To establish a Space and Atmospheric Physics facility at North Carolina A&T State University

IHY-India
UN/NASA/IIA International Heliophysical Year Workshop, Bangalore India
November 27/06-December 01/06

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NASA grant number: NNG04GD63G
Dr. Larry Cooper, GSFC, NASA

Abstract: The Study of Space and Atmospheric Physics is planned at Department of Physics, NC A&T State University, NC, to meet the needs of the minority community to build a general capability in atmospheric/space science as a necessary support for academic infrastructure development. The course will be intended for graduate and undergraduate students who wish to pursue research in space/atmospheric physics. In order to fortify this effort, we have initiated a collaborative work with US Air Force and GSFC, NASA. The main rationale of this proposed project work is to investigate the current scientific issues associated with MITS like the TEC variations, scintillations and disturbances, and the morphology/manifestations of Ionospheric Spread F phenomena that vary with locations (longitude and latitude), especially over low and mid-latitudes, which is also an important diagnostic for understanding space weather. In addition to this, we plan to install two ground based instruments, a magnetometer and a coherent beacon receiver, at North Carolina A&T State University (a mid-latitude station: Geog. Latitude ~36^0N), to provide local measurements for geomagnetic activity and TEC/scintillations effects respectively. Scientists, teachers/ professors and students who are interested in studying the space/atmospheric physics and located at different institutions can also make use of these facilities. This work will be the first of its kind in the sense that it will be first ground-based instruments to be installed in North Carolina in a minority community university (HBCU) as a part of Research and Education outreach in space/atmospheric physics. Some of these aspects are discussed here.

Education and Research objectives

- to meet human resources needs of NASA, Academia and others
  - How ?- Must be enabled to recruit and retain students. The requirements are
    - build a general capability in Space Science
      - Develop a curriculum at all levels (BS/MS)
      - Develop the minimum infrastructure
        - Telescope, SCINDA, Magnetometer, NWRA Antenna (ITS30)
      - Acquire expertise
        - Tenure track position (very difficult)
        - Research associate (hard but achievable)

Education and Research objectives cont.

Approach

–Collaborate (NASA, NIA, UMICH, UNCG, Arizona, NOAA, UNCCH-PROMPT, Caltech-TIE, LSU, SEC, Stanford-AWSOME)

–Adopt and customize courses and space science education materials

–Develop collaborative proposals aimed at

–Course and curriculum development, capstone experience, K14 outreach

–Research and Education grants (NSF planning and workshops, PIRE)

Course and Curriculum

- Created a new space physics curriculum
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  - PHYS280: Introduction to Space Science
  - PHYS490: Introduction to Solar Physics
  - PHYS4XX: Introduction to Space Radiation
  - PHYS451: Introduction to Astrophysics
  - PHYS101: Introduction to Astronomy

- Made changes to our MS-level professional physics to include a coherent set of upper-level space sciences and thesis content.
  - PHYS680: Space and Atmospheric Physics
  - PHYS690: Advanced Solar Physics
  - PHYS6XX: Advanced Space Radiation
  - PHYS6XX:Advanced Astrophysics

- **Capstone experience PHYS550**

  Balloon Project (LSU Greg Guzik), Aurora Studies Greenland Mission (UMICh Papatashvili, Clauer) , Space Weather Institute and CISM (FIT-Ramon Lopez, BU- Hughes), Astronomy and Astrophysics (Vanderbilt-Keivan Stassun , Anita Krishnamurti-GSFC), Summer Undergraduate Research Programs (everywhere)

  Enhancement: Introduced several interdisciplinary seminars on space science and technology to shape the mind set of STEM students in such a way to pursue careers in space science (MUST ATTEND)

- **Current Space Science education programs at NC A&T**

  - **BS in Physics with space science concentration**
    - **Physics Core (23 cr.), Space Science Core (24 cr.), University Studies (25 cr.), Science and Mathematics (25cr.)**
    - **Space Science electives (18-21cr.), Other technical elective (9 cr.)**
    - **Students have choices from electives from EE, ME and Earth Science**

  - **MS in Physics with space science concentration**

    Space and Atmospheric Physics, Solar Physics and Astrophysics
    - **Two graduate students have signed up**

Outreach

K12 outreach (Sun Earth Connection)

- Cosmos in the classroom Workshop for middle and High School Teachers
- Summer Space Science Institute for Teacher-Student Teams
- October World Space Week (world wide)
- World Year of Physics 2005 (world wide)
- Virtual After School
- Science on Wheels
- Ask a Scientist

- Public Outreach
  - 2001 African Solar Eclipse, Venus Transit, Mercury Transit, 2006 Libyan Solar Eclipse

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

The COSMOS in the Classroom Workshop for
Science, Mathematics and Technology Teachers
North Carolina A&T State University
January 26-28, 2005

BENEFIT FOR TEACHERS

Teachers will identify and learn to use NASA resources

Teachers will learn how to use the web, to develop email lists, websites with links to simulation, virtual laboratories and to enhance their lesson plans

Hands on experience in undergraduate Physics laboratories

Teachers will learn how to integrate NASA K12 learning/teaching materials, and technology tools in the science syllabus

Research - Space Physics strand (To study the dynamics and electrodynamics associated with the Magnetosphere-Ionosphere-Thermosphere System (MITS))

Why it is important to study MITS?

- Many of the phenomena taking place in the Magnetosphere-Ionosphere-Thermosphere System (MITS) region serve as a useful precursor for space weather forecasting.
- One of the most important requirements for the space weather community is to improve ionospheric predictions for HF radio communications.
- Ionospheric scintillation caused by density fluctuations (irregularities) results in outages of the communication/ navigations systems that depend on trans-ionospheric radio links, and can result in a complete loss of lock on a satellite signal.

Collaboration with NASA and US Air Force

(Dr. Dieter Bilitza, GSFC, NASA, MD, and Dr. Keith Groves, Air Force Research Laboratory)

- Magnetosphere-Ionosphere coupling processes
- Ionospheric scintillation and disturbances
- Morphology/Manifestations of Spread F (ionosphere)
- TEC variations, which can further affect the F-region phenomena like Spread F
- Effects of solar variations on the Magnetosphere-Ionosphere-Thermosphere System

Two proposal have been submitted (NSF, and AFRL)

Three graduate and three undergraduate students are (will be) supported by the program

One research associate will be hired

Support for SCINDA and IHY Workshops

Support for Space Science Institutes and summer/winter schools in Africa

African Institute of Space Physics (FUTURE)

Experiment facility:

Plan to purchase and install two pieces of equipment-

1. Magnetometer: Ionospheric and magnetospheric current systems produce disturbances in the geomagnetic field. Thus, by measuring these effects with ground based magnetometers, one can monitor magnetospheric activity (triggering and temporal evolution of geomagnetic storm and sub-storms) continuously.
2. Coherent beacon receiver (150 MHz and 400 MHz): It will provide the Total Electron Content (TEC), and VHF/UHF scintillations, over mid-latitudes, caused by density fluctuations (The PO is being processed to purchase NWRA Antenna.

Note: UMICH via Clauer and Papatashvili plan to install a magnetometer

The AFRL scintillation sensor system is composed of two components:

1. VHF receiver - Two or three Yagi antennas placed along a baseline of 50-150 m in the east-west direction to monitor geostationary satellite link(s) to measure ionospheric drift velocity and scintillation parameters at 250 MHz. If it is not possible to accommodate spaced antennas at a given site, a single Yagi is deployed to measure scintillation only.
2. Sensor : GPS receiver – especially modified to sample GPS signals at a high rate and calculate scintillation and TEC parameters in real-time. The GPS component includes a CPU for acquisition, a receiver and an antenna. Combined the sensors require approximately 600W of electrical power and can operate on either 110V/60 Hz or 220V/50 Hz sources.

Mid-latitude Ionosphere

- Mid-latitude ionospheric scintillations are known to have an effect on transionospheric radio signals.

- The mid-latitude ionosphere is known as the quietest region and it can be noted that such events as scintillation of transionospheric signals are greatly reduced in magnitude from their counterparts in the other regions. Although less complicated than the high and low latitude cases, the morphology of mid-latitude ionospheric scintillations is not as simple as is sometimes stated, especially when effects from the high and low latitudes spill over into the mid-latitude ionosphere.

INTERNATIONAL RESEARCH AND EDUCATION

Funded by European Office of Aerospace Research and Developme

- **The overall goals of the workshop are to establish space science expertise and develop a network of space weather observations across Africa. The workshop will cover equatorial aeronomy and the physics of low latitude ionospheric disturbances that affect space-based communication and navigation systems. The workshop will provide instruction on the deployment, operation and interpretation of SCINDA sensors and their associated data.**

- **Low latitude ionospheric disturbances routinely degrade UHF SATCOM and other space-based RF systems. The proposed workshop squarely addresses those impacts by providing the requisite training to install and operate sensors that provide real-time warnings of scintillation impacts on DoD systems.**

Committee members
Dr. Abebe Kebde, USA,
Dr. Benvenu Dinga, Congo-Brazzaville
Dr. Gizaw Mengistu, Ethiopia
Dr. Baylie Damtie, Ethiopia
Dr. Rabiu Babatunde, Nigeria
Dr. Jyoti Nair, USA,
Dr. Keith Groves, USA,
Dr. Olivier Obrou, Cote d'Ivoire
Ing. Jose Pimenta, Cape Verde,
Dr. Zainol, Malaysia,
Mr. Ita Eyo, United Kingdom,
Dr. Oyedmi Oyekola, Nigeria,
Mr. Sabino Batista, Cape Verde


Certificate of Participation

Gizaw Mengistu

1st International Heliophysical Year SCINDA Workshop

Sal Island, Cape Verde, July 10-14, 2006

Dr. Abebe Kebede
Director Space Programs, NC A&T

Ing. José Pimenta Lima
President INMG

Dr. Keith Groves
Director of SCINDA, AFRL

Dr. Madalena Neves
Minister of Environment and Agriculture
Cape Verde

Local Organizing Committee

Gizaw Mengistu, Department of Physics, Addis Ababa University
Baylie Damtie, Department of Physics, Bahir Dar University

Abebe Kebede, USA, International Laison

International Organizing Committee:

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Rabiu Babatunde, Nigeria
Jyoti Nair, USA,
Keith Groves, USA,
Olivier Obrou, Cote d'Ivoire
Jose Pimenta, Cape Verde
Zainol Abidin Abdul Rashid, Malaysia
Ita Eyo, United Kingdom
Oyedmi Oyekola, Nigeria
Sabino Batista, Cape Verde
Tim-Fuller Rowell, USA
Amory Christine Mazaudier, France
Sunanda Basu, USA

Under the auspices of the International Heliosphysical Year (IHY) the international space science community plans to organize Space Weather Workshop in Africa on November 12-16 2007. The purpose of the workshop is to facilitate scientific interaction and promote space science and education in Africa. The proposed location of the meeting is Addis Ababa Ethiopia in Sub-Saharan Africa, a region of particular geographic and geomagnetic interest for understanding space weather phenomena.

Sessions

I. Ionospheric irregularities and scintillations
II. Total Electron Content
III. Electrodynamics and the Plasmasphere
IV. Space Science Education

Astronomy and Astrophysics Research

Telescope in Education- Caltech
UNCCH-PROMOT
Three College Observatory
New Robotic Telescope