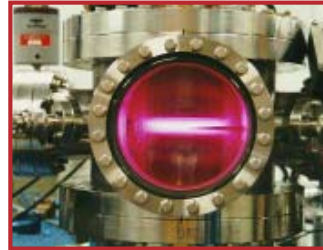


# CASPER Research Updates

## Coulomb Crystals Detected at Hypervelocity Impacts and Dusty Plasmas Laboratory

Experimental researchers at CASPER's HIDPL (Hypervelocity Impacts and Dusty Plasmas Laboratory) have reached an important milestone in their efforts to study dusty plasmas: the first coulomb crystal has been seen in the GEC Reference cell.

When asked the significance of seeing coulomb crystals, Dr. Lorin Matthews, Senior Research Scientist and Experimental Group manager says, "Seeing crystals in the lab means that we can now get down to work! We were especially happy to see that the first thing we had theorized should occur (particles with a size distribution forming behaving as a liquid), did occur." And as Ph.D. student Bernie Smith says, "It's gratifying to know that we haven't been spinning our wheels for the last two years for naught."



GEC Reference Cell to study Coulomb Crystals at the HIDPL

## Recent CASPER Publications

"Coagulation in Dust Clouds Immersed in Transient Plasma Environments,"

L. Barge and T.W. Hyde, submitted to *Advances in Space Research*.

"Digital Imaging and Analysis of Dusty Plasmas," C.M. Boesse, M.K. Henry, T.W. Hyde, and L.S. Matthews, submitted to *Advances in Space Research*.

"Parameter Space Investigations of Free Fermionic Heterotic Models," G. Cleaver, accepted for publication in *Proceedings of String Phenomenology 2002*.

"String Cosmology: A Review," G. Cleaver, submitted to *Advances in Space Research*.

"Flat Directions in Left-Right Symmetric String Derived Models," G. Cleaver, D. Clements, and A. E. Faraggi, *Physical Review D*, 65 (2002).

"On The Possibility of Optical Unification in HAHE-Based Free Fermionic Heterotic Models," G. Cleaver, V. Desai, H. Hanson, J. Perkins, D. Robbins, and S. Shields, accepted for publication in *Phys. Rev. D*.

"Phenomenology of Non-Abelian Flat Directions in a Minimal Superstring Standard Model," G. Cleaver, A. E. Faraggi, D. V. Nanopoulos, and J. W. Walker, *Nuclear Physics B*, 620 (2002).

"Ratio of Quark Masses in Duality Theories," G. Cleaver, and K. Tanaka, submitted to *Modern Physics Letters*.

"Effects of Protoplanetary Perturbations of Systems of Planetismsals," B.D. Lindsay, K.W. Orr, T.W. Hyde, and L. Barge, submitted to *Advances in Space Research*.

"Effects of Planetesimal Perturbations on the Motion of Protoplanets," B.D. Lindsay, T.W. Hyde, and L. Barge, submitted to *Advances in Space Research*.

"Charged Grains in Saturn's F-Ring: Interaction With Saturn's Magnetic Field," L.S. Matthews and T.W. Hyde, submitted to *Advances in Space Research*.

"Gravitoelectrodynamics in Saturn's F-Rings: Encounters with Prometheus and Pandora," L. Matthews and T.W. Hyde, accepted for publication in *Journal of Physics A*.

"Asymptotic Expansions of Hermite Functions on Lie Groups," J. Mitchell, *Potential Analysis*, 17 (2002).

"Asymptotic Behavior in Heat Kernel Analysis on Manifolds," J. Mitchell, accepted for publication in *Contemporary Mathematics*.

"Coherent States on Spheres," J. Mitchell and B. Hall, *Journal of Mathematical Physics*, 43 (2002).

"The Large Radius Limit for Coherent States on Spheres," J. Mitchell and B. Hall, *Mathematical Results in Quantum Mechanics*, 155-162, CMS Conf. Proc., 307, Amer. Math. Soc., Providence, RI, 2002.

"Dust Grain Orbital Behavior Around Ceres," R. Nazzario, T.W. Hyde, and L. Barge, submitted to *Advances in Space Research*.

"Numerical Simulation and Analysis of Thermally Excited Waves in Plasma Crystals," K. Qiao and T.W. Hyde, accepted for publication in *Journal of Physics A*.

"Numerical Simulation and Analysis of Thermally Excited Waves in Plasma Crystals," K. Qiao and T.W. Hyde, submitted to *Advances in Space Research*.

"Dusty Plasma Correlation Function Experiment," B. Smith, J. Vasut, T.W. Hyde, L. Matthews, J. Reay, M. Cook, and J. Schmoke, submitted to *Advances in Space Research*.

"Finite Coulomb Crystal Formation," J. Vasut, T.W. Hyde, and L. Barge, submitted to *Advances in Space Research*.

## RECENT CASPER Proposals & Awards

*Quantum Optics Initiative*

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a Request from the Office of Naval Research (November, 2002) • **FUNDED** •

*Waco Community Network TIF Proposal*  
TIF Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a Request from the State of Texas (June, 2002)

• **FUNDED** •

*CASPER VAL / PCircus Proposal*

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a Request from the Sid Richardson Foundation (August, 2002)

*Baylor HPNC Proposal*

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF ANI - Network Infrastructure Program Announcement (May, 2002) • **FUNDED** •

*CASPER MSP Proposal*

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF MSP Program Announcement (April, 2002)

*Sun Marching Grant Program*

Matching equipment grant proposal to Sun Microsystems - April, 2002 • **FUNDED** •

*Evergreen Mechanical Systems*

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a DOE Request (March, 2002)

*Dirac Centenary Conference*

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF01-159 Program Announcement (February 1, 2002) • **FUNDED** •

*TSTC Technologies Institute: A Closing the Gap College Mentor Program*

Co-Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a THECB Perkins NOI for 2001-2002 (November, 2001)

*Parameter Space Investigations of Heterotic Strings*

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF ANI - Submissions for the Division of Physics Announcement 02-139(25 September, 2002)

*Parameter Space Investigations of Heterotic Strings*

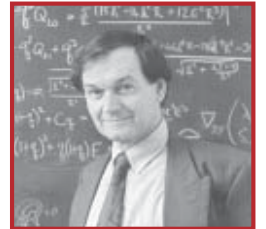
Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a DOE High Energy Physics Outstanding Junior Investigator Award Announcement 02-26(01 November, 2002)

# CASPER Conferences & Presentations

## Penrose Delivers Campus Lecture on Quantum Mechanics

Sir Roger Penrose delivered a campus lecture on "Why We Need an Improved Quantum Mechanics" on Sept. 30 in the Cashion fifth floor conference room. Roger Penrose is the Emeritus Rouse Ball Professor of Mathematics at the University of Oxford and Francis and Helen Pentz Distinguished Professor of Physics and Mathematics, Penn State University, USA. He has received a number of prizes and awards including the 1988 Wolf Prize (which he shared with Stephen Hawking for their understanding of the universe), the

Royal Society Royal Medal, the Dirac Medal, and the Albert Einstein prize. His 1989 book *The Emperor's New Mind* became a best-seller and won the 1990 (now Rhone-Poulenc) Science Book Prize. He has research interests in many aspects of geometry and has made significant contributions to the theory of non-periodic tilings, to general relativity theory, and to the foundations of quantum theory. The lecture, free and open to the public, was sponsored by CASPER, the departments of physics, mathematics, engineering and computer science, neuroscience and philosophy, and the Vice Provost for Research.



Dr. Roger Penrose was knighted for his outstanding contributions to mathematics.

## Margaret (Peggy) Shea Gives Lecture on Space Weather and Archeology

Peggy Shea recently presented a joint CASPER/Physics Seminar on her research in cosmic radiation and solar terrestrial phenomena.

Peggy Shea was awarded the Waldo E. Smith Medal at the AGU Fall Meeting Honors Ceremony, which was held on December 8, 1998, in San Francisco, California. The medal recognizes extraordinary service to geophysics.

Peggy not only has had a remarkable personal research career, but she has also expended an enormous amount of energy facilitating the research of oth-

ers, especially within the international community. Not only is she a prodigious publisher, authoring or coauthoring over 300 papers, but she is also a prodigious editor, editing more reports, proceedings, and journals than AGU would grant me room to mention. Moreover, even though she has spent most of her career doing basic research for the U. S. Air Force, she was so highly regarded in the Soviet Union that she was a recipient of their Academy of Sciences' Commemorative medal honoring 100 Years of International Geophysics.



Dr. Peggy Shea was awarded the Waldo E. Smith Medal

## Dirac Conference Held in October 2002

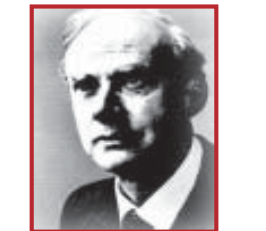
Baylor University held the Dirac Conference from September 30 through October 2, sponsored by the Vice Provost for Research, the National Science Foundation, CASPER, the Baylor University Department of Physics and others. The Dirac Conference held in honor of the centenary of the birth of 1933 Nobel Prize Winner Paul Dirac was an interdisciplinary evaluation of Dirac's contributions to the methodology and progress of twentieth century physics.

In addition to considering Dirac's impact on present

research at the frontiers of theoretical physics, Dirac's approach to problem-solving and theory construction was also studied.

Scheduled speakers included Sir Roger Penrose of Oxford University, John Polkinghorne of Cambridge University, Gordon Kane of the University of Michigan and Laurie Brown of Northwestern University.

Thank you to all the CASPER faculty and students who helped make the Dirac Conference a huge success.



Dr. Paul Dirac, 1933 Nobel Prize Winner

## COSPAR 2002/LPSC XXXIII/Advances in Space Research

**COSPAR 2002** - Members from the ASSTG, HIDPL, and EUCOS research groups had 11 oral and poster presentations accepted at the bi-annual international space conference in Houston in October 2002. The presentations from the ASSTG, EUCOS and HIDPL groups, covered research areas from string theory to dusty plasmas and gravitoelectrodynamics. All submissions will be published in the reference journal *Advances in Space Research*.

**LPSC XXXIII** - Two research papers from the ASSTG group were accepted for presentation at the Lunar and Planetary Science Conference held in Houston in March of 2002.

Truell Hyde, Ray Nazzario, and Bruce Lindsay presented their results at this annual international meeting of scientists.

**Advances in Space Research Publications** - Seven papers from the ASSTG group were recently published in the peer-reviewed journal *Advances in Space Research*. The papers cover the CASPER research areas of dusty plasma charging processes, coagulation in dusty plasmas, formation of coulomb crystals and dust particle orbits around planets and protoplanetary migration. The impact rating for *Advances in Space Research* is now second out of all journals in aerospace science.