

Musa A. M. Hussien

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Education

- Jan. 2019 - **Ph.D.**, *Theoretical and Computational Condensed Matter Physics*, University of KwaZulu-Natal, South Africa.
Dec. 2022
- March 2015 - **M.Sc.**, *Physics*, Faculty of Science, Sudan University of Science and Technology, Sudan.
Dec. 2016
- Sep. 2010 - **B.Sc.**, *Physics - Excellent first class honors*, Faculty of Science and Technology, Omdurman Islamic University, Sudan.
June 2014

Teaching and Mentoring Experience

- April 2024 - **Postdoctoral Scholar**, *Materials Science Division*, Lawrence Berkeley National Laboratory, Berkeley, CA, USA.
Present
- March 2023 - **Head Tutor & Teaching Assistant**, *African Institute for Mathematical Sciences (AIMS)*, Cape Town, South Africa.
April 2024
- 12–23 June 2023 **7th African School on Electronic Structure Methods and Applications**, *Tutor*, The Abdus Salam International Centre for Theoretical Physics (ICTP-EAIFR), University of Rwanda, Rwanda.
- April 2023 - **Project Assistant**, *African Institute for Mathematical Sciences (AIMS)*, Cape Town, South Africa.
April 2024
- 27 Nov. - 14 Dec. 2023 **Teaching Assistant**, *Quantum Computing*, African Institute for Mathematical Sciences (AIMS), Cape Town South Africa.
- 06 - 23 Nov. 2023 **Teaching Assistant**, *Geometry of Electromagnetism*, African Institute for Mathematical Sciences (AIMS), Cape Town South Africa.
- 30 Oct. - 17 Nov. 2023 **Teaching Assistant**, *Concepts in Physics: Physics Solved Problems*, African Institute for Mathematical Sciences (AIMS), Cape Town South Africa.
- 11 - 29 Sep. 2023 **Teaching Assistant**, *Introduction to Machine Learning*, African Institute for Mathematical Sciences (AIMS), Cape Town South Africa.
- 21 Feb. - 08 Jul. 2022 **Part-time Lecturer**, *Electromagnetic Theory and Classical Optics*, Department of Physics, PMB Campus, University of KwaZulu-Natal, South Africa.
- Jan. 2017 - Present **Lecturer**, *General Physics, Electricity and Magnetism, Python Programming, Modern Physics, Guide to Electronics*, Department of Physics, Omdurman Islamic University, Sudan.
- Jul. 2019 - Jul. 2022 **Part-Time Lab Demonstrator in Physics**, *Department of Physics*, PMB Campus, University of KwaZulu-Natal, South Africa.
- June 2017 - Jan. 2019 **Part-Time Lab Demonstrator in Physics**, *Department of Physics*, Sudan University of Science and Technology, Sudan.
- Sep. 2014 - Aug. 2016 **Part-Time Teaching Assistant & Lab Demonstrator in Physics**, *Faculty of Engineering*, Faculty of Medicine, University of Science and Technology, Sudan.
- Sep. 2014 - Dec. 2018 **Part-Time Lab Coordinator & Demonstrator in Physics**, *Department of Physics*, Faculty of Science, Omdurman Islamic University, Sudan.
- Sep. 2014 - Aug. 2016 **Part-Time Teaching Assistant in Physics**, *Department of Physics*, Faculty of Science, Omdurman Islamic University, Sudan.

Research Interests

Diagnose topology in amorphous materials
Quantum materials
Quantum sensing
Superconductivity
Dark matter detection and Qubit protection

Publications

- 2024 **Musa A. M. Hussien, Michael Tsampanlis, Mariano de Souza, and Aniekan Magnus Ukpog, *Quantum Phase Transitions of the Topological Edge State in Bismuth Selenide*, **Pre-print**.**
- 2022 **Musa A. M. Hussien and Aniekan Magnus Ukpog, *Quantum Phase Transition in the Spin Transport Properties of Ferromagnetic Metal-Insulator-Metal Hybrid Materials*, *Nanomaterials* 2022, 12(11), 1836, <https://doi.org/10.3390/nano12111836>.
Q1, IF = 5.3**
- 2021 **Musa A. M. Hussien and Aniekan Magnus Ukpog, *Electrodynamics of Topologically Ordered Quantum Phases in Dirac Materials*, *Nanomaterials* 2021, 11(11), 2914, <https://doi.org/10.3390/nano11112914>.
Q1, IF = 5.3**

Conferences, Workshops, and Schools

- 27 - 28 Nov. 2023 **Quantum ESPRESSO: Applications for Material Sciences and Chemistry**, *Online International Conference*, University of Évora, Portugal.
- 28 Feb. - 3 March 2023 **UKZN Data Science Hackathon 2023**, *Tutor*, College of Agriculture, Engineering and Science, South Africa.
- 09 - 11 Nov. 2022 **Advanced Quantum ESPRESSO Tutorial: Hubbard and Koopmans Functionals from Linear Response**, *Virtual Tutorial*, Switzerland.
- 08 - 12 Aug. 2022 **Emergent Quantum Matter in Artificial Two-Dimensional Materials**, *University of Jyväskylä Campus*, Online, Finland.
- 01 Jul. 2022 **Advanced Magnetoelectric Nanocomposites and Their Applications**, *Nanomaterials Webinar*, Online, Switzerland.
- 16 - 21 May 2022 **Machine Learning in Electronic Structure and Molecular Dynamics**, *The Abdus Salam International Centre for Theoretical Physics (ICTP-EAIFR)*, University of Rwanda, Rwanda.
- Oct. 2021 - May 2022 **Machine Learning in Electronic Structure and Molecular Dynamics**, *The Abdus Salam International Centre for Theoretical Physics (ICTP-EAIFR)*, Online Training, Rwanda.
- 18 - 19 Oct. 2021 **Spin Control in Twisted Van der Waals Heterostructures**, *Institute of Physics (IOP)*, CMD 29 Online Series, UK.
- 23 - 27 Aug. 2021 **Spintronics and Magnetism on 2D Materials**, *EPFL-ETHZ Summer School*, Online, Zürich.
- 16 Apr. - 29 May 2020 **Solid State Physics in Quarantine**, *The Abdus Salam International Centre for Theoretical Physics (ICTP)*, Online, Italy.
- 10 - 21 Jun. 2019 **1st Southern African School on Electronic Structure Methods and Applications (SASESMA-2019)**, *Department of Physics*, University of Pretoria, South Africa.
- 08 - 17 Jan. 2017 **3rd Khartoum Workshop on Advances in Material Sciences (KWAMS'17)**, *Department of Physics*, University of Khartoum, Sudan.

Oral and Poster Presentations

- 16 - 21 Mar. 2025 **Diagnosing Topological Properties of Amorphous Bi₂Se₃ from First-Principles**, *New Topological Materials*, APS Global Physics Summit 2025, CA, USA.
- 14 - 16 Aug. 2024 **Ab Initio Diagnosis of Non-Trivial Topology in Amorphous Materials**, *Next-Generation Quantum Materials for Quantum Computing, Sensing, and Devices*, Molecular Foundry User Meeting, Berkeley Lab, CA, USA.
- 16 Dec. 2023 **An Overview of Condensed Matter Physics and Density Functional Theory**, *Online Talk: Photon SCNSM*, Khartoum University Journal Club, Sudan.

- 30 May 2023 **Insights from Condensed Matter Physics and Density Functional Theory**, *Talk: African Institute for Mathematical Science*, AIMS Journal Club, South Africa.
- 18 - 23 Sep. 2022 **Quantum Phase Transitions in Dirac Materials**, *Oral Presentation at the 1st International Congress on Advanced Computational Modelling of Materials (CAMOM)*, University of Pretoria, South Africa.
- 22 - 25 Aug. 2022 **Magnetoelectric and Proximity Effects in Ferromagnetic Metal-Insulator-Metal Hybrid Materials**, *Psi-k Conference*, SwissTech Convention, EPFL, Lausanne, Switzerland.
- 09 - 10 Dec. 2021 **Electric-Field-Induced Quantum Phase Transition in Multilayer Heterostructures**, *Postgraduate Research and Innovation Symposium*, University of KwaZulu-Natal, South Africa.
- 30 Nov. - 02 Dec. 2020 **Field-Tunable Topological Quantum Phase Transitions in Dirac Materials**, *The 14th CHPC National Conference*, Centre for High Performance Computing, South Africa.
- 18 - 20 Nov. 2020 **African Physical Society (AfPS) International Conference**, *The Abdus Salam International Centre for Theoretical Physics (ICTP)*, Online, Italy.
- 17 Oct. 2019 **Strain-Tunable Quantum Phase Transition in Bulk Bi₂Se₃**, *Postgraduate Research and Innovation Symposium*, University of KwaZulu-Natal, Poster Presentation, South Africa.

Grants and Awards

- 2024 Exceptional leadership, dedication, and outstanding contributions as Head Tutor, African Institute for Mathematical Sciences, Cape Town, South Africa.
- 2022 ASESANET fellowship to attend the Psi-k Conference in Lausanne, Switzerland.
- 2016 Prize of the Minister of Higher Education and Scientific Research for Excellent Academic Performance in Physics, Sudan Institute for Natural Science, Sudan.
- 2014 Excellent Academic Performance in Physics, Physics Department, Omdurman Islamic University, Sudan.

Memberships

- 2024 **Early Career**, *American Physical Society (APS)*, United States
- 2023 **Certified Physicist (CPhys)**, *South African Institute of Physics (SAIP)*, CSIR Campus, Pretoria, South Africa.

Skills

Windows, Linux, Mac OS
 Python
 Quantum pyqula and Scikit-learn
 Gnuplot, Xmgrace, OriginLab
 High Performance Computing
 DFT Calculations with QE and VASP
 MD with LAMMPS
 Development of Interatomic Potentials using ML

References

- PI Dr. Sinead M. Griffin, Staff Scientist, Materials Sciences Division and Molecular Foundry, Berkeley Lab, CA, USA, SGriffin@lbl.gov
- PhD Adviser Dr. Aniekang Magnus Ukpong, Academic Leader of Physics Department (PMB), University of KwaZulu-Natal, South Africa, UkpongA@ukzn.ac.za
- Prof. Omololu Akin-Ojo, ICTP-East African Institute for Fundamental Research, University of Rwanda, Kigali Campus, Rwanda, oakinojo@eaifr.org
- Prof. Layla Martin-Samos, Computational Material Scientist, National Research Council (CNR-IOM Democritos), Italy, marsamos@iom.cnr.it
- Prof. Richard Martin, Physics Department, University of Illinois Urbana-Champaign, USA, RMartin@illinois.edu