



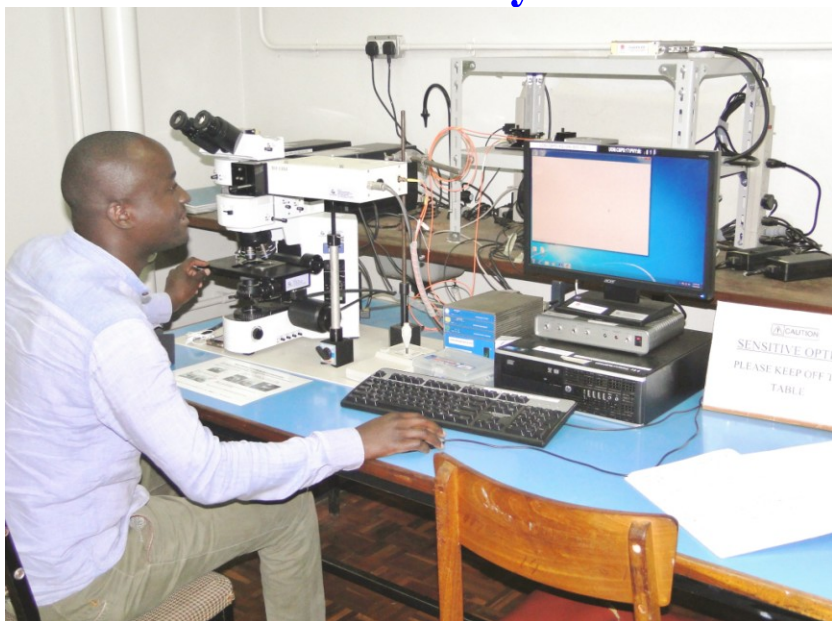
Celebrating 50 years of Academic Excellence (1970-2020)

UNIVERSITY OF NAIROBI

DEPARTMENT OF PHYSICS

Postgraduate Programmes

- **MSc in physics**
- **PhD in Physics**



Providing Quality research and Training

INTRODUCTION

With 50 years of existence and experience, the University of Nairobi is now celebrating **50 years of Academic Excellence**. The Department of Physics has come of age and is now addressing the question of innovation and entrepreneurship in its curriculum that are essential for country to achieve its goal of industrialization by the year 2030.

The postgraduate programmes in Physics are to foster excellence in physics, creativity and innovation, professionalism and integrity through quality scholarly and research. This is in line with the University philosophy which is guided by the need to connect and inspire humanity to provide leadership and stewardship and to give hope and faith so that mankind can excel in whatever it chooses to do so with passion, moral responsibility and a strong sense of patriotism.

MASTERS OF SCIENCE (MSc) IN PHYSICS

The **MSc in Physics** is a two (2) year degree program offered on a full time basis. The degree program is either by coursework and thesis or by coursework and project and it provides for specialization in the following distinct areas of Physics:

- **Theoretical Physics**
- **Condensed Matter Physics**
- **Geo and Space Physics**
- **Electronics and Instrumentation**
- **Nuclear and Radiation Physics**
- **Laser Physics and Spectroscopy**

ENTRY REQUIREMENTS

1. Bachelor's degree with at least 2nd Class Honours (Upper Division) in Physics or a related subject from the University of Nairobi or any other

Institution recognized by the Senate OR a cumulative Grade Point Average (GPA) of 3.00 on a scale of 4.00.

2. Bachelors degree with a 2nd Class Honours (Lower Division) in Physics or a related subject, OR a cumulative Grade Point Average (GPA) of 2.50 on a scale of 4.00, with two years relevant post-qualification experience and evidence of research capability either through paper presentations or peer reviewed publications.
3. Further, evidence of adequate coverage and understanding of the following courses at undergraduate level will be required: *Mathematical Physics, Quantum Mechanics, Electrodynamics and Classical Mechanics.*
4. In addition to meeting the above requirements, applicants must have met the minimum admission qualifications for undergraduate programmes. i.e.
 - a) C+ (plus) for KCSE or its equivalent as determined by the Kenya National Examinations Council (KNEC).
 - b) C (plain) PLUS a KNEC diploma or its equivalent.

PROGRAMME STRUCTURE

FIRST YEAR:

All candidate shall register for specified core courses for the chosen area of specialization together with suitable electives to total a minimum of **EIGHT (8)** units.

SECOND YEAR

- (a) MSc BY COURSE WORK AND PROJECT
 - Candidates will take FOUR (4) course units together (i.e. **TWO DOUBLE UNITS**) with a dissertation (equivalent to FOUR units) during the second semester.
- (b) MSc BY COURSE WORK AND THESIS
 - Candidates will undertake research thesis (equivalent to 8 units)

COURSES OFFERED

FIRST YEAR, SEMESTER 1 (Take 4 CORE UNITS)

*SPH 601	Classical Mechanics (Laser Physics Group take SPH 617)
SPH 602	Statistical Mechanics (CORE)
SPH 603	Quantum Mechanics (CORE)
SPH 604	Electrodynamics I (CORE)

*SPH 613	Advanced Electronics	(For Electronics Option)
*SPH 617	Optics & Laser Physics	(For Laser Physics Option)
*SPH 620	Advanced Nuclear Physics	(For Nuclear Option)
*SPH 626	Geodynamics	(For Geophysics Option)

FIRST YEAR, SEMESTER 2 (ELECTIVE COURSES)

SPH 605	Solid State Physics I
SPH 606	Solid State Electronics
SPH 608	Mechanical, Thermal & Optical Properties of Solids
SPH 611	Solar Energy Materials
SPH 612	Surface Physics
SPH 613	Advanced Electronics
SPH 614	Signal Processing
SPH 615	Embedded Systems
SPH 616	Electronic Communication Systems
SPH 618	Laser Applications
SPH 619	Photonics and Optoelectronics
SPH 620	Advanced Nuclear Physics
SPH 621	Radiation Physics
SPH 622	Radiation Measurement and Spectroscopy
SPH 623	Radiation Protection and Dosimetry
SPH 624	Application of Radiation
SPH 625	Spectro-Physics
SPH 626	Geodynamics
SPH 627	Exploration Geophysics

SPH 628	Paleomagnetism
SPH 629	Rock Magnetism
SPH 630	Advanced Aeronomy
SPH 631	Remote Sensing Physics
SPH 632	Advanced Laboratory Techniques
SPH 633	Mathematical Physics
SPH 634	Advanced Mathematical Physics
SPH 635	Computational Physics I
SPH 636	Quantum Mechanics II
SPH 637	Electrodynamics II
SPH 638	Space Physics
SPH 639	Relativity
SPH 640	Planetary Physics

FIRST YEAR, SEMESTER 2 (ELECTIVES) PER THEMATIC AREA	
Theoretical Physics	<p>Year 1: Core: SPH 601 602, 603, 604 Electives: SPH 605, 612, 631, 633/634, 635, 636, 637, 638, 639</p> <p>Year 2: Core: SPH 707 Electives (2 DOUBLE UNITS): SPH 701, 702, 703, 704, 705, 706, 708, 709, 710, 711, 713; 714</p>
Condensed Matter Physics	<p>Year 1: Core: SPH 601, 602, 603, 604, 632 Electives: SPH 605, 608, 611, 612, 635</p> <p>Year 2: Thesis</p>
Electronics & Instrumentation	<p>Year 1: Core: SPH 602, 603, 604, 613, 614, 615, 632 Electives: SPH 606, 616, 618, 620</p> <p>Year 2: Thesis</p>
Laser Physics & Spectroscopy:	<p>Year 1: Core: SPH 602, 603, 604, 617, 618, 619, 632 Electives: SPH 606, 613, 614</p> <p>Year 2: Thesis</p>
Geo- and Space Physics	<p>Year 1: Core: SPH 601, 602, 603, 604, 626, 627, 628, 629, 632</p> <p>Electives: SPH 608, 623, 624, 625, 630, 631, 633, 635, 638, 640</p> <p>Year 2: Thesis</p>
Nuclear & Radiation Physics	<p>Year 1: Core: SPH 602, 603, 604, 620, 622, 632 Electives: SPH 623, 624, 635</p> <p>Year 2: Thesis</p>



**SECOND YEAR COURSES - THEORETICAL PHYSICS
(Register For Two (2) Double Units = 4 Units)**

SPH 701	Many Body Problem
SPH 702	Field Theory
SPH 703	High Energy Physics
SPH 704	Astrophysics
SPH 705	General Theory of Relativity
SPH 706	Group Theory
SPH 707	Project
SPH 708	Plasma Physics
SPH 709	Remote Sensing Physics II
SPH 710	Computational Physics II
SPH 711	Solid State Physics II
SPH 713	Solar Systems Dynamics
SPH 714	High Energy Astrophysics

HOW TO APPLY

Applications shall be done through the online application system and considered, verified and shortlisted by the Department/School of physical sciences. The letter of offer shall be valid for two (2) academic years.

FEE STRUCTURE

YEAR	ITEM	East African (KShs)	Other Foreigners (US\$)
Year 1	Tuition: 8 units @ Kshs 14,000/=	112,000	125% of local fees
	Statutory fees	34,000/=	125% of local fees
	SUBTOTAL	146,000/=	125% of local fees
Year 2	Tuition: 8 units @ Kshs 14,000/=	112,000	125% of local fees
	Statutory fees	29,000/=	125% of local fees
	SUBTOTAL	141,000/=	125% of local fees
TOTAL		287,000/=	287,000/=

SCHOLARSHIPS

Interested candidates can source for scholarships and fellowships from among:

- University of Nairobi Postgraduate Scholarships
- DAAD (incountry and Sandwich fellowships)
- IAEA
- Mahatma Scholarships
- etc



Some Research Facilities in the department

DOCTOR OF PHILOSOPHY IN PHYSICS

The **Doctor of Philosophy in Physics** is a three (3) year degree program offered on a full time basis. The degree program has been aligned to the global trend in Physics by enriching its content with knowledge and skills that address emerging issues in this discipline and their application for economic development.

The **PhD** Program providing for specialization in the various areas:

- Theoretical Physics
- Condensed Matter Physics
- Geo and Space Physics
- Electronics and Instrumentation
- Nuclear and Radiation Physics
- Laser Physics and Spectroscopy

ELIGIBILITY FOR PhD REGISTRATION

1. A holder of a Bachelor's and Master's degree in physics from the University of Nairobi or equivalent academic qualifications from another institution recognized by the University of Nairobi Senate as of comparable status.
2. In either case, the applicant must be able to produce evidence, to the satisfaction of Senate, of the capacity to carry out original research.
3. In addition to producing evidence of eligibility for registration, candidates may be required to appear for interview by the Department/School of Physical Sciences to determine their suitability for registration.

SUBMISSION & PROCESSING OF APPLICATIONS

Applications and draft proposals of about 15 pages shall be done through

The online applications system and considered, verified and shortlisted by Department and the School of Physical Sciences and forwarded to Graduate school for provisional registration. *The draft proposal shall include a brief statement of the problem, research objectives, research questions, hypothesis, literature review, methodology, theoretical framework and a work plan.*

- **Provisional registration** is valid for 6 months during which time the candidate is to develop a full research proposal.

FEE STRUCTURE

YEAR	ITEM	East African (KShs)	Other Foreigners (US\$)
Year 1	Tuition:	108,700	125% of local fees
	Statutory fees		
	SUBTOTAL	158,700/=	5,888 US\$
Year 2	Tuition:	108,700	125% of local fees
	Statutory fees		
	SUBTOTAL	141,700/=	3,938 US\$
Year 3	Tuition:	108,700	125% of local fees
	Statutory fees		
	SUBTOTAL	141,700/=	3,938 US\$
TOTAL			

SCHOLARSHIPS

Interested candidates can source for scholarships and fellowships from among:

- PASSET
- DAAD (incountry and Sandwich fellowships)
- Mahatma Gha Scholarsid
- ect

RESEARCH AREAS

A: CONDENSED MATTER PHYSICS

Condensed matter physics is the field of physics that deals with the macroscopic and microscopic physical properties of matter such as solids and liquids which arise from the electromagnetic forces between atoms. Condensed matter physicists seek to understand the behavior of these phases by using physical laws. The diversity of materials studied in the field of Condensed matter physics makes this field a multi-disciplinary and even a trans-disciplinary one. For example, it embraces solid state physics, materials science, and it overlaps with chemistry, nanotechnology, and engineering.

The condensed Matter research group currently offers research in the following areas: -with aim of solving typical problems facing humanity:

- (a) **Energy and Renewable Energy**; This encompasses the following research area:
 - Photovoltaics mainly in: Dye sensitized solar cells (DSSC) based on nanostructured titanium dioxide or other wide bandgap semiconductors, Perovskite solar cells, Extremely thin absorber solar cells, Silicon solar cells, Thin film solar cells, Electrochemical solar cells
 - Photothermal materials
 - Solar energy materials
- (b) **Computation condensed matter physics**
- (c) **Thermal mechanical properties of materials (ceramics)**
- (d) **Nanotechnology applications in water purification systems**

The Group also runs a series of two-week trainings on PV systems installations and maintenance – dubbed the Solar Academy.

Research Facilities

The department is well equipped with the following equipments

- Silar coarter, The spray pyrolysis, High temp programmable furnace, The tube furnace, Ball mill, Electro impedance spectroscopy measurements,



Silar Coarter



Solar simulator



Spray Pyrolysis



Alpha step Q



Tube Furnace



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Solar Academy Trainings on PV sizing

Research Group Members



Prof. B. Aduda Prof. J. Mwabora Prof. F. Nyongesa Prof. R. Musembi Dr. S. Waita



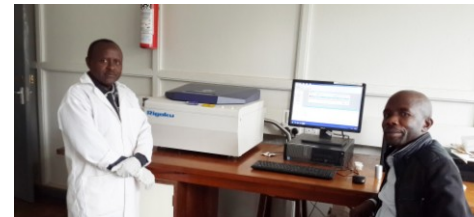
Prof. J. Simiyu Dr. A. Ogacho Dr. S. Mureramanzi Dr. T. Nyangonda

B: RESEARCH IN NUCLEAR AND RADIATION PHYSICS

The Applied Nuclear and Radiation Physics deals with method development in atomic & nuclear spectroscopy and instrumentation for trace chemical and radiogenic analysis and their spectral imaging utilizing chemometrics and machine learning. We also do applied nuclear radiation and health physics with emphasis on *Methodologies for radiometric beam and dose quality assessment and assurance in radiation medicine; analysis and modeling of nuclear traces and their immobilization dynamics in complex ecosystems; Monte Carlo radiation transport calculations in spectrometry, dosimetry and radiation detector modelling; Surface discharge spark and laser plasma spectral diagnostics and modelling.*

Research Facilities

The department is well equipped with equipments such as EDXRF etc



Postgraduates using EDXRF to analyse samples in the department

Research Group Members



Dr. H. Kalambuka Dr. Odumo Ruth Wabwile Rr, Ian Kaniu Mr. J. Okonda

C: LASER PHYSICS AND SPECTROSCOPY

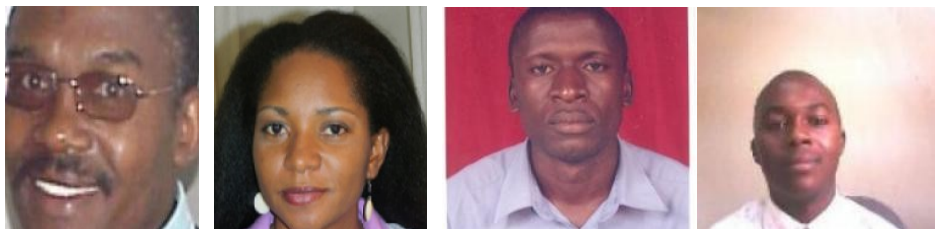
The Laser Physics and Spectroscopy group carries out an inter- and multi-disciplinary research involving applications of Raman spectroscopy in detection of various toxic chemicals, disease screening such as malaria, detection of radioactive elements among others. It also explores various potential uses of LIBS. The group also uses extensively chemometric statistical techniques such as PCA, PLSR, MLR, Artificial Neural networks among others in data analysis and quantification. Research involving Holographic and optical imaging of biological cells is also carried in the group.

Research Facilities

The department is equipped with the Raman spectroscopy and other equipments



Research Group Members



Prof. K. Kaduki

Dr. A. Massop

Mr. D. Omucheni

Mr. J. Githaiga

D: ELECTRONICS AND INSTRUMENTATION

Applied Electronics & Instrumentation is an advanced branch of physics which deals with the application of existing or known scientific knowledge in [electronics](#), instrumentation, [measurements](#) and [control](#) for any process, practical [calibration](#) of instruments, automation of processes etc. It is a combination of [Electronics](#) and [Instrumentation Engineering](#). This branch is an industry-oriented branch of physics which needs more knowledge and experience in industrial applications to excel in a career.

Apart from covering core subjects such as [Industrial Instrumentation](#), Measurements, Sensors & Transducers, [Process Control](#), Bio-Medical Instrumentation, students deal with software and hardware topics such as [Microprocessor](#) and [Microcontroller](#)-based instrumentation, [VLSI](#) and [Embedded System](#) designs, [pSPICE](#), [Computer Architecture](#) and organization, Virtual Instrumentation ([LabVIEW](#)), Industrial Automation ([PLC](#), [SCADA](#) etc.) and computer control of processes.

The department offers reserach in the following disciplines of electronics:

- Analogue electronics
- Digital electronics:
- Instruction processors/Microprocessors
- Power Electronics

Research Facilities



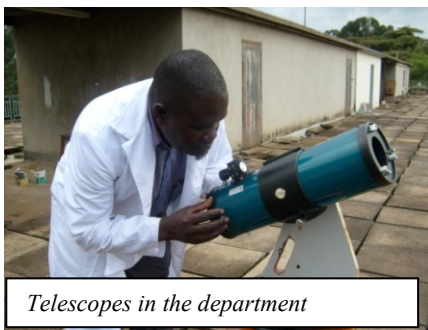
E: RESEARCH IN GEO AND SPACE PHYSICS

Geo-Physics covers integrated geophysical studies of the rocks and sediments of Kenya. It includes the explorations of minerals, geothermal reservoirs, nuclear minerals and their environmental radiations hazards.

Space physics, is the study of plasmas as they occur naturally in the Earth's upper atmosphere (aeronomy) and within the Solar System. Space physics is fundamental part of space weather and has important implications from the understanding the universe to understanding the operations of communications and weather satellites.

On the other hand, astrophysics studies the plasma phenomena beyond the Solar System and relies on deduction of theory and astronomical observation. Trainings in this area is designed to train graduates who will have the skills to work in Satellite Space Stations (e.g., San Marco in Malindi), Astronomical Observations, Astronautics and Aeronautical Engineering Departments and Remote Sensing.

Research Facilities



Research Group Members



Prof. C. Mito



Dr. G. Okengo

F: THEORETICAL PHYSICS

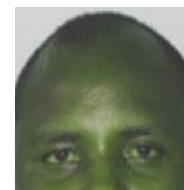
Theoretical physics is a branch of physics that employs mathematical models and abstractions of physical objects and systems to rationalize, explain and predict natural phenomena. This is in contrast to experimental physics, which uses experimental tools to probe these phenomena.

Theoretical Physics is a multi-disciplinary area and it includes nearly all branches of physics. In this area, physical properties of matter are represented and determined by physical equations which have been derived using the relevant mathematical theories. The theoretical results obtained either predicts further physical possibilities or confirms the already known experimental results that can be applied by the experimentalists.

Research Group Members



DR. J. B. Awour



Dr. G. Maumba



Dr. G. Okengo

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