

# CENTRE FOR SPACE RESEARCH, (CESPAR), ANCHOR UNIVERSITY LAGOS



OUR JOURNEY TO

# SPACE

*...exploring the space environment for the benefit of humanity.*



Dr. Victor U. J. Nwankwo with Prof. Jean-Pierre Ranlin (Director of CRAAM, Brazil) during the initiation of the scientific cooperation and collaboration with Anchor University Lagos (2019)




First visit of the pioneer Vice Chancellor, Prof. J. A. Afolayan and the Deputy Vice Chancellor, Prof. Johnson Fatokun to the Anchor University Space Lab in 2021.



**CESPAR**



Dr. V. U. J. Nwankwo with the early Space Lab Team: L-R: Mr. Muiyiwa Ajakaiye, Mr. Muiyiwa Adeyanju, Dr. Michael Olatunji, Mr. Johannes Strohacker and Mr. Timothy Akinsola.

The background of the page is a light orange color with a repeating pattern of various educational icons. These icons include books, pencils, lightbulbs, scissors, triangles, and other symbols associated with learning and education. The icons are scattered across the entire page, creating a textured, patterned effect.

*Dedicated to our colleague, friend and brother,*  
**Paul Izuchukwu Anekwe** *BSc. MSc.,ISP, BCS, ZCE, SCWCD, SCJP, OCA*  
*(1977 – 2022)*

# ▶ FOREWORD BY THE VICE CHANCELLOR

Anchor University, Space, Atmospheric Physics and Radio Wave Propagation Laboratory (AUL Space Lab) was established in 2018, when a Memorandum of Understanding (MOU) was signed with India centre for Space Physics (ICSP). AUL Space Lab also initiated MoU with Centro de Radio Astronomia e Astrofisica Mackenzie (CRAAM), Mackenzie Presbyterian University (MPU), São Paulo (Brazil) in 2019. The laboratory has been involved in collaborative research with renown international and local research institutes and scientists including ICSP (India), CRAAM/MPU (Brazil), University of Bolton (UK), National Oceanic and Atmospheric Administration (USA), Dublin Institute of Advanced Studies (DIAS) Dunsink Observatory (Ireland), National Space Research and Development Agency (Nigeria). Our Collaboration and scientific cooperation has resulted in the donation of data capturing equipment such as a very low frequency (VLF) radio wave receiver (by ICSP and DIAS Dunsink Observatory) and magnetometer (by DIAS Dunsink Observatory). In 2021, the laboratory was awarded a research grant by the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP), to create a database for research in solar-Terrestrial science.



The Laboratory exploits the propagation characteristic of VLF Radio waves (received from transmitters in Australia, France, India and Japan) and combines the observed variations with observation from other space-borne and ground-based facilities (such as high frequency (HF) radio pulses) to monitor and study atmospheric and ionospheric irregularities, to be able to derive quantitative measures and develop methods and indices to describe space weather interference level on technological systems. The findings of our research can help mitigate impact and support space weather services (e.g., forecast, warnings and alerts of potentially hazardous conditions) that can help stakeholders/agencies to be aware of imminent events and to adjust their operations to minimise the impacts on their systems.

Although AUL is relatively young when compared with other Institutions in Nigeria, she has been put in a vantage position to contribute meaningfully to the study of solar, atmospheric and weather sciences in Nigeria using satellite data and in-situ measurements. This will enable us to manage our environment and natural resources using the acquired information, to understand how the universe works and what its impact is on the society and the world at large. A better understanding of our land, air and water resources and associated problems due to climate change will be enhanced

As an institution, the laboratory will enable us to conduct research to expand the frontiers of knowledge in solar-terrestrial science and develop the skills and knowledge of researchers. Today, the AUL Space laboratory has been upgraded and now recognised as Anchor University Centre for Space Research (CESPAR). The centre will afford AUL to collaborate with other centres with similar interests, give students (coming generation) a comprehensive and comprehensible educational experience in space science and technology, a sense of the power of the mind that comes from a deepening of understanding and also the satisfaction that comes from competence in intellectual activities.

The centre is blessed with dedicated staff who through doggedness and faithfulness made the centre the success story we are seeing today.

**Professor Bandele Samuel Oye**  
*Vice Chancellor, Anchor University, Lagos*

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# 1. OUR JOURNEY TO SPACE



*The immediate past Vice Chancellor, Prof J.O. Afolayan (Middle) with the Dean, Faculty of Natural & Applied Sciences, Prof J.O. Fatokun (left) and Dr Victor U. J. Nwankwo (Right) during the inspection of a VLF Radio-wave receiver given to Anchor University by the Indian centre for Space Physics at the Office of the Vice Chancellor, AUL.*

## Introduction

The Space, Atmospheric Physics and Radio wave propagation Laboratory (AUL Space Lab), Anchor University, Lagos was established to strengthen the University's capabilities in space sciences and cutting edge research through coordinated and collaborative research and mentorship.

The Laboratory conducts research in Atmospheric and Radio sciences, Solar-terrestrial Physics, Space weather and its application in the field of natural, physical and applied sciences, to address the challenges posed by space weather to both ground-based and space-borne technology, thus contributing to sustainable development in Nigeria, Africa and the world.

The study of the Earth's atmosphere and the associated changes is important because of the role played by the medium in the activities that directly or indirectly affect the Earth and its inhabitants. Radio propagation and communication are made possible by the transmission of waves in the atmospheric medium, the space systems operate in the atmospheric medium

while providing important services on Earth for human survival. However, the variable state of the coupled space environment related to the changing conditions on the sun and in the terrestrial atmosphere can influence the performance and reliability of both space-borne and ground-based technological systems and can also endanger human health.

The Laboratory exploits the propagation characteristic of very low frequency (VLF) Radio waves, satellite data and other ground-based facilities to monitor and study atmospheric and ionospheric irregularities. We combine simultaneously observed variations in the properties of radio waves in the ionospheric D-region with high frequency (HF) radio pulses in the E and F region to probe the state of both the lower and upper atmosphere.



*Wide view of Anchor University, Lagos campus showing the Admin building and a female hostel.*

The database and research activities of AUL Space Lab is also geared towards addressing the obvious dearth of research data in the West African region. The Earth's atmosphere is both dynamic and complex, and characterised by temporal and spatial variability. Therefore, regional deployment of scientific observational facilities for atmospheric data acquisition is imperative for better coverage and remote sensing of regions of interest.

It is worrisome that Nigeria and most parts of Africa lack adequate deployment of ground-based and space-borne observational tools. Our regions are not well represented in the ongoing effort by the World Archive of Low-frequency data and observation (WALDO) as seen in the figure below.

The map of global GNSS and digital ionosonde ground sites have also shown very limited deployment of these observational tools in the African regions (see figure below). Even the areas covered by current observational tools are limited in space and Earth.

The scenario underscores the need to embark on global deployment of more facilities and upgrading the existing ones for a wider coverage, especially in the African continent. Anchor University Space Laboratory is therefore committed to building regional and institutional databases for advancing research in solar-terrestrial science and technological innovations, towards significant contribution to sustainable development in Nigeria, Africa and the world at large.





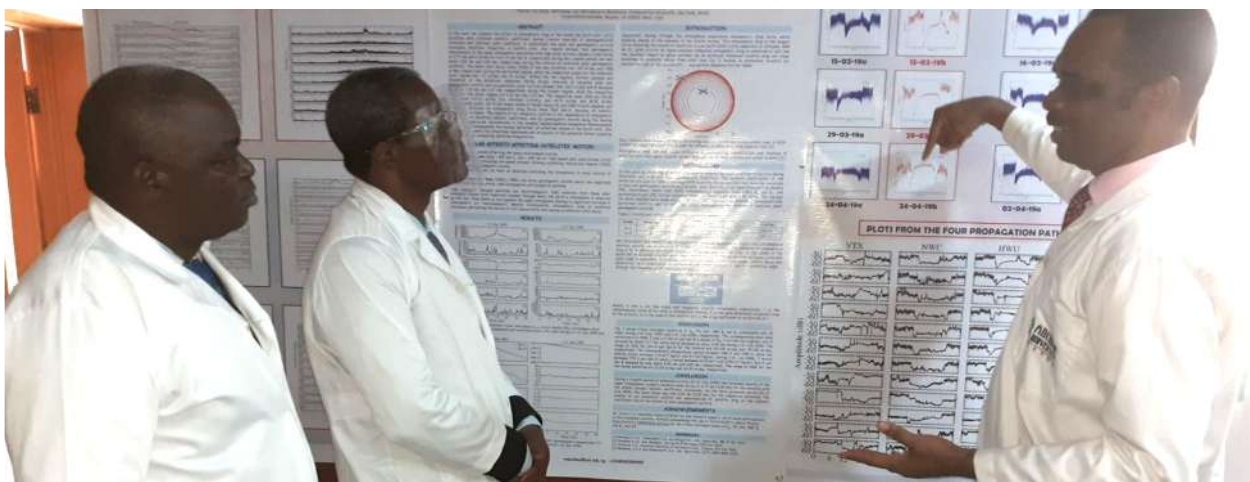
## History of Anchor University, Lagos (AUL) Space Laboratory

In March 2018, Dr. Victor U. J. Nwankwo travelled to seek research collaboration and scientific cooperation with the Indian centre for Space Physics (ICSP) following the approval of the Vice Chancellor, Anchor University, Lagos (AUL).



*Dr Victor U. J. Nwankwo with colleagues at ICSP Ionospheric and Earthquake Research Centre and Optical Observatory, Sitapur, West Bengal, India during his visit in 2018*

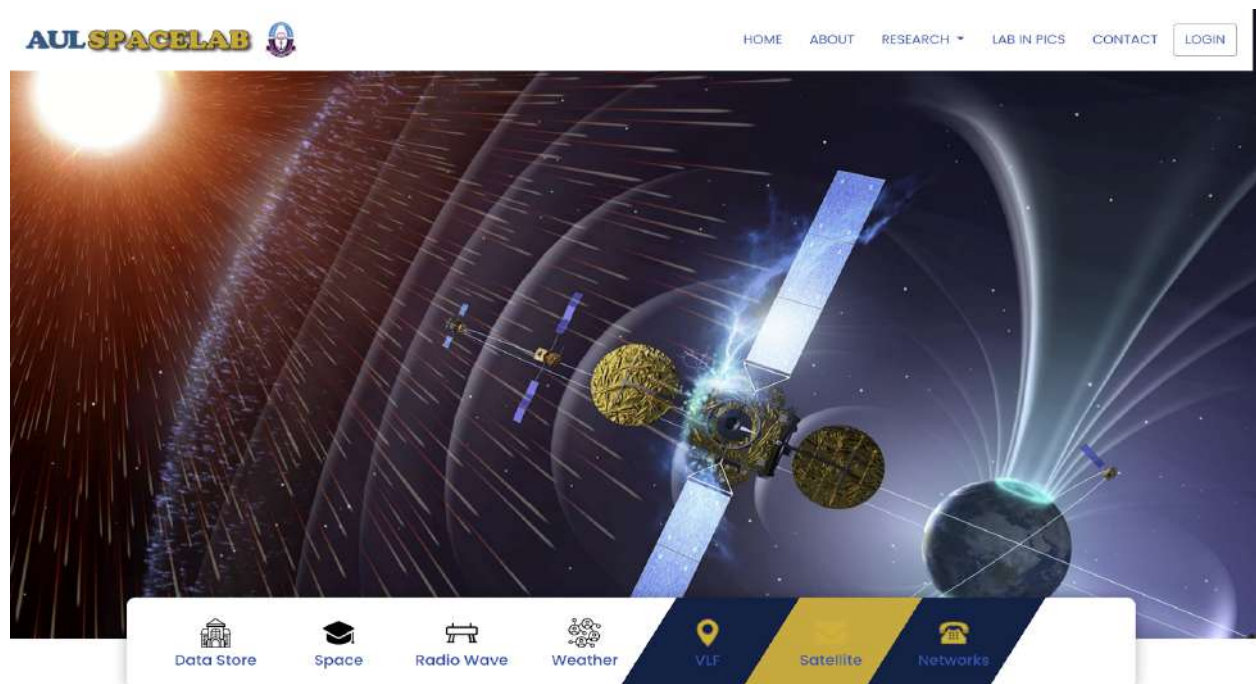
The move resulted in the donation of VLF Receiver to AUL for atmospheric data acquisition and research by ICSP, and subsequent signing of the memorandum of understanding (MoU) between ICSP and Anchor University, Lagos. With the VLF Receiver donated, the lab was able to capture **time-variant amplitude signals** from four different transmitters globally - France, Japan, Australia and India.



*L-R: Prof. Johnson Fatokun (DVC), Prof. J. O. Afolayan (Former VC) with Dr. Victor U. J. Nwankwo at the Space Lab.*

Between July and December 2018, the **Space, Atmospheric Physics and Radio wave Propagation Laboratory** was established in the Department of Physics, during which we conducted site survey, components assembly and subsequent installation of the VLF Receiver. Effectively, the operation of the Receiver began in February 2019 with data collected from four transmitters; HWU (France, ), JJI (Japan), NWC (Australia) and VTX (India).

Due to the need for proper storage, retrieval, processing of the already acquired data, and provision of a real-time data catalogue that will be publicly available for researchers and stakeholders in the field, the laboratory developed and launched her official database/website February 2021. The domain name for Anchor University Space Laboratory is [www.aulspacelab.space](http://www.aulspacelab.space)

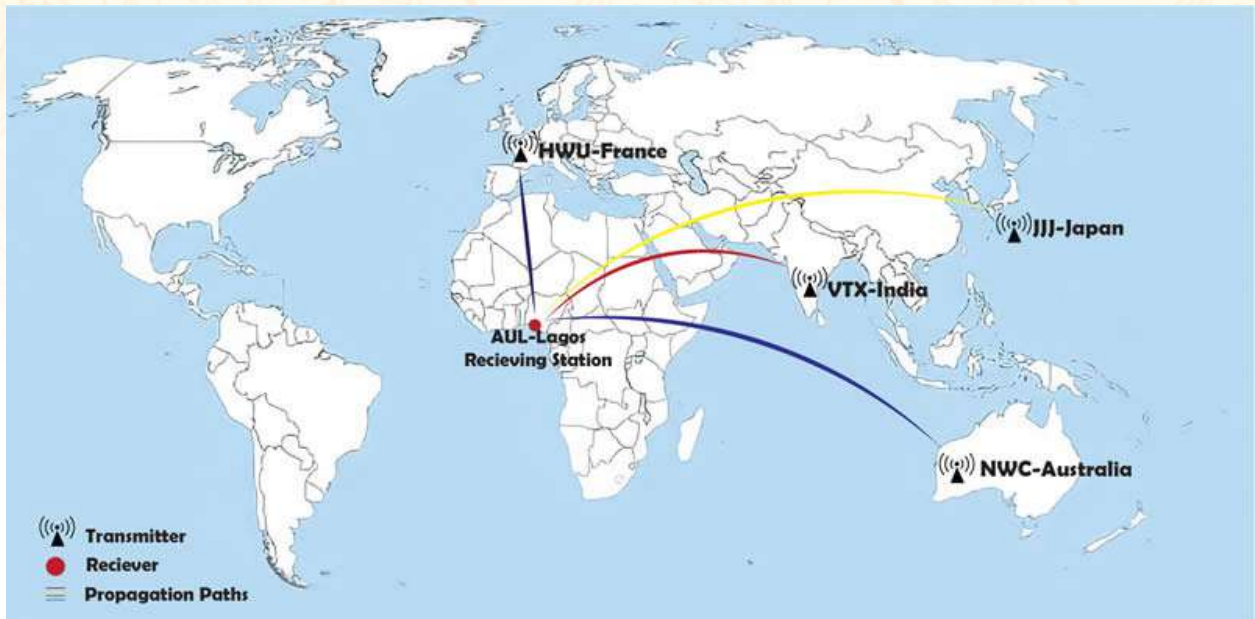


*AUL Space Lab homepage at [www.aulspacelab.space](http://www.aulspacelab.space)*

## AUL Space Laboratory Database

The following datasets are now available in our database:

- 1. Diurnal VLF Amplitude**
  - AUL-HWU propagation path
  - AUL-JJI propagation path
  - AUL-NWC propagation path
  - AUL-VTX propagation path
- 2. Air temperature**
- 3. Solar Ultraviolet (UV) radiation**
- 4. Wind speed and direction**
- 5. Light intensity**
- 6. Humidity**
- 7. Rainfall parameters**
- 8. Air pressure**
- 9. Heat index**



Sources of VLF data being received at AUL Space Lab

## Usefulness of the AUL Space Laboratory Database

The findings derived from the research/study of solar-terrestrial transients and atmospheric dynamics using our datasets can be resources for...

1. forecast, situational awareness, anomaly resolution, and mitigation of the impact of extreme weather conditions, ✓
2. improve the understanding of space weather effects on critical technology, to be able to contribute to countermeasures, in cooperation with scientific, industrial and government partners, ✓
3. support weather services (e.g., forecast, warnings and alerts of potentially hazardous conditions) that can help stakeholders/agencies to be aware of imminent events and to adjust their operations to minimise the impacts on their systems. ✓

We will be able to combine the observed propagation characteristics of this planned VLF Narrowband measurement with other observational data from space-borne and ground-based facilities, sound theoretical framework and modelling tools to study the response of the ionosphere to non-solar phenomenon (e.g., sudden stratospheric warming, gravity waves, lightning) and the solar counterparts such as sudden ionospheric disturbances, solar eclipse, and geomagnetic storm-induced energetic particle penetrations in our region (and their space weather implications).

The VLF Narrowband measurement can also be used as an anthropogenic climate change monitoring technique. Our research will also be addressing Sun-induced variability in the interplanetary and geospace, which are coupled to the upper and lower atmosphere.

## 2. AUL SPACE LAB WINS SCOSTEP GRANT



Source: CODATA Blog: News from the CODATA community and from Simon Hodson, CODATA Executive Director

### AUL Space Lab awarded SCOSTEP/PRESTO Grant by the Scientific Committee On Solar-Terrestrial Physics (SCOSTEP)

In 2021, the Lead Scientist and Team members of AUL Space laboratory successfully applied for SCOSTEP/PRESTO Grants for Year 2021 by submitting a proposal for building a robust database for proper storage, retrieval and the processing of the already acquired data, and provide real-time data catalogue that will be publicly available for researchers and stakeholders in the field.

The SCOSTEP/PRESTO grant supports successful applicants to ‘create databases of solar-terrestrial data that are related to one or more of Predictability of the Solar-Terrestrial Coupling (PRESTO) Pillars and contribute to the PRESTO activities.’ AUL Space laboratory won this highly competitive research grant and was awarded in October/November 2021.

### What Worked For Us?

1. **Well-articulated website:** Our website collects data 24/7 for research purposes.
2. **Achieved Milestones:** We have been able to publish several papers in the field.
3. **Expertise:** Our research team comprises individuals with great research potentials.

### 3. RELOCATION AND EXPANSION OF THE LAB



Following the award of Grant by SCOSTEP, we acquired more equipment to enhance the operations and performance of the laboratory, which include additional Servers (Workstations), VLF radio wave receivers and associated accessories, **high-speed independent internet connection and Relevant software and hardware**, 4.5 KVA Power Generator, 24 V Inverter, Solar Power Panels, etc.

#### The Old Location

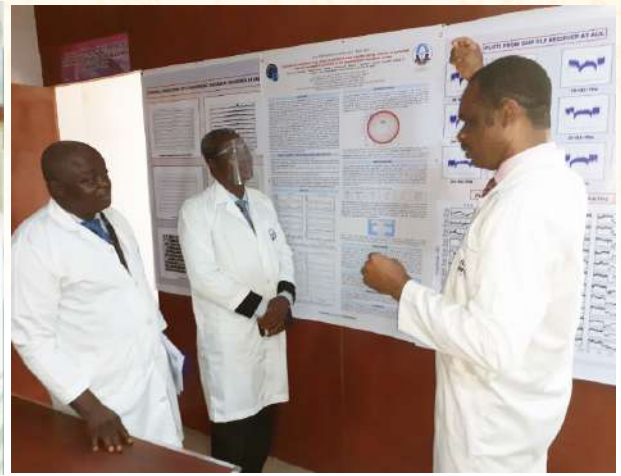


*The makeshift cubicle used for the AUL Space lab when it was first set up.*



*Early members of the AUL Space Lab Team at the old location where it was first set up.*

The AUL Space laboratory, at inception, was carved out of the office of the Head of the Department of Physics. It was more of a **makeshift cubicle**, housing the equipment with very limited space for researchers. This was the case until the acquisition of the new equipment, hence the need for expansion.

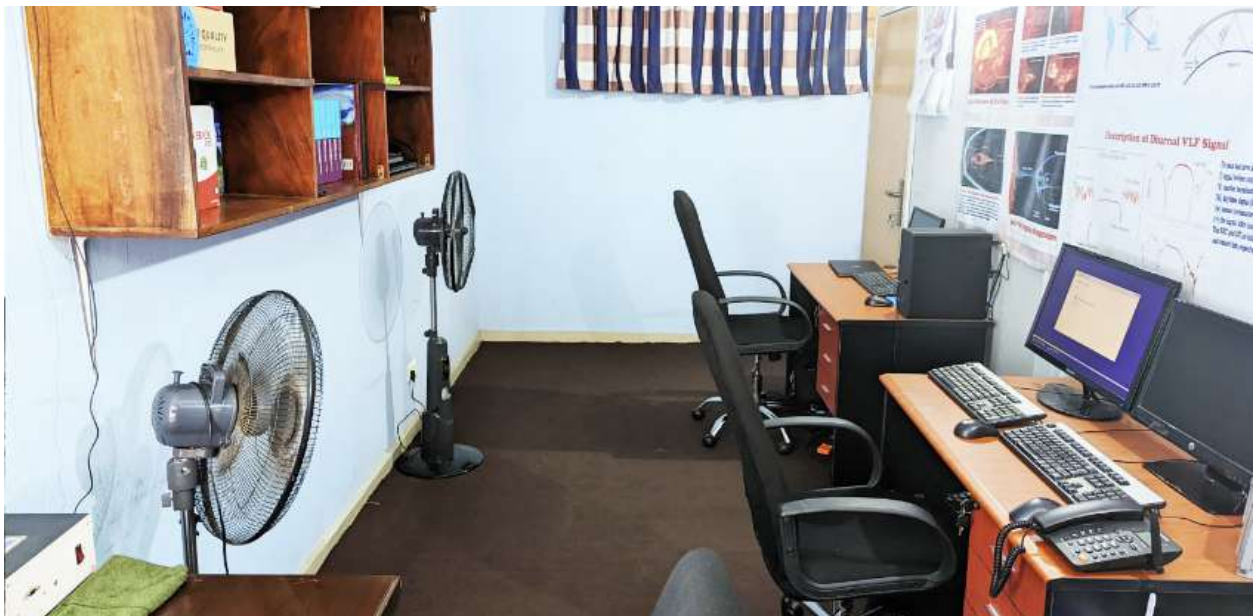


L-R: Prof J. A. Fatokun, Dr Victor U.J. Nwankwo and Prof. J. O. Afolayan at the Old Space Lab Location

## The New Location



Dr. Victor U. J. Nwankwo having a session with students during the VLF Antenna installation at the new location.



*The New Location of the AUL Space Laboratory.*

The SCOSTEP grant enabled the expansion of the laboratory as it was moved to a new location with about four-room space that can accommodate many researchers and provide comfort as well as make provision for a mini conference or discussion room for visiting researchers. The AUL Space Laboratory in its current shape bears the ambience of a world-class research lab.

## **Facilities and Features in the New Location**

- *Four spacious rooms with a mini-conference area.*
- *24-7 uninterrupted power supply,*
- *High-speed internet connection.*
- *Continuous data collection system*
- *Basic amenities (Air conditioning system, Convenience, etc.)*
- *etc.*



## 4. UNINTERRUPTED POWER AT THE LAB



### Solving the Power Challenge at the Lab

One of the challenges faced at the AUL Space Laboratory from inception was ‘epileptic’ electric power supply, which causes surge and fluctuations that can over time impact the functionality of the data capturing systems. The laboratory receives and archives data from our VLF radio wave receiver on a 24/7 basis. Unfortunately, data reception was sometimes interrupted by power failure, which often resulted in breaks/gaps in the archived data: Our workstations should ordinarily remain operational without downtime. In line with this objective, we procured and installed an inverter system, solar panels and a stand-by generating set to provide constant power supply to the lab.

### Inverter System



The laboratory acquired and installed a 1 kVA inverter in 2019. However, with the expansion of the lab's operation and acquisition of more equipment it became imperative to upgrade the alternative power system. Consequently, the laboratory acquired a new 2.5 KVA inverter, supported with solar panels.



*Installation of the inverter system at the AUL Space Lab.*

## **Electric Generator**

The laboratory also acquired a 4.5 KVA electric power generating set, to power the lab in the event of prolonged power outage. When complemented with power from the mains, It is hoped that the research lab will have a constant power supply to achieve its goals.



*4.5 KVA electric power generating set for the AUL Space Lab*

## Solar Panel Installation

Because of the importance of the continuous stream of data being collected, it was necessary to further ensure that the power is supplied to the systems in the lab on a 24/7 basis. In line with this objective, the laboratory in February 2022, procured and installed solar panels to support the inverter system.



*Members of the Space Lab research team installing the solar panel system for the lab.*

With the solar system installed, and based on the average power usage by the data capturing system, the lab currently enjoys 24 hours of constant power supply and an uninterrupted data collection necessary to achieve its goals and objectives.

# 5. VLF RECEIVER INSTALLATION



## Overview

The team also procured more VLF radio wave receivers from the United Kingdom Radio Astronomy Association (UKRAA) in April 2022, assembled and installed by the research team in May, 2022 at the Anchor University Space Laboratory.

With the additional VLF radio receivers, AUL Space Laboratory now has the capacity to receive uninterrupted digital signals without noise interference from the environment.



*The research team, installing the sub-assembly of the VLF Antenna at the AUL Space Lab.*



*The research team, winding the aerial of the VLF Antenna at the AUL Space Lab.*



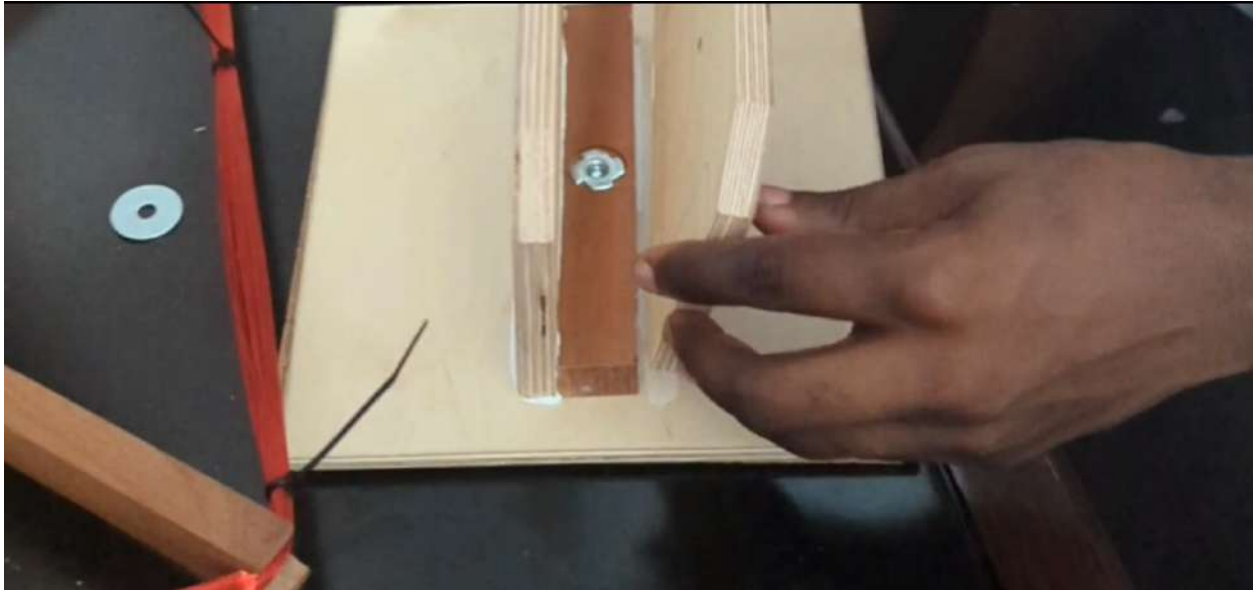
*Dr. Victor U. J. Nwankwo with the research team, winding the aerial during the installation of the VLF Antenna at the AUL Space Lab in May, 2022.*

## Installation Process

The VLF Antenna installation has four major aspects/stages. The first stage was the Frame Base Assembly. This flat base provides a rigid support for the whole antenna. It consists of a system that allows the Frame Sub-Assembly to lock into it to make a firm grasp with the base.

### **Part 1: Frame Base Support**

The first part was to form the Base Support on which the antenna would sit.



*Installation of the frame base support*

### **Part 2: Frame Sub-Assembly**

The next stage was the Frame Sub-Assembly which consists of a cross-shaped frame for the winding of the antenna.



*Forming the Frame Sub-Assembly*

### ***Part 3: Winding The Aerial***

The next stage was to wind the aerial around the Frame Sub-Assembly, about 120 turns.



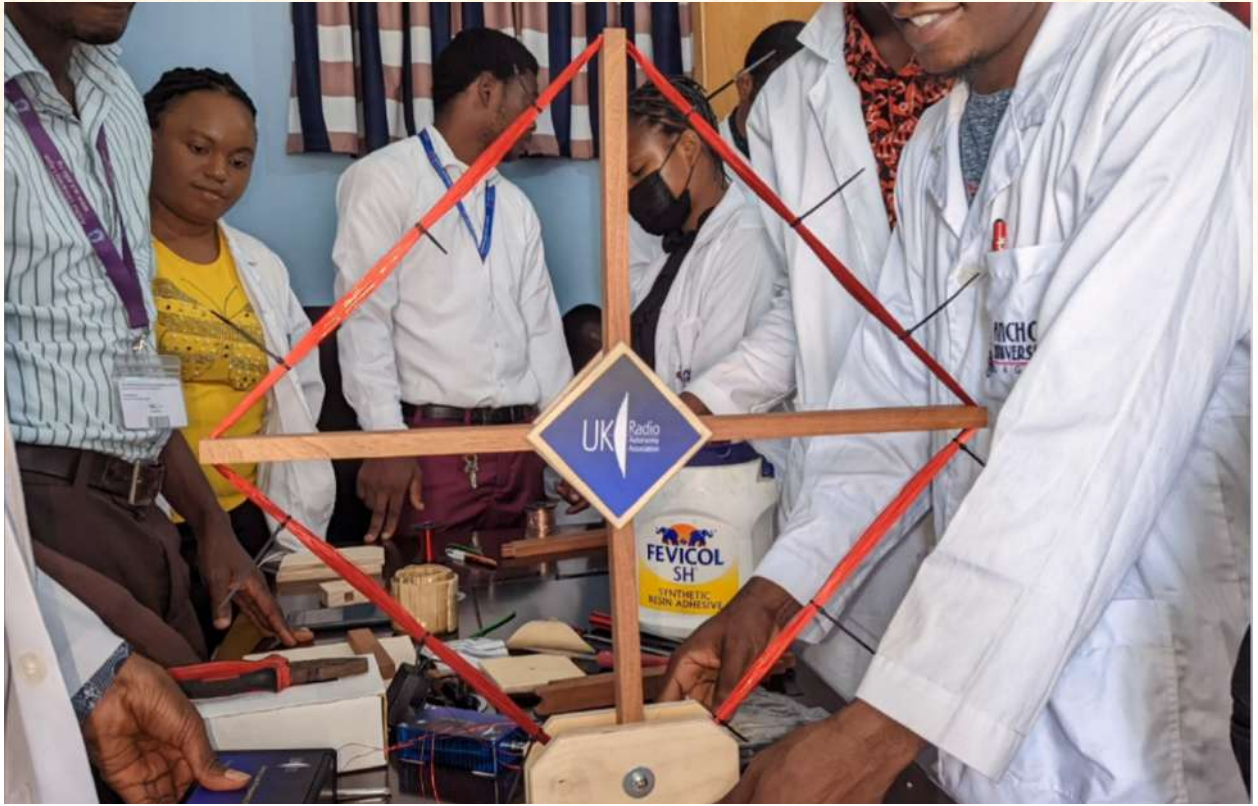
*The student working together with the team members of the Space Lab, winding the aerial*

### ***Part 4: Final Assembly of All The Parts***

The final stage of the assembly was to put all the parts together to complete the installation of the antenna frame.

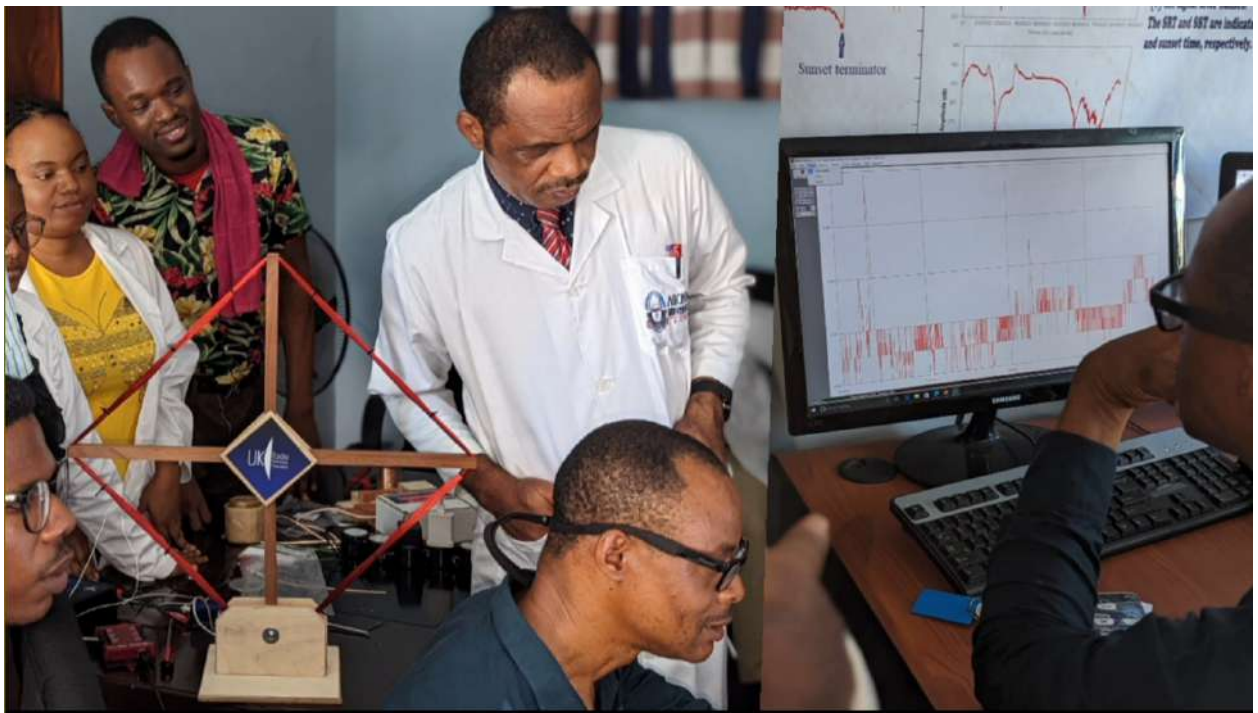


Below is the final look of the receiver.



### ***Part 5: Software Installation and Testing***

The final stage of the installation was to connect the antenna to the software system to confirm the data that's been received to be strong.



*Software Installation and Testing*



## 6. TESTIMONIAL OF RESEARCH TRAINING AT THE LAB

Miss Oghenenyovwe Ovie was a student of the University of Medical Sciences, Ondo, Ondo State, Nigeria. She was mentored and trained in retrieval, assimilation, processing and analysis of atmospheric and solar-geophysical data at AUL Space Laboratory, using relevant softwares and/or computer programs. Her undergraduate dissertation entitled '**The Effect of Solar-Induced X-Ray on the VLF Radio Waves Propagation in the D-region of the Ionosphere**' was successfully supervised by scientists at AUL Space Laboratory, and adjudged to be one of the best projects in her class.

She also emerged the best student in her class. The manuscript produced from the work has been accepted for publication by the NIP Journal of Physics, and will be available to the scientific community in the coming days. The work was also accepted for presentation in two international conferences; 44th Scientific Assembly of the Committee for Space Research (COSPAR) and the 2022 European Space Weather Week (ESWW) Conference.

### Testimonial

*It gives me a great pleasure to say with pride that I completed my undergraduate (Final year) dissertation at Anchor University Space, Atmospheric Physics and Radio Wave Propagation Laboratory (AUL Space Lab), Department of Physics, Faculty of Natural, Applied and Health Sciences, under the supervisions of Dr. Victor U.J. Nwankwo (Space Scientist/Physicist) and Dr. Michael Olatunji (Materials, Nuclear/Radiation Physicist).*

*I would like to thank the university for permitting me to use their Atmospheric Space Lab to collect VLF signal amplitude data, which was used in the completion of my project. I would like to also thank all the research team members in the lab and indeed, the Department of physics for their support.*

*The experience and knowledge will surely help me to go further in my future studies. Anchor is a great place to study, having the chance to learn from very good and well trained Lecturers and Professors, who display a high sense of responsibility in all they do. The time spent at Anchor University had both impacted my professional and personal life. I am glad I came to Anchor University. It is indeed a great institution to learn.*



**Miss Oghenenyovwe Ovie**

*Research Student at Anchor University Space Lab,  
from the University of Medical Sciences, Ondo.*

# 7. PUBLISHED PAPERS IN INT'L JOURNALS



## AUL Space Lab Published Papers in International Journals

1. Nwankwo V.U.J., Denig, W., Chakrabarti, S. K., Ogunmodimu, O., Ajakaiye, M. P., Fatokun, J. O., Anekwe, P. I., Obisesan, O. E., Oyanameh, O. E., and Fatoye, O. V. 2022. Diagnostic study of geomagnetic storm-induced ionospheric changes over very low-frequency signal propagation paths in the mid-latitude D region, *Ann. Geophys.*, 40, 433–461, <https://doi.org/10.5194/angeo-40-433-2022>.
2. Ovie, O., Nwankwo V.U.J., Olatunji, M.A., Obisesan, O.E., Fatoye, O.V., 2022. The Effect of Solar-Induced X-Ray on the VLF Radio Waves Propagation in the D-region of the Ionosphere. *NIP Journal of Physics (Accepted)*
3. Nwankwo V.U.J., W. Denig, S.K. Chakrabarti S.K., Ajakaiye M.P., Fatokun J., Akanni A.W., Raulin J-P., Correia E. and Enoh J.E., 2021. Atmospheric drag effects on modeled low Earth orbit (LEO) satellites during the July 2000 Bastille Day event in contrast to an interval of geomagnetically quiet conditions . *Ann. Geophys.* 39, 397–412, 2021 <https://doi.org/10.5194/angeo-39-397-2021>.
4. Ogunmodimu O., Honorary F., Rogers N., Richardson I.G. and Nwankwo V.U.J., 2020. Empirical modeling of auroral absorption during disturbed periods of interplanetary coronal mass ejection events. *J Atmos. Solar-Terres. Phys.*, 207, 105364, [doi:10.1016/j.jastp.2020.105364](https://doi.org/10.1016/j.jastp.2020.105364).
5. Nwankwo V.U.J., Chakrabarti S.K., Sasmal S., Denig W., M.P. Ajakaiye, T. Akinsola, M.Adeyanju, P. Anekwe, K. Iluore, M. Olatunji, D. Bhowmick, J. Fatokun, M.A. Ayoola, O.O. Soneye, and J. Ajamu, 2020. Radio aeronomy in Nigeria: First results from very low frequency (VLF) radio waves receiving station at Anchor University, Lagos. 2020 IEEE-ICMCECS, Lagos, Nigeria, pp 1-7, DOI:10.1109/ICMCECS47690.2020.247002.
6. Nwankwo V.U.J., Denig W., Ajakaiye M.P, Wahabbi Akanni, Johnson Fatokun, Jean-Pierre Raulin, Emilia Correia and John E. Enoh, 2020. Simulation of atmospheric drag effect on low

*Earth orbit satellites during intervals of perturbed and quiet geomagnetic conditions in the magnetosphere-ionosphere system. 2020 IEEE-ICMCECS, Lagos, Nigeria, pp 1-7, DOI: 10.1109/ICMCECS47690.2020.247003.*

7. Nwankwo V.U.J., Jibiri N.N. & Kio M.T., 2020. *The impact of the space radiation environment on satellite operation in near-Earth space . In Demyanov V. and Becedas J. (Eds), Satellites Missions and Technologies for Geosciences. InTech Open Publishing, London, DOI:10.5772/intechopen.90115*
8. Nwankwo V.U.J., 2018. *Space Weather: Responses of the Atmosphere to Solar Activity and Its Implications for LEO Satellites Aerodynamic Drag . In Mukhopadhyay B., Sasmal S. (Eds.), Exploring the Universe: From Near Space to Extra-Galactic . Springer International Publishing, Springer Nature Switzerland AG. DOI:10.5772/intechopen.90115*

## **Submitted Papers**

1. Nwankwo V.U.J., Chakrabarti S.K., Ogunmodimu O., Denig W., Ajakaiye M.P. and Anekwe P.I., 2022. *Diagnostic study of geomagnetic storm-induced ionospheric changes over VLF signal propagation paths in hi-and mid-latitude D-region. Ann. Geophys., angeo-2016-84, doi.org/10.5194/angeo-2021-42*
2. Kereza A.P., Akinsola T.O., \*Nwankwo V.U.J., Ajakaiye M.P., Orokhe J.E., Ahmed T.S. and Ebong N. U. *Design And Construction Of 1kva Solar – Powered Inverter (2022)*

# 8. OUR FIVE-YEAR PROJECTED GOALS



AUL Space Lab team will continue to work towards making the institution a world-class, globally recognized centre for space research and provide solutions for industries. Our projected goal for the next few years include:

## ***1. Collaborations with World-class Space Agencies***

Viable collaborations with international Space Agencies, e.g., NASRDA, ESA, NASA, etc.

## ***2. State-of-the-art Research and Observational Facilities***

Different ranges of telescopes and monitoring devices to help collect more data for research and applications in industries.

## ***3. Stakeholder in Satellite Technology in Nigeria and Africa***

Helping the nation and continent effectively maximise the use of our satellites and in-situ data.

## ***4. World-acclaimed centre of Excellence in Space Science***

With collaborations with different global networks of space centres, we are going to be attracting top researchers from all over the world to carry out their projects and research at the centre.

## ***5. Anchor University first satellite in space***

The launch of AUL first nano-satellite into space

## ▶ ASSESSMENTS OF THE LAB...

### **“Very Active to Make a Mark on the Globe.”**

*“AUL Space Lab is a very active and focussed laboratory which will leave a mark on the globe. I am excited with the level of research activities and data captured at the laboratory. I advise the present management to upgrade it to a centre of excellence and fund it appropriately so that it will brand AUL as a centre of excellence for Space research globally.”*



**Professor J. A. Afolayan,**

*Pioneer (immediate past) Vice Chancellor, Anchor University, Lagos.*



### **“Of Comparable Global Standard.”**

*“AUL Space Lab is of comparable standard to any laboratory of such description globally with ongoing standard and enormous academic research. We will consistently ensure that members of staff are exposed to global space centres and that the laboratory is converted to a world-class space centre.”*

**Professor S. O. Bandele,**

*Vice Chancellor, Anchor University, Lagos.*

### **“A World-Class Research Centre of Excellence.”**

*“The facilities at Anchor University Space Laboratory are superb and the members of staff are well-trained and experienced. The University management is determined to expand and make the laboratory a world-class research centre of excellence.”*



**Professor J. O. Fatokun,**

*Deputy Vice Chancellor, Anchor University, Lagos.*



### **“A centre of attraction to Anchor University, Lagos.”**

*“The AUL Space laboratory is strategically located in a serene environment ideal for productive academic research work. It is extremely neat, fully-equipped and of international standard. It is a centre of attraction to Anchor University where people come to carry out independent research works.”*

**Pastor M. O. Salami,**

*Registrar, Anchor University, Lagos.*

### **“From Ayobo, Lagos to the World!”**

*“Anchor University Space Laboratory has been my pride in the Faculty. Currently, Anchor University and the Faculty of Natural, Applied and Health Sciences in particular is very rich in facilities e.g., the AUL Space Laboratory, Atomic absorption spectrometer, etc. Any aspiring student desiring to study Science related courses in Anchor University, Lagos is lucky as the faculty offers the best in facilities and human resources.”*



**Professor K. V. F. Fatokun,**

*Dean, Faculty of Natural, Applied and Health Sciences, Anchor University, Lagos.*



### **“So, this is how we get these predictions?”**

*“My visit to Anchor University Space Lab has enlightened me on how climatic information is received and predictions about rainfall, weather conditions are processed for the benefit of the general populace. It is a great service to the society at large.”*

**Professor D. S. Adeyanju,**

*Faculty of Humanities, Social and Management Sciences, AUL.*

### **“A window to a great career and brighter future”**

*“With the level of collaborations leading to grants and the extent of research work going on at Anchor University Space Lab here, I am convinced that any student or researcher working in partnership with the AUL Space Lab will certainly build a great career and eventually a pathway to achieve greatness and expertise in space physics.”*



**Professor S.O. Oyero,**

*Dean, Faculty of Humanities, Social & Management Sciences, Anchor University, Lagos.*



### **“Where the abstract becomes real”**

*“Anchor University Space Lab is ahead of all Nigerian Universities as it presents physics live to students. Presently, such a facility does not exist in any University in Nigeria. The laboratory will enhance studies in areas of communication technology, space Physics, weather forecast, atmospheric Physics and post graduate studies in space Physics.”*

**Professor B. A. Ezekoye,**

*Condensed Matter Physics (On sabbatical, from University of Nigeria, Nsukka)*

### **“Bringing Physics to Reality.”**

*“The Space Laboratory in Anchor University, Lagos is bringing Physics to reality and migrating from the concept of abstract studies and research. It has opened a platform for climate change studies in Nigeria and sub-saharan Africa. We now have data collected locally for research works and understanding of our environment.”*

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**Professor B. A. Arogundade,**  
*Computer Science (On Sabbatical, Federal University of Agriculture, Abeokuta)*



### **“The best place to study Physics in Nigeria!”**

*The AUL space laboratory is very useful in the study and research into the causes and effects of radiation on human beings etc and it will help our students to research into means of mitigating such effects of human negligence. This is the best place to study Physics in Nigeria.*

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**Dr. J. A. Bamikole,**  
*Radiation and Nuclear Physics (On sabbatical, from Federal University, Lafia)*

### **“Not found anywhere in Nigeria.”**

*“I’ve been part of many Space and Weather stations but what makes AUL Space Lab unique is that it is connected to many space laboratories globally. This makes collaborations easier and I can say that I’ve not found this type of lab anywhere in Nigeria.”*

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**Dr. R. T. Akinnubi,**  
*Atmospheric Physics (On sabbatical, from Adeyemi Federal University of Education, Ondo)*



### **“Where the abstract becomes Real.”**

*“The study of Physics at Anchor University is greatly enhanced by the facilities available at Anchor University Space Laboratory and this helps simplify the abstract nature of space physics, making it practical-oriented. In Anchor University and Physics department in particular, we make difficult concepts simple and our experienced lecturers support and guide our students to succeed.”*

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**Dr. O. E. Obisesan,**  
*Atmospheric Physics, Dept. of Physics, Anchor University, Lagos.*

### **“A Reference Point for Excellence in Physics.”**

*AUL Space lab has all the facilities and data that you need to carry out a successful research in space physics. The lab prepares students and researchers with needed experiences for a career in aviation, telecommunication, weather forecasting, nano satellite manufacturing etc. This is the best place for research in space physics.*



**Mr. Muyiwa Ajakaiye,**

*Atmospheric Physics, Dept. of Physics, Anchor University, Lagos.*



### **“This Lab’s Impact is Enormous on all and Sundry!”**

*Our lives are heavily impacted by the activities happening in the upper atmosphere. Weather conditions affect aviation, telecommunications, internet connectivity, banking etc. This laboratory demystifies these phenomena and helps our students and researchers better appreciate our environment and mitigate problems associated with atmospheric changes and activities.*

**Dr. M. A. Olatunji,**

*Radiation and Nuclear Physics, Anchor University, Lagos.*

### **“A Reference Point for Excellence in Physics.”**

*AUL Space laboratory enables students and researchers to study solar flares, climate changes, weather activities etc from, our up-to-date localised data which is readily available for research purpose on per second bases here. These data can be analysed here and predictions made based on the results.”*



**Miss. O. V. Fatoye,**

*Environmental Geologist, Dept. of Earth Sciences, Anchor University, Lagos.*



### **“Positioned to Fill the Space Science Gap in Africa”**

*We are committed to strengthening AUL’s capabilities in space science research and building regional and institutional databases for advancing research in solar-terrestrial, environmental and space science (and technology), as well as driving innovation towards significant contribution to sustainable development in Nigeria, Africa and the world over.*

**Dr. V. U. J. Nwankwo,**

*Lead Scientist, Centre for Space Research (CESPAR), Anchor University, Lagos.*



# 10. AUL SPACE LAB TEAM MEMBERS



## Technical Crew

*This achievement is a product of team work by colleagues drawn from various departments.*

*They include:*

- *Dr. Victor U.J. Nwankwo - Lead Scientist - Physics*
- *Mr. Paul I. Anekwe - Principal System & Software Developer - Mathematical Sciences (deceased on 12 June 2022)*
- *Mr. Paul Muyiwa - Atmospheric Physics/Meteorology - Physics*
- *Mr. Timothy Akinsola - Technical/Engineer - Physics*
- *Mr. Joel Ajamu - Technical/Engineer - Mathematical Sciences*
- *Mr. Muiyiwa Adeyanju - Geophysics/Data Management - Earth Sciences*
- *Mr. Ademoh Adams - Technical Support - ICT*
- *Mr. Ndifreke Ebong - Web Development/Engineer/Data Management - Physics*
- *Mr. Tolulope Ahmed - Technical/Media - Physics*

## Research Areas

*Our programme of research in atmospheric and radio science, solar-terrestrial Physics and space weather include:*

- *Space weather (and its effects on ground-based and space-borne technology)*
- *Magnetosphere-ionosphere-thermosphere (MIT) coupling*
- *Ionospheric-Tropospheric coupling*
- *Radio waves propagation in Earth-ionosphere waveguide*
- *Atmospheric-lithospheric-Oceanic connections*
- *Meteorology and Climate Change*
- *Modelling and prediction of atmospheric phenomena using artificial intelligence*
- *Astronomy, Astrophysics and Cosmology*
- *Nuclear Materials, Radiation and Safety for Space and Industrial Applications*

# ▶ IN MEMORIAM, PAUL ANEKWE (1977-2022)



It is with a heavy heart that we share the passing of a principal team member, Mr. Paul Izuchukwu Anekwe, to glory on 12 June 2022. Until his passing, Paul was the Principal System & Software Developer (PSSD) in charge of the development and maintenance of AUL Space Lab website and database project. He was also the Chairman of the Project Finance and Procurement for the SCOSTEP/PRESTO Grant, awarded to AUL Space Lab in 2021. In addition to his unparalleled sacrifice and commitment to the development of the Lab, Paul played a significant role leading to the successful application and subsequent award of the 2021 SCOSTEP/PRESTO Grant. Mr. Anekwe was an amazing, selfless, exceptional, and beautiful personality. He was a gift to us, the entire university community and humanity.

Mr. P.I. Anekwe had his first degree in Computer Science from the University of Nigeria, Nsukka, and masters in computing: Information Engineering from Robert Gordon University, Aberdeen, Scotland. He was to resume his PhD in September 2022 at the University of Quebec at Montreal (UQAM), Canada, before his demise. He was a Zend Certified Engineer (ZCE), Sun Certified Web Component Developer (OCA), Professional Member of British Computer Society (BCS), Member, and Scientific Reviewer, Canada Computer Information Society (CIPS) and a Member of the Board of Directors, CIPS Saskatchewan Body. AUL Centre for Space Research, and the entire university community will miss him deeply. We send condolences to his family, loved ones and friends.

## Tributes

- *You're one of the beautiful souls I have ever met in life, as I navigated through the walks of life. If 'death could not hold JESUS captive and He remains LORD even in the grave'; your departure to the great beyond will continue to announce your greatness, exploits and the legacy you left here on Earth. It doesn't matter how long you were here. What matters is the fact that you left your footprint on the 'sand of time and history'. By His grace, we will not rest until the light of your legacy shines across the globe – it's a promise! You are like 'a City that is set on a hill'. You Lived, You Won, You Conquered, and You continue to conquer! Good night my beloved Brother and Friend! By His Grace, we'll reunite at the Pearly Gates! — **Victor U.J. Nwankwo***
- *The shock I received from the news of your demise surpassed those from my parents, because your departure was exceptionally sudden. Mr. Anakwe, you were such a friend one would work with for a thousand years. What can a mortal say when the immortal permits, Blessed be His Name. Continue to rest until the invisible shall be made visible, then shall the unknown and darkness give way to light. — **Muyiwa P. Ajakaiye***
- *Accepting that we've parted on this side of the Sun is a very difficult thing for me. Remembering all the moments we shared as a colleague, friend and brother bring the pains of your earthly departure to memory. The last moment with you on June 10, 2022 captured your life of simplicity, forgiving nature, and "not being weary in well doing". Your quality of dedication to work, delight in people's welfare, dexterity, and devotion to God, still speaks for you even as you've parted from this earth To bring your students' mind back to the subject of the class from your moral and spiritual admonitions, you'll say, "Okey-Dokey! Okey-Dokey" - we're back to the reality that we're separated for now till we meet at the feet of our Saviour. - **Joel Ajamu***
- *Brother, words cannot express how deeply hurt I felt at the sudden news of your departure. For a long time, every Friday Staff Prayer meeting brought tears to my eyes as I don't get to see you there again. Although, I was preparing to miss you (when you leave for your PhD programme) but not in this way! You left in the middle of your aspirations! 'Farther along we'll know all about it. Farther along, we'll understand why'. Though you are gone, the legacy you left behind continuously speaks. I may not know so much but I have the witness of some AUL Computer Science graduates who have testified that you helped them find their career in life. You practically poured yourself into them. I wish you had a little more time to stay. But I have realised that a fruitful life is not measured by its length. I do hope you found rest for your soul. Till we meet at Jesus' feet. (I can't forget your usual 'Mary, how are you? ; in a jiffy) - **Mary A. Olowajembola***

## ▶ APPRECIATION

# Thank You!

*AUL Space Lab and Centre for Space Research (CESPAR), Anchor University, Lagos, would like to express her sincere appreciation to Prof S.O. Bamdele (VC, AUL), Prof J.O. Fatokun, Pst M. Salami, Prof (Mrs) Fatokun, Prof. D.S. Adeyanju, Prof. S.O. Oyero, Prof. B.A. Ezekoye, Prof O.O. Akinwunmi, Dr. J.A. Bamikole, Dr. Philip Idehen, and Dr. R.T. Akinnubi for the wealth of experience they brought to bear to make this document a reality.*

*We also thank the following members of staff for their outstanding efforts towards the success of the laboratory, Eng. Apkasa, Mr Victor Bawo, Mr. Julius Onoyiweta, Mr. Obaleke Olalere, Mr. Taiwo Badru, Mr. Akorede Olaniyi, Mr. Bamidele Iyiola, Mr. Ekindayo, Mr. Adams Ademoh, Mr Musa P. Ojonugwa, Mr. Abolurin O. Elijah, Miss Oluwaseun V. Fatoye, Mr. Olufemi E. Oyanameh, Mr. Okoro Ifeanyi, Mr Prince M. Okoi, Mr Wisdom Katre, Mr Blessing F. Tamunobelega.*

*We appreciate everything that you have done over the past years since you volunteered to join us in this effort. The endless hours you have spent working here, and the professionalism you have shown has motivated the entire team immensely.*

*Thank you once again for all your contributions.*

*Best regards,*



*The Entire CESPAR Team*

## ▶ VISITS TO THE LAB



*Vice Chancellor's visit to the Space Lab.*



*Deputy Vice Chancellor's visit to the Space Lab*



*Registrar's visit to the Space Lab*



Dean of the Faculty of Natural, Applied and Health Sciences, Anchor University Lagos, Professor K. V. F. Fatokun visits the Centre for Space Research (CESPAR), AUL



L-R: Prof Peter Gallagher, Dr Victor U. J. Nwankwo and Prof Cairtriona Jackman at the William R. Hamilton Museum at DIAS Dunsink Observatory, Dublin during his visit to foster scientific cooperation with AUL. DIAS Dunsink Observatory donated a VLF Receiver and Magnetometer to AUL Space Laboratory during the visit.



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Signed: **M. O. SALAMI**, Registrar

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- B.Sc. Biology
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- B.Sc. Biotechnology
- B.Sc. Chemistry
- B.Sc. Computer Science
- B.Sc. Geology
- B.Sc. Industrial Chemistry
- B.Sc. Information Technology
- B.Sc. Mathematics
- B.Sc. Microbiology
- B.Sc. Physics
- B.Sc. Physics with Electronics
- B.Sc. (Ed) Biology
- B.Sc. (Ed) Computer Science
- B.Sc. (Ed) Chemistry
- B.Sc. (Ed) Mathematics
- B.Sc. (Ed) Physics

**FACULTY OF SOCIAL AND MANAGEMENT SCIENCES**

- B.Sc. Accounting
- B.Sc. Banking and Finance
- B.Sc. Business Administration
- B.Sc. Economics
- B.Sc. International Relations
- B.Sc. Mass Communication
- B.Sc. Political Science

**FACULTY OF HUMANITIES**

- B.A. Christian Religious Studies
- B.A. English and Literary Studies
- B.A. French
- B.A. History and International Studies

For further enquiries, please contact:

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