66

Application adaptée des panneaux solaires photovoltaïques dans le domaine de l'agro-industrie

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Abstract Category:

Energy

67

Novel organometallic complexes and their application in solar cells

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Abstract Category:

Energy

Nuclear and Particle Physics / 68

Boosting Physics in Africa within the ASFAP Strategy: Particle physics as prototype

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In this talk we present the African Strategy for Fundamental and Applied Physics (ASFAP). This initiative aims to boost Africa's science, particularly in fields such as fundamental and Applied Physics. To this end, ASFAP has dedicated several working groups to define strategic capacity development, retention and boost research in physics. As a prototype, a preliminary report prepared by the particle physics working group will be summarized.

Abstract Category:

Particle Physics

70

Mapping the Distribution of Gamma-Ray Bursts using Open Data GIS

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Abstract Category:

Community Engagement

Nuclear and Particle Physics / 71

The Physics of a Trillion Degrees

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A microsecond after the Big Bang, all of space existed at a trillion degrees, one hundred thousand times hotter than the center of the sun. 13.8 billion years later, massive collaborations of thousands of scientists recreate these conditions of the early universe thousands of times a second in one of the most expensive and complicated science experiments ever attempted. In this talk I provide a general introduction to the physics explored in these Little Bangs, ephemeral fireballs that—during their lifetimes of less than a billionth of a trillionth of a second—are droplets of the hottest, most perfect fluid in the universe.

Abstract Category:

Nuclear Physics

Parallel Session 1 / **72**

A Light shed on Lepton Flavor Universality in B meson decays

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In view of the recent measurements of anomalies in semileptonic B meson decays at LHCb and several collider experiments hinting at the possible violation of lepton flavor universality, we will present a concise review of theoretical foundations of the tree- and loop-level b decays (→ ,) and (→ + –) along with the updated experimental background. We study the 2-dependence of form factors for the semileptonic decays and then present the world averages in the updated environment for ( ), ( ), / and , in a model dependent (based on Relativistic independent quark model as well as independent approach. We further provide predictions of other anomalies linked with LFU such as, anomalous magnetic moment of electron and muon by Fermilab (,), mass of W boson by CDF collaboration, the CKM puzzle (( )) in view of future high-statistics data, are also discussed. We then look over to the combined explanation of flavour anomalies (( ),), in the language of effective field theory. As flavor anomalies are the strongest hints for physics beyond standard model, therefore, the confirmation of these measurements would soon turn out to be a remarkable evidence, unravelling the New Physics in the flavour fraternity giving a better understanding on the subject for future experimentalists and theorists.

Abstract Category:

Particle Physics

73

Oblique Parameters in the Two-Higgs Doublet Model with Vector-Like Quarks: An Approach to explain the W Boson Mass Anomaly

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Abstract Category:

Particle Physics

74

Turbulence characteristics in the atmospheric surface layer over a heterogeneous cultivated surface in a tropical region

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Abstract Category:

Women in Physics

76

PREDICTING AND OPTIMIZING ORGANIC MATERIAL PROPERTIES WITH QUANTUM MACHINE LEARNING (QML) FOR EFFICIENT OLEDs DEVELOPMENT

Authors: Jean-Pierre TCHAPET NJAFA[1]; Job-Ravel DONTSA NDONFACK[2]

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Abstract Category:

Materials Physics

Parallel Session 1 / **77**

Investigating octupole correlations in Xe nuclei with mass A < 120

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Nuclei with mass A <120 are perfectly placed to study the shape-driving properties of different quasiparticle configurations. For these nuclei, the Fermi surface for the protons lies close to the low-Ω h11/2 orbitals which drives the nucleus towards prolate shape, while the neutron fermi surface lies near the mid-Ω h11/2 orbitals which induces an oblate deformation [1]. Due to the conflicting deformation driving properties, the nuclei observe prolate, oblate or triaxial shape in this mass region. Also, the presence of octupole driving h11/2 and d5/2 orbitals near the Fermi surface make them

suitable to exhibit octupole correlation. In this mass region, octupole correlations have been reported earlier in several isotopes of Xe-Cs-Ba having N < 70 [5–7]. In previous high spin gamma ray spectroscopy measurements in 118Xe nuclei though the octupole correlations have been reported in Refs. [8–10] but in almost all the cases a precise data on parity assignments, was missing. For example, in Ref. [10], though the issue of octupole collectivity has been discussed in relation to the observed inter-band transitions, 1022 keV (7− ⟶ 6+), 846 keV (9− ⟶ 8+), 726 keV (11− ⟶ 10+) and 924 keV (8− ⟶ 8+), however, the quoted B(E1) values have errors in the range from 4% to 28%. In the present work, the excited states in 118Xe nucleus were reinvestigated with the aim: 1) to update the level scheme with inclusion of more γ transition in the non-yrast bands (if any), 2) to fix the missing parities with polarisation measurements and 3) to provide a more precise data on the octupole collectivity (transition). We have also performed the triaxial projected shell model (TPSM) calculations to investigate the observed band structures further. High spin states in 118Xe have been populated via 93Nb (28Si, xpyn) 118Xe fusion-evaporation reaction at a beam energy of 115 MeV provided by the 15 UD pelletron accelerator facility at the Inter University Accelerator Center, New Delhi. In the experiment, several new γ-transitions have been found and are placed appropriately in the level scheme. Theoretical study using the triaxial projected shell model (TPSM) approach suggests that the first band-crossing is due to the alignment of two neutrons, and a parallel band tracking the yrast configuration is the γ-band built on the two-quasiparticle state. Enhanced E1 transition rates have been obtained between opposite parity bands, involving νh11/2 and νd5/2 orbitals having $\Delta j = \Delta l = 3$, indicates the presence of octupole correlation in this nucleus. More details of the analysis and the physics outcomes will be discussed during the presentation.

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Abstract Category:

Nuclear Physics

Parallel Session 2 / 78

USATLAS SWT2-OU Storage Evolution from XRootD to CEPH

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I will give an overview of the high performance storage used at the US-ATLAS Tier2 computing facility (SWT2-OU) at the University of Oklahoma (OU), and the plans to migrate from the current XRootD based storage to the large CEPH based solution developed at OU. Both XRootD and CEPH are free high performance parallel file systems that can be deployed on any commodity storage hardware. XRootD was developed specifically for High Energy Physics (HEP) and optimized for data analysis using the root analysis framework, while CEPH is a more general file system that is now commonly used at High Performance Computing (HPC) clusters. CEPH is also a good candidate for small and medium size computing clusters with limited budget.

Abstract Category:

Computing & 4IR

Parallel Session 1 / 79

Theory and Phenomenology of Relativistic Heavy-Ion Collisions

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In high-energy physics, the study of the Theory and Phenomenology of Relativistic Heavy-Ion Collisions examines how atomic nuclei behave when they collide at exceedingly fast speeds, nearly at the speed of light. These collisions produce rich observable signatures that can provide insight into the properties of quark-gluon plasmas (QGPs), a state of matter believed to exist at high temperatures and densities. This study will focus on understanding the various stages of Relativistic Heavy-Ion Collisions (RHIC), as well as the signatures associated with some of the stages. One of the key signatures of QGP formation is the suppression of J/ mesons, the bound states of charmed and anti-charmed quarks. This suppression is based on the strong forces between quarks and anti-quarks being screened by the hot and dense medium produced by the collisions. The degree of J/ suppression can provide information about the temperature and density of the QGP. The increase in strangeness production is another key indicator of QGP formation. Strangeness is a characteristic of a few subatomic particles, including the strange quark, and it is not preserved in strong interactions. In QGP, the presence of many strange quarks and antiquarks is thought to increase the abundance of strange particles.

Overall, the research on these signatures of heavy ion collisions sheds light and provides important insights into the properties of QGPs and how matter behaves in extreme conditions. Furthermore, the study will review on how recent high energy heavy ion experiments at RHIC and LHC are consistent with the production of the quark gluon plasma in high energy Pb+Pb collisions.

Abstract Category:

Astrophysics & Cosmology

80

Prediction of Photovoltaic Power output characteristics using Artificial Neural Network for Different Number Hidden Layers

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Abstract Category:

Energy

81

Indian Philosophy, Poetry, and Physics: A Triadic Approach to Enhancing Physics Education

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Abstract Category:

Physics Education

84

Geothermal Potential and Exploration Opportunities in Central Tanzania, East Africa

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Abstract Category:

Earth Physics

Biophysics / **85**

Biophysics in Africa

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Biophysics is a scientific field of study that uses basic principles in physics and chemistry to unravel the details of biological phenomena. It is a multidisciplinary field that also uses mathematical methods to predict/explain the function, dynamics and structural organization of biological systems.

Specialties in biophysics include computational biophysics, membrane biophysics, protein engineering, molecular structures and mechanisms. Thus, biophysics involves the study of proteins, lipids carbohydrate and nucleic acids.

Biophysics finds application in human health, environment and the interaction between the duo. It has contributed to the development of life-saving treatments and device innovations such as radiotherapy, kidney dialysis, neuronal electrical conduction, cardiac defibrillator and pacemakers. Biophysics also helps in understanding how other living organisms interacts, survive, compete and reproduce within the natural environment.

According to the World Health Organization, some African countries are designated as developing nations while many others are classified as underdeveloped. These come with diverse environmental and human health challenges that need different approaches for resolution.

This presentation, on "Biophysics in Africa', looks into the current Biophysics education in Africa, current research activities, available facilities/resources and the socio-economic impact of biophysics research. This is with a view to understanding the relevance of Biophysics research to the development of Africa and how research scientists can work together for a common goal.

Abstract Category:

Biophysics

Nuclear and Particle Physics / **87**

Electromagnetic Field Evolution in Relativistic Heavy Ion Collision and its Effect on Flow of Particles

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Understanding the Quark Gluon Plasma (QGP), whose existence was known from the combination of three observations; is the central goal of high energy physics. All the three observations came from studying elliptic flow: how the energy; momentum and number of created particles are not uniform with direction. Any elliptic flow related studies have the chance to clear the road of understanding QGP well and answering what affects elliptic flow is part of the journey. This includes quantifying the created electromagnetic field during heavy ion collisions; which is ignored by the hydrodynamic models; and investigating its contribution to the flow of particles. So; the purpose of this research was to investigate the effect of electromagnetic field evolution created in relativistic heavy ion collision on the flow of identified particles. In order to address these problems; our model set-up followed three basic steps: describe the full relativistic viscous hydrodynamics of the considered heavy ions collision using the well known iEBE-VISHNU frame work; calculate the electromagnetic field created by the system with the possible drifting velocity sparked by it and finally investigate the change it brought to the final flow of those particles after injecting the drift velocities. The evolution of the electromagnetic fields calculated was found to play a role on the bending of flow. Beside the nature of created particles; the field evolution was affected by the electrical conductivity of the evolved system. The field arouse flow at lower transverse momentum and suppress it at higher. This change in flow is larger for heavier particles than the lighter ones during the early evolution time. Finally we found that; even flow harmonics are affected than the odds. This study definitively answers the question on whether elliptic flow is affected by the evolved electromagnetic field or not. Further study by softening many of the crude assumptions we made and a full event by event viscous hydrodynamic simulation, keeping the functionality of parameters we took as constant, is needed to establish a better ground on understanding the effect of electromagnetic field well and see from there what new things we can learn about the QGP.

Abstract Category:

Nuclear Physics

Parallel Session 2 / **88**

Electronic Structure Calculations using Quantum Computing

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The computation of electronic structure properties at the quantum level is a crucial aspect of modern physics research. However, conventional methods can be computationally demanding for larger, more complex systems. To address this issue, we present a hybrid Classical-Quantum computational procedure that uses the Variational Quantum Eigensolver (VQE) algorithm. By mapping the quantum system to a set of qubits and utilising a quantum circuit to prepare the ground state wavefunction, our algorithm offers a streamlined process requiring fewer computational resources than classical methods. Our algorithm demonstrated similar accuracy in rigorous comparisons with conventional electronic structure methods, such as Density Functional Theory and Hartree-Fock Theory, on a range of molecules while utilising significantly fewer resources. These results indicate the potential of the algorithm to expedite the development of new materials and technologies. This work paves the way for overcoming the computational challenges of electronic structure calculations. It demonstrates the transformative impact of quantum computing on advancing our understanding of complex quantum systems.

Abstract Category:

Computing & 4IR

89

Plasmonics for Sustainable developments

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Abstract Category:

Optics & Photonics

Atomic, molecular & laser physics / **90**

Unlocking Quantum Correlations and Coherence in Double Quantum Dots for Scalable Solid-State Qubits

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Solid-state systems have emerged as highly promising options for constructing qubits in the field of quantum technologies. Among these systems, double quantum dots (DQDs) have attracted considerable attention due to their versatility and potential for scalable qubit implementation. In this presentation, our primary focus will be to explore the quantum properties exhibited by DQDs, which make them particularly well-suited for advancing quantum technologies. We will delve into the impact of environmental factors on the quantum resources of DQD-based qubits, with a specific emphasis on quantum correlations and coherence. Our discussion will encompass various strategies for creating qubits using quantum dots, and we will present our research findings regarding the utilization of these resources. To quantitatively assess these properties, we will employ a range of quantum quantifiers, including local quantum uncertainty, local quantum Fisher information, and l1-norm coherence. Through our comprehensive analysis, our objective is to identify adjustable control parameters that can effectively preserve quantum correlations and enhance coherence even in the presence of diverse sources of noise. By highlighting the potential for manipulating quantum correlations and coherence within solid-state systems, our presentation will pave the way for the development of practical quantum technologies.

Keywords—Quantum Dots, Quantum Correlations, Quantum Coherence, Quantum Control

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Abstract Category:

Materials Physics

Parallel Session 2 / 91

Directed Transport of Bose-Einstein Condensate with kicked Interactions

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We study the response of a Bose-Einstein condensate (BEC) in a δ-kicked optical lattice ratchet potential with δ-kicked interactions, at quantum resonances. Solving the Gross-Pitaevskii Equation (GPE) and its associated Classical map, we found that our results strongly depend on the kicking strength K and the interaction parameter ˜g. A critical curve emerging from the (K, ˜g)-space, separating quasi-periodicity from full chaos, shows that the system can easily be driven into full chaos for stronger interactions. In the full chaos regime, the transport experiences large currents including current reversals, and the symmetry of the current spectrum can be destroyed. Remarkably, directed transport's property is lost after 50-kicks outside the stability window $|\tilde{g}| \leq 1$. These results are expected to be crucial for experimental purposes.

Abstract Category:

Atomic & Molecular Physics

95

ESTIMATION OF SIZE-SPECIFIC DOSE ESTIMATES BASED ON TISSUE ATTENUATION METRICS FOR PEDIATRIC COMPUTED TOMOGRAPHY EXAMINATIONS IN NIGERIA

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Abstract Category:

Medical Physics

96

Implementing Bidirectional Quantum Teleportation of Even and Odd Coherent States using the Multipartite Glauber Coherent State: A Theoretical Approach

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Abstract Category:

Physics Education

97

Feasibility study for the evaluation of doses received by organs during medical exposure for pediatric patient undergoing CT scan and estimation of the potential risk of radiation-induced cancers

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Abstract Category:

Medical Physics

98

Short term Prediction of Atmospheric Dispersion of Radionuclides. A case study of a Hypothetical Accident in the Transportation of Uranium from Kayelekera Mine in Malawi

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Abstract Category:

Nuclear Physics

99

1T – NbS2 Thermodynamic Stability Prediction from mixing GGA and GGA+U Calculations

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Abstract Category:

Materials Physics

Parallel Session 1 / 100

Upcycled symmetries

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Recent years have seen an explosion of generalisations of the idea of symmetry in particle physics. These include higher form symmetries, higher group symmetries and, in particular, non-invertible symmetries. All of these are characterised by the necessity of moving beyond the groups and into more complicated structures, whose physical implications are not yet fully understood.

In this talk I will give a pedagogical introduction to non-invertible symmetries with illustrative examples in familiar systems (QM and 2d Ising). I will then show how we can recover group structure by exponentiation, and why this is advantageous when calculating observables.

Abstract Category:

Particle Physics

101

Novel synthesis of Al-Mg-Si alloy matrix hybrid composite reinforced with bean pod ash and alumina using two-step stir casting method

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Abstract Category:

Materials Physics

Parallel Session 1 / 102

Search for axions in H → aa → 4γ decays at the LHC's ATLAS experiment

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The axion particle discovery could answer the big CP problem as it is hypothetically predicted. Hence a study on the exotic decay of the Higgs boson to two Axion Like Particles (ALPs) [1], [2], which in turn decay to two photons, was carried out. This analysis covers the mass range of ALPs between 100 MeV and 60 GeV and ALPs-photon couplings C_aγγ of 10ˆ{−5} to 1, a region that includes signatures with significantly displaced vertices and highly collinear photons, which present the challenges of this analysis. No significant deviation from the SM expectations has been found, excluding a large parameter space of models that could have explained the (g - 2)μ discrepancy.

Index Terms
Higgs, Axion, ALP, Photons, Anomalous Higgs Decays, HDBS

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CERN, Geneva, 2022.

Abstract Category:

Particle Physics

Parallel Session 2 / 104

3D Position-Sensitive Semiconductor Detectors for Nuclear Fuel Imaging

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The Passive Gamma Emission Tomography (PGET) device was approved by the IAEA for spent nuclear fuel safeguards inspections at the end of 2017 resulting from the JNT 1510 project. It is based on a collimator, consisting of a linear array of narrow slits with a pitch of 4 mm, with a relatively small CZT (cadmium-zinc-telluride) gamma ray detector behind each slit [1,2]. The detectors have a good energy resolution, enabling them to collect tomographic data in 4 user-defined energy windows. Because of the small detectors, the probability that a gamma ray is fully absorbed, providing ideal imaging information, is small. Large CZT detectors would have a higher probability for detecting the full energy of gamma rays, increasing the sensitivity and image quality (in terms of statistics and contrast-to-noise ratio) of the PGET device. However, a large CZT detector would cover more than one collimator slit, requiring position sensitivity to determine through which slit a gamma ray travelled in order to maintain image spatial resolution. In addition to utilizing the position sensitivity along the direction of the collimator, which gives transaxial position information, we are

investigating to what extent Compton imaging can provide information on the origin of a gamma ray along the axis of a spent fuel assembly (SFA). This opens the prospect of creating 3D images with the PGET device in a single axial position, adding axial information to the current 2D transaxial images. The imaging detector technology being developed is also useful for other than safeguards applications, such as the non-invasive post-irradiation examination of nuclear fuel to characterise its important properties [3].

We are studying the performance of a PGET device that uses state-of-the-art 3D position-sensitive semiconductor gamma ray detectors. CZT and germanium detectors are being considered. A Monte Carlo (MC) model of the PGET device was set up using the Geant4 framework. The MC model was used to simulate the performance of both large position-sensitive CZT detectors and small CZT detectors as installed in the PGET device. The performance of these detectors was compared. Tomographic measurements with a position-sensitive germanium detector and rod-shaped Cs-137 sources mimicking spent fuel were performed at Uppsala University. Compton imaging was demonstrated with a germanium imaging spectrometer and a Cs-137 point source at the University of Helsinki. The status and prospects of the project will be reported.

Keywords: passive gamma emission tomography, PGET, CZT detector, Compton imaging, spent fuel

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This work is financially supported by the Swedish Research Council, grant number 2017-06448, by the Swedish Foundation for Strategic Research, grant number EM-16-0031, and the forum for Nordic Nuclear Safety, grant number NKS_R_2022_136.

Abstract Category:

Nuclear Physics

105

Electrical Yield Enhancement for Silicon Solar Panels through Cooling by MgO and ZnO Nanofluids at Different Concentrations

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Abstract Category:

Energy

Nuclear and Particle Physics / 108

The beauty of the Higgs boson

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Eleven years ago two experiments of the Large Hadron Collider, ATLAS and CMS, announced the observation of a new particle. A new particle with properties consistent with the Higgs boson, the last missing ingredient from the Standard Model's zoo of particles, the manifestation of the Higgs field permeating all the space and mass donor for all fundamental particles according to the Standard Model of particles. Since 2012, more than 30 times as many Higgs bosons have been recorded by the ATLAS experiment which allowed us to do more precise studies of this particle. What do we know today that we did not know in 2012? Are there still missing pieces on the Higgs field puzzle? What is the future of the Higgs physics looking like?

In this talk I will provide an overview of latest results from the multiple unprecedented number of production and decay processes of the Higgs boson scrutinized in ATLAS. Also will discuss the future of the Higgs physics in view of the different future colliders projects currently proposed. And I will make special emphasis on the importance of understanding our detectors and develop cutting-edge data analysis methodologies in order to achieve the understanding we have today of the Standard Model.

References:
ATLAS Collaboration. A detailed map of Higgs boson interactions by the ATLAS experiment ten years after the discovery. Nature volume 607, pages 52–59 (2022)

Abstract Category:

Particle Physics

Parallel Session 1 / 109

LA-CoNGA physics: an open science education collaboration between Latin America and Europe for High Energy Physics

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A region with strong scientific traditions. A region with a lot of potential and a young generation interested in advanced physics topics, cutting-edge techniques, avid for knowledge. A region with a very heterogeneous development among countries and even among regions in the same country, with different funding opportunities and affected by a variety of social and economical realities. That's Latin America. How to build capacity under those conditions? What happens when person power available in the universities and research center is small but motivated? Well, we can merge efforts because together we are stronger. In this contribution I would like to discuss how Virtual Research and Learning Networks (VRLCs)[1] generating international productive consortiums in virtual research environments and forming the new generation of scientists, can be part of the solution to this reality. These environments are key to improve accessibility and inclusion for students and researchers in developing countries. In this talk we will discuss one VRLC in particular: LACoNGA Physics (Latin American alliance for Capacity buildiNG in Advance physics) [2]. LA-CoNGA physics aims to support the modernization of the university infrastructure and the pedagogical offer in advanced physics in four Latin American countries: Colombia, Ecuador, Peru and

Venezuela. This virtual teaching and research network is composed of 3 partner universities in Europe and 8 in Latin America, high-level scientific partners (CEA, CERN, CNRS, DESY, ICTP), and several academic and industrial partners. The project is co-funded by the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Commission. Open Science education and Open Data are at the heart of our operations. In practice LA-CoNGA physics has created a set of postgraduate courses in Advanced Physics (high energy physics and complex systems) that are common and inter-institutional, supported by the installation of interconnected instrumentation laboratories and an open e-learning platform.

This program is inserted as a specialization in the Physics masters of the 8 Latin American partners in Colombia, Ecuador, Peru and Venezuela. It is based on three pillars: courses in high energy physics theory/phenomenology, data science and instrumentation. The program is complemented by transversal activities like seminars, citizen science projects and open science hackathons [3]. In the current context, VRLCs and e-learning platforms are contributing to solve challenges, such as distance education during the COVID19 pandemic and internationalization of institutions in developing countries.

If other contributions featuring similar initiatives in Africa and other regions in the Global South are sent to ACP2023, then I would be very glad to organise a discussion or panel session with all these contributions. I am sure there are many things to learn from each other and good practices to share as well.

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[2] http://laconga.redclara.net
[3] https://laconga.redclara.net/hackathon/

Abstract Category:

Physics Education

111

Accelerometer Experiments Prove and Clarify Einstein's Gravity Theory

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Abstract Category:

Physics Education

Parallel Session 2 / **112**

The dark side of the photon, ongoing ATLAS search for dark matter through a dark photon.

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A collider search for dark matter through dark photons based on a phenomenological study [1, 2] is presented. Where simulated samples with the ATLAS detector at the CERN LHC with a center-of-mass energy of 13 TeV are used. A dark photon is a hypothetical dark matter particle which may be detected through its kinetic mixing with the general photon. In which it couples weakly to electrically charged particles and allows a non-gravitational window into the detection of dark matter. We will be considering a hypothetical heavy top like quark decaying to a top quark and dark photon. The dark photon will decay to a lepton pair, while we typically look at jets from hadrons, two energetic and collimated photons or leptons can give to jet-like signatures in calorimeters. These lepton jet final states are an unusual topology and have scarcely been studied. We have focused on the hadronic decay of the top quark which gives a final state consisting of a heavy top quark jet. The search is for a large radius jet in the mass range of the top quark and a small radius jet close to the produced lepton both with high transverse momenta. The mass of the small radius jet is that of the dark photon. The main backgrounds are multijet, hadronic and semileptonic top quark pair production, which will be estimated using simulation. The aim of this talk is to discuss the search strategy of this dark photon with the ATLAS detector.

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Abstract Category:

Particle Physics

Parallel Session 1 / 114

Enhancing Reactor Performance: Computational Study on Optimizing Beryllium Shim Plates in the Nigerian Research Reactor-1

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This study investigates the efficiency of beryllium shim plates in the Nigerian Research Reactor-1 (NIRR-1), also known as the MNSR, to assess their impact on reactor performance. The research focuses on the reactor's unique design, the material properties of the shims, and their manufacturing accuracy. The WIMS-ANL code is utilized, employing multi-region integral transport theory, to solve the neutron transport equation and obtain group constants for various reactor components. Cross-section data, including scattering, absorption, and fission cross sections, are derived from ISOTXS files containing nuclear properties, energy levels, and decay characteristics of isotopes. The behavior of neutrons in the fuel region is analyzed using a super-cell representation, providing essential parameters such as diffusion coefficients, absorption cross sections, and fission cross sections. Group constants for non-fuel regions, including beryllium, water, control rods, and the reactor tray, are also generated. The REBUS-ANL code plays a significant role in calculating the reactor multiplication factor and excess reactivity, solving the neutron diffusion equation numerically with consideration of the reactor's geometry, material properties, and neutron cross sections. The study calculates the efficiency worth of beryllium shims in both high-enriched uranium (HEU) and low-enriched uranium (LEU) cores and presents the relationship between shim thickness and excess reactivity. The results demonstrate that beryllium shim plates effectively compensate for reactivity losses due to fuel burn-up and fission product accumulation. Optimal shim thickness is determined to maintain the desired excess reactivity level. The study emphasizes the critical role of computational tools, such as the WIMS-ANL and REBUS ANL codes, in reactor design, optimization, and safety analysis.

The findings highlight the positive impact of beryllium shim plates on reactivity and safety in the Nigerian Research Reactor-1 (NIRR-1). These shims play a crucial role in maintaining reactivity levels and contribute to the overall safety features of the reactor. Beryllium's advantageous properties, including high thermal conductivity and low neutron absorption cross-section, make the shims effective heat conductors, minimizing the risk of fuel overheating. In small research reactors like the NIRR-1, effective heat management is essential for stable and safe operation, making the beryllium shims important components. Moreover, the presence of beryllium shims in the NIRR-1 allows for flexibility in adjusting the neutron flux distribution within the reactor core. By strategically placing the shims, reactor operators can optimize the neutron flux to meet specific experimental or operational requirements. This capability is particularly valuable in research reactors, enabling tailored neutron irradiation conditions for scientific studies, materials testing, neutron activation analysis, and radioisotope production. The presence of beryllium shims enhances reactivity, contributes to safety through heat conduction, and allows for customizable neutron flux distribution in the NIRR-1. These findings have implications for reactor design, optimization, and safety analysis, ultimately supporting stable and efficient operation of the Nigerian Research Reactor-1. The combined capabilities of the WIMS-ANL and REBUS-ANL codes provide powerful tools for modeling and simulating neutron behavior, calculating group constants, and determining reactor performance. These tools contribute to reactor design, optimization, and safety analysis, supporting efficient and reliable nuclear energy systems.

Keywords: Nigerian Research Reactor-1, NIRR-1, MNSR, beryllium shim plates, reactor performance, efficiency, neutron transport equation, WIMS-ANL code, multi-region integral transport theory, group constants, ISOTXS files.

Abstract Category:

Nuclear Physics

115

Future careers for scientists and engineers –a look into the crystal ball

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Linear career paths for scientists and engineers are less likely in the future –and a career could be what one makes for her/himself. For careers outside academia, particularly getting into industry and entrepreneurial endeavors, additional skill sets are needed beyond one's academic degrees. In order to prepare for such a scenario, skills to translate, transform or extend knowledge from one field or application to another would be very much needed. Innovation and entrepreneurial skills provide a pathway for commercialization of our own creative ideas and inventions through start-ups thus transforming oneself from an employment seeker to an employment creator. In this presentation, we will discuss the needs of the above skills in detail, avenues and opportunities to acquire such skills and also briefly mention about our work on capacity building in such skills in many developing countries.

Abstract Category:

117

Quantum Cluster Equilibrium Prediction of Liquid Ethanol

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Abstract Category:

Atomic & Molecular Physics

Parallel Session 1 / 118

Isospin breaking in the upper fp-shell nuclei

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The concept of isospin symmetry originates in the attributes of charge symmetry and charge independence of the strong nuclear force. This implies that the strong interaction exhibits equal strength between proton-proton, neutron-neutron, and proton-neutron pairs. As a result, isobaric analog nuclei with the same mass, A = N + Z, but with differing neutron and proton numbers, such as N = Z - 2, N = Z, and N = Z + 2, called isobaric analog states (IAS), should possess degenerate sets of excited states. However, electromagnetic effects introduce energy differences among IAS. The measurement of these differences has proven valuable in probing nuclear structures and examining the conservation of isospin symmetry. However, experimental data for the A = 70-80 region are minimal, and conducting experiments in this region is challenging.

An experiment was performed at the University of Jyvaskyla Accelerator Laboratory to investigate the structures of 78Y using the 40Ca(40Ca, np) reaction. The experiment employed the JUROGAM 3 Ge-array, MARA vacuum-mode recoil separator. The recoil-beta tagging method was employed to investigate the excited states in the nuclei of 78Y. Several new gamma-ray transitions were detected from the decay of the excited states in the 78Y nucleus. This presentation discusses the experimental methods to study exotic nuclei close to the proton dripline and discusses results from the 78Y experiment compared to theoretical predications.

Abstract Category:

Nuclear Physics

120

DEMAX: The Deuteration and Macromolecular Crystallization Support labs for the European Spallation Source.

Author: Zoe Fisher[None]

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Abstract Category:

Biophysics

Biophysics / **121**

Life science research using neutrons at the European Spallation Source: applications, instruments, and support labs

Author: Zoe Fisher[1]

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The European Spallation Source (ESS) is a partnership of European Nations collectively building and operating the world's leading user facility for research using neutrons. The ESS will provide unique possibilities for life science research due to high flux, specialized instruments, and support labs for sample preparation and characterization. This will enable faster measurements on smaller samples and will support researchers from medicine, drug discovery, agriculture, and general biological sciences to effectively use the ESS. The suite of neutron instruments includes reflectometry, small angle scattering, spectroscopy, and protein crystallography. This talk will provide an overview of the various fields where ESS will make an impact and include a summary of the relevant neutron beamlines and support laboratories constructed on site.

Abstract Category:

Biophysics

122

THE INVESTIGATION OF STILBENE SCINTILLATOR DETECTOR AT ACCULINNA–2

Authors: Grzegorz Kaminski[1]; Anh Mai[1]

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Abstract Category:

Nuclear Physics

123

Investigation of the process development methods for standardized chemical synthesis of Zinc-Titanium oxide nanocomposite material

Authors: Yamilla M. G. Kuruses[1]; Ambicious M Lifasi[1]; Dipti R. Sahu[1]

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Abstract Category:

Materials Physics

General / **124**

The interactions of Physics, Environmental, and Developmental Issues: Taking complexity Seriously

Author: George Ellis[1]

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Physics underlies all that emerges, including ecosystems and societies, and some issues to do with energy usage and global warming have direct relations to physics, as pointed out by Vaclav Smil. However it is not true that one can take simple physics concepts such as some form of thermodynamics or network theory and make policy recommendations on this basis alone. The ecological/social/economic environment is a truly complex system, and any holistic view of physics for sustainable development must take this into account, in particular noting the interacting adaptive modular hierarchical structures one is dealing with and the way that both bottom up emergence and downward causation take place in them via non-linear contextual mechanisms.

Abstract Category:

Community Engagement

Parallel Session 2 / **125**

The Role of Optical Fiber Sensor in Internet of Things: Applications and Challenges: Review

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The use of fiber Bragg grating (FBG) Optical sensors in the Internet of Things (IoT) has made a lot of research interest because of the potential applications, such as remote monitoring of transformer substation subsidence, intelligent power grid sensing, and mine safety monitoring [1]. Disaster prediction and forecasting in infrastructure building, on the other hand, necessitate the use of remote sensing and monitoring disruptive technology of IoT [1,2]. There is need to develop optical sensors based on FBG sensor technology to overcome the present challenges with monitoring using the conventional sensors which are not immune to Electromagnetic Interference and, are prone to corrosion and have no capacity to perform distributed sensing [3]. In Optical fiber a sensing device is used in

made of grating structures. These sensors detect various physical parameters like temperature, pressure, vibrations, displacements, rotations, and chemical species concentration. Optical fiber Sensors have a wide range of applications in the field of remote sensing because they do not require electrical power at the remote location and are tiny [3] which makes them easier to proliferate even in buildings. Some other applications of Optical Fiber Sensors include monitoring the health of composite materials, determining different chemical characteristics, biological and biometric applications, such as blood flow measurement and also industrial applications such as product characterization, real-time thermal imaging, composition analysis, delamination and defect detection, surface inspection, and many others [2,3]. The downside of optical fiber sensors requires much expertise in the fabrication and deployment of the sensors. This paper will review more of the adoption of optical fiber sensors in IoT with corresponding opportunities and challenges.

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Abstract Category:

Optics & Photonics

Parallel Session 2 / **126**

Luminosity calibration and beam-beam interactions at hadron colliders with Q-Gaussian beams

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Precise luminosity measurements is a crucial aspect of collider physics. Luminosity calibration at hadron colliders relies on the van-der-Meer scan method, where colliding particle beams are swept across each other and the reaction rates are recorded based on the separation distance between them. Initially, Gaussian distributions adequately described particle densities for luminosity calibration. However, with advancements in collider facilities, the deviations of the particle densities from Gaussian ones become more pronounced.

The electromagnetic interaction between colliding beams exerts both coherent and incoherent effects, impacting the overall motion of the beam and individual particle distribution within the beams, respectively. This interaction directly influences the number of collisions and introduces biases in luminosity calibration. To achieve higher precision, such as target precision 1% for LHC and 0.5% in HL-LHC, it is necessary to consider models that account for the non-Gaussian nature of the beam shapes to achieve enhanced precision in luminosity calibration.

Currently, models based on double Gaussian and/or multi-Gaussian beam densities are used to describe beams with heavy tails, where Gaussian of small width are used to describe the core while Gaussian function with a wider width are used to describe the tails. The Q-Gaussian distribution was found to be a more natural approach to the beam density for the LHC and HL-LHC upgrades, as it provides a more realistic description of the beam profile.

In this study, we explore the influence of the non-Gaussianity of the colliding beams on luminosity calibration and beam-beam interactions using beams with Q-Gaussian transverse profile. The deviation of the luminosity of Q-Gaussian beams from that of Gaussian is investigated, and an analytical formula is derived. To facilitate practical applications, a van-der-Meer scan-fit model based on the Q-Gaussian function was proposed. The van-der-Meer scans using the Q-Gaussian beams are simulated, and the proposed fit model is applied and compared to the traditional Gaussian fit models. The fit models are applied to the actual van-der-Meer scan dataset from CMS at Run 2. To consider the effect of the non-Gaussianity of the colliding beams on their beam-beam interaction, we introduce the model for coherent and incoherent interactions of Q-Gaussian colliding beams. The comparison of this model with the regular Gaussian model is performed for LHC conditions. Also, the evolution of the effect during the van-der-Meer scan is demonstrated.

By investigating the impact of non-Gaussian deviations on both luminosity calibration and beam-beam interactions, our research provides valuable insights for optimizing collider performance and achieving more accurate measurements in future high-energy experiments.

Abstract Category:

Accelerators

Parallel Session 1 / 127

Computational fluid dynamics modelling of the infectiousness of airborne droplets.

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Airborne transmitted diseases are a public health concern [1]. They are ubiquitous in human's life and include large variety of diseases such as the common cold, chicken pox, mumps and more serious ones like COVID-19 and tuberculosis. These diseases are transmitted through saliva droplets emitted in the environing air [2]. While being airborne, droplets are affected by multiple environmental factors mainly air flow, humidity, and temperature. Furthermore, droplets are interacting with the surrounding air, exchanging mass and momentum. Droplets are also released under specific conditions defined by parameters like injection speed, the height from where they are emitted, their size distribution, and temperature. The physical processes involved in droplets'evolution over time have influence on how they are spread and likely to transmit pathogens. Computational Fluid Dynamics (CFD) can be used to model droplet transport, and interaction with surrounding air, considering environmental parameters to get the spatial and temporal distribution of the expelled droplets [3]. In this study, the CFD model is augmented with an infectiousness tracker, to evaluate the likelihood of each droplet to transmit diseases. Infectiousness corresponds to the amount of pathogen the droplet is carrying and is decreasing with the droplet size. The two-way coupling approach was applied

to compute momentum and mass exchange between droplets and its environment. Interactions between particles were also considered with the stochastic collision model including droplet breakup and coalescence. The Rosin-Rammler distribution was used for the size distribution of droplets with a range varying from 1 to 200 microns. An exponential decay was used to model the infectiousness variation as a function of the droplet size. When increasing the speed at which droplets are ejected, particles are occupying a wider range of position, more spread and reaching farther distance. Increasing injection velocity is equivalent to considering different respiratory events from which particles are generated. In fact, speaking has a lower injection speed than coughing which injection velocity is lower than that of sneezing. Therefore, violent respiratory events are more likely to transmit diseases because droplets are more spread. Infectiousness of droplets are neutralized in a reasonable amount of time under the condition that evaporation is occurring. For the safety of public and confined spaces, it is encouraged to fulfil the conditions that trigger evaporation like aeration. Our model will be used as a guide for configuring clinical and public spaces.

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Abstract Category:

Computing & 4IR

128

A computational fluid dynamics study of the infectiousness decay of droplets propagating pathogens when exposed to evaporation coupled with UVGI

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Abstract Category:

Computing & 4IR

131

The Exploration of Bottom-quark-phillic Semi-visible Jets Scenario in ATLAS

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Abstract Category:

Particle Physics

Physics education & community engagements / 132

GENDER Equity and Equality in the research area

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In recent decades, there have been significant changes in women's participation in education in science and in the research area. While progress have been made and the achievements of young female scientists are celebrated, gender asymmetries in scientific contexts still persist. Women in science often encounter gender bias, lack of representation and unequal access to resources and opportunities, with no real awareness in the research world of the unique obstacles they face. To address these issues, it is essential to create an inclusive environment that supports and nurtures woman scientists and more in general people that belong to minorities. This involves
promoting gender mentorship programs, providing equal opportunities for career advancement, challenging gender stereotypes considering the human diversity as much as possible into account. More must be done to reduce gender gaps while equipping new generations with the skills of the future to participate in and contribute to the economic development of their countries. Working toward the gender equity and equality means to work for the wellbeing of women and men.

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Abstract Category:

Women in Physics

Parallel session on African countries joining and thriving in large international collaborations / 134

African Countries Joining Large International Collaborations - PHENIX and EIC

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Particle and high energy physics has been a fascinating research field in which scientists globally have been making combined efforts to understand the building blocks of matter and the force that binds them together. The study requires diverse and skilled manpower at various academic levels such as undergraduate, graduate, postgraduate, and faculty levels. In addition, mathematical, physics, computational, and engineering skills with knowledge are equally required. To meet this demand successfully, scientists globally work together in large collaborations such as the ATLAS Collaboration at the European Organization for Nuclear Research (CERN) in Switzerland and the PHENIX Collaboration at the Relativistic Heavy Ion Collider (RHIC) in the United States. However, at present, few African countries such as South Africa, Morocco, Egypt, Senegal, Zambia, etc, are making contributions to these types of research collaborations. This talk is, therefore, aimed at encouraging several African research institutions and universities to develop interest in this research, and to discuss research contributions the University of Zambia is making in the PHENIX Collaboration using the PHENIX detector at RHIC and Electron Ion Collider (EIC) research prospects including some of the challenges. PHENIX is an exploratory experiment designed for investigating high energy collisions of heavy ions and protons whose primary goal is to discover and study a new state of matter called the quark-gluon plasma (QGP) that in turn allows us to better understand the early universe. The PHENIX detector is decommissioned and is replaced by sPHENIX following some upgrades. The EIC, on the other hand, will be a discovery machine to be used to unlock the secrets of the force binding the building blocks of visible matter in the universe. The EIC will comprise two intersecting accelerators for producing intense beams of electrons and protons or heavier atomic nuclei that will be steered into head-on collisions at high energies in the order of giga electron volt (GeV). The benefits include scientific discoveries in a new frontier of fundamental physics and triggering technological breakthroughs on the human health plus other global challenges.

Abstract Category:

Particle Physics

135

Study of the Hubble tension in the framework of a phantom dark energy model

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Abstract Category:

Astrophysics & Cosmology

136

Effect of annealing temperature and doping concentration on the Properties of Sm doped ZrO2 thin Films

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Abstract Category:

Materials Physics

137

Energy loss in small-system Quark Gluon Plasmas

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Abstract Category:

Particle Physics

Special session on big detectors & large research infrastructures in Africa / 139

Towards black hole movies with the Africa Millimetre Telescope (AMT)

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The Event Horizon Telescope (EHT) is a network of antenna's across the globe that is used to image super massive black holes (SMBHs). These antennas observe together in very long baseline interferometry (VLBI) at a frequency of 230 GHz to produce a single image. Since the release of the first image of M87*in 2019 and subsequently the image of Sgr A* in 2022 by the EHT collaboration, the focus has shifted to not only taking better resolved images such as in the case of Sgr A* but also to

dynamically image black holes. This has led to a search for possible sites to extend and fill in the gaps within the EHT network. The Khomas highlands of Namibia have been found to have optimal conditions for astronomy and thus has been identified as one such area to add an observatory. The observatory shall consist of a 15 m diameter telescope called the Africa Millimetre Telescope (AMT). Two sites within the Khomas highlands have been identified as potential sites, this being the Gamsberg Mountain and H.E.S.S. site. The Gamsberg Mountain has an elevation of 2347m above sea level (a.s.l) and is an iconic site with the top of the summit relatively flat. Despite attempts to built an observatory as early as 1970, no facilities have ever been buillt, there is no power and water utilities ontop and the road to the submit of the mountain is in a bad state. The H.E.S.S. site makes up the H.E.S.S. observatory, which is world leading gamma ray observatory. The H.E.S.S. site sits at an elevation of 1800m a.s.l and already has power and water utilities. Precipitable water vapour (PWV) in the atmosphere is the main source of opacity when observing at millimeter to submilimeter waves. Millimetre waves either get absorbed or scattered by PWV in the atmosphere and therefore results in the signal being attenuated and delayed. For this reason, before a millimeter observatory can be built on one of the two sites, PVW measurements at the two potential sites have to be taken and analyzed. In this presentation, previous results at both sites and the status of new PWV measurements being taken will be discussed.

Abstract Category:

Instrumentaions & Detectors

Parallel Session 2 / **140**

Citizens and Travelers II - A Collection of African Scientists' stories

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Citizens and Travelers II is a project that is aimed towards the collection and publishing of the stories of African scientists. We strongly believe that everyone has a story to tell either those with happy endings or unhappy ones. These stories, if shared, will, in turn, motivate, guide and correct others. We have read stories of how the western world has made an impact in science, we believe it's time to tell the world the impact of African scientists in Science and Technology. We considered diverse backgrounds, age groups, gender and experiences of African scientists. The ongoing batch featured seven scientists namely: Dr. Azote Somiealo, Professor Mirjana Povic, Dr Mounia Laassiri, Professor Wole Soboyejo, Dr Marie- Clementine, Professor Claudio and Dr Bertrand Tchanche. Stories are collected via either surveys or interviews. We are working on designing a web-based application where people can access this information and share with students within their network.

Abstract Category:

Community Engagement

Physics education & community engagements / **141**

Engaging teachers for informal education in modern physics

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The International Masterclasses (IMC) Programme was launched in 2005 by IPPOG (then EPOG/EPPOG) –the International Particle Physics Outreach Group –on the occasion of the celebration of UNESCO' s 2005–World Year of Physics. The programme has grown substantially since then, attaining today a level of nearly 14 000 students participating in 220 institutes in 52 countries. A student participating in IMC would go to the closest university hosting a session, and "Be a scientist for a day⋯ with hands-on particles". The day consists of training in the morning, data analysis paired with another student after lunch, and discussion of results in an international videoconference, connecting high-school students that participated in different institutes, moderated by scientists at CERN and other places. However, the number of involved countries in IMC from the African continent remains relatively low. To get more African students involved, one of the paths pursued was to reach their teachers, particularly through the CERN's Portuguese Language Teachers Programmes. These were started in 2009, following the CERN Portuguese Teachers Programmes started in 2007.

In this presentation, a small review of such programmes is discussed (the Teachers Programmes and the IMC programmes), along with plans for the immediate and medium- term future.

Abstract Category:

Particle Physics

Science Diplomacy / **142**

Future careers for scientists and engineers –a look into the crystal ball

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Linear career paths for scientists and engineers are less likely in the future –and a career could be what one makes for her/himself. For careers outside academia, particularly getting into industry and entrepreneurial endeavors, additional skill sets are needed beyond one's academic degrees. In order to prepare for such a scenario, skills to translate, transform or extend knowledge from one field or application to another would be very much needed. Innovation and entrepreneurial skills provide a pathway for commercialization of our own creative ideas and inventions through start-ups thus transforming oneself from an employment seeker to an employment creator. In this presentation, we will discuss the needs of the above skills in detail, avenues and opportunities to acquire such skills and also briefly mention about our work on capacity building in such skills in many developing countries.

Abstract Category:

Young Physicists Forum

144

Band Offsets, Optical Conduction, Photoelectric and Dielectric Dispersion in InSe/Sb2Te3 Heterojunctions

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Abstract Category:

Materials Physics

Parallel Session 1 / 145

Electronic and magnetic properties of Selected TM doped MoS2 monolayer: A DFT calculation

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The exfoliation of free-standing graphene in 2004 had led to several other monolayered materials synthesis and characterization, of which Molybdenum disulfide (MoS2) is one of them. MoS2 has superior physical and electronic properties comparable to that of graphene and candidate material for next generation device materials application since its semiconducting while graphene is semimetal. In addition, MoS2 has a good potential application in nanoelectronics, optoelectronics, and flexible devices. It has the capability of controlling spin and valley degrees of freedom making it a promising material for spintronic and valleytronic devices. Monolayer MoS2 by its nature is nonmagnetic, and it has been reported that using electron beam mediated substitutional doping, transition metals (TM) can alter the electronic and magnetic properties of MoS2 monolayer. Vacancy defects have also been found to induce magnetic properties under Molybdenum rich conditions extending the magnetic applications of MoS2 from the experimental point of view. TM doped MoS2 and vacancy creations are promising ways to induce magnetic effect in MoS2 and to achieve that, we examine the combined effect of both localized (TM= V, Ni, Fe Cu and Mn)-vacancies of MoS2 using quantum mechanical approach in the framework of density functional theory with generalized gradient approximation. The results demonstrate that, it is energetically stable to incorporate Ni and Cu in MoS2 structure under Mo-rich conditions than others. There are observed induced magnetic effects originating from the dopants and the nearest-neighbour Mo with magnetic moments between 0.82 and 3.00 μB. Some of the dopants showed 100% spin polarization which is useful for engineering spin filter devices on magnetic MoS2 nanostructures.

The results reported here are certainly important and interesting, and will contribute to the present knowledge in the field of spintronics.

Keys works: transition metal, monolayer, spin and magnetic properties

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Acknowledgment

All calculations were performed on the Southern African Centre for High Performance Computing (CHPC)

Abstract Category:

Materials Physics

Parallel Session 2 / 146

Search for a Higgs boson decaying to a four lepton plus missing transverse energy final state via four vector bosons

Author: Xola Gugulethu Mapekula[1]

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This analysis presents the search for the Standard Model Higgs that decays to a pair of dark Higgs to an eight-lepton final state via four dark vector bosons. In this scenario, the SM Z boson can kinetically mix with the U (1)D gauge boson ZD while the dark Higgs S and the SM Higgs can exhibit mass mixing. Either of the Higgses can can be formed from gluon-gluon fusion and decay to the other type of Higgs which in turn can decay to a ZD pair.The overall topology envisioned is H $\longrightarrow$ SS $\longrightarrow$ ZD ZD ZD ZD $\longrightarrow$ 8l, which gives an eight lepton final state where l could be ν, e or μ. The probability of observing different configurations of the final states was calculated. We compared these results to the observed final states from generated samples and found that they agreed. In the case where we observe four detectable leptons(e or μ) and four undetectable leptons (ν), an investigation was then done to see whether the visible leptons pairs from the same S particle (denoted as the 4-4 case) or different S particles (2-2-2-2 case). We then developed a discriminator based on the angular kinematics of each event in order to separate the 4-4 case from the 2-2-2-2 case. The discriminator was found to work for specific values of the parameter phase space, while in the other phase space the data was found to be irreducible.

Abstract Category:

Particle Physics

147

Assessing Lead Content and Lead Isotopic Ratio in Paints from South Africa: Implications for Environmental Health Using ICP-MS Analysis

Author: Dr. Stephen Friday OLUKOTUN[1]

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Abstract Category:

Medical Physics

149

All the Light we cannot see: the search for Dark Photons

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Abstract Category:

Particle Physics

Parallel Session 1 / **150**

Use of a High Resolution ΔE-E Gas-Ionisation Detector for the 6Li + 10B System at ELAB = 20 MeV

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Light heavy-ion scattering reactions at incident energies not far above the Coulomb barrier can yield useful information when investigating nuclear astrophysics problems. A 20 MeV 6Li beam provided at the EN Tandem Van de Graaff accelerator of iThemba LABS (Gauteng) was used for the measurement of 6Li + 10B nuclear scattering reactions. A ΔE-E gas ionisation detector, which operates on the principle of energy loss, provided excellent charged particle identification (charge and mass) was positioned at θLab = 35o with respect to the beam. The scattered ions are stopped in a solid-state silicon surface barrier detector after traversing the ΔE gas ionisation cavity of the detector, which uses iso-butane gas. The very good energy resolution of the ΔE-E detector leads to various ground and excited states identified for the different reaction channels. Identified states are discussed and compared with the states already found in the previous work related to this low-energy nuclear scattering reaction.

Abstract Category:

Nuclear Physics

Parallel Session 2 / **152**

Genius in Africa

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Genius in Africa (GiA) is a platform that searches out and supports the best and most promising students residing in the rural areas of Africa. Our primary objective is to locate and assist rural geniuses and also support them towards achieving their goals. Rural geniuses in this context are both the reached (via technology) and the unreached talents across the continents that have mastered the art of doing much with the little resources available.

In their day-to-day activities, children can be subjected to misinformation under the disguise of religion and other organized philosophical ideas. The quality of information they are exposed to at an early age has a great influence on who they will become in the future. Many of these children have skills in different vocations like hunting, cooking, and even arithmetic through buying and selling. The question here is, "How can we maximize these talents and, through them, raise the next generation of problem solvers across all areas of life?"

Through outreach, book support, and other promising media, GiA is designed with the purpose of reaching out to our rural geniuses across the continent. GiA proposes to develop an effective outreach and communication strategy for young pupils to channel them toward education and training, keep them away from negative influences and misinformation, and support their societal growth and advancement.

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Abstract Category:

Community Engagement

Parallel Session 1 / 153

Enhanced removal of Methyl red dye from aqueous solutions using Zirconium oxide impregnated Royal palm fiber Activated carbon (ZrO2-RPAC)

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Co-authors: Charles Kwame Bandoh [1]; Eric Selorm Agorku [2]; Francis Kofi Ampong [2]

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In recent years, the removal of organic dyes from wastewater has gained significant attention due to its negative impacts on the environment and human health. In view of that, this work seeks to investigate the possibility of using zirconium oxide impregnated royal palm fiber activated carbon (ZrO2-RPAC) to remove methyl red dye from aqueous solutions and determine the effectiveness of the composite as an alternative eco-friendly and cost-effective adsorbent for dye removal in wastewater. The ZrO2-RPAC composite was prepared through a simple impregnation technique by combining the properties of royal palm fiber activated carbon (RPAC) and zirconium oxide nanoparticle (ZrO2). Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction spectroscopy (XRD), and other analytical techniques were used to analyze the morphology and structural properties of the composite. The effects of parameters such as initial dye concentration, contact time, pH, and adsorbent dosage were examined. The results showed that under optimum conditions, the ZrO2-RPAC composite exhibited an improved removal capacity of methyl red dye. The adsorption equilibrium data were analyzed using the Langmuir and Freundlich isotherm models, with the Freundlich isotherm

providing a superior fit. The kinetics of adsorption also showed pseudo-second-order model as the best from the experimental data. The improved performance in adsorption can be attributed to the presence of zirconium oxide nanoparticles, which increases the surface area and provide extra active sites for dye adsorption. Furthermore, the presence of functional groups on the surface of RPAC allows for strong electrostatic interactions with methyl red dye molecules. This study shows that ZrO2-RPAC has the potential to be a possible alternative adsorbent for the removal of methyl red dye from wastewater.

Keywords: Royal palm activated carbon; zirconium oxide; adsorption; methyl red dye

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Abstract Category:

Materials Physics

155

Transforming disease detection: Simulated RT-LAMP results for HIV, COVID-19, and TB diagnostics

Author: mosidi mokoena[1]

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Abstract Category:

Medical Physics

Accelerators & Light Sources / 156

"The first African Light Source: lighting the future of Africa"

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Bringing forward the African educational systems, employment status, scientific and technological advancement, besides the human capacity building - which is alleged to be the backbone of any advanced society- is considered a huge challenge that puts more question marks on many other deep distresses such as (1) how to establish sustainable cutting-edge research infrastructures and institutions?, (2) how to reverse the brain-drain dramatic concern?, (3) how to efficaciously address the local and regional alarms related to health, environment, and human heritage?, (4) how to use science as a vehicle for industrial development and growing economy?, and (5) how to minimize the gender gap in science?. Well-established large infrastructures as light sources can give answers to the above. They have a global role and sustainable impact by serving a wide range of applications of basic and applied science giving answers to agricultural domains, diseases and public health, environment, air and water pollution, food security, new materials science, industrial applications, as well as energy and climate change. Light sources are the best example of an open and multidisciplinary research infrastructure. Being beyond the financial and operational capacity of individual countries, they provide strong opportunities for networking, cost-sharing, and promote multi-disciplinary collaboration with wider global community, while promoting science diplomacy and peace at large in particular cases.

Back again to Africa, this presentation will travel around the history and the milestones of the African Light Source (AfLS). The AfLS Foundation - together with its community- is extensively and expansively working towards founding the first synchrotron facility in Africa being the only continent that is left behind without such technology. It pursues to answer the above mentioned questions in Africa through collective brainpower, networking, community engagement, and constructive agreements and partnerships. Many doors are opened, and the best is yet to come. A special light will be also shed on the African Strategy for Fundamental and Applied Physics (ASFAP) Light Sources Working Group goals and outcomes.

Reference:
"ASFAP impact towards the 1 st African Light Source", Gihan Kamel,
https://doi.org/10.48550/arXiv.2207.08127

Abstract Category:

Light Sources

157

Comparative study of internal dose calculation :Monte Carlo versus MIRD method

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Abstract Category:

Medical Physics

Parallel Session 2 / 158

Elimisha Msichana Elimisha Jamii an Astronomia (Swahili for "Educate a girl, educate the entire community with Astronomy").

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Abstract Category:

Young Physicists Forum

Special sessions on small detector labs & internet of things / 160

Cosmic Watch for Education and Outreach in Africa and Beyond

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Several years ago, Spencer Axani of the Massachusetts Institute of Technology designed and tested a very small, inexpensive cosmic ray detector that he named the Cosmic Watch. He also provided plans and resources to the public for anyone to build and use one. A little over a year ago, inspired by the TanQ project in Japan, the U.S. QuarkNet program built 48 of these detectors, which have been used and tested by QuarkNet members in a variety of scenarios. We will discuss what was learned about the Cosmic Watch and then shift that discussion to how it may be used in physics outreach and education in Africa. The goal is for students and teachers to collect and analyze cosmic ray muon data in order to build enthusiasm for and deeper understanding of fundamental physics.

Abstract Category:

Physics Education

161

Computational fluid dynamics study of helium-air heat pipe heat exchanger for application in nuclear reactors

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Abstract Category:

Nuclear Physics

162

The Influence of Gadolinium on the Photocatalytic Performance of ZrO2-g-C3N4 Systems Towards the Degradation of an Organic Dye in Water

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Abstract Category:

Materials Physics

163

Proton beam, electron beam, and femtosecond laser writing lithography method for semiconductor microstructures

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Abstract Category:

Materials Physics

Renewable energies & Energy Efficiency / 164

State of Renewable Energy Development in South Africa

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The world is experiencing one of the worst energy crises exacerbated by the Russia-Ukraine conflict in addition to the traditionally known global population growth-induced rising energy demand,

poor organization of resource distribution, general aging infrastructure, inefficient use of energy resources, and limited or no renewable energy options. The effect of the crisis is, among others, the untenable increase of fossil fuel and electricity prices, making renewable power technologies much more economically attractive. Like many countries in the continent and abroad, South Africa has not been spared. The country's rising energy demand overwhelms existing power-generating plants, critically threatening energy security. The country is traversing the worst electricity shortage in its history, resulting in power cuts extending up to 12 hours a day in some parts of the country, hampering economic growth, increasing job losses, and threatening the viability of basic social systems upon which these services depend. Aging coal-fired plants that still contribute more than 80% of South Africa's electricity generation has been the first culprit to the electricity crisis the country is experiencing. South Africa thus has a double challenge to solve, improve its electricity generation and reduce its carbon dioxide footprint as outlined in the outcomes of COP27. Like in many countries, South Africa has launched the Just Transition, an integrated climate-cum-economic development program that seeks to navigate from its heavily carbon-intensive economy that put the country at the 13th highest emitter position globally in 2020. Through renewable energy investment, South Africa could leverage high economic multiplier effects whilst reducing its current vulnerability to fossil fuel price volatility and the associated negative environmental externalities. This paper reviews the current state of renewable energy in South Africa, focussing on the policy environment, technical feasibility, and prospects. Appropriately selected international global and national energy reports and energy-related policy documents are critically reviewed, and recommendations on possible pathways to accelerate the Just Transition implementation are outlined.

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Abstract Category:

Energy

Parallel Session 2 / 165

Search for the dark vector boson

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Hidden sector or dark sector states appear in many extensions to the Standard Model, to provide a particle candidate for dark matter in universe or to explain astrophysical observations such the as positron excess observed in the cosmic radiation flux. A hidden or dark sector can be introduced with an additional U(1)d dark gauge symmetry. The presence of the dark sector could be experimentally inferred at colliders as deviations from the SM-predicted rates of Drell-Yan (DY) events, from Higgs boson decays through exotic intermediate states, or other processes, which may depart from the SM predictions. The discovery of the Higgs boson during Run 1 of the Large Hadron Collider opens a

new and rich experimental program based on the Higgs Portal. This discovery route uses couplings to the dark sector at the Higgs level, which were not experimentally accessible before. These search studies possible exotic decays: H -> Zd Zd -> 4l. Here Zd is a dark vector boson. We have experience of this search from Run 1 and Run2 period of the LHC using the ATLAS detector at CERN. As things evolved, the search now further broadened and includes allowing the mass of the originating scalar to vary away from the SM Higgs : S -> Zd Zd -> 4l, where S is a scalar. This allows the search for the dark vector boson to also explore additional masses (instead of limiting the dark boson mass range [15 GeV, 60 GeV] as previous analysis). This extended search is efficient and could include a more general class of models, with the constraint of the SM Higgs portal lifted. This contribution focuses on the extension of the additional scalar by using full Run 2 with 13 TeV collision energy, which expands the search area, takes advantage of higher statistics, and substantially better performance of the ATLAS detector.

Abstract Category:

Particle Physics

166

Towards a Century of Physics in South Africa: Achievements and Advances

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Abstract Category:

Physics Education

167

Studying the dependence of observables on the impact parameter (b) in Pb+Pb High Energy Heavy-Ion collision particle multiplicity from the microscopic model (UrQMD) at Eelb = 990 AGeV.

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Abstract Category:

Particle Physics

168

Direct Photons as an Evidence for the QGP Formation in Heavy-Ion Collisions

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Abstract Category:

Particle Physics

Medical Physics Education / **169**

The Status, Challenges and Opportunities of Medical Physics in Africa

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The aim of this talk is to provide information on the status, challenges and opportunities of the medical physics profession in Africa. An introduction will be given on the role of medical physics in healthcare. A brief history of medical physics in South Africa will be presented. South Africa has one of the oldest medical physics societies in the world. An overview will be given on the education and training requirements to become a clinically qualified medical physicist, and which African countries offer these. Medical physicists are healthcare professionals who should require registration with a health professions council. The professional recognition of medical physicists across Africa will be presented. The medical physics gap will be described, as well as current attempts at capacity building in medical physics in Africa. The role of a national society and the of the Federation of African Medical Physics Organizations will be elaborated on.

Abstract Category:

Medical Physics

170

PRECIPITABLE WATER VAPOUR MEASUREMENTS FOR THE AFRICA MILLIMETRE TELESCOPE

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Abstract Category:

Astrophysics & Cosmology

Parallel Session 1 / 173

Measurement of the Energy Response of the ATLAS Calorimeter to Charged Pions from tau-lepton Decays in Run 2 Data

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The measurement of the ATLAS calorimeter response E/pT is performed for single charged pions with a transverse momentum (pT) ranging from 10 to 300 GeV using 139 fb−1 of proton-proton collision data at √s=13 TeV taken in RUN 2 by the ATLAS detector of the Large Hadron Collider (LHC) [1]. The use of charged pions originating from τ-lepton decays allows the measurement of the response of the calorimeter in the high pT regime. In the ATLAS simulation, this response is found to be approximately 2% overestimated in the central region and 4% underestimated in the endcaps. The uncertainties in the measurements in the central region are less than 1% for pT ranging from 15 to 185 GeV and reach 0.6% in the most precise region. A brief introduction about the ATLAS calorimeter will be presented, followed by a description of the event selection. The energy response as well as the uncertainties in the measurements will also be evaluated [2].

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URL: https://cds.cern.ch/record/1129811
[2] Measurement of the Energy Response of the ATLAS Calorimeter to Charged Pions from W ± ⟶τ ±(⟶ π±ντ)ντ Events in Run 2 data : CERN-EP-2021-147
URL: https://cds.cern.ch/record/2778857

Abstract Category:

Instrumentaions & Detectors

Parallel Session 2 / 176

STUDY OF SPECTRA OF HF VI

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Hafnium (Z = 72) is an element that could be employed in plasma-facing materials in Tokamaks [1,2] and is also produced in neutron-induced transmutation of tungsten (Z = 74) and its alloys that will compose the divertors in these fusion reactors [3]. As a consequence, their sputtering may generate ionic impurities of all possible charge states in the deuterium-tritium plasma. These impurities could contribute to radiation losses in controlled nuclear fusion devices. The radiative properties of these ions have therefore potential important applications in this field [4,5,6]. Many lines of Hf VI in UV range, precisely from 193 A° to 474 A° , have been calculated. As no experimental determination of radiative rates is available in the literature, a multiplaform approach has been adopted to carry out the present calculations so as to estimate the accuracy of the computed rates. From the comparisons of our three independent models based on both the HFR [7] and MCDHF [8,9] methods along with

the calculations published by Ryabtsev et al. [5] that they used for line classification purpose, it was found that the uncertainties affecting the theoretical rates range from a few percent (for our HFR model) to ~40 % (for our MCDHF-RCI-A model) for the strong E1 transitions with S ≥ 1 a.u. With respect to the other lines, they can be highly inaccurate with uncertainties far more than 100 % due to strong cancellation effects and important gauge disagreements that render the rates highly model sensitive. This is essentially caused by the strong mixing affecting most of the Hf VI atomic states. Finally, we recommend our HFR rates except for the two lines at 223.172 Å and at 231.451 A˚ where the gA-values of Ryabtsev et al. [5] should be used instead with an uncertainty indicator Unc. equal to E (> 50 %), due to strong cancellation effects affecting the former for these two transitions. We have plotted in 3 figures the difference between the level energy calculated in our three independent models and the one determined experimentally by Ryabtsev et al [5]; also plotted in 3 figures the comparison of our transition probabilities, with respect to the calculation of Ryabtsev et al. [5], The ratio, gAHFR/gARYA, is plotted versus our HFR line strength, SHFR, both in logarithmic scale. Similar plots are displayed for our MCDHF-RCI-A and our MCDHF-RCI-B models.

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Abstract Category:

Atomic & Molecular Physics

177

A High-Granularity Timing Detector for the ATLAS Phase-II upgrade

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Abstract Category:

Instrumentaions & Detectors

Parallel Session 1 / 178

High-quality Chemical Vapour Deposition (CVD) produced graphene.

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Since its first isolation from graphite, graphene has exhibited interesting properties such as high electrical conductivity and flexibility. These properties catapulted graphene to be at the forefront of most applications from energy storage to biological sensors. The effectiveness of graphene in different applications is affected by the synthesis technique used, which affects the quality, the number of layers and the orientation of the graphene sheets. Many synthesis techniques have been developed; however, the chemical vapour deposition (CVD) technique has attracted much attention because it generates high-quality graphene. In this study, the use of CVD for the synthesis of high-quality graphene with a controllable number of layers is explored. Different parameters were investigated such as carbon source type, carbon source flow rate and the reaction time. The synthesised graphene was characterised using Raman spectroscopy, Scanning electron microscopy (SEM) and X-Ray photoelectron spectroscopy (XPS). Graphene materials with different quality and number of layers were produced. Preliminary Results have shown that graphene materials with bilayers to multiple layers were successfully produced. The Raman analysis also indicated the formation of high-quality graphene. The produced graphene materials will be tested for the development of biosensors, where it will be used as a substrate in Surface-enhanced Raman spectroscopy (SERS) for the detection of different analytes.

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Abstract Category:

Materials Physics

Parallel Session 1 / 179

Indoor exposure prediction through Monte Carlo Simulation Geant4 : Case of primary schools of the Doukkala-Abda Region

Author: Asmae Ettoufi[1]

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A higher level of radiation may result from the use of building materials with a higher degree of radioactivity in addition to the ongoing exposure of humans to background ionizing radiation. As a result, it is important to assess the radionuclide content of construction materials as well as the

potential exposure to occupants from these materials. is study employed Monte Carlo simulations to determine the absorbed dose rate and annual effective dosage brought on by the presence of naturally occurring radioisotopes Ra226, 232, and K40 , in a common primary schools[1] . Additionally, values determined from frequently used straightforward equations pertaining to the dose rate emitted by granite plates covering the inside of a typical room were compared with the results of the dose rate simulation. In the simulation, a room/class was built with typical proportions (4 m by 5 m by 2.8 m) with a 3 cm thick granite floor and walls. The room's focal point was a MIRD Human phantom. It was simulated that the sample matrix would emit the strongest gamma rays from the progeny of Ra226, 232, and K40. Each simulation's quantity of produced photons—typically of the order of 106 —exactly matched the amounts of Ra226, 232, and K40 activity seen in material samples. e spectra of deposited energy inside of the water cylinder were obtained ater GEANT4 simulation software took into account all processes involved in the interactions of gamma photons with the granite matrix itself, the outer concrete shell, the air inside the room, and the water cylinder. For the different examined samples, each with a different amount of Ra226, 232, and K40 , the deposited energy was used to determine the distribution of the absorbed dose rate and yearly effective dosage. e numbers obtained by applying a standard formula were found to be 30%–40% lower than the values obtained by simulating the absorbed dose rates and, subsequently, the annual effective dosage.

Key words: Geant4,indoor exposure, Dose,Annual effective dose

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estimate annual efective doses in the primary schools of the Doukkala-Abda region, Morocco. Indoor and Built Environment.
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Abstract Category:

Nuclear Physics

Physics education & community engagements / **180**

A look into the physics education system in Zambia and Africa as a whole

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As we push Africa towards becoming an equal competitor in scientific research and socio-economic development on the global stage, we can not ignore the crucial role that a high quality physics education system has to play in achieving this goal. In addition to its various other benefits, physics can greatly contribute to a steady supply of trained, motivated and competent researchers to exploit scientific advancement which would in turn bring about development in various sectors of the economy. Therefore, it is imperative that Africa builds a sustainable high quality physics education system. In this contribution, we will briefly review the status of physics education in Africa, with a particular focus on Zambia. We will also discuss some major factors affecting the advancement of physics education in Africa and ways to make physics research attractive to both high school learners and university students. Finally, we will highlight the existing African and international initiatives that can be accessed by Africans in this effort.

Abstract Category:

Physics Education

Parallel Session 2 / 181

A novel 3D vertex model predicts the biomechanical factors of cell delamination in stratified epithelial tissues

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Multilayered epithelial tissues, such as skin and gut, comprise major organs in humans. These tissues perform multiple functions, including serving as a barrier to mechanical insults, and pathogens. They are constantly self-renewing while balancing proliferation in the basal layer with a tightly controlled differentiation program in which cells move upward while undergoing stepwise transcriptional and cell shape changes to form the distinct suprabasal layers. Misregulation of these self-renewal processes causes disease, including cancer and many inflammatory diseases. Understanding how mechanosensitive mechanisms at the scale of molecules couple to the collective mechanical behavior of the self-renewing tissue and help regulate stratified tissue homeostasis is thus essential. The stratified epithelium displays apico-basal polarization, with differential expression of polarity proteins across layers. It is not clear how stratified epithelial tissues like the epidermis integrate local and global changes in mechanochemical signals to allow single or multiple cells of the basal layer to differentiate and move upward crossing the sharp basal-suprabasal boundary. Here we develop a biomechanical model to help unravel such complexities. We use the model to investigate several experimentally-driven hypotheses for what drives delamination: i) changes in the adhesion of basal cells to extra cellular matrix in the basement membrane, ii) local fluidization of surrounding tissue due to fluctuations or nearby cell divisions, or iii) cell autonomous changes to cell-cell adhesion and cortical tension. Future work will also investigate cell-autonomous changes to cell mechanics during symmetric or asymmetric cell division.

We investigate these hypotheses using computational simulations of a novel dynamic 3D Vertex model of stratified epithelia, recently developed in our group. Experimental data from the developing mammalian epithelium in the Niessen and Wickström labs have identified specific changes to the transcriptome of cells committed to delamination. Many of these changes are associated with cell-cell and cell-substrate adhesion pathways. We incorporate them in the computational models as changes to the model parameters describing heterotypic and homotypic cell-cell interfacial tensions and adhesion to a fiber network substrate. We make quantitative predictions for cell shapes, delamination probabilities, and delamination speeds that we compare directly to experiments, in both control and perturbed systems, in order to determine how different mechanisms are driving delamination.

Abstract Category:

Biophysics

182

Echoes of quadratic divergences cancellation on the Next-two Higgs doublet model

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Abstract Category:

Particle Physics

183

Latest Result of the STEREO Experiment at the ILL & Interpreting Reactor Antineutrino Anomalies

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Abstract Category:

Particle Physics

Special session on big detectors & large research infrastructures in Africa / 185

Overview of Ion Beam Analysis (IBA) activities at iThemba LABS-NRF

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iThemba LABS is a facility that houses various research accelerators, including the latest 3 MV TandetronTM Accelerator, which was installed in 2017 to replace the 51-year-old 6 MV CN Van de Graaff Accelerator. High Voltage Engineering Europa B.V. (HVE) was responsible for installing and commissioning the new accelerator in the Tandetron Laboratory. The accelerator has the ability to accelerate charged particles to MeV energies from three ion sources, including a Cs sputter source for heavy ions and two multi-cusp ion sources for helium ions and protons. The primary purpose of the accelerator is to facilitate research in ion beam analysis (IBA) and low-energy astrophysics. The 3 MV TandetronTM accelerator is linked to the experimental section through 90-degree analysing and switching magnets that direct the charged particle beam into the experimental chambers. Currently, two active beam lines are designated for solid-state physics techniques like Rutherford Backscattering Spectrometry (RBS) and Elastic Recoiled Detection Analysis (ERDA), as well as nuclear microprobe-based techniques such as Particle-Induced X-ray Emission (PIXE) and proton beam writing. Another beam line is under commissioning for astrophysics-related research projects. The ion sources available with the accelerator can produce high-intensity beams of 200 eμA and 25eμA for protons and helium light ions, respectively, and a maximum of 150 μA for heavy ions at the terminal voltage of 3 MV. This makes the accelerator particularly promising for materials research areas such as ion implantation, radiation hardness testing, and shielding studies. The Tandetron laboratory has recently expanded its research areas to include studies associated with laser-matter interaction using femtosecond lasers, diffusion kinetics studies in nuclear waste storage materials and hydrogen storage materials, measurement of fundamental parameters in ion-matter interactions, and surface texturing or patterning using proton beams.

Abstract Category:

Accelerators

Special sessions on small detector labs & internet of things / **186**

IoT and its implications to Africa

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This talk will explore the implications of the Internet of Things (IoT) for Africa's development and how Sustainable Development Goals (SDGs) provide a comprehensive framework for addressing the challenges in advancing sustainable development in Africa. We will talk about The Internet of Things (IoT) as a rapidly growing technology that has the potential to transform various sectors in Africa, including agriculture, healthcare, transportation, and smart cities. We will also examine the challenges to the adoption of IoT in Africa, such as limited access to reliable and affordable internet connectivity, lack of technical skills and infrastructure, and security concerns. We will discuss possible solutions to address these challenges and promote IoT adoption in Africa, here we will talk about the Unity Board (www.unityboard.ng) as a project based learning system for skills development. We will Highlight the role of governments, private sector, and civil society in promoting IoT adoption. Africa We will also discuss the activities of the Nigerian Government so far in adopting IoT. Case studies: we will discuss my various indigenous IoT solutions deployed and recommendations on the way forward. Finally, We will talk about the activities within td4pai IoT Hub (www.td4pai.org.ng), an innovation charity I established in Nigeria for capacity development in emerging technologies.

Abstract Category:

Computing & 4IR

Special sessions on small detector labs & internet of things / **187**

Zigbee-based wireless smart device for enclosed space real-time air quality monitoring: Experiment, data analysis and risk assessment

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This project deals with the development of a smart real-time indoor (offices and family homes) air quality monitoring device based on Internet of Things (IoT). Environmental data from the sensor nodes are sent over the ZigBee wireless communication protocol, and after collection are subjected to careful statistical analysis for exposure risk assessment. The free XCTU platform application in interaction with the XBee modules is used to visualize real-time temporal evolution of the measured data. This portable device is composed of a microcontroller board, XBee wireless transmission modules, and some low-cost air pollutant sensors including particulate matter (PM2.5) and toxic gas (ground-level ozone O3, carbon monoxide CO, sulfur dioxide SO2, nitrogen dioxide NO2) sensors. Particular attention is paid to indoor air quality in this chapter due to the long-term occupation of confined spaces by people. The results of measurements taken from September 21 to October 22, 2020, in two different confined spaces (home and office), in the city of Yaoundé-Cameroon, gave maximum exposure rates of 13.06 µg/m3 (home) and 10.71 µg/m3 (office) for PM2.5 ; 18.65 ppm (office) and 17.72 ppm (home) for SO2; 4.97 ppm (office) and 7.49 ppm (home) for NO2; 2.42 ppm (office) and 1.30 ppm (home) for O3 and, 18.03 ppm (office) and 13.66 ppm (home) for CO. Thus, both office and home spaces gave an internal Air Quality Index (AQI) lower than 50 and an Air Quality Health Index (AQHI), less than 1. The values are low, very varied but still acceptable compared to the WHO standard values. This is due to the diversity of potential sources of pollution which are the number

of inhabitants of the confined space, the gas emissions of the installed devices and the intake of outside air. From the results obtained, it emerges that in addition to its low-cost and its flexibility, the proposed device exhibits interesting performance in terms of reliability and global functionality. Keywords. Indoor Air quality; Microcontroller; Low-cost sensors; ZigBee protocol; Exposure risk assessment.

Abstract Category:

Computing & 4IR

Special sessions on small detector labs & internet of things / **188**

Empowering Students through Hands-On Learning: The IoT Development Lab at the University of Cape Coast, Ghana

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This presentation focuses on the IoT Development Lab at the University of Cape Coast in Ghana. The lab provides students with hands-on experience in developing and integrating embedded systems using Python and Micropython. The presentation highlights the controllers used in the lab, including the ESP32 and ESP8266, as well as the Raspberry Pi for high-level projects. The presentation also covers the impact of the lab on students' academic and professional development.

Abstract Category:

Computing & 4IR

Computing & big data / **189**

Unleaching the power of digital transformation in accelerator physics: a new collaborative approach

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The digital transformation of our society, fueled by big data, plays a vital role in addressing environmental concerns. The world of particle accelerators is constantly evolving, and both digital and environmental challenges have become significant factors that impact it. In this context, ensuring the reliability and optimal operation of research infrastructures becomes of utmost importance. To tackle these challenges, the European Accelerator Physics community is coming together with a synergetic approach, leveraging machine learning and artificial intelligence techniques. However, this endeavor brings its own set of challenges, particularly in terms of knowledge sharing and open science. Sharing computations, data, and methods in an open, FAIR (Findable, Accessible, Interoperable, Reusable), and collaborative context lies at the core of this new network. This presentation will focus on introducing this newly established European Network, discussing its current developments, and outlining the roadmap it aims to draw. The network's ambitions are not confined to the European sphere but strive to foster connections with the worldwide scientific community, creating a fully interconnected global endeavor.

Abstract Category:

Community Engagement

Parallel Session 1 / 190

Measurement of the electroweak cross-section for a same-sign W boson pair produced in association with two jets using 139/fb of ATLAS data

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Within the Standard Model (SM), weak vector bosons are allowed to be massive as a result of the spontaneously broken electroweak symmetry which is said to have been caused by a phase transition of the Higgs potential in the early universe [1]. However, there are still many unanswered questions surrounding the nature of this spontaneously broken electroweak symmetry. By probing the inner structure of electroweak interactions via measurements of the scattering of weak vector bosons at the Large Hadron Collider (LHC), we expect to have some answers. A deviation of these measurements from SM predictions would be indicative of the involvement of new physics. One important process used to probe the inner structure of electroweak interactions is the scattering of two same-charge W bosons. This is an extremely rare process within the SM, which was only observed for the first time about five years ago at a significance of 6.9σ [2] and 5.5σ [3] by the ATLAS and CMS experiments respectively. In ATLAS, the cross-section for this process was measured to be 2.91+0.51−0.47(stat.) ± 0.27(sys.) fb using only 36.1 fb−1 of data collected at a p − p center of mass energy of 13 TeV in Run II of the LHC. The large statistical uncertainties observed on this measurement are a consequence of the low statistics on the dataset used. Therefore, precision measurements have followed - utilizing the full Run II ATLAS dataset which amounts to 139 fb−1. This contribution will present the latest cross-section measurement for the electroweak production of a same-sign W boson pair in association with two jets using 139 fb−1 of data collected by ATLAS. A model-independent interpretation of these results in the search for a doubly charged Higgs boson produced in Vector Boson Fusion (VBF) processes will also be presented.

References
[1] P.W.Higgs, "Broken symmetries and the masses of gauge bosons,"Phy.Rev.Lett 13, vol. 508, 1964.
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Detector,"Phys. Rev. Lett., vol. 123, p. 161801, Oct 2019.
[3] CMS Collaboration, "Observation of electroweak production of same-sign w boson pairs in the two jet and two same-sign lepton final state in proton-proton collisions at √s = 13 TeV,"Phys. Rev. Lett., vol. 120, p. 081801, Feb 2018.

Abstract Category:

Particle Physics

Community Engagement & Tech. transfers / 191

Cultivating the skills ecosystem of the future

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By stating that the skills ecosystem needs cultivation, I imply that it needs care –that there currently is a skills shortage. Within my context, the skills shortage refers narrowly to the shortage of software developers in South Africa. I will argue that the way we do the cultivation is as important for the Physics skills ecosystem. Over the past 5-10 years, there has been a significant growth of software development companies in Gqeberha. S4 Integration, the biggest employer of our graduates, has been acknowledged more than once as the Exporter of the Year for the software they write for European clients. However, local industry partners such as S4 Integration, JAS, Avocado Chocolate, VSC Solutions, and Jendamark acknowledge that employing new developer talent remains a growing challenge. This reality is prevalent across South Africa, and there are growing signs that it applies more and more to the rest of the continent. During my visit to Europe in March, the conversations I had highlighted a similar pattern in countries such as Germany, the Netherlands, Ireland, and the UK. Whenever there is a skills shortage in the job market, companies first turn to, what we call "Harvesting the Pipeline". This refers mainly to aggressively recruiting from university graduates, or from employees at other companies. This clearly does not address the skills shortage. Another way of doing it is to "Nurture the Pipeline", which is upskilling your own staff –once again with its own challenges. Our engagement project, Tangible Africa, believes we need to "Feed the Pipeline" , or as our title says, cultivate the skills ecosystem of the future. Tangible Africa is an engagement partnership between Nelson Mandela University Department of Computing Sciences and the Leva Foundation. Our objective is to introduce school learners to coding concepts and careers without the use of computers. Since its inception in 2017, as an honours project by Byron Batteson, Tangible Africa's initial coding app TANKS (followed by RANGERS and BOATS) has been instrumental in educating over 100 000 learners and training 20 000 teachers in tangible coding. The games entail providing learners with specific challenges related to moving objects around on a grid, using a mobile device. The commands to move these objects are provided by making use of customised physical tokens, which are uniquely identified by QR Codes (referred to as Top Codes). When a photo is taken of the tokens, the commands are internalised before being executed, which moves the object on the screen of the device. The presentation will expand on this project, highlighting the 21st century skills that are enhanced, in addition to coding. These skills include computational thinking, problem solving and strategy. We believe that this is the pivotal link between what we do and the world of Physics.

Abstract Category:

Physics Education

Parallel session on African countries joining and thriving in large international collaborations / 192

The glue that binds us all: The Science of the Electron-Ion Collider

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The Electron-Ion Collider (EIC) under construction at Brookhaven National Laboratory will explore in detail the quantum world of quarks and gluons at distance scales less than a trillionth the width of a strand of hair. Though gluons are massless, and quarks nearly so, the emergent dynamics of these elementary objects in Quantum Chromodynamics (QCD) describes the vast bulk of the mass of the visible universe. Despite significant developments in our understanding of QCD, many of the details of quark-gluon dynamics remain deeply mysterious. We will discuss some of the outstanding questions that remain and outline how finely resolved multi-dimensional images extracted from high energy electron-ion collisions at the EIC can lead to fundamental insight into the glue that binds us all. In particular, we will highlight some of the interdisciplinary connections of this science across

energy scales, from the physics of primordial black holes and the early universe, to the dynamics of ultracold atoms.

Abstract Category:

Nuclear Physics

Astrophysics and Cosmology / 193

The growth and structure of nearby galaxies based on HI observations: capabilities of SKA pathfinders: KAT-7 and MeerKAT.

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Studying galaxies provides the best glimpse at how the universe is organised on a large scale, making their properties an important part of understanding the universe's nature and evolution. The Neutral hydrogen (HI), 21-cm line emission is a powerful tracer of an essential component of baryonic matter in the Universe. Unlike other tracers at other wavelengths, HI can be traced to a much larger distance from the galactic centre thus an ideal medium to trace the kinematics, dynamics, and environmental effects of galaxies out to larger radii. The Square Kilometer array, which is hosted jointly by South Africa and African partner countries, is a next-generation power telescope that will enable a deeper probe of HI. In the midst of the SKA implementation, there have been ongoing observations of nearby galaxies using its pathfinders KAT-7 and MeerKAT. I will describe the observations, discuss some of the derived results, and how these observations contribute to answering key questions about cosmology and astrophysics.

Abstract Category:

Astrophysics & Cosmology

Parallel session on African countries joining and thriving in large international collaborations / 194

The Status and Opportunities at the Electron Ion Collider

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A high-luminosity high-energy polarized electron-ion/proton collider (EIC) with variable Center of Mass Energies (CME) between 30-140 GeV will be built jointly by Brookhaven National Laboratory (BNL) and Jefferson Laboratory (JLab) at BNL in New York, US. When completed it will be the only polarized e-p/light-ion collider and the first and only e-Heavy-Ion collider in the world. The EIC is excepted to begin collisions starting early 2030's and operate for approximately two decades. Its operation and performance requirements driven by the exciting and challenging science —to study role of gluons in QCD —make the EIC (arguably) the most complex accelerator project ever undertaken. A full-acceptance hermetic detector is being designed and will be built by a newly formed ePIC Detector Collaboration. Seeds are being sown for a second detector. In this talk I will present the status of the machine, the detector ideas, and invite groups to join this exciting project not only

to take advantage of this scientific opportunity but also to educate future generations of African scientists.

Abstract Category:

Nuclear Physics

Nuclear and Particle Physics / **197**

Compact Colliders of Tomorrow for High Energy Physics

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Collider physics is rich, diverse, and versatile. Over the last several decades, colliders have played a central role in experimental establishment of the SM, from discovery of the charm quark in 1974 to the Higgs boson discovery in 2012 at the LHC. New colliders are likely be necessary to shed light on the existence and nature of new physics. Muon Colliders present a highly attractive future collider option due to their small size, high efficiency, and the potential to reach very high energies. In this talk I will present the case for a future high energy muon collider, review associated challenges and technology needs and outline a path forward. I will also discuss the Cool Copper Collider, which is an attractive compact, power-efficient electron-positron machine capable of making percent-level measurement of Higgs couplings. Innovative power delivery to the C-band copper linac structure that is kept at liquid-nitrogen temperature, allows accelerating gradients of over 120 MeV/m resulting in a small collider foot-print.

Abstract Category:

Accelerators

198

Synchronized TeraHertz Radiation and Soft X-rays Produced in a FEL Oscillator

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Abstract Category:

Accelerators

Astrophysics and Cosmology / **199**

Dark Matter: Looking beyond the Lamppost

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From astrophysical observations we conclude that about 27% of the universe consists of cold dark matter. Current theories of the exact nature of particle physics candidate for dark matter, provide several avenues for detection of this missing component of our Universe. Experimental efforts to directly verify the particle nature of this component of the Universe have been underway for more than two decades and continue to diversify as detection eludes us. I will present an overview of the most well motivated experimental efforts to detect dark matter candidates, as well as future detection prospects.

Abstract Category:

Astrophysics & Cosmology

Nuclear and Particle Physics / **200**

The Naturally Unnatural Standard Model of Particle Physics

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The Standard Model (SM) of Particle Physics provides an excellent description of nature. However, it is very much an empirical model: Why are there 3 generations of matter with such large mass hierarchies? What is the origin of their mixings? What is dark matter (DM)? What dynamics govern the Higgs mechanism? If Ultraviolet symmetry breaking governs the structure we observe at the weak scale, apparent fine-tunings may be a hint of the global structure dictating beyond the SM physics. In this talk I will discuss some fine-tunings that may be responsible for the structure we observe in Higgs couplings, fermion masses and mixings, and possible connections of the Higgs sector with DM.

Abstract Category:

Particle Physics

Atomic, molecular & laser physics / **201**

Introduction to spintronics: (c.f. Overcoming the skyrmion Hall effect)

Author: Collins Ashu Akosa[1]

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The recent years has witnessed a surge of research in the field of spintronics in which, the spin degree of freedom of electrons in combination with its charge, is employed to create smart, high-density, high-efficiency and low power-consuming data storage and memory technologies. Ever

since it was demonstrated that current traversing a magnetic sample may alter its magnetic configuration through the transfer of angular momentum, research in this direction has evolved into a large zoology of subfields with enormous potential applications. Fundamental to the realization of such applications requires the detail understanding of the behavior of tiny magnets and magnetic heterostructures at very short length and time scales.

This talk starts with a pedagogic introduction to the field of spintronics and some of our recent results with focus on magnetic skyrmions - chiral, localized and topologically protected whirling spin textures with enormous potential for spintronic applications. An interesting property of magnetic skyrmions is that spin-polarized carriers feel an emerging electromagnetic field. In spite of the remarkable potential application of magnetic skyrmions, they suffer from the so-called skyrmion Hall effect-a motion transverse to the current flow. This parasitic effect hinders the robust manipulation of skyrmions via charge current. We will discuss different approaches/proposal to overcome this parasitic effect.

Abstract Category:

Materials Physics

Computing & big data / **202**

Workforce development in quantum information science

Author: Silvia Zorzetti[1]

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Quantum Information Science (QIS) is a rapidly emerging field of study that holds immense importance for research. The Superconducting Quantum Materials and Systems Center, or SQMS, led by Fermilab, brings together national laboratories, educational institutions, and industry players to drive groundbreaking advancements in quantum computing and sensing. The technologies developed within SQMS will have far-reaching effects on both fundamental science and our daily lives. Beyond its technical objectives, the SQMS research center is dedicated to empowering the upcoming generation of quantum scientists and engineers. It offers distinctive opportunities such as internships, externships, and hands-on research experiences, engaging hundreds of students. These initiatives expose students to a diverse range of impactful careers within the expanding and innovative realm of QIS. Through these efforts, SQMS actively contributes to the growth of the quantum ecosystem while fostering the development of young talents who will shape the future of the field.

Abstract Category:

Materials Physics

Science Diplomacy / **203**

Science diplomacy and developing communities

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The term "science diplomacy"has traditionally been used to describe either science in diplomacy (the use of science to improve relations between countries, since scientists work across political borders), or diplomacy to assist science (collaboration between countries in major projects, such as the Square Kilometre Array). Now, perhaps, the concept of diplomacy might be extended from the management of relations between countries to the relations between science and society. Science serves different kinds of communities: the local community near a university or school; the students (where they're coming from and where they're going to), the interests of the nation, the economic community, the global scientific community, and the global society. Communities in Africa are evolving fast, and the role of science is more influential than it has been before. The principle of freedom and responsibility in science, which is fundamental to scientific advancement and human and environmental well-being, has become more important than ever. In Africa, nations are making progress in science and also improving the quality of life, when the dialogue between science and society is functioning well. We are also suffering regress due to catastrophes and circumstances beyond our control, as well as policy failures (the provision of electricity is an excellent example). This session explores some of the challenges, such as insight and vital evidence in reports that are never read by policymakers; the session also explores new learning about project management on our continent. Scientists are used to paradigm shifts. What new understanding do we need to develop to gain traction for science in the service of our societies?

Abstract Category:

Community Engagement

News and Information / **204**

Welcome addresses

Abstract Category:

Conference Reception & Early Career Panel Discussion / **205**

Early Career Panel Discussion—"Beauty of Physics"

Early Career Panel Discussion—"Beauty of Physics" will give some of tomorrow's physicists a little bit of inspiration from the experts, to help tackle the widely publicised "decline in physics".

Featured panelists:
• Prof. Azwinndini Muronga (Executive Dean of Natural Science, Nelson Mandela University)
• Prof. Mmantsae Moche Diale (Full Professor, University of Pretoria)
• Prof. Mohamed Chabab (Director of High Energy and Astrophysics Laboratory, Cadi Ayyad University Marrakesh)

If you would like to pose a question to our panelists, but would like to remain anonymous, please enter it below. We will be monitoring responses live during the early career panel discussion and will get to as many as time allows.

Abstract Category:

Astrophysics and Cosmology / **206**

African Astronomical Society –from Cape to Cairo

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Abstract Category:

Astrophysics & Cosmology

Physics & Climate Change / **207**

The application of physics in weather and climate sciences

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According to the Assessment Report 6 of the Intergovernmental Panel on Climate Change (IPCC), climate change has changed the characteristics of weather and climate extremes, including over southern Africa. These extremes undermine the attainment of the National Development Plan, the African Union Agenda 2063 and the Sustainable Development Goals. The United Nations has pledged to work through one of its agencies, the World Meteorological Organization, to ensure that everyone on the globe has access to early warning systems by the year 2027. Early warnings can mitigate against the severity of weather and climate related disasters. Weather forecasts and climate predictions rely on the use of numerical weather and climate models. These models solve partial differential equations based on conservation of momentum, energy and mass, as well as the equation of state. Processes with a length scale much larger than the grid length are resolved explicitly by the models, while subgrid processes are parametrized. The regime where the grid length and the length scale of the targeted process are the same has been termed the greyzone. Models used for short-range forecasts generally use higher resolution than those used for climate studies. The spatial resolution used by models has increased over time due to increased availability of super-computers. This means new subgrid models need to be developed or existing ones need to be tested for high resolution or scale awareness. Model simulations continue to be associated with shortcoming, such as, missing the location of heavy rainfall events, or the intensity of events. There is an expectation that as resolution is increased, the model skill and detail will improve. The presentation will show results from sensitivity studies to resolution, cumulus schemes, cloud microphysics schemes and planetary boundary layer schemes. The use of convection scheme that are not scale aware at convective scales results in intense rainfall events being missed. Scale aware schemes are able to capture the intensity of tropical cyclones better. Rainfall simulations are more sensitive to changes in the convection schemes than they are to cloud microphysics and planetary boundary layer schemes. Subgrid models are a major source of uncertainty in climate change projections, especially of rainfall. More work is needed from across the globe, including from the African continent whose contribution to model development has remained limited, to improve models further. These developments have to be coupled with efforts to improve the observation network across the continent, that can inform better understanding of earth science processes, as well as be used as input to models.

Abstract Category:

Earth Physics

Computing & big data / **208**

IDIA Science Gateway For Radio Astronomy

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The Inter-University Institute for Data Intensive Astronomy Science Gateway has been created to access the ilifu OpenStack system that is based at the University of Cape Town. Much of the work done on ilifu is processing data from the MeerKAT telescope, which is a precursor of the Square Kilometre Array (SKA). This is the start of creating tools that can be used to set up a federation of cloud computing and storage systems throughout South Africa. Some of the requirements for the gateway include limiting the amount of code that needed to be written by us, to minimize the amount of support time needed to manage user accounts and take advantage of web based federated identity management. We also wanted to provide single-sign-on to existing best in class applications.

Abstract Category:

Computing & 4IR

Medical Physics / 209

Tiny drones to target cancer, powered by Artificial Intelligence

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Cancer is a major global health challenge that causes millions of deaths every year. Current treatments such as surgery, chemotherapy, and radiotherapy have limitations and side effects. Therefore, there is a need for novel and effective approaches to fight cancer. Here, a new approach is presented that uses tiny drones to target and kill cancer cells that have spread in the body. These drones include nanodrones loaded with immunotherapy drugs that can amplify the effect of radiotherapy on cancer cells locally (via Einstein's photoelectric effect), while releasing immunotherapy medicine that trains a subject's white blood cells to recognize and eliminate cancer cells throughout the body. The design, fabrication, and testing of these drones in vitro and in vivo leading to FDA approved clinical trials is described with the integration of artificial intelligence for image-guided precision treatment. The potential benefits, challenges, and future directions of this innovative technology for making immunotherapy low-cost and widely accessible across Africa are presented, offering a promising and personalized way to treat cancer with minimal damage to healthy tissues. Opportunities for cross-disciplinary research and career development in medical/bio-physics and artificial intelligence are also presented.

Abstract Category:

Medical Physics

Parallel session on African countries joining and thriving in large international collaborations / 210

Discussion on EIC

News and Information / **211**

Address by BD Reddy, PhD | Professor Emeritus Vice-Chancellor at the University of Cape Town

Abstract Category:

Conference Dinner / **212**

Conference dinner and keynote address

Abstract Category:

Nuclear and Particle Physics / **213**

Unveiling New Frontiers in Particle Physics: Exploring Beyond the Standard Model at the LHC

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Discover the remarkable world of the Large Hadron Collider (LHC) and its experiments as we journey into the heart of particle physics. Designed for non-experts in particle physics, this talk showcases the LHC's achievements and sets the stage for the motivation behind Beyond the Standard Model (BSM) physics.

We'll dive into the mysteries of the Standard Model, highlighting the fascinating deviations that inspire BSM investigations. Through compelling examples, we'll shed light on the hunt for hidden particles and forces, including dark matter candidates.

The journey concludes with the High-Luminosity LHC (HL-LHC) horizon, where even greater discoveries await. Join us in unraveling the universe's fundamental fabric and igniting the spirit of scientific exploration.

Abstract Category:

Particle Physics

Astrophysics and Cosmology / **214**

New Approaches on Dark Matter Detection

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The search for particle dark matter has seen tremendous progress and developments in the last decade. One of the primary methods for understanding the particle nature of dark matter is through direct detection. In this talk, I will provide an overview of the progress made in dark matter direct detection, discuss the synergies with other probes for dark matter, and give a look at what we can hope to see in the next decade.

Abstract Category:

Astrophysics & Cosmology

Renewable energies & Energy Efficiency / 215

The renewable energy and green hydrogen landscape in Namibia

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Namibia, situated in southwestern Africa, is emerging as a significant player in the renewable energy and green hydrogen landscape. As a country blessed with abundant solar and wind resources, Namibia has recognized the potential of these renewable sources to address its energy needs and reduce its carbon footprint. This presentation provides an overview of the current state and future prospects of renewable energy and green hydrogen in Namibia. The vast expanses of arid land in Namibia are ideal for solar energy generation, and the country has the potential to become a regional hub for solar power production. In addition to solar energy, wind power is also gaining traction in Namibia. The country's coastal regions exhibit strong and consistent winds, presenting an excellent opportunity for wind energy development. Several wind farms have been established along the coast, contributing to Namibia's growing renewable energy capacity. Namibia's ample renewable resources make it an attractive location for green hydrogen production, positioning the country to become a key player in the emerging global hydrogen economy. The development of renewable energy and green hydrogen in Namibia presents numerous advantages. It reduces the country's reliance on fossil fuels, enhances energy security, and promotes sustainable economic growth. Moreover, the expansion of the renewable energy sector creates job opportunities and contributes to the mitigation of climate change. However, challenges such as infrastructure development, financing, and regulatory frameworks need to be addressed to unlock the full potential of renewable energy and green hydrogen in Namibia. Collaborations with international partners and knowledge sharing can play a crucial role in overcoming these barriers and accelerating the transition to a sustainable and decarbonized energy system in Namibia. Namibia is making significant strides in renewable energy deployment, particularly in solar and wind power, while also exploring the potential of green hydrogen. With its abundant renewable resources and favorable policy environment, Namibia has the opportunity to become a regional leader in the renewable energy and green hydrogen landscape, contributing to both its own sustainable development and the global transition to a low-carbon future.

Abstract Category:

Energy

Computing & big data / 216

High Performance Computing developments in South Africa: The Efforts in support of Physics

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The need for High Performance Computing as a third pillar of investigations for physics discoveries has been clearly demonstrated globally. In South Africa the need for HPC has been driven from many sectors of science and engineering, and physics has been one of the major drivers. For example many activities in material science in search of solutions for mineral beneficiation, participation in large science projects, such as Large Hydrogen Collider, and now recently, the award of the square Kilometer Array (SKA) to both Australia and South Africa. The focus of this talk will look at investments in developing capacity in south Africa and the entire African continent for skills and infrastructure in support of these initiatives.

Abstract Category:

Computing & 4IR

Renewable energies & Energy Efficiency / **217**

Opportunities and challenges of exploiting white and green hydrogen in Africa to decarbonise the global economy

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Hydrogen is the most abundant element in the universe. The molecular form of hydrogen that is of interest as an energy carrier is the diatomic molecule composed of two protons and two electrons, H2. Hydrogen could be the energy carrier of the future. Captured in its natural form, known as ‘white hydrogen’, or produced from renewable energy sources, known as ‘green hydrogen’, it is climate-friendly and can be used to reduce greenhouse gas emissions. Because it can be transported over long distances and stored for long periods, hydrogen has the potential to become the basis for climate-neutral mobility, industry and heat supply. Hydrogen can be produced using a variety of processes and energy sources. Colour codes are used to distinguish between the different processes. This presentation will introduce the different production processes before assessing the challenges and opportunities of harnessing ‘white’ and ‘green’ hydrogen in Africa for the decarbonisation of the global economy.

Abstract Category:

Energy

News and Information / **218**

News and Info

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News and Information / **219**

An overview of the African School of Physics

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Abstract Category:

News and Information / **220**

The 4th Edition of the African Conference on Fundamental and Applied Physics, ACP2025, in Togo

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Abstract Category:

Biophysics / **221**

Neutrons and Model Membranes

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The understanding of the function of cellular membranes requires the study of their structure and dynamics. Cellular membranes are complex assemblies of lipids and proteins. In particular the lipid scaffold, is composed by a large variety of lipid species and levels of chain unsaturation, often difficult to synthesise chemically. Because of this complexity, model membrane systems from simple lipid bilayers are often used for fundamental studies and those can profit from probes able to access different scales of size and time like thermal neutrons and synchrotron radiation. Since the pioneering neutron scattering work in the seventies on cell membrane structure, developments driven by constantly improving neutron instrumentation, coupled with development of measurement and analysis methods, have involved both the optimisation of samples towards more biologically relevant model systems including the use of more and more complex lipid mixtures up to natural extracts.

Abstract Category:

Biophysics

News and Information / **222**

Closing—ASP/ACP Outlook

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Abstract Category:

Atomic, molecular & laser physics / **223**

Capturing a quantum image without a camera

Author: Chané Moodley[1]

Co-author: Andrew Forbes [2]

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Pairs of entangled photos are used to reconstruct an image in the application area known as quantum ghost imaging. It is the correlation between the photon pair that allows for the reconstruction of the image, as opposed to single photon detection. The entangled photons are spatially separated into two independent paths, one to illuminate the object and the other which is collected by a spatially resolving detector. Initially, ghost imaging experiments accomplished spatially resolving detectors by moving a single-pixel detector throughout a transverse scanning area. Advancements consisted of using ultra-sensitive cameras to avoid a system consisting of physically moving detectors. Ultra-sensitive cameras are, however, expensive and have limited spectral sensitivity. Here we demonstrate an alternative by utilising a spatial light modulator and a bucket detector to spatially resolve what is detected. Historically, imaging speeds have been slow and inefficient due to the quadratic increase in the scanning capability for spatially resolved detectors and the low light levels associated with quantum experiments. Here we additionally utilise deep learning algorithms to improve both image reconstruction time and resolution. We demonstrate this with a non-degenerate ghost imaging setup where the physical parameters such as the mask type and resolution are varied and controlled on a spatial light modulator. Thereby answering the question: can we image an object without using a camera?

Abstract Category:

Atomic & Molecular Physics

Special session on big detectors & large research infrastructures in Africa / **224**

Large Detector Systems in Particle Physics Experiments and the Role Africa Will Play in the Detector Technologies of the Future?

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In this talk, we will give a brief overview of some of the detector technologies deployed in large-scale experiments in particle physic research labs and through a specific Micro Pattern Gaseous Detector (MPGD) technologies example, we will discuss challenges associated to these technologies in term of production, assembly, characterization and deployment in complex detector system for the experiments.

In the second half of the talk, we will initiate the discussion on the role that African countries could play in the development of detector technologies in the future for application in various field of fundamental and applied science. We will hope to engage the audience to explore initiatives under the African Strategy for Fundamental and Applied Physics (ASFAP) umbrella to encourage African research institutions and universities to invest in detector research and development (R&D) and in infrastructures dedicated aimed at covering all aspects of detector technologies and providing opportunities to generation of bright young African minds to take part in international collaboration of large-scale experiments at facilities such as the Electron Ion Collider (EIC) in the USA or the European Organization for Nuclear Research (CERN) and to contribute to the deployment and operation of detector technologies in future experiments.

Abstract Category:

Instrumentaions & Detectors

Materials Physics Computing / **225**

Collaborative Research in Machine Learning on the African Continent

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After a series of training in Machine Learning (ML), we developed a group of about 15 researchers across different countries in Africa working together online to use ML tools in the study of materials and compounds. In particular, the group is developing ML models for:
a) determining whether a material is an insulator or a conductor
b) predicting the nature (direct/indirect) of band gaps of semiconductors with little computation
c) searching for hard materials
d) finding compounds with very high thermal conductivities
The research group shares computational resources (hardware and software) as well as human expertise through its online weekly meeting and is open to anyone interested. Some of our scientific results will be presented as well as benefits and challenges of the team.

Abstract Category:

Materials Physics

Discussion on light source infrastructures in Africa / **226**

Inverse Compton Scattering & Light Source Research Infrastructure

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Abstract Category:

News and Information / **227**

Address by the Director of iThemba LABS

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Abstract Category:

Poster Session / **228**

List of contributed posters

https://indico.cern.ch/event/1229551/contributions/?config=dbdcd63e-7d61-4caf-93fe-b9465d472e28

Nuclear and Particle Physics / **229**

Novel probes of dark matter at the LHC

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Historically searches for dark matter (DM) in colliders have focussed on weakly interacting scenarios, where the experimental signature is so-called mono-X, X being a standard model (SM) particle or a jet. However, recent phenomenological work has also suggested novel signatures emanating from strongly interacting scenarios, one of them is termed semi-visible jets (SVJ). In this case, jets are produced interspersed with DM particles, resulting in a signature of missing transverse momentum aligned with one of the jets, which is an experimentally challenging search. In this talk, I will discuss the first ATLAS result, and also cover multiple pioneering studies our group has performed on SVJ, and touch upon future plans.

Parallel Session 1 / **230**

Measurements of heavy-flavour production in pp collisions at √s = 13 TeV with the ALICE detector

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Heavy-flavour production measurements in pp collisions are important tools to test theoretical models based on pertubative quantum chromodynamics (pQCD) calculations and to investigate the mechanisms of heavy-quark hadronization. In ALICE, heavy-flavour particles are measured via the hadronic and electronic decay channels at central rapidity ($|\eta|<0.9$), and via the muonic decay channels at forward rapidity ($-4 < \eta < -2.5$).

In this contribution, the production cross section measurements of leptons from heavy-flavour hadron decays are presented and compared to pQCD-based calculations. In particular, the measurements of heavy-flavour decay muon at forward rapidity and electron production at mid-r.apidity as a function of charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 8 and 13 TeV will be presented, respectively. Measurements of charm-hadron production are crucial to study the charm-quark hadronization mechanisms in a partonic-rich environment generated in pp collisions at the LHC energies. The latest measurements of D-mesons and charm-hadron production performed with the ALICE detector at midrapidity in pp collisions at $\sqrt{s}$ = 13 TeV are also presented. These results will also be compared to theoretical model calculations

Parallel Session on "Early Career African Physicists" / 231

Opening

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Parallel Session on "Early Career African Physicists" / 232

Trailblaizing: From ASP (MSc Student) to PDRA in Extragalactic Astrophysics

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"One of the most enduring and fundamental questions in modern astrophysics is
understanding how galaxies form and evolve through cosmic time. Key to this question is understanding the interplay and feedback between star-formation (SF) and accretion onto supermassive black holes (SMBHs). High sensitivity, high angular resolution radio
observations are a crucial part of these investigations, uniquely providing spatially resolved tracers of SF and accretion (Active Galactic Nuclei, AGN) in high redshift galaxies. I use radio interferometry and the Very Long Baseline Interferometry (VLBI) techniques to disentangle AGN contribution from SF processes over a range of redshifts, using unprecedented large field-of-view, ultra-deep and high-resolution radio imaging provided by radio instruments such as the eMERLIN, the European VLBI Network and the Very Large Array.

At Newcastle, I am working on the Quasar Feedback Survey and using radio observations from facilities such as the eMERLIN, VLA and LOFAR to establish how quasars feedback on their host galaxies.

Besides research work, I am passionate about education and mentorship. I founded the programme "Elimisha Msichana Elimisha Jamii, EMEJA" (Swahili for 39;Educate a Girl, Educate the entire Community39;), a mentorship programme addressing the issue of gender disparity and equality in education among young schoolgirls in rural areas of Kenya and Uganda. EMEJA is working with the local communities and positively tackling some of the social issues (e.g., teenage pregnancies, early marriages, low STEM uptake) hampering girls'education via Astronomy outreach, mentorship, targeted STEM workshops and scholarships opportunities, guided by long-term student tracking and monitoring. The overarching objective for this programme is to ensure a 100% primary-secondary education transition for these schoolgirls."

Abstract Category:

Parallel Session on "Early Career African Physicists" / 233

A brief story tale of an ASP alumnus

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Since my undergraduate studies, I immersed myself in the fascinating realm of quantum mechanics and particle physics. I delved into the theory of quantum fields, studying the behavior of particles at the smallest scales. My journey as a particle physicist became enriched and an exhilarating adventure after my participation in the African School of Physics in 2012 in Ghana. Today I will briefly go through my journey, which I hope will give motivation and inspiration to the youngest generation.

Parallel Session on "Early Career African Physicists" / **234**

Bridging Africa and inspiring the future through science

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In this presentation, I will discuss my career path, the challenges I faced along the way, and how I overcame these challenges. Furthermore, I will speak about the opportunities I have received along the way that have enabled me to pursue my research journey in Africa.

Parallel Session on "Early Career African Physicists" / **235**

My Journey from ASP to Medical Physics

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Every step is preparation for the next one. Preparation with the right opportunity is all that you need to get to where you desire to be.

Parallel Session on "Early Career African Physicists" / **236**

From ASP to Illuminating Africa's Future in Light Sources

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I am an ambitious researcher deeply passionate about the realm of Accelerator Physics and Light Sources (LS). My unwavering curiosity is dedicated to exploring how LS can propel humanity's progress through the lens of physics. With a special focus on Africa, a continent currently devoid of a dedicated light source, I am committed to pioneering transformative advancements. My journey from the African School of Fundamental Physics (ASP) in 2016 has ignited a dream to illuminate Africa's scientific future through the development of indigenous light sources, a dream I am relentlessly pursuing.

Abstract Category:

Parallel Session on "Early Career African Physicists" / **237**

Escaping the Prism

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A prism is a geometric object that refracts light, causing it to separate into different colors. Metaphorically, it can represent a confined or limited viewpoint, a rigid system, or a set of societal norms that restrict individuality. “escaping the prism” suggests liberating oneself from those constrictions, embracing a broader perspective, and pursuing personal growth, freedom, or self-expression. It implies transcending boundaries, exploring new possibilities, and challenging existing paradigms to achieve a more expansive and authentic existence. This is a testament to my journey towards and through physics, a male dominated field.

Parallel Session on ”Early Career African Physicists” / 238

High energy physics: The edge of possibility

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My talk will be talking about how I came into the field of High energy physics considering the fact that I am an engineer. I will talk about why I chose to continue in this path and what I think the possibilities are when it comes to gaining insights into the inner workings of the universe, how innovation can come from this field and what the future might hold when it comes to physics discovery and their implications on the world.

Parallel Session on ”Early Career African Physicists” / 239

A passion for physics at the nanoscale

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I will share in this presentation, my experience as a young researcher after ASP 2014, lessons learned, my research and a motivation for research in Africa.

Abstract Category:

Parallel Session on ”Early Career African Physicists” / 240

Closing

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News and Information / 241

Welcome guests to Nelson Mandela University

News and Information / **242**

Welcome guests to George

News and Information / **243**

Welcome guests on behalf of the LOC & IOC

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Abstract Category:

244

ATLAS Masterclass at Inkcubeko Science Centre

Up to 36 high school learners will be “particle physicsts for a day” in which they learn about the ATLAS experiment at CERN.

Abstract Category:

Poster Session / **245**

Press Event / Special Session: Proving Einstein’s Theory Again in Africa, 100 Years Later

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