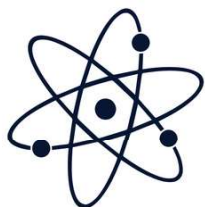


NELSON MANDELA
UNIVERSITY



100 years
of Physics in Africa
Past, Present and
Future

Date:
4-8 July 2022

Gqeberha
formerly Port Elizabeth

Conference Proceedings

**ANNUAL CONFERENCE OF THE SOUTH
AFRICAN INSTITUTE OF PHYSICS (SAIP 2022)**

Edited by Prof Aletta Prinsloo

PROCEEDINGS EDITOR-IN-CHIEF:

Prof Aletta Prinsloo, University of Johannesburg

PUBLISHER:

The South African Institute of Physics (SAIP)

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The conference was hosted virtually by the Nelson Mandela University on 4–8 July 2022. The Proceedings of SAIP 2022, the 66th Annual Conference of the South African Institute of Physics, will be available electronically only on the SAIP website: www.saip.org.za.

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ISBN: 978-0-6397-4426-1

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CONTENTS

Editorial	9
Message from the Organisers	11
• Local Organising Committee	12
Divisions, Editorial Team, and Reviewers	13
• Division Chairs	13
• Editorial Team	14
• List of Reviewers	16
• Group Photo of Delegates	20
A Physics of Condensed Matter and Materials	23
• Atomistic simulation studies of binary Rh_9S_8 and ternary $\text{Ru}_4\text{Pd}_5\text{S}_8$ Pentlandite-like systems	24
• Structural stability of some gold (Au) and silver (Ag) nanoparticles	30
• Preparation and characterization of erbium-activated yttrium orthovanadate-phosphate by chemical bath deposition	36
• Electronic, elastic, and transport properties of alpha-type copper sulphide	43
• Development of machine learning models for predicting energies of sodium-ion battery materials	49
• Structural and magnetic study of NdCrTiO_5 nanoparticles	55
• Effects of deposition temperature on the properties of CdTe thin films prepared by electrodeposition method for solar energy applications	62
• Structural stability of Cubic Ti_2AlV and Tetragonal TiAl_2V using First Principle Calculations	68
• Tin (IV) oxide-coated gold nanocomposite materials for solar thermal energy collection and harvesting	73
• The phase stability, mechanical and electronic properties of CsCl-type intermetallic: $\text{Ti}_{50}\text{TM}_{50}$ (TM = Ni, Ru and Pd), a first-principles approach	81
• Effect of Ce^{3+} substitution at B site on magnetic phase transitions in CoCr_2O_4 nanoparticles	88

• Computational analyses of graphene quantum dots for anode material in lithium-ion batteries	97
• Impact of Cr substitution on magnetic properties of cobalt-doped ZnO nanoparticles	103
• Structure, optical and magnetic properties of combustion synthesized Ni-Cr doped ZnO	111
• Synthesis, Characterization and Simulation of Graphene Oxide Nanomaterial for Application in Hybrid Supercapacitors	118
• Investigating the effects of Carbon and Boron atoms on the τ -MnAl alloy properties employing the first principle approach	123
• Electronic, Magnetic and Mechanical Properties of Nd ₂ Fe ₁₄ B Permanent Magnets: Ab Initio Study	127
• Synthesis of copper nanowires for application as flexible transparent conducting electrodes	133
• Study of magnetic properties in doped intermediate valent Ce ₂ Rh ₂ Ga	139
• Mechanical properties of Ti _{50-x} Hf _x Pt ₅₀ , ($0 < x < 50$) for high shape memory alloys applications	145
B Nuclear, Particle, and Radiation Physics	153
• Design and development of the ALICE common readout unit user logic firmware for the Muon Identifier readout chain	154
• Search for dark sector showering in ATLAS using semi-visible jets	161
• Studying the Production of a Singlet Scalar at Future e^+e^- Colliders with Deep Neural Networks	168
• Evaluation and Optimisation of a Generative-Classification Hybrid Variational Autoencoder in the Search for Resonances at the LHC	175
• Time stability of the response of gap and crack scintillators of the Tile Calorimeter of the ATLAS detector to isolated muons from $W \rightarrow \mu\nu_\mu$ events	182
• Study of systematic uncertainties and spurious signals of resonant $H \rightarrow Z\gamma$ production at ATLAS Experiment	189
• Compatibility of the CMS dilepton spectra with the Neutral Scalar with Mass around 151 GeV	195
• A study of top quark pair production in association with a high energy photon at the LHC	200
• Kernel Density Estimation-based simulation of Monte-Carlo events at LHC	206
• Search for resonant production of strongly-coupled dark matter in proton-proton collisions	212
• A search for tWZ production with the ATLAS detector using the three and four lepton final states in proton-proton collisions at $\sqrt{s} = 13$ TeV	218
• Characterisation of a new LSO block detector for Positron Emission Particle Tracking	224
• Search for new spin-1 boson using ATLAS detector data	230
• Geant4 Analysis of Secondary Neutrons in Proton Therapy	236
• Investigating the effect of neutrons on cadmium zinc telluride Compton camera	242
• Higgs boson decays to four leptons and missing transverse momentum via dark vector bosons	248
• A frequentist study of the false signals generated in the training of semi-supervised neural network classifiers using a Wasserstein Generative Adversarial Network as a data generator	254
• Simulation of neutron and electron damage in Al ₂ O ₃ and MgO using the FLUKA code	261

C Photonics	267
• Towards two-mode mode averaging with Orbital Angular Momentum modes	268
• Effects of nanoparticle geometry on photon statistics	274
• <i>In vitro</i> effects of aluminium (iii) phthalocyanine chloride tetra sulphonic acid-mediated photodynamic therapy on oesophageal cancer	279
• Recombinant antibody-conjugated silver nanoparticles for improved drug delivery in photodynamic therapy for metastatic melanoma	286
• <i>In vitro</i> antiproliferative effects of berberine in phthalocyanine-mediated photodynamic therapy on MCF-7 breast cancer cells with overexpressed P-Glycoprotein	293
• Investigating the morphology of an optically trapped particle using Mie scattering	299
• Photobiomodulation at 830 nm modulates proliferation and migration of wounded fibroblast cells	305
• Simulation of a malaria nanoplasmonic biosensor based on extraordinary optical transmission	311
• Wavelength calibration of a monochromator system	317
• Photonic quantum entanglement	323
• Photobiomodulation at 830 nm influences diabetic wound healing <i>in vitro</i> through modulation of inflammatory cytokines	328
D Astrophysics and Space Science	335
• Interacting viscous dark cosmology	336
• Probing dark matter in 2HDM+S with MGCLS	345
• A Closer Look at Potential Exoplanets Targets from the Nooitgedacht Observatory	351
• Primordial Black Holes and the SZ effect	357
• Studying gas flows in the SUNBIRD starburst galaxies and LIRGs: Gas flows in NGC 6000	362
• From setting up a new telescope to optimizing astrometric solutions	369
• Investigating HI size-mass relation in TNG50 and MIGHTEE-HI	375
• Spectral and temporal analysis of short gamma-raybursts detected by the Fermi space telescope with known redshift	382
• Spatially-resolved stellar kinematics of the CLoGS brightest group early-type galaxies	389
• MeerChoirs: Preliminary neutral gas kinematics of interacting galaxies in the J1250-20 group	395
• Tracing Water Masers at their Smallest Scale with VLBI	402
• Simulating the radio emission of dark matter for new high-resolution observations with MeerKAT	408
• MeerKAT's view on galaxy clusters: Diffuse radio emission in MeerKAT Galaxy Cluster Legacy Survey	414
• Collimation of Ion Density Distribution of Vacuum Arc Thrusters with Axial Magnetic Fields	419
• Compact stars: Numerical solutions to the structure equations using Python	425
E Physics for Development, Education, and Outreach	433
• The inclusion of nature of science in grade 12 high-stakes physics assessments in South Africa	434
• Exploring the impact of teacher education programme on the development of pre-service science teachers' TPACK	438
• Correlations between matriculation marks and mechanics misconceptions	444
• Language in learning. Does teaching Physics in isiZulu aid students' understanding?	450

• The impact of simulation experiments on the understanding of the concepts of acceleration and energy	456
• Students' understanding of physical components of electrical circuits	463
• The effects of monitored peer teaching and learning on the understanding of basic Physics concepts	470
• Teach electronics to applied Physics students: Prototyping, design and research on a printed circuit board	477
• High School learners' difficulties with kinematics graphs	482
• Using a Mobile Kibble Balance to explain Physics principles in Education	490
F Applied Physics	497
• Synthesis and characterization of adsorbent biopolymer composite pellets and their potential application for VOCs removal from pharmaceutical effluents	498
• Sol-gel derived and electrospun mesoporous TiO ₂ : Effects of calcining temperature on the structure, morphology and surface area	505
• A Nonlinear Logistic Regression Model for the Measurement of Drug Potency in Photodynamic Therapy	511
• Implementation of the LED Integrator panel for the Prometeo system in the ATLAS Tile Calorimeter	517
• Upgrade of ATLAS Tile Calorimeter TTC system for Phase-II test-beam campaigns	523
• Threading a Laser Through the Eye of a Needle: Multimode Fibre Coupling in Turbulence	528
• Ion fraction measurements of vacuum arc thrusters	535
• Comparison between the empirical and machine techniques to predict global solar irradiance for Mutale area in Limpopo Province, South Africa	541
• Investigating the effects of turbulence-induced tilt and lateral displacement on OAM modes	547
• Environmental Monitoring in the ATLAS ITk Detector	553
• The investigation between covariability of energy fluxes and CO ₂ flux exchanges at Skukuza Kruger National Park by Eddy Covariance technique	559
• Characterisation of bulk materials using fast neutron transmission analysis	565
• Validation of the Monte Carlo Detector Effects Model for the UCT Polaris Compton Camera	570
• Setting up an environment that continuously analyse The ATLAS Tile Calorimeter temperature data	576
• A modified Zinc oxide gas sensor approach to detect oxidizing gases	582
• MicroPEPT: A step towards hybrid PEPT detectors	588
• Developing an infectiousness model for droplet transmission	594
• Measurement of fast neutron removal cross sections for the elemental analysis of concrete	600
• Communication distance and security improvement in satellite based quantum key distribution via photon polarization pseudo-random bases encoding	606
• Direct-coupled photovoltaic water pumping system sizing using borehole hydraulic parameters	620
G Theoretical and Computational Physics	627
• Black holes and nilmanifolds: quasinormal mode calculations	628
• The 5D MSSM at two loops	634
• Matters of the $R_h = ct$ universe	640
• The QCD Equation of State in Small Systems	648

• Energies of the Anharmonic Oscillator using the Metropolis Algorithm and Matrix Methods	654
• Quantum Network Coding on a Superconducting Processor	660
• Cavity QED based Open Quantum Walks	666
• Analytic Continuation of the Generalized Epstein zeta function for calculating finite system corrections in ϕ^4 theory	672
• Structural, thermodynamics, mechanical and thermal properties of monazite-type LnPO_4 (Ln=La, Ce): A first principles study	677
• Particle rapidity distributions in Pb+Pb and Au+Au high-energy collisions from the Ultra-relativistic Quantum Molecular Dynamics (UrQMD 3.3p2) model at $E_{\text{elb}} = 200$ AGeV.	683
• Modeling the infectiousness of droplets when exposed to ultra-violet germicidal system: A computational fluid dynamics approach	689
• An Introduction to Statistical Thermal Models for Particle Production in Heavy-Ion Collisions	695

EDITORIAL

Nelson Mandela University (NMU) hosted the annual South African Institute of Physics (SAIP) conference virtually during 2022. Despite the fact that many of the Covid-19 pandemic limitations were lifted, there were still many uncertainties and with interested parties hesitant to travel, NMU decided to rather run the 66th conference in the series of SAIP as a virtual event. This was done with great success and the delegates commented on the professional running of the online event. Some papers from this online meeting are collected in this peer-reviewed volume. Submissions for the proceedings of SAIP2022 were handled by an Editorial Board headed by an Editor-in-Chief and Associate Editors responsible for submissions in different subject tracks.

The Editorial Board of the SAIP2022 Proceedings received 120 manuscripts for consideration by the advertised deadline. A total of 106 of these manuscripts met the relevant criteria and were submitted to a full peer-review process involving many individual reviewers. The list of the reviewer names are reflected elsewhere in the document and it is noted that certain reviewers took responsibility for more than one manuscript. The style of these proceedings is that of the (British) Institute of Physics Conference Series, similar to the styling used in previous SAIP Proceedings. Authors were requested to ensure that the defined layout were adhered to in their submitted pdf documents. In the past the review process was initiated with a layout review, followed by a content review. This year the Associate Editors conducted the layout review on each manuscript parallel with the content review. It was noted that there were small deviations between the layout templates available in MSWord and Latex – both of these formats were accepted by the Associate Editors. Manuscripts that deviated considerably from the specified layout specifications, while still broadly appropriate in their composition, were referred back to the authors for layout corrections. This was done in one step, together with the content reviews prepared by knowledgeable experts in each field. This year the Editorial Board aimed to reduce the time between the submissions and publication, with the authors being informed of the outcome of their submissions before the closure for the December holiday and the publication of the document online shortly after that.

The publication of the SAIP Proceedings are highly dependent on the efficiency of the Associate Editors and the goodwill of reviewers from the scientific community in South Africa. The Editor-in-Chief wishes to acknowledge the hard work of the Associate Editors who spent much

time considering the papers and reviewer reports in order to ensure that acceptable academic standards were met during peer-review for the proceedings to be credible. The majority of the content reviews received were done with great care and diligence and to the highest standards. The Editorial Board wishes to voice their sincere thanks to the participating Reviewers for their pro bono work, specifically to those Reviewers that read more than one paper. The meticulous reviewing process described above has ensured that these proceedings contain thoroughly peer-reviewed manuscripts of a high professional standard, which report on novel work that has not been published elsewhere.

This year the Editorial Board included a Technical Associate Editor, Dr Bruno Letarte from NWU. He took responsibility for finalising the complete document and ensured that it was of a high technical standard. The Editor-in-Chief wish to recognise Dr Letarte's enormous contribution in preparing the neat final document. The Editorial Board appreciate all the hours you dedicated into producing this exceptional document.

The Editor-in-Chief also wishes to recognise and thank Prof Strauss from NWU, Mr Mokhine from the SAIP office and Mr Jano Jonker from MNU for their support and help in preparing these proceedings.

Finally, the Editorial Board wishes to thank all of the authors for submitting their research work to this proceedings to undergo the rigorous review process. It is our sincere hope that the final product offered here constitutes a due outcome of their hard work.

MESSAGE FROM THE ORGANISERS

The year 2022 is of great significance to the global physics community, being both the centenary of the International Union of Pure and Applied Physics (IUPAP 100) and also the International Year of Basic Sciences for Sustainable Development (IYBSSD 2022). As such, the 66th South African Institute of Physics Annual Conference aptly focused on “100 Years of Physics in Africa: Past, Present and Future”. As the LOC (from Nelson Mandela University), we are privileged and proud to have been part of this historical event.

We would like to thank all participants, sponsors, editors and reviewers, without whom this conference would not have been possible. A special word of thanks to the plenary speakers for their willingness to give us their excellent lectures. Despite this conference being virtual (the last as such!), we as the LOC hope that it nevertheless contributed to the sense of community amongst physicists locally, and that it inspired the younger generation of physics students to persevere in their studies by showcasing the important role that physics plays in building a better and brighter future for all!



From left to right at the back: Prof Ernest van Dyk, Prof Japie Engelbrecht, Prof André Venter, Mr Jano Jonker, Prof JR Botha, Mr Collin Bacela, Prof Tim Gibbon. Front row, from left to right: Dr Lindsay Westraadt, Ms Chanie Neveling, Dr Gretta Hashe.

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Editor-in-chief:

– **Aletta Prinsloo** is a Professor of Physics in the Department of Physics at the University of Johannesburg. She is an NRF rated research physicist in the field of experimental solid state physics. Her research is focused on the magnetism of chromium-based bulk alloys, thin films and nanomaterials.

Associate Editors:

- **Physics of Condensed Matter and Materials**

– **Charles Sheppard** is an Associate Professor and a member of the Cr Research Group in the Physics Department at the University of Johannesburg. His current research interest focuses on the various physical properties observed in bulk Cr alloys, Cr thin films, and chrome oxide magnetic nano-materials.

- **Nuclear, Particle, and Radiation Physics**

– **Mukesh Kumar** is a Lecturer of Physics in the School of Physics at the University of the Witwatersrand. He is an NRF Y- rated research physicist in the field of high energy particle physics. His research is focused on Higgs boson, top quark, and dark matter physics at the Large Hadron Collider (CERN) including the future e^-p and e^+e^- colliders. He is a member of TileCal Speaker committee for ATLAS detector at CERN.

- **Photonics**

– **Pieter Neethling** is a Senior Lecturer in the Physics Department at Stellenbosch University. He is currently the Director of the Laser Research Institute at Stellenbosch University and the Chairman of the Photonics Division of the SAIP. His research focus is applied laser spectroscopy with applications in chemical and biological systems.

- **Astrophysics and Space Science**

– **Eugene Engelbrecht** is a Professor of Physics at North-West University, whose research covers topics relevant to the transport of charged particles in turbulent astrophysical plasmas, including both theoretical and observational aspects pertaining to cosmic ray modulation, non-linear diffusion theories, and plasma turbulence.

- **Physics for Development, Education, and Outreach**

– **Grace Phalwane** is a Dental Doctor and Health Professions Educationalist in the Department of Community Dentistry at the Sefako Makgatho Health Sciences University. Her research interest is focused on the Service Learning (SL), Problem-Based Learning (PBL) and Inter-Professional Education (IPE).

- **Applied Physics**

– **Thulani Hlatshwayo** is an associate Professor in the Department of Physics in the Faculty of Natural & Agricultural Sciences. His research is focussed on the understanding of the release of radioactive fission products from fuel in the modern nuclear reactors, where chemical vapour deposited (CVD)-SiC is the main barrier to fission products, and on finding alternative materials for nuclear waste storage. Professor Hlatshwayo recently received the Exceptional Young Researchers Award by the University of Pretoria. He is a PIs coordinator for SA-JINR projects in material research and nanoscience and is C2 NRF rated.

– **Kittessa Roro** is the Principal Researcher & Research Group Leader for Energy Supply & Demand (ESD) Research Group (RG) within the Energy Centre at the Smart Places Cluster of the CSIR. He is C2 NRF rated researcher in the field of Energy, Renewable Energy, nanotechnology and solid-state Physics. The ESD RG underpins the Energy Centre work in solar, on- and off-shore wind, renewable energy production/supply forecasting, energy efficiency / demand response, and thermal energy optimisation inclusive of thermal energy efficiency, recovery, and storage. The group also research on techno-economic viability of emerging and existing approaches to energy supply and end-use efficiency to provide impartial advocacy to industry and consumers.

- **Theoretical and Computational Physics**

– **W. A. Horowitz** is an Associate Professor of Physics at the University of Cape Town. Among other honours, Prof Horowitz has received the Claude Leon Merit Award for Early-Career Researchers and the Meiring Naudé Medal for Outstanding Early Career Contributions to Science from the Royal Society of South Africa. Prof Horowitz' research explores the non-trivial emergent many-body properties of the strong force using the methods of perturbative quantum field theory and the AdS/CFT correspondence.

- **Technical**

– **Bruno Letarte** is a Senior Lecturer at the Centre for Space Research of the North-West University. He specialises in observational astronomy, photometry as well as spectroscopy, with his main interest in stellar astrophysics. He manages the optical telescope at the Nooitgedacht observatory, used to train undergraduate and postgraduate students. He is also the physics subject group leader, what other universities call head of department, on the Potchefstroom campus.

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- **Dr Henerica Tazvinga** – SAWS, RSA
- **Prof Moise Tchokonte Tchoala** – University of Western Cape, RSA
- **Dr Thabisile Thabethe** – University of Pretoria, RSA
- **Prof Iyabo Usman** – University of the Witwatersrand, RSA
- **Prof Johan van der Walt** – North-West University, RSA
- **Dr Brian van Soelen** – University of the Free State, RSA
- **Prof Christo Venter** – North-West University, RSA
- **Dr Robert Warmbier** – University of Johannesburg, RSA
- **Dr Heneric Wilkens** – CERN, Switzerland
- **Prof Hartmut Winkler** – University of Johannesburg, RSA
- **Dr Dawit Worku** – Cape Peninsula University of Technology, RSA
- **Dr Maosen Zhou** – IHEP; UCAS, China

Group Photo of Delegates



