

UNIVERSITY OF NAIROBI

Department of Physics

Annual Report 2014/2015

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This document gives a summary of the events, activities and achievements within the physics department during the period Jan 2014 to December 2015

Department of physics
Annual Report 2014/2015

Introduction

The Department of Physics , university of Nairobi is situated at school of physical sciences building, 2nd floor in Chiromo campus. It offers both undergraduate and postgraduate courses. It also provide service courses to the College of Architecture and Engineering, College of Education and External Studies and the College of Agriculture and Veterinary Sciences.

Research Groups

There are six research groups in the department of physics which include;

1. Condensed matter physics
2. Applied electronics
3. Geophysics
4. Laser physics and spectroscopy
5. Applied nuclear and radiation physics
6. Theoretical physics

Staff

1. Professors	5
2. Associate Professors	0
3. Senior Lecturers	11
4. Lectures	8
5. Tutorial Fellows	9
6. Part-time lecturers	10

Staff promotions

The following staff received promotions during the year 2014

1. Prof. J. M. Mwabora Promoted to Full professor
2. Dr. R. J. Musembi Promoted to Senior lecturer
3. Dr. J. Simiyu Promoted to Senior lecturer
4. Dr. H. K. Angeyo Promoted to Senior lecturer
5. Dr. S. Waita Promoted to Senior lecturer
6. Dr. G. O. Maumba Promoted to lecturer

New Staff

In the year 2014, one new staff Dr. E. O. Ayieta joined the department as a senior lecturer. In 2015 Mr. Justus Okonda joined the department as a Graduate assistant.

Enrolled students

1. Undergraduate
2. Postgraduate
 - Msc.
 - PhD.

Graduated students

3. Undergraduate
4. Postgraduate
 - Msc.
 - PhD.

Prof. Malo gives a Public Lecture on Creation Vs. Evolution



Prof. Malo delivering a public lecture at the Milenium hall in Chiromo Cumpus

Eminent Professor of Physics, Prof. Joseph Malo, took the plunge to discuss one of the **most intriguing questions in physics today, the origin of the universe**. Prof. Malo gave a public lecture titled ***Creation versus Evolution*** where he highlighted that science and religion do indeed appreciate and recognize not only the beauty and magnificence of the universe but also desire to discover what is behind this grandeur. In his lecture held on October 15, 2015, Prof. Malo noted that it is naive for a scientist to conclude that the existence of God is impossible because God cannot be observed or experimented. He highlighted that current research in Physics focuses on the understanding of the following: **how galaxies form in the Bing Bang theory, Physics at the earliest instant of time** and reconciling **observation and basic theory** as well extrapolation of the **Universe backward in time** using general relativity. "The basic theory predicts that an instant time in the past we came face to face with infinity in terms of extreme densities, temperatures and pressures," accounted Prof. Malo. "Thus without

any credible evidence associated with the earliest instant of the expansion with very extreme physical conditions, the Big Bang theory cannot and does not provide any explanation for such initial conditions. It rather describes and explains the general evolution of the universe after that instant," Prof. Malo said. He noted that there is profound mystery in science in explaining the creation of the universe. Prof. Malo pointed out that there is a concept of creation that leads to the existence of the Supreme Being- God. Present during this public lecture was the **President of the Atheists in Kenya**, Mr. Harrison Mumia. The atheists' president welcomed the discussion and proposed for incorporation of additional religions in the comparison study between creation and evolution.

Solar Academy trains entrepreneurs on Photovoltaic Sizing, Installation Maintenance and Entrepreneurship



Trainees listening attentively during the Solar Academy Training session held in September 2015.

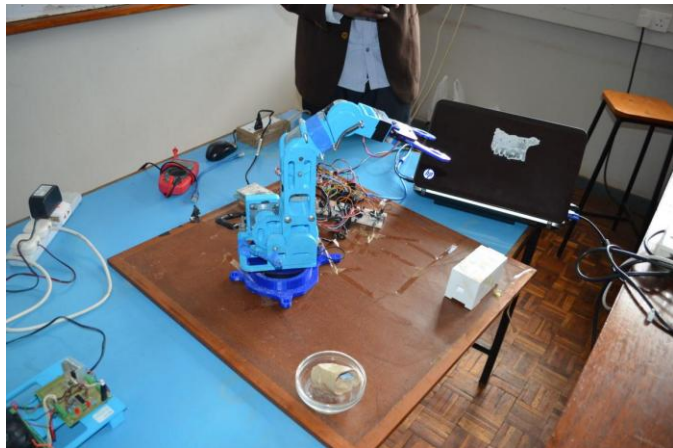
The entrepreneurship landscape is rapidly changing and entrepreneurs need to align themselves with the changing dynamics in order to stay afloat with new requirements in the business environment. Aspects such as leveraging on new skills, networking, spotting opportunities and finding new markets are important in gaining a competitive edge in entrepreneurship. During the Solar Academy training held at the Department of Physics, entrepreneurs were taught various skills which are imperative in strengthening their entrepreneurial acumen. The participants were taken through hands on skills which included PV system installation and commissioning and system maintenance. During the two weeks training, which ran from September 7 to 17, 2015 entrepreneurs gained soft skills such as report writing and presentation. Participants were also taught entrepreneurship and solar energy, inverters and controllers, solar cells/modules characteristics,

status of PV utilization in Kenya and system sizing. At the end of the training, entrepreneurs were awarded certificates. The department of physics has been conducting such trainings and the initiative has seen over 250 technicians so far trained. Majority of them being licensed PV installers, they are already undertaking PV projects across the country. In the year 2014 on April ,August and November the training covered areas in Basics of Photovoltaics, Design, Installation and Maintenance of Solar Photovoltaic Systems.

Nairobi Innovation Week

The Department of physics participated at the **Nairobi Innovation Week** event that happened from 5th to 7th August, 2015. On display at our departmental booth were some of the innovations that our undergraduate and postgraduate

students have come up with after attending some of our courses, like the Bachelor of Science in Applied Microprocessor and Instrumentation course. Among them was a robotic arm, controlled using a wirelessly connected joystick. Both the control board and the joystick boards were implemented using the modern **ARM-based Free scale micro-controllers**. **FreeRTOS** was used to create a real-time firmware running in both boards. The robotic arm is a basis KIT for learning robotics. This a step forward in demonstrating the level of preparedness of our graduates to work in a problem solving environment armed with relevant skills and able to utilize modern embedded systems development tool-sets to come up with custom solutions for specific problems.



A robotic arm. Project by Kevin Amadiva from the BTech class.

Physics Final Year Projects Presentations

The Department of Physics final year students (Class 2015) presented their projects on 24th of April, 2015. There were two main categories: theoretical and applied physics. Projects in applied physics had some interesting demonstrations among them a home automation system and a robotic arm for industrial automation.

The 3D printed robotic arm (see image below) was an applied microprocessor project by Kevin Amadiva, from the BTech class. He put together some 6 motors in a 3D printed structure of support and gears and he was able to program a microcontroller to precisely control the robotic arm to pick and place objects.

Held 1-Day RS-DFID Consortium Members' Workshop

The Condensed Matter group of the Department of Physics held a one day RS-DFID consortium workshop in Nairobi on 2nd February 2015 to discuss phase 2 bid after having won phase one worth £25000. The meeting comprised of Prof Jenny Nelson (UK Principal Investigator) of Imperial College London, Prof. Ernest van Dyke (South Africa Principal Investigator) of Nelson Mandela Metropolitan University, South Africa and Dr. Murape (Zimbabwe Principal Investigator) of National University of Science and Technology, Bulawayo, Zimbabwe.



Condensed matter group - DFID consortium members from left to right: Prof. Aduda (Principal CBPS, condensed matter research group leader), Prof. Jenny Nelson (UK Principal Investigator, Imperial College London), Dr. Murape (National University of Science and Technology, Zimbabwe), Prof. Ernest van Dyke (Nelson Mandela Metropolitan University S.A) and Dr. J. Simiyu (Co-Principal Investigator, Kenya) during a courtesy call to the CBPS Principal's office

The hosts were Prof. Bernard Aduda (CMG group leader and Kenya Principal investigator) and Dr. Justus Simiyu (CMG member and co-PI, Kenya). Dr. Dube Nokuthula, the UK co-PI participated via conference call as she was unable to travel to Nairobi. The first bid comprised of scientific networking while the second phase comprise of five years support towards research collaboration. In the workshop, the participants presented their respective ongoing research programmes, the students involved and the equipment available. After deliberations, the team toured the Department of Physics and held discussions with the Chairman, Department of Physics and had the opportunity of a brief encounter with Prof. Lucy Irungu, the DVC Research and Extension who was giving a lecture at the Department. Prof Ernest later on interacted with some of the MSc students in Solid State Laboratory who were carrying out their research. During the interaction, the students talked about what research they were carrying out and the challenges and successes they have gone through while on the other hand Prof Ernest shared with them the areas of research he is heading at NMMU. He also hinted on possible collaboration with his university in capacity building through

advanced University of Nairobi Solar Academy commonly known as T3 Solar academy.

ChristianAid donation to the physics department

ChristianAid donated Solar Panels, Light Emitting Diodes (LED) Lamps, Power Packs and Radio Connectors worth Ksh. 600,000 to aid in research and training at both the physics department and the School of Physical Sciences. The programme coordinator ChristianAid Mr. Eston Njuki presented it to the condensed matter group leader at the physics department and also the CBPS principal Prof. B. Aduda. Present during the event were physics lecturers Dr. Francis Nyongesa and Dr. Robinson Musembi.



Dr. Waita and Dr. Simiyu explaining to the Principal CBPS, Prof. B. O. Aduda the operation of the solar trainer

Solar Trainer Equipment Commissioned

A Kshs 4.6M state of the art solar training equipment was successfully commissioned in the Solar Energy lab. The modern equipment has a vast resources that can enable the group to carry out training in PV at an advanced level of grid-connected PV & hybrid systems. Present at the commissioning event held on 10th of March, 2015 was the Principal, CBPS. He reminded the Condensed matter group to continue reviewing their content in line with emerging technologies in PV industry in order to remain at the top. The equipment is one of its kind sourced from IKS, Germany.



Dr. Simiyu (Co-coordinator, Schools Outreach Programme Dpt. of Physics) addressing Nairobi Muslim Academy students on career matters

The department of physics visited by high school students

A number of schools from Nakuru and Nairobi County visited the department of physics during years 2014 and 2015. The students were given career talks by the physics academic staff and also had a chance to visit our labs where they got demonstrations on various experiments. The labs visited included the laser physics research lab, the condensed physics research lab and nuclear physics lab. The co-ordinators of Schools Outreach and Promotion of Physics Programme, included Dr. J. Simiyu and Miss. Ruth Wabwire. The students were also guided on career paths available and application of physics in different areas such as medical diagnosis, education, research and industrial processing.

Distance learning students orientation

Distance learning has successfully been in use at the University of Nairobi, as an additional mode of study, since the year 2003. This alternative mode of learning has worked in the previous years, and will continue to work. The Bachelor of Education Science distance learning students, were given advices during the April 2014 orientation week where both CBPS principal, Prof Aduda, the Center for Open and Distance Learning (CODL) Director, Dr. J. Odumbe made speeches.

The new BEd Science students were taken through different subject combinations from the Department of Chemistry, Department of Physical Sciences, Department of Meteorology, Department of Geography and Environmental Studies and Department of Geology. Heads of Departments from School of Physical Sciences and their respective Chairs of Departments and subject coordinators were among those present during the orientation

A visit to UBINK

Some staff from the physics department, condensed matter research group made a visit in September 2014 to UBINK East Africa solar manufacturing plant in Naivasha.

Exchange students from Upsalla University, Sweden

The department of physics played host to six Upsalla University, Sweden, students. Three of them were postgraduate students and were there from January to April 2014. This group was under the guidance of Dr. Simiyu. The other three were undergraduate students namely; Jacob Andren, Elin Lundin and Carl Christian Kirchman and were on an exchange programme from April to June 2014. The latter students were under the guidance of Dr. Kaduki and Karibe and they did their project on Digital Holography for Malaria detection. The presentation of the results for the two groups of students were made in a seminar at the Physics department at room 222 at the school of science building.

PUBLICATIONS

Publications, conferences attended together with postgraduate theses for the year 2014/2015 at the physics department are summarized in the table below.

	AUTHOR	TITLE	JOURNAL	PERIOD*
1.	Austine A. Mulama, Julius M. mwabora, Andrew O. Oduor , Cosmas M. Muiva, Boniface Muthoka Betty N. Amukayia, Drinold A. Mbatia	Role of Bismuth and Substrate Temperature on the Optical Properties of Some Flash Evaporated Se _{100-x} Bi _x Glassy System	New Journal of Glass and Ceramics, 2015, 5, 16-24	April 2015
2.	C. O. Ayieko, R.J Musembi A.A Ogacho, B.O Aduda, B. Muthoka, P.K Jain	Characterisation of TiO ₂ -bound FeMnCuO ₄ solar absorber paint on textured Aluminum substrate for solar thermal applications	3rd AMSEN Workshop, Johannesburg, South Africa.	27-29 May 2015
3.	F.P Buabeng, D.Doodoo-Arhin J.M. Mwabora	Nanostructured Titanium Dioxide particles: Synthesis, Characterisation and Energy applications	3rd AMSEN Workshop, Johannesburg, South Africa.	27-29 May 2015
4.	R.S Richter, B. Onwona-Agyeman R.J. Musembi	Preparation and characterization of doped transparent Zinc Oxide thin films for Solar cell applications	3rd AMSEN Workshop, Johannesburg, South Africa.	27-29 May 2015
5.	Henry Wafula, Musembi Robinson Albert Juma, Thomas Sakwa Manasse Kitui, Rodrigo Araoz Christian Fischer	Role of Cl on Diffusion of Cu in In ₂ S ₃ Layers prepared by ion layer gas reaction method	Coatings 2015,5,54-62	February 2015
6.	J. N nguu, B.O. Aduda, F.W Nyongesa, R.J Musembi S.M Nguu, P.M Mwathe	Electrical Charaterization of Nano TiO ₂ /Nb ₂ O ₅ Composite thin film deposited using electrophoretic deposition technique	International Journal of innovative Research in Advanced Engineering ISSN:2349-2163 issue 2 volume 2	February 2015
7.	Valentine Muramba Maxwell Mageto Francis Gaiho Victor Odari Robinson Musembi	Structural and optical characterization of tin oxide Co-doped with Aluminum and sulphur	American Journal of Material Science 2015,5(2):23-30	2015
8.	Austine Mulama Julius Mwabora Andrew Oduor Cosmas Muiva Boniface Muthoka	Stability Investigation in the optical properties of thermally evaporated Ge ₅ Se ₉₅ Zn _x thin films	Journal of advances in Physics Vol7 No 3 pp1923	Feb 2015
9.	J. N Nguu, B. O. Aduda, F. W Nyongesa, R. J Musembi	Electrophoretic deposition of TiO ₂ /Nb ₂ O ₅ composite electrode thin films for photovoltaic application	Journal of Energy and Power Engineering	April 2014
10	Zephania Birech , Markus Schwoerer, Teresa Schmeiler, Jens Pflaum and Heinrich Schwoerer	Ultrafast dynamics of excitons in tetracene single crystals	Journal of Chemical Physics 140, 114501 (2014)	2014
11	Zephania Birech , Markus Schwoerer, Jens Pflaum and Heinrich Schwoerer	Davydov splitting in triplet excitons of tetracene single crystals	Conference paper, FTu1G.8.pdf FiO/LS 2014	19-23 October 2013
12	Walter Maina Muteithia	Design and Development of an FPGA based Signal Generator	Masters thesis, University of Nairobi	April 2014
13	Daniel Maitethia Memeu	A rapid malaria diagnostic method based on automatic detection and classification of Plasmodium parasites in stained thin blood smear images.	Masters thesis, University of Nairobi	March 2014
14	Daniel Maitethia Memeu, Kenneth Kaduki, C. K Mjomba	Detection of plasmodium parasites from images of thin blood smears	Open journal of clinical diagnostics	November 2013
15	Benjamin Odumo, Jayanti Patel Hudson Kalambuka	Impact of gold mining associated with mercury contamination in soil, biota sediments and tailings in Kenya	Environ Sci Pollut Res	June 2014

16	Austine Mulama, Julius Mwabora Andrew Oduor, Cosma Muiva Chrispinus Walloga	Effect of Ga Incorporation and Film Thickness on the Optical properties of as-Deposited amorphous Ga _x Se _{1-x} Thin films	IOSR Journal of Applied Physics	Sept/October 2014
17	Elijah Cheruiyot, Collins Mito Massimo Menenti, Ben Gorte Roderik Koenders Nadia Akdim	Evaluating MERIS based aquatic vegetation mapping in Lake Vitoria	Remote Sensing	August 2014
18	S Mureramanzi, S. P. Stoylov	Electric Field Light Scattering: Application to Biological Systems	International Journal of BioChemPhysics	December 2013
19	Ian Kaniu, K.H Angeyo	Challenges in rapid soil quality assessment and opportunities presented by multivariate chemometric energy dispersive X-ray fluorescence and scattering spectroscopy	Geoderma	October 2014
20	P Mwinzi, R Musembi, M Munji B Odari, L Munguti, A Ntilakigwa J Mwabora W Njoroge B. Aduda	Surface passivation effect on CO ₂ sensitivity of spray pyrolysis deposited Pd-F:SnO ₂ thin film gas sensor		
21	Justus Simiyu, Sebastian Waita Robinson Musembi, Alex Ogacho Bernard Aduda	Promotion of PV uptake and sector growth in Kenya through value added training in PV sizing, installation and maintenance.	Energy Procedia	2014
22	Dickson L Omucheni, Kenneth A Kaduki, Wallace D Bulimo, Hudson K Angeyo	Application of principal component analysis to multispectral-multimodal optical image analysis for malaria diagnostics	Malaria Journal	Dec 2014

Conferences

No	Staff Name	Title of the Paper	Conference	Venue	Date
1.	Birech Zephania	Application of Raman spectroscopy in Aflatoxin B1 detection in maize kernels	CLEO-PR 2015 conference	BEXCO, Busan, Korea	August 24-28, 2015
2.	Zephania Birech	Davydov splitting in triplet excitons of tetracene	Frontiers in Optics/Laser Science	USA	19-23 October 2014
3.	Peter Okech	Inherent Diversity for Fault Detection in Complex Hardware/Software Systems	The 44 th Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN 2014)	Atlanta, Georgia, USA	25 th June 2014
4.	H K Angeyo	Nuclear forensics via Machine learning laser based spectral analysis and imaging	International Conference on Advances in Nuclear forensics	Vienna, Austria	7-10, July 2014

Theses

	Daniel Maitethia Memeu	A rapid malaria diagnostic method based on automatic detection and classification of Plasmodium parasites in stained thin blood smear images.	Masters thesis, University of Nairobi	March 2014
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