ELECTRO-MAGNETICS

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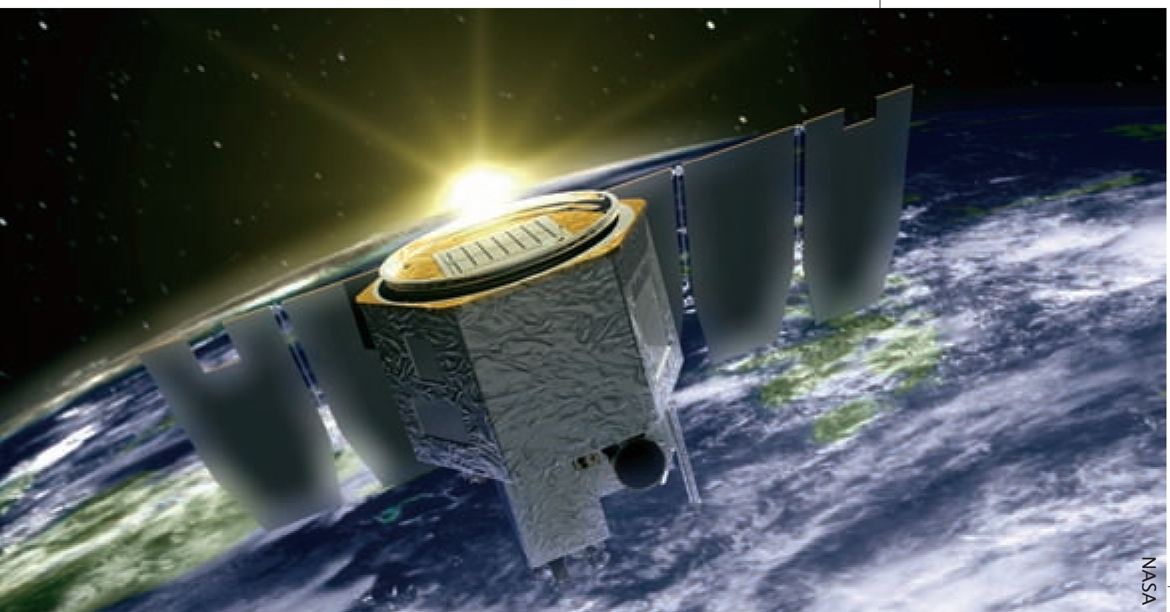


Scott Bailey is deputy principal investigator of NASA's AIM mission. Right: At South Pole Station—testing a prototype of an instrument that will help map the electrical current systems that are driven by solar wind and the magnetosphere.

AIM satellite to study noctilucent clouds

ECE's Scott Bailey is serving as deputy principal investigator for NASA's AIM mission, which launches in April. AIM is a two-year mission to study polar mesospheric clouds, which form an icy membrane 50 miles above the ground at the edge of space. The clouds, when viewed from the ground, are seen as very bright clouds reflecting the sun at twilight and are called noctilucent clouds.

The clouds have been seen for more than a century in spring and summer at high latitudes. The mission's primary goal is to explain why the clouds form and discover what is causing them to appear more frequently and at lower latitudes.

The AIM satellite is 55 inches tall, 43 inches wide and weighs 430 pounds. The satellite carries three instruments: Cloud Imaging and Particle Size (CIPS); Solar Occultation For Ice Experiment (SOFIE), which measures the thermal and chemical environment inside the clouds; and the Cosmic Dust Experiment (CDE), which measures the input of cosmic dust into the atmosphere.

James M. Russell III of Hampton University serves as the project's principal investigator.

Mapping the systems driven by solar winds

Bob Clauer wants to understand the global electrical current systems that are driven by the solar wind/magnetosphere interaction. He is currently involved in establishing an ionospheric HF radar at Virginia Tech to measure ionospheric plasma convection —measurements that can be used to deduce the electric field of the ionosphere.

He is also developing an autonomous magnetic field measurement platform for use in remote regions of the Antarctic. In December (the Antarctic summer), the system will be redeployed from the South Pole where it has been tested for the past year, onto the Antarctic Plateau. The system will be the start of a magnetometer chain along the 40-degree magnetic meridian that will be magnetically conjugate (reciprocal) to the Greenland west coast chain of magnetometers. Using data from both hemispheres, it will be possible to begin to map the global electrical current systems that are driven by the interaction of solar wind with the magnetosphere.


Bradley Fellow Evan Lally sets a stone on a prototype imaging system for asphalt aggregates.

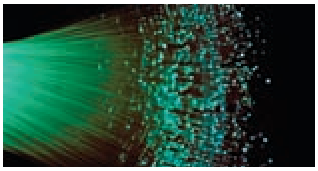
ETA telescope coming near Tech

In 2006, an ECE/physics research team, including Steven Ellingson and Cameron Patterson, began operation of a low-cost, direct-sampling radio telescope in a rural mountainous region of North Carolina. Called the ETA (Eight-meter-wavelength Transient Array), the telescope was designed for unattended operation to monitor the skies for single, dispersed radio pulses associated with prompt emission from gamma ray bursts and exploding primordial black holes. The telescope analyzes signals from 24 dipole antennas using an arrangement of 28 FPGA boards and four PCs interconnected with custom I/O adapter boards. Thanks to additional funding from the physics department, a second, portable instrument is planned near the Tech campus to improve performance using "anticoincidence"—a technique in which simultaneous detections are required at both sites as a means to rule out local radio frequency interference.

Measuring an ozone destroyer

ECE researchers are studying high altitude nitric oxide, which is a catalytic destroyer of ozone, in the first-ever effort to measure the chemical in the polar night. Scott Bailey is collaborating with Chris Hall of aerospace and ocean engineering on the $1.4-million NASA project, which will launch in 2010. The instrument will consist of a very large telescope and will view a bright UV star in occultation. Bailey and Hall are working with researchers from the University of Colorado on the project.

Center for Photonics Technology
Director: Anbo Wang
www.ee.vt.edu/~photonics/



Fiber & Electro-Optics Research Center
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Dusty Plasma Laboratory
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Time Domain & RF Measurement Laboratory
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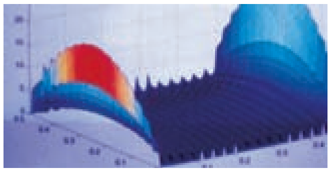

ElectroMagnetic Interactions Laboratory
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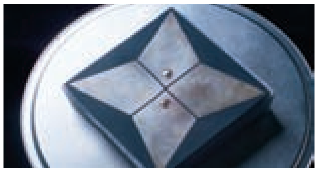

Virginia Tech Antenna Group
Director: William Davis
http://antenna.ece.vt.edu

High-res, 3D imaging for asphalt aggregates

Work is underway at the Center for Photonics Technology to develop a new laser imaging system for small rocks and sand particles. Sponsored by the National Cooperative Highway Research Program (NCHRP), the three-year project is geared towards improving the analytical models of rocks and small particles in asphalt aggregates.

A special mounting system holds particles ranging from 50mm to 75μm in diameter, allowing the user to position them for viewing at any angle. The object is illuminated by a series of interference fringes, generated by a red visible laser and an end-polished fiber optic coupler. These fringes, when reflected off the face of the object, contain quantitative information about the surface height profile. The image itself is collected with a high-resolution digital camera. The camera uses a thermoelectric cooling device to cool the CCD pixel array for extremely low noise operation. This low noise results in increased measurement resolution. The system is projected to achieve better than 5μm resolution in all three imaging directions.

Sapphire temperature sensor stands up to harsh environment

A miniature fiber optic sensing probe has proven its mettle in the harsh industrial environment of a coal gasifier at Tampa Electric's Polk Power Station. The sapphire-wafer-based fiber optic temperature sensor was installed in late May 2006 and continued operation for seven months—far exceeding the project objective of 45 days. During that time, all thermocouples installed in the gasifier were replaced.

In a coal gasifier, most of the fuel is not burned, but chemically broken down by temperature and pressure in a limited oxygen environment, producing syngas. The syngas is cleaned and used as fuel in a combustion turbine. Accurate, reliable temperature measurements are critical: operating too high will reduce conversion efficiency and shorten the refractory life, while operating too low will cause the molten slag to become viscous, plugging the tap-hole.

The sapphire temperature sensor, developed by the Center for Photonics Technology, provided continuous, real-time temperature data as high as 1392°C. The research program is funded by the National Energy Technology Laboratory of the U.S. Department of Energy. A second field test is underway in 2007.