

# PHYSICS, ASTRONOMY AND ENGINEERING SCIENCE

## Optical instrument orbits Earth

SHIMMER (spatial heterodyne imager for mesospheric radicals), the primary payload aboard STPSat-1, began its one-year mission March 8, 2007, when the satellite was launched from Kennedy Space Center. Developed collaboratively by Professor John Harlander and researchers at the U.S. Naval Research Laboratory and the University of Wisconsin-Madison, SHIMMER measures solar fluorescence from OH molecules in Earth's upper atmosphere.

## Award-winning student projects

- Stephen Horvat, Josh Swanson, Denise McGuire Student Research Award (DMMSRA) Honorable Mention for "Degeneracy Pressure in a Quark-Gluon Plasma." Sponsor: Kevin Haglin
- Thomas Pundsack, Brandon Smith, DMMSRA \$450 for "Time of Flight Charge Mobility Measurements in Organic Semiconductors." Sponsor: Russell Lidberg
- Thomas Pundsack, Brandon Smith, Neale Haugen, Student Research Colloquium Best Poster Semi-finalist for "Charge Carrier Mobilities of Semiconductor Materials Determined Through Time-of-Flight Measurements." Sponsor: Lidberg
- Brandon Smith, Student Research Fund Award (SRFA) \$750 for "Irradiation Patterning of Co/Cu/Co GMR Layers for Use in Magnetic Random Access Memory." Sponsor: Timothy Vogt
- Josh Gainey, SRFA \$1,000 for "Characterization of Organic Crystal Surfaces by Atomic Force Microscopy." Sponsor: Lidberg

## Probing pressures

Professor Kevin Haglin is the principal investigator in "Bursts of Electromagnetic Energy from Highly Excited Subatomic Matter." The three-year project, funded by a \$154,216 National Science Foundation Research at Undergraduate Institutions (RUI) award, investigates the degeneracy pressure in the liquid-like matter that results when heavy nuclei collide at high energies as at Brookhaven National Laboratory in New York.

Unlike anything previously encountered, this matter includes a soup of quarks and gluons and behaves almost like a perfect liquid — with zero viscosity. The researchers propose to model the quark behavior as a relativistic ideal quantum gas to understand its collective behavior.

## Spectrometer may measure Martian winds

Professor John Harlander is the coinvestigator in "Stepped SHS Doppler Wind Imager for Planetary Atmospheres." The two-year project to develop and build small, lightweight optical sensors for space is the most recent in a series between SCSU, the US Naval Research Laboratory in

Washington, D.C., and the University of Wisconsin-Madison.

The NASA-funded grant totals \$450,000 and its goal is to demonstrate in the laboratory a spatial heterodyne spectrometer (SHS) optimized for measuring winds in the upper atmospheres of planets, with an eye toward measuring the winds on Mars.

## Alumnus sheds light on dark matter

*Dark Cosmos* is Dan Hooper's first book. Originally from Cold Spring, Minn., Hooper received his bachelor's in physics at St. Cloud State University, his Ph.D at the University of Wisconsin-Madison and was a postdoctoral fellow at the University of Oxford in the United Kingdom. He is currently a fellow in the theoretical astrophysics group at the Fermi National Accelerator Laboratory in Batavia, Ill., where he investigates dark matter, supersymmetry, neutrinos, extra dimensions and cosmic rays.

## 2007 Student Research Colloquium participation:

Eight students, 4 projects, 3 sponsors

## Awarded internships and research experiences

- Joshua Swanson — REU at Montana State University-Bozeman, summer 2007 (See p. 21)
- Thomas Pundsack — Internship in medical physics at St. Cloud Hospital, 2006 – 2007
- Tanya Hall — REU at University of Wisconsin-Madison, summer 2006
- Fahad Hussain — Internship at Vision EZ in the Twin Cities, summers 2006 – 2007
- Michael Albright — REU in nuclear physics, St. Cloud State, summer 2007
- Stephen Horvat — REU in nuclear physics, St. Cloud State, 2006 – 2007
- Joshua Swanson — REU in nuclear physics, St. Cloud State, 2006 – 2007

## Planetarium renovation complete

A state-of-the-art Chronos projector and a Spitz dome are just two of the features of the planetarium's \$790,000 renovation — the first redo since it opened 35 years ago. The new projector fills the planetarium dome with 8,500 very realistic stars and can show 24 constellations, the Milky Way and other galaxies. It can also instantaneously display the skies at any time in the past, present or future as well as from any spot on Earth or in the solar system.

## Smectic liquid crystals specialist joins department

Assistant Professor Zengqiang "John" Liu earned his B.S. from Nankai University, Tianjin, China, in 2000, and his Ph.D. from the University of Minnesota in 2007.

**Matthew Bigelow**, Assistant Professor. Ph.D. 2004, University of Rochester.

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**Michael Garrity**, Professor. Ph.D. 1968, Arizona State University.

**diagnostic imaging, health physics, medical physics, nuclear medicine, radiation oncology**

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*Certification/Licensure*

Diplomat of the American Board of Radiology in Nuclear Med. Physics, Radiation Oncology Physics, Diagnostic Imaging Physics

**Kevin Haglin**, Professor. Ph.D. 1990, University of Minnesota.

**electromagnetic probes, heavy flavor, heavy ion collisions, nuclear (hadronic) matter, nuclear theory, quark gluon plasma**

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*Selected Presentations*

Haglin, Kevin. Unturned Stones for Electromagnetic Probes of Hot Hadronic Matter. International Conference Hot Quarks '06, May 2006, Villasimius, Sardinia, Italy.

*Publications*

Haglin, Kevin. Diphoton Production from Quark-gluon Plasma and Hadronic Matter. European Physical Journal C, 49 (1) 269 – 273.

*Grants*

\$154,216 for Bursts of Electromagnetic Energy from Highly Excited Subatomic Matter. From the National Science Foundation, 2006 – 2009.

**John Harlander**, Professor. Ph.D. 1991, University of Wisconsin-Madison.

**academic research directory, instrumental spectroscopy, optical design**

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*Publications*

Mierkiewicz, E. J., R. J. Reynolds, F. L. Roesler, J. M. Harlander, and K. P. Jaehnig. Detection of Diffuse Interstellar [O II] Emission from the Milky Way Using Spatial Heterodyne Spectroscopy. The Astrophysical Journal, 650 (1) L63 – L66.

Englert, C. R., and J. M. Harlander. Flatfielding in Spatial Heterodyne Spectroscopy. Applied Optics, 45 (19) 4583 – 4590.

*Grants*

\$58,424 as a co-investigator for Stepped SHS Doppler Wind Images for Planetary Atmospheres. From NASA, 2007 – 2009.

**Russell Lidberg**, Assistant Professor. M.S. 1995. University of Nevada-Las Vegas.

**analytical and portable instrumentation, application of spectroscopic and electrical techniques in the development and understanding of molecular materials, chemical sensor development, development and application of spectroscopic techniques for chemical and materials analysis, interfaces, molecular electronics, optoelectronics and chemical sensors, organic semiconductors, thin films**

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**Zengqiang “John” Liu**, *Assistant Professor*. Ph.D. 2007, University of Minnesota.

**structures and phase transitions of smectic liquid crystals**

**Maria Womack**, *Professor*. Ph.D. 1991, Arizona State University.

**chemical composition of comets, spectroscopy and imaging of comets**

*Selected Presentations*

Womack, M., S. Choi, M. Gesmundo, J. Swanson. CO, HCN and H<sub>2</sub>S in Comet C/2001 Q4 (NEAT). Division for Planetary Sciences, American Astronomical Society, Oct. 2007, Orlando.

*Publications*

Biver, N., Bockelee-Morvan, D., Crovisier, J., Lis, D.C., Moreno, R., Colom, P., Henry, F., Herpin, F., Paubert, G. and M. Womack. Radio Wavelength Molecular Observations of Comets C/1999 T1 (McNaught-Hartley), C/2001 A2 (LINEAR), C/2001 WM1 (LINEAR), and 153P/Ikeya-Zhang. *Astronomy and Astrophysics*. 449, 1255 – 1270.

Milam, S.N., Remijan A.J., Womack, M., Abrell, L., Ziurys, L.M., Wyckoff, S., Apponi, A.J., Friedel, D.N., Snyder, L.E., Veal, J.M., Palmer, P., Woodney, L.M., A'Hearn, M.F., Forster, J.R., Wright, M.C.H., de Pater, I., Choi, S. and Gesmundo, M. Formaldehyde in Comets C/1995 O1 (Hale-Bopp), C/2002 T7 (LINEAR), and C/2001 Q4 (NEAT): Investigating the Cometary Origin of H<sub>2</sub>CO. *Astrophysical Journal*. 649 ( 2) 1169 – 1177.

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