The 45,000-pound infrared German Aerospace Center telescope assembly inside the SOFIA aircraft.

SOFIA Specs

Airframe: Modified Boeing 747SP
Telescope: 45,000-pound (20 metric tons), 98.4-inch (2.5-meter) diameter infrared telescope assembly provided by the German Aerospace Center. The telescope observes through a 16 foot (4.5 meters) cavity
Maximum Altitude: 45,000 feet (13.7 km)
Purpose: To fly above more than 99% of the Earth's water vapor to capture infrared images and spectra not possible by even the largest ground-based telescopes
Operational target date: 2014

Center for Astrophysics, Space Physics & Engineering Research
One Bear Place 97310
Baylor University
Waco, Texas 76798-7310
www.baylor.edu/CASPER
(254) 710-3763 (voice)
(254) 867-3167 (voice)
(254) 710-7309 (fax)

Hypervelocity Impacts, Dusty Plasmas Lab and Space Science Lab
3801 Campus Drive
Waco, TX 76705
www.baylor.edu/CASPER
(254) 867-3167 (voice)
(254) 710-3763 (voice)
(254) 867-DUST (fax)

BAYLOR UNIVERSITY

Texas State Technical College Waco

In this issue

CASPER
Astrophysics & Space Science Theory Group
Early Universe Cosmology & Strings Group
Gravity, Cosmology & Astroparticle Physics Group
Hypervelocity Impacts & Dusty Plasmas Lab
Space Science Lab & Meyer Observatory

SOFIA says farewell to Waco

Late last year, NASA's Stratospheric Observatory for Infrared Astronomy finally said goodbye to Waco, first visiting NASA-Ames for flight testing and then taking up permanent residency at the Palmdale (California) Airport. Prior to this, SOFIA has routinely made history in Waco for years. Major milestones occurred in Waco, with many local players contributing to the success of the project.

"First light" astronomical science data is expected in early 2009, and by 2014, she is projected to be fully operational. SOFIA started out as a Boeing 747 aircraft and has now been transformed into an airborne observatory that will study the universe in the infrared spectrum. SOFIA will also be a major factor in the development of observational techniques, of new instrumentations and in the education of young scientists and teachers in the discipline of infrared astronomy.

Ground breaking Past – Milestones

1996: NASA awards the $162M SOFIA prime contract to a Universities Space Research Association team comprised of Chrysler Technology Airborne Systems, Waco TX, United Airlines, San Francisco, CA, MAN Technologies and Kaiser-Threde Aerospace, Germany. USRA manages the $25M Science Instrument Development grant budget, distributed among seven universities and NASA Centers.

June 1999 - The forward bulkhead section mock up of the SOFIA aircraft is loaded into the telescope cavity of the Section 46 mock up. A wing pylon on the SOFIA aircraft was detached and mounted for maintenance work.

December 11, 2000 – Testing and fabrication in Waco.

September 4, 2002 - The SOFIA telescope lands in Waco, Texas after a 7,000 mile journey from Germany

August 19, 2006 - SOFIA rolls down L-3 runway, the first time on its own power since 1997.

April 26, 2007: L-3 Communications announces the SOFIA has completed its first test flight following extensive aircraft modification and telescope integration at the company's L-3 Integrated Systems Waco, Texas facility.

Far above: An unpainted SOFIA moves down the taxi way at L-3 in Waco, Texas on August 19, 2006. Above: SOFIA's first test flight takeoff, at L-3 in Waco, Texas, April 26, 2007.

Some of the more significant Waco accomplishments include:

- Completion of a post-contract fully redesigned Cavity Door System with a more efficient upper/lower overlapping external door system - the original concept included an internal barrel door design;
- Successful seven percent model wind tunnel testing, completed by L3 Waco at University of Washington and validating system design;
- Successful completion of the largest aircraft Computational Fluid Dynamics Modeling and Finite Element Modeling exercise ever attempted
- Successful joint US-German installation of the three meter primary mirror into the aircraft;
- Successful completion of the aircraft interior proof pressure testing validating the load bearing capability of a first ever flat aircraft interior pressure bulkhead;
- Successful installation and motion testing of the upper rigid and lower flex door;
- First successful on-ramp sky observations by the HIPO instrument, which provided the first reference benchmark for telescope pointing ability;
- First successful floating of the world's largest aircraft bulkhead installed telescope assembly hydraulic bearing. The assembly is so sensitive that a person can move the 35,000 lb telescope with simply the pressure of an index finger;

SOFIA will fly above more than 99 percent of the atmospheric water vapor, enabling astronomical observations that Earth-based telescopes cannot equal. While the project is still underway at the Dryden Flight Research Center in California, Waco SOFIA team members know that without their work, the project would have never taken flight.

For more information regarding visit http://www.sofia.ursa.edu/

Photography and some article information courtesy of NASA

Baylor Signs Agreement with the University of Stuttgart

Baylor recently signed a Memorandum of Understanding (MOU) with the University of Stuttgart in Germany to enable joint research activities and projects as well as the exchange of students and faculty between both organizations.

"To be successful and competitive, CASPER's research groups need to collaborate with other researchers outside their own university, and this new agreement will provide an avenue for our faculty to do just that," said Dr. Truell W. Hyde, vice provost for research at Baylor. "Additionally, it will provide a host of new opportunities for CASPER undergraduate and graduate students as well."

The agreement specifically references ongoing research at the Space Science Institute at Stuttgart. Over the past several years, Dr. Hans-Peter Roeser, director of the Institute, has already launched two satellites built by his students into orbit. Roeser and his team are currently working on another satellite scheduled to launch in 2009. That program, Hyde said, has involved close collaboration with industry and is seen as a successful model to cost-effectively create hands-on experiences for students with private industry investments.

Two of the Stuttgart satellites are in a low-earth polar orbit, which bring them directly over Waco about five times each day. Through this new agreement, Baylor will provide Stuttgart the capability to communicate with their satellites over a previously communications-silent area from the Gulf of Mexico to southern Canada. In return, Baylor students and faculty will be able to use the Stuttgart satellites to train and perform various uplink/downlink commands, maneuvers and observations.

The new agreement with Stuttgart follows a similar agreement between Baylor and Texas State Technical College Waco in place since 2001 through CASPER. The agreement with TSTC provides CASPER students and faculty technical training and support in the CASPER research labs.

American Physical Society Division of Plasma Physics

CASPER was recently invited to participate in the 2007 American Physical Society Division of Plasma Physics Science Teachers Day/Student Plasma Expo held in Orlando, which occurred during the final two days of the 49th APS DPP conference and was co-located in the same venue. Several thousand students and teachers visited the CASPER booth to investigate the physics behind representative hands-on exhibits from the Physics Circus. Students arrived at the expo well prepared by their teachers with questions in hand to which they were required to find the answers during their time at the event. Given the mix of University, National Lab and Industry exhibits, a solid overview of the manner in which the physics of plasmas impacts the 'real world' was readily apparent. Additionally, Truell Hyde, Jorge Carmona-Reyes, and Bernard Smith presented a paper titled "Educational Outreach at CASPER" outlining CASPER outreach activities as part of the Education and Outreach session.

Gravity, Cosmology & Astroparticle Physics Group Updates

The Gravity, Cosmology and Astroparticle Physics Group, or GCAP, research topics including string/brane inflation, current acceleration of the universe in the framework of string/M-Theory, the nature and origins of the dark matter and dark energy, the hierarchy and cosmological constant problems, higher dimensional black holes, and their thermodynamics and formation.

During 2007, GCAP members A.Wang, A. Tziolas, P. Sharma, and Q. Wu attended two international conferences including the Origins of Dark Energy held at the Origins Institute, Hamilton, Canada, May 14-17, 2007 and the 2007 Joint Fall Meeting of the Texas Sections of the APS and AAPT, October 18-20, 2007, College Station, Texas.

At the 2007 Joint Fall Meeting of the Texas Sections of the APS and AAPT GCAP group members presented papers titled:

- *Collision of Orbifold Branes and Formation of Spacetime Singularities in String Theory*
- *Colliding Branes and the Formation of Spacetime Singularities*
- *Dark energy and cosmic curvature: Monte-Carlo Markov Chain approach*

GCAP Members

Faculty/Adjunct Faculty

Dr. Anzhong Wang, Dr, Rong-Gen Gai, Dr. Yumei Wu, Dr. Qin Sheng, Dr. N.O. Santos

Visiting Faculty/Postdocs

Dr. Z.-H. Li - Zhejiang University of Technology, Hangzhou
Dr. Y.-G. Gong - Chongqing University of Posts & Telecommunications
Dr. J. Alcaniz - National Observatory of Rio de Janeiro, Brazil
Dr. N.O. Santos - Queen Mary College, London

Graduate Students

Michael Devin, Andreas Tziolas, Preet Sharma, Yongqing Huang, Qiang Wu

Undergraduate Student:

Pamela Vo

EUCOS Updates

During the year Drs. Ali and Cleaver continued an investigation of half-flat manifolds (a generalization to well-known Calabi-Yau manifolds). Most recently they have applied their half-flat manifold research to heterotic strings. By again embedding a six-dimensional half-flat manifold in a seven-dimensional G_2 manifold, they have shown that heterotic string compactification on a half-flat manifold leads to $E_8 \times E_8$ gauge breaking to $E_6 \times E_8$, rather than to $SO(10) \times E_8$ as earlier claimed by a string group at Oxford University. Thus, Ali and Cleaver have shown that compactification on half-flat manifolds produces the same breaking as standard Calabi-Yau manifolds.

With his students, Dr. Cleaver began a long-term systematic study of the generic physical properties of the string landscape in the free-fermionic heterotic region. Over the summer, Dr. Cleaver, Tim Renner, and REU student Jared Greenwald began a systematic statistical study of NAHE-based string models. Dr. Cleaver and Matthew Robinson began a comprehensive investigation of statistics of gauge groups of weakly coupled free fermionic heterotic strings. Both projects are long term, on the scale of two years in length. A series of publications are expected from each.

Additionally, Dr. Cleaver and Richard Obousy have been studying, in the context of string/M-theory, the viability of the famous 1994 proposal by University of Wales physicist Miguel Alcubierre for (effectively speaking) faster-than light travel. They examined the implications of an advanced civilization theoretically developing the technology to locally alter the cosmological constant by locally manipulating the size of the compactified directions of string/M-theory. Dr. Cleaver and Richard Obousy were interviewed about their related invited paper that Richard presented at the November British Interplanetary Society conference by a writer for the British Institute of Physics' Physics World magazine and by BBC radio. An additional article, entitled "Physicists Do the Math on Warp Drive Science," discussing Obousy's talk and their paper, appeared December 12th on the Wired Science Web site.

EUCOS Members

Faculty

Dr. Gerald B. Cleaver
Dr. Tibra Ali

Graduate Students

Richard Obousy
Matthew Robinson
Tim Renner
Kristen Pechan

2007 REU student

Jared Greenwald

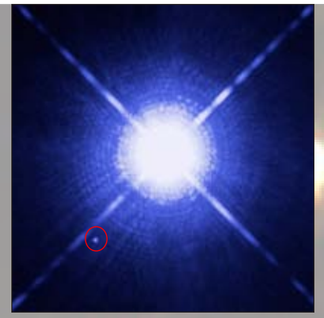
New CASPER Experimental Group

The newest of CASPER's experimental groups routinely keeps its students and faculty seeing stars.

The CASPER experimental astronomy group employs the Paul and Jane Meyer Observatory through its partnership with Central Texas Astronomical Society to work with McDonald Observatory and the University of Texas astronomy department, to measure luminosity curves for white dwarf stars as a mechanism for studying periodic variations in their intensities. Since expected periodicities generally fall between one second and 1000 seconds, usable data can be collected in the relatively short time period of one to a few nights.

White dwarfs are thought to be the end-state remnant of all but the largest main sequence stars. Pulsating white dwarfs exhibit luminosity variations due to radial gravity wave pulsations and/or periodic changes in atmospheric temperature. Determining the characteristics of these pulsations provides the data necessary to determine their internal composition and cooling rate. This data can also help verify current white dwarf convection models, providing boundaries to better determine the age of our galaxy.

Over the summer of 2007, RET fellow Shelly Hynes, Dick Campbell and Dr. Dwight Russell collected data from three white dwarfs employing the Paul and Jane Meyer Observatory near Clifton, TX. Two of these, G226-29 and G29-38 have already been extensively studied and have well known pulsation periods. As such, they provided the opportunity to collect calibration data for analysis methods before they were applied to a third, medium low-mass white dwarf PG1654+637. PG1654+637 is an unstudied magnitude 16, white dwarf with a temperature of approximately 15,000K, positioning it outside currently proposed models of the instability zone.



A White dwarf star, circled in red, a burned out stellar remnant, is a faint companion of the brilliant blue-white Dog Star, Sirius.

"It is now believed that the 'Instability Strip' is part of the natural life cycle of a main sequence star, but the exact boundaries of this strip are not well defined," says Campbell, head of the Experimental Astronomy Group. "PG1654 has a mass and temperature that would appear to place it near the edge of the Strip. By determining that it was not pulsating, it contributed to the data defining the edge of the Strip."

Accurate data for this white dwarf, like other medium low-mass white dwarfs, is important for proper characterization of the surface gravity boundary since the lower and upper boundaries of the instability strip have yet to be clearly defined. The data collected by the group during the summer of 2007 indicates this white dwarf is not a pulsator as predicted thereby maintaining and extending the purity of the DA instability strip.

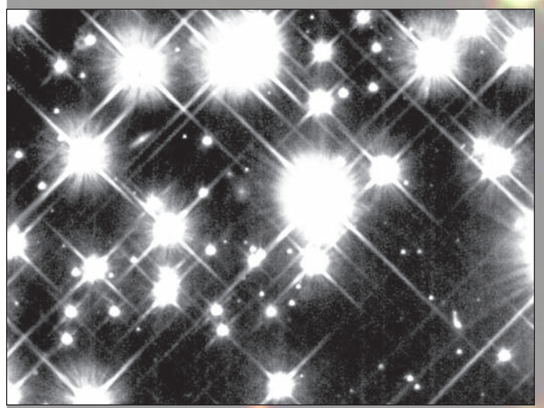
"When I look at the night sky, I am dazzled by the beauty of God's creation, but I am also in awe and curious by how it all works," says Campbell. "The collaboration of CASPER and CTAS provides resources to answer some of these questions, and puts these resources in the reach of students. The academic benefits are extensive."

Most universities don't have their own research-grade telescope, says Campbell. But at Baylor we do.

"We have the potential for long term serious astronomical research right here at Baylor."

Additional information about CTAS can be found at http://www.centexastronomy.org/

Additional information about the Paul and Jane Meyer Observatory can be found at http://www.centexastronomy.org/



Above: White dwarf stars, imaged by JPL's Wide Field and Planetary Camera 2 on NASA's Hubble Space Telescope.
Background: Diminutive by stellar standards, white dwarf stars are also intensely hot, but they are cooling. No longer do their interior nuclear fires burn, so they will continue to cool until they fade away. This Hubble Space Telescope image covers a small region near the center of a globular cluster known as M4. Here, researchers discovered a large concentration of white dwarf stars (circled).

Images courtesy of NASA

Meyer Observatory dedicated

Dick Campbell and Seth Shostak pose in front of the Paul and Jane Meyer Observatory telescope the day of the dedication.

One of CASPER's newest partners, the Central Texas Astronomical Society, formally dedicated the Paul and Jane Meyer Observatory June 9, 2007. As part of this occasion, CTAS and CASPER cosponsored a public lecture by Seth Shostak, Senior Astronomer at the SETI Institute (www.seti.org).

Dr. Shostak holds the B.A. in physics from Princeton and a Ph.D. in astronomy from Caltech and is responsible for much of the Institute's outreach. He is science editor for "The Explorer," gives more than 50 talks annually for both academic and general audiences, and is the host for the weekly radio program, Are We Alone? Dr. Shostak is well known for readily translating the most complex scientific discoveries into terms accessible to the non-scientist. He has written three books as well as hundreds of articles for newspapers, magazines, and the SPACE.com web site. He was recently awarded the Klumpke-Roberts Award by the Astronomical Society of the Pacific in recognition for his outstanding contributions to the public understanding and appreciation of astronomy, Shostak is Chair of the International Academy of Astronautics SETI Permanent Study Group. As a practicing scientist personally engaged in SETI observations, his technical expertise—combined with his quick wit and engaging personality—make him a sought-after speaker and writer. Dr. Shostak's lecture attracted interest from across the region with many in the audience driving over fifty miles to be in attendance.

Some material adapted from www.seti.org.

G.W. Carver Academy teachers take on "Vomit Comet"

Four G.W. Carver Academy teachers took the ride of a lifetime in February 2007 aboard a modified DC-9, or more affectionately called, the "Vomit Comet."

Dave Gibson, Becky Winkler, Jim Heston and Erica Bradley attended NASA's Explorer School, a CASPER partner, in Houston, Texas at Ellington Field. The program was designed to spark innovative science and math instruction for students in grades four through nine. The experience will then be applied directly in the classroom.

For two hours at a time, the middle school teachers repeatedly rose and fell over the Gulf of Mexico in the aircraft as it flew 30 parabolic flight trajectories producing about 25 seconds of weightlessness during each cycle. In addition to periods of micro-gravity, the flight also produced periods of hypergravity.

During the flight, Carver teachers collected data using an experimental research device designed and built by CASPER HIDPL technicians, Mike Cook and Jimmy Schmoke, and funded in large part by a generous contribution from Richard and Susan Swint.

Courtesy of NASA

Jim Heston secures the "Texas Tornado" so his Carver Academy team can collect data during the weightlessness and hypergravity cycles aboard the DC-9.

The research cell or "Texas Twister," consisted of a torsion bar with differently-shaped containers filled with Skittles. The "Twister" was designed to provide a rotating reference frame and work under conditions ranging from micro- to hypergravity. Integrated video cameras recorded the candies' movements, producing data, which was then analyzed for symmetry and structure.

Mike Cook stated that the machine was designed to be as simple as possible to operate during flight.

"They're probably going to be busy holding their (throw-up) bags," he said. "We tried to design it so they could operate it with one hand."

The basic research question the "Twister" was designed to answer was the role that packing can play in producing structural symmetry starting from individual particles. The answer to this question has impacts in both complex plasmas as well as nanofabrication.

In true CASPER tradition, the "Texas Twister" was also designed to act as an outreach tool. Although the concepts are complex, the ideas of changing volumes and probabilities fit easily into the Texas middle school curriculum. "It's really all about exposure and trying to see if the students are interested in something like this for something they might want to pursue later," said David Gibson, an eighth-grade science teacher at Carver. "We're looking for any chance to get kids excited about that side of the world."

Astrophysics & Space Science Theory Group
Hypervelocity Impacts & Dusty Plasma Lab
Research Updates

Bob Merlino, Truell Hyde and John Goree talk at the 49th Annual Meeting of the Division of Plasma Physics in Orlando, Fla.

Members of CASPER's ASSTG and HIDPL research teams were invited to present papers at a number of international conferences during 2007. Several have already been accepted for publication in a special thematic issue of IEEE Transactions on Plasma Science.

In November, Truell Hyde, Lorin Matthews, Matthew Benesh, Mike Cook, James Creel, Jie Kong, Ke Qiao, Jorge Carmona-Reyes, Jimmy Schmoke and Bernard Smith traveled to Orlando to attend the 49th Annual Meeting of the Division of Plasma Physics where they presented seven papers:

- *Phase Transitions in a Polydisperse Dusty Plasma*
- *Determination of Plasma Sheath*
- *Dust Parameters from Dust Particle Oscillation Modes*
- *Effect of Dipole-Dipole Charge Interactions on the Coagulation of Fractal Aggregates*
- *Complex Plasma Studies on Ferromagnetic Dust*
- *Dust/Wall Interactions in Fusion Research*
- *Investigation of Dust Vertical Dispersion Relations and Educational Outreach at CASPER*

Earlier in the summer, Truell Hyde, James Creel, Jorge Carmona Reyes, Jie Kong, Ke Qiao and Jimmy Schmoke also attended the 34th IEEE International Conference on Plasma Science (ICOPS), Albuquerque, New Mexico where they presented five papers:

- *Charging of Fractal Dust Agglomerates in a Plasma Environment*
- *Particulate Contamination and Its Niche Within Complex (Dusty) Plasmas*
- *Structural Symmetry and Vertical Modes in Finite 2D Plasma Crystals*
- *Dust Particle Oscillations in a Wakefield Potential*
- *Vertical Dust Particle Chains Mass and Charge Measurements*.

ASSTG / HIDPL Members

Faculty/Staff
Dr. Truell Hyde,
Dr. Lorin Matthews
Dr. Jie Kong
Dr. Ray Nazzario
Dr. Ke Qiao
Dr. Bernard Smith
Dr. Victor Land
Jorge Carmona-Reyes
Michael Cook
Jimmy Schmoke
Dr. Phillip Anz-Meador

Graduate Students
James Creel
Michael Whitaker
Qianyu Ma
Chelsea Chan
Jay Murphree
Victor Zhang

Undergraduate Students
Matthew Benesh
Eileen Fernandez
Kyle Lartigue
Jon Brown

2007 TSTC Interns
Chelsea Chan
Daniel Eklund
Jeremy Gonzales
Britt Harris
Sean Kennedy
David Knapp
Kevin Locashio
Maxie McCary
Timothy Brown
Mark Westgate
Michael Darr
Micheal Lambden
Arron Westbrook
Chase Pearson
Kenneth Warschak

REU Fellows
Brandon Harris
Michael Gilbert
Chelsea Chan
Collin Komar
Lauren McClelland

RET Fellows
Shelley Hynes
Steve Rapp
Gary Shetler

CASPER Seminars

Anita Cochran - Assistant director of the McDonald Observatory; research scientist at University of Texas

Abstract: Comets are the least altered materials left over from the formation of the Solar System so their study can lend constraints to that formation. I will review our present state of knowledge of the formation and structure of the Solar System and what we know about the chemical composition of comets. This will include discussion of different classes of comets and what constraints we have on temperature from isotopes. I will include some information obtained with NASA's Deep Impact and Stardust missions.

Research Updates
Recent Publications

Randall-Sundrum and Flipped SU(5), Ben Dundee and Gerald Cleaver, Accepted for publication in the International Journal of Modern Physics A, 2008.

Reconstruction of the deceleration parameter and the equation of state of dark energy, Y. Gong and A. Wang, Phys. Rev. D75, 043520, 2007.

Relationship Between the DC Bias and the Debye Length in a Complex Plasma, Jie Kong, Jorge C. Reyes, James Creel and Truell W. Hyde, IEEE Transactions on Plasma Science, Vol. 35, No. 2, pp. 323-327, April, 2007.

Splitting methods for differential equations, Q. Sheng and A. Khaliq, Int. J. Comput. Math. 84 (2007), 709-711.

Stringent Phenomenological Investigation into Heterotic String Optical Unification, John Perkins, Ben Dundee, Richard Obousy, Stephanie Hatten, Eric Kasper, Matthew Robinson, Cassel Sloan, Kristen Stone, and Gerald Cleaver, Physical Review D75 (2007) 026007.

Structural Phase Transitions of Three-Dimensional Shielded Coulomb Clusters (Finite Yukawa System), Ke Qiao, Matthew Benesh and Truell W. Hyde, IEEE Transactions on Plasma Science, Vol. 35, No. 2, pp. 346-351, April, 2007.

Supersymmetry Breaking Casimir Warp Drive, Richard Obousy and Gerald Cleaver, in AIP Conference Proceedings 880 (2007) 1163.

Teaching International Technology Entrepreneurship in the Undergraduate Engineering and Computer Science Curriculum, C. Fry, G. Leman et.al., Proceedings of the 2007 ASEE Gulf-Southwest Annual Conference University of Texas – Pan American, Published by American Society for Engineering Education.

The Ricci Curvature of Half-Flat Manifolds, Tibra Ali and Gerald Cleaver, Journal of High Energy Physics 0705 (2007) 009.

Thermodynamical properties of the Universe with dark energy, Y. Gong, B. Wang, and A. Wang, JCAP, 0701, 024, 2007.

Thermodynamical properties of dark energy, Y. Gong, B. Wang, and A. Wang, Phys. Rev. D75, 123516, 2007.

Vertical Dust Particle Chains – Mass and Charge Measurements, J. Carmona-Reyes, J. Kong and T.W. Hyde, 16th IEEE International Pulsed Power Conference Proceedings, Albuquerque, NM, 2007 (CD-ROM).

Warp Drive: A New Approach, Richard Obousy and Gerald Cleaver, Journal of the British Interplanetary Society, 2007.

Submitted for Publication as of January 2008

A Note on the standard embedding on half-flat manifolds, Tibra Ali and Gerald Cleaver, submitted to the Journal of High Energy Physics, 2008.

Characterization of an External Variable DC Bias in a GEC rf Reference Cell System, Bernard Smith, Jimmy Schmoke, Mike Cook and Truell W. Hyde, Submitted to IEEE Transactions on Plasma Science, 2008.

Structural Phase Transitions and Vertical Mode in 2D Finite Plasma Crystals, with K. Qiao, Accepted for publication in, IEEE Transactions on Plasma Science ,2008

Quasi-realistic heterotic-string models with vanishing one-loop cosmological constant and possibly perturbatively broken supersymmetry, Gerald Cleaver, Alon Faraggi, Elisa Manno, and Cristina Timirgaziu, submitted to the Physical Review D, 2008.

CASPER hires new director of outreach

CASPER recently hired Dr. Cynthia Hernandez into a new position, the director of outreach. The new position is responsible for writing K-12 curriculum aligned with Texas Essential Knowledge Skills, TEKS, and integrating curriculum into the Physics Circus. Dr. Hernandez will also be responsible for teacher professional development, identifying and addressing educational and pedagogical areas of concern, designing innovative science, technology, engineering and mathematic modules, and creating business, higher education and school district partnerships.

The new position hopes to improve student STEM achievement, as well as foster interest in students pursuing STEM-related careers. As such, Dr. Hernandez will work to create a STEM network and resource center for K-12 teachers so they can utilize state-of-the-art technology and incorporate that technology into the classroom setting. Students will be given the opportunity to work side-by-side scientists, physicists, chemists, engineers and mathematicians in a mentorship program.

Dr. Hernandez earned her Bachelor of Education from Texas Tech University, her Master of Curriculum and Instruction from the University of Houston and her P.h.D. in educational administration from the University of Texas. Her previous work experience includes teaching and school administration, working for the Texas Education Agency and three regional education service centers, as well as the University of Mary Hardin-Baylor and Tyler Junior College.

"Dr. Hernandez brings much-needed research experience to the CASPER Outreach initiatives," says Dr. Truell Hyde, CASPER director. "Her track record in curriculum development, her proven abilities in working with K-12 teachers and her research assessment skills will all prove invaluable both to CASPER graduate students in education and to the growing CASPER outreach program."

"I'm absolutely delighted that we were able to attract such a talented individual to this position."

Welcome to CASPER, Cyndi!

Research Updates
Recent Publications

Accelerating Universe in Randall-Sundrum Models of Two 3-Branes, A. Wang, R.-G. Cai, N.O. Santos, Nucl. Phys. B, in press, 2008.

A moving-mesh splitting scheme for 2-dimensional quenching problems, Q. Sheng, Proc. Appl. Math. Mech., in press.

A paradoxical consistency between dynamic and conventional derivatives on hybrid grids, Q. Sheng, Comm. Numeri. Math., in press.

A semi-adaptive split-cosine scheme for the sine-Gordon equation, Q. Sheng, Proc. Appl. Math. Mech., in press.

An effective semi-implicit method for circularly symmetric quenching optical waves, Q. Sheng, Dynamic Systems and Applications, in press.

Boundary data smoothness for solutions of nonlocal boundary value problems for second order ordinary differential equations, J. Ehrke, J. Henderson, C. Kunkel and Q. Sheng, J. Math. Anal. Appl., 333 (2007) 191-203.

Charging and Growth of Fractal Dust Grains, L. Matthews and T.W. Hyde, IEEE Transactions on Plasma Science, IEEE Transactions on Plasma Science, Vol. 36, No. 1, pp. 310-314, 2008

Charging of Fractal Dust Agglomerates in a Plasma Environment, L.S. Matthews and T.W. Hyde, 16th IEEE International Pulsed Power Conference Proceedings, Albuquerque, NM, 2007 (CD-ROM).

Current Constraints on Interacting Holographic Dark Energy, Q. Wu, Y. Gong, A. Wang, and J. Alcaniz, Phys. Lett. B659, 34-39, 2008.

Description of light focusing by a spherical lens using diffraction integral method, S. Guha, L. P. Gonzalez and Q. Sheng, Proc. Appl. Math. Mech., in press.

Direct evidence of acceleration from distance modulus redshift graph, Y. Gong, A. Wang, Q. Wu and Y.-Z. Zhang, JCAP, 0708, 018, 2007.

Employing Dust Particle Chains as a Wakefield Diagnostic, J. Kong, T.W. Hyde and J. Carmona-Reyes, IEEE Transactions on Plasma Science, Vol. 36, No. 2, pp 554-558, April, 2008

Energy Conditions and Current Acceleration of the Universe, Y. Gong and A. Wang, Phys. Lett. B652, 63-68, 2007.

Existence of black holes in Friedmann-Robertson-Walker universe dominated by dark energy, Z.-H. Li and A. Wang, Mod. Phys. Lett. A22, 1663-1676, 2007.

Formation of Cosmic Dust Bunnies, Lorin S. Matthews, Ryan Hayes, Michael Freed and Truell W. Hyde, IEEE Transactions on Plasma Science, Vol. 35, No. 2, pp. 260-265, April, 2007.

Friedmann equation and thermodynamics of the apparent horizon, Y. Gong and A. Wang, Phys. Rev. Lett. 99, 211301, 2007.

Homothetic Self-Similar Solutions of the Three-Dimensional Brans-Dicke Gravity, G.A. Benesh and A. Wang, Gen. Relativ. Grav. 39, 277-289, 2007.

Hybrid approximations via second order combined dynamic derivatives on time scales, Q. Sheng, Electronic J. Qualitative Theory Diff. Eqns, 17, (2007) 1-13.

Hybrid approximations via second order crossed dynamic derivatives with the diamondsuit-alpha derivative, Q. Sheng, Nonlinear Anal., Series B, in press.

In Search of the (Minimal Supersymmetric) Standard Model, Gerald Cleaver, chapter 2 of String Theory Research Progress, Nova Publishers, Dec. 2007.

Investigation of Dusty Wake Field Oscillations, J. Kong, T. Hyde, L. Matthews, M. Cook, J. Schmoke and J. Carmona-Reyes, 16th IEEE International Pulsed Power Conference Proceedings, Albuquerque, NM, 2007 (CD-ROM).

Kink Stability of Self-Similar Solutions of Scalar Field in 2+1 Gravity, A. Wang and Y. Wu, Gen. Relativ. Grav. 39, 663-676, 2007.

Kuiper Binary Object Formation, R. Nazzario, K. Orr, C. Covington, D. Kagan and T. Hyde, Advances in Space Research, Volume 40, pp. 280–283, 2007.

Notes on the diamond-alpha dynamic derivative on time scales, J. W. Rogers, Jr. and Qin Sheng, J. Math. Anal. Appl., 326, (2007) 228-241.

On Monotonicity of an adaptive splitting scheme for two-dimensional singular reaction-diffusion equations, A. Khaliq and Q. Sheng, Int. J. Comput Math., 84 (2007) 795-806.

On the Cauchy Problem for one-Dimensional Compressible Navier-Stokes Equations, Y Qin, F. Liu, Portugaliae Mathematica, 64 page 1-40(2007).

On the Nth mode numerical solutions of a second order boundary value problem on semi-infinite domain, Q. Sheng and J. W. Haus, Communications on Applied Nonlinear Analysis, 14 (2007) 121-133.

Particulate Contamination Within Fusion Devices and Complex (Dusty) Plasmas, J. Creel, J. Carmona-Reyes, J. Kong and T.W. Hyde, 16th IEEE International Pulsed Power Conference Proceedings, Albuquerque, NM, 2007 (CD-ROM).

Phase Structural Transitions for Large 2D Dust Clusters in Complex Plasmas, K. Qiao and T.W. Hyde, 16th IEEE International Pulsed Power Conference Proceedings, Albuquerque, NM, 2007 (CD-ROM).

Phase Transitions in a Dusty Plasma with Two Distinct Particle Sizes, B. Smith, T.W. Hyde, L. Matthews, J. Reay, M. Cook and J. Schmoke, Advances in Space Research, Vol. 41, pp. 1509-1512, 2008

Propagation of high intensity light in semiconductors, L. P. Gonzalez, S. Guha and Q. Sheng, Proc. Appl. Math. Mech., in press.

Randall-Sundrum and Flipped SU(5), Ben Dundee and Gerald Cleaver, Accepted for publication in the International Journal of Modern Physics A, 2008.

Continued on next page

CASPER Seminars

Dr. Hans-Peter Roeser, director of the Institute of Space Systems at the University of Stuttgart in Germany, was a special CASPER Colloquium speaker, Friday, June 29, 2007. Dr. Roeser provided insight into Stuttgart's small satellite programs, payloads, and the associated ground downlink operations and data analysis.

Dr. Roeser's research team at Stuttgart has already launched two satellites and has plans for several more, including a moon mission in 2010. One of the most exciting aspects of Dr. Roeser's research is that the Stuttgart small satellite program is planned, designed, manufactured, launched and monitored by undergraduate and graduate students and faculty, in partnership with private industry.

Since 2002, Roeser has been a professor at Stuttgart and managing director of the Institute of Space Systems. He received his bachelor's and doctorate from the University of Bonn in Germany and worked for 20 years at the Max-Planck-Institute for Radioastronomy, where he has held a number of positions. He served as the German spokesman of the US-German Stratospheric Observatory, also known as "SOFIA", which is a Boeing 747 with a 2.7 m telescope on board. He has authored more than 70 papers in international journals, more than 80 papers in conference proceedings and has received several prestigious international awards in physics and engineering.

Dr. David Dooley - Professor of chemical biology and provost at Montana State University

Abstract: Metalloenzymes that require copper for activity are widely distributed in nature and play a multitude of critical functions. Three such enzymes: the amine oxidase family, which oxidize primary amines to aldehydes using O2; galactose oxidase, which oxidizes primary alcohols using O2; and nitrous oxide reductase, which reduces N2O to N2 and is important in the global nitrogen cycle. The active sites of these enzymes, where catalysis occurs, contain structurally novel features that are functionally essential. The reactivity and mechanisms of the enzymes will be discussed in the context of how the active site structure controls the chemistry.

Dr. Matt Hejduk - RABA Technologies

Abstract: It's important to determine when foreign satellites change operational status or configuration, but the instrumentation and techniques to determine this are extremely expensive and low-capacity. Interest in developing algorithms to attempt to make these determinations from the serendipitous photometric measurements obtained as part of routine "metric" tracking of a satellite - low-cost, high-throughput measurements taken to maintain a satellite's orbital parameters. Accomplishing this, with a degree of reliability, will assist the overall satellite status determination process at little cost. The simplest purely photometric change-detection approach is to compare a high-fidelity brightness prediction for a given satellite illumination geometry to the actual measurement for that geometry, with the magnitude of the difference indicating the likelihood of a configuration change. Past photometric prediction modeling in has been attempted by entirely deterministically, which is crippling when little is known about the satellite's construction; or in an extremely simplistic stochastic manner, which holds very little predictive or extrapolative force. The present approach is to combine these techniques by applying a fairly generic, tailorable deterministic model to address expected deterministic trends and then modeling the residual with a BLUE stochastic technique used for spatial analysis. The result is a minimum-variance "brightness map" of the illumination geometry parameters and estimation variance map over the hyperplane. The predicted/actual brightness difference and the point-specific estimation variance can be combined into a tunable function that achieves the proper operational balance between type 1 and 2 prediction errors.

Dr. Patrick Hartigan – Professor of physics and astronomy at Rice University

Abstract: Newly-Formed low mass stars are unusually surrounded by a dense disk of gas and dust that is left over from the star formation process. Within the first few million years of the lifetime of a star this disk continues to gradually accrete material onto the star, and the disk redirects some fraction of these jets is a subject of much active research, and has implications for other accreting systems with jets, including X-ray binaries, active galactic nuclei, and even planetary nebulae. Most models of jet acceleration involve magnetic fields in some way, but inferring the presences of magnetic fields in stellar jets is difficult from both observational and theoretical standpoints. This talk reviews what we know about the field and shows how new data from the Hubble Space Telescope and new models of pulsed magnetized flows are improving our understanding of these remarkable objects.

CASPER Seminars

Dr. Pamela Marcum, associate professor of physics and astronomy at Texas Christian University, and current program scientist for the Wide-field Infrared Survey Explorer and Kepler missions at NASA, recently visited Baylor to speak as part of CASPER's seminar series.

Marcum gave an overview of the technical capabilities and science goals of NASA astrophysics missions focusing on development or production, including WISE and Kepler, and the opportunities they bring to the community.

"Just as the Hubble Space Telescope has awed and inspired the public for nearly a generation now," said Marcum during her lecture. "These promising future missions are sure to provide new surprises about our universe and to address such fundamentally human questions such as, 'How unique is Earth?'"

Marcum earned her Ph.D. in astronomy from the University of Wisconsin-Madison. For her post-doctoral work, she attended the University of Virginia, where she worked with a team at NASA Goddard Space Flight Center on the shuttle-based ASTRO science missions, analyzing data taken with the Ultraviolet Imaging Telescope.

Dr. Marcum is on a temporary assignment as program and discipline scientist at NASA headquarters in Washington, D.C. Her responsibilities include managing the grant program, which supports detector development, laboratory astrophysics and suborbital payloads.

Dr. Partha Banerjee - Professor of Electro-Optics and Electrical and Computer Engineering at the University of Dayton.

Abstract: We'll look at some of my investigations over the last three decades in the general area of nonlinear dispersive propagation. Beginning with simple dispersion relations, and upon heuristically adding the nonlinearity as a change in the velocity, it is shown how baseband and envelope PDEs that give rise to solitary wave and soliton solutions can be derived. Dispersion relations associated with positive and negative index media; envelope propagation, the nonlinear Schrodinger equation and its extensions, particularly in reference to spatial and/or temporal solitary waves and their stabilization in D+1 dimensions, will be discussed. Stabilization techniques include saturation nonlinearity, and nonlinearity and/or dispersion management.

Dr. Victor Land - Utrecht University, now Baylor post doc

Abstract: Dusty plasma provides unique systems to study a multitude of phenomena from different fields of physics, such as solid state physics and fluid physics, on a scale visible to the naked eye. This recent realization has led to a demand for the hard to find, large, isotropic, three-dimensional dust crystals. Experiments under micro-gravity, on sounding rockets, during parabolic flights, or even on board of the International Space Station, produce three-dimensional dust structures, containing possibly millions of dust particles. However, a dust-free region in the centre of the discharge forms a void. This void really breaks the isotropy of the crystal, which is unwanted for studying. It's important to know the formation and how to close the void, from the point of view of the forces acting on the dust particles, but also with the aspect of self-organization in dusty plasma in mind.

Kurt Swogger - Vice president of Performance Plastics & Chemicals Business Development for Dow Chemical

Abstract: To rapidly implement a new development called "Insite Technology", the Dow Chemical's Plastics Business changed its approach to commercializing new technology. The Speed Based Development Philosophy relies on people in the right roles doing the right things with the right information using the right tools to get the right results. This approach has been very successful in Insite Technology efforts, but more importantly is proving useful in a wide range of other businesses. Successful use of these principles is difficult. The further utility of this philosophy is that any part can be used or adapted depending on the need.

Research Updates
Recent Presentations

Dark energy and cosmic curvature: Monte-Carlo Markov Chain approach, Q. Wu and A. Wang, presented at the 2007 Joint Fall Meeting of the Texas Sections of the APS and AAPT, October 18-20, 2007, College Station, Texas.

Determination of Plasma Sheath and Dust Parameters from Dust Particle Oscillation Modes, Ke Qiao, Jorge Carmona, Bernard Smith, Mike Cook, Jimmy Schmoke and Truell Hyde, Presented at the 49th Annual Meeting of the Division of Plasma Physics (American Physical Society), Orlando, Florida, 2007.

Dust Particle Oscillations in a Wakefield Potential, J. Kong and T.W. Hyde, presented at the 34th IEEE International Conference on Plasma Science (ICOPS), Albuquerque, New Mexico, 2007.

Dust/Wall Interactions in Fusion Research, James Creel, Jorge Carmona-Reyes, Mike Cook, Jimmy Schmoke, Lorin Matthews and Truell Hyde, Presented at the 49th Annual Meeting of the Division of Plasma Physics (American Physical Society), Orlando Florida, 2007.

Educational Outreach at CASPER, Truell Hyde, Bernard Smith and Jorge Carmona-Reyes, Presented at the 49th Annual Meeting of the Division of Plasma Physics (American Physical Society), Orlando, Florida, 2007.

Effect of Dipole-Dipole Charge Interactions on the Coagulation of Fractal Aggregates, Lorin Matthews and Truell Hyde, Presented at the 49th Annual Meeting of the Division of Plasma Physics (American Physical Society), Orlando, Florida 2007.

Experiential Learning at Hankamer -Exploring the "Golden Triangle" of Entrepreneurship, Innovation and Global Competency, G. Leman, presented to the 4th Annual International Conference on Global Entrepreneurship at Zhejiang University, China, June 22, 2006.

Feasible approximations of hybrid dynamic derivatives on time scales, Q. Sheng, presented at the Joint AMS-MAA-SIAM Annual Meeting, New Orleans, Jan., 2007.

From the exponential splitting to adaptive splitting and beyond, Q. Sheng, mathematics colloquium, Department of Mathematics, Baylor University, October 25, 2007.

Heterotic Models with Vanishing One-Loop Cosmological Constant and Possible Perturbatively Broken Supersymmetry, Jerry Cleaver, presented at the Texas Section of the American Physical Society's Fall Meeting at Texas A & M in College Station, Texas, 2007.

Heterotic Strings on Mirror Half-flat Manifolds, Tibra Ali and Jerry Cleaver, presented at the Texas Section of the American Physical Society's Fall Meeting at Texas A & M in College Station, Texas, 2007.

Hybrid dynamic derivative approximations and computational applications, Q. Sheng, presented at the 7th International Conference on Computational and Mathematical Methods in Science and Engineering, Chicago, Illinois, June 2007.

Integration of TRIZ Methods into Stage-Gate® Processes for New Product Development, G. Leman, presented to the Central Texas Chapter, PDMA (Product Development Managers Association), December 2006.

Investigation of Dust Vertical Dispersion Relations, J. Kong, K.Qiao and T.W. Hyde, Presented at the 49th Annual Meeting of the Division of Plasma Physics (American Physical Society), Orlando, Florida, 2007.

Light Gas Accelerators and Shock Physics, T.W. Hyde, Invited Physics Colloquium at the University of Texas at Dallas, Dallas, Texas, 2008.

Mirror Half-Flat Phenomenology, Gerald Cleaver, coauthored by Tibra Ali, presented at the Tenth European Meeting *Planck'07* held in Warsaw, Poland, June 9-13, 2007.

On exponential splitting on hybrid grids, Q. Sheng, presented at the 6th International Congress on Industrial and Applied Mathematics, Zurich, Switzerland, July 16-20, 2007.

Particulate Contamination and Its Niche Within Complex (Dusty) Plasmas, J. Creel, J. Carmona-Reyes, J. Kong and T.W. Hyde, presented at the 34th IEEE International Conference on Plasma Science (ICOPS), Albuquerque, New Mexico, 2007.

Phase Transitions in a Polydisperse Dusty Plasma, Bernard Smith, Truell Hyde, Lorin Matthews, Mike Cook and Jimmy Schmoke, Presented at the 49th Annual Meeting of the Division of Plasma Physics (American Physical Society), Orlando, Florida, 2007.

Sine schemes for solitary wave equations, Q. Sheng, presented at the 6th International Congress on Industrial and Applied Mathematics, Zurich, Switzerland, July 16-20, 2007.

Structural Symmetry and Vertical Modes in Finite 2D Plasma Crystals, K. Qiao and T.W. Hyde, presented at the 34th IEEE International Conference on Plasma Science (ICOPS), Albuquerque, New Mexico, 2007.

Systematic Statistical Study of NAHE-Based String Models, Tim Renner, Jerry Cleaver and Jared Greenwald, presented at the Texas Section of the American Physical Society's Fall Meeting at Texas A & M in College Station, Texas, 2007.

Vertical Dust Particle Chains Mass and Charge Measurements, J. Carmona-Reyes, J. Kong, J. Schmoke, Mike Cook and T.W. Hyde, presented at the 34th IEEE International Conference on Plasma Science (ICOPS), Albuquerque, New Mexico, 2007.

Warp Drive: A New Approach, Richard Obousy and Jerry Cleaver, presented at the November conference of the British Interplanetary Society (BIS), *Warp Drive, Faster Than Light: Breaking the Interstellar Distance Barrier*, London, England, 2007.

Research Updates
Awards and Proposals

21st Century Learning Community
Submitted in Response to a MCYC Program Announcement
(July, 2007) • **$23,800** •

Summer Undergraduate Research Experience
Submitted in Response to a NSF REU
Program Announcement
(August, 2006) • **$422,708** •

GearUp Central Texas
Submitted in Response to a Department of Education AO
(March, 2006) • **$11,360,124** •

Phase Transitions in Complex Plasmas
Submitted in Response to a DOL Program Announcement
(February, 2006) • **$72,000** •

Quick Shot: An Imaging Diagnostic Tool for Hypervelocity Flight Path Reconstruction
Submitted in Collaboration with Start Vision Technologies, Inc. to an Arnold Air Force Base Program Announcement
(January, 2006) • **$20,000** •

NSF Photonics Center of Excellence Proposal
Submitted in Response to a NSF Program Announcement
(April/October, 2005) • **$50,000** •

Numerical Study of Forces Affecting Charge Dust: Space and Laboratory Applications
Submitted in Response to a Baylor URSA
Program Announcement
• $3000 •

Pending Awards

NSF S-STEM Physics Success Scholarships
Submitted in Response to a NSF Program Announcement

Highly Effective and Efficient Simulation Technology for Infrared Optical Material Developments
Submitted in response to U.S. Air Force
Program Announcement

OVPR Application for Postdoctoral Fellowship Funds for Mathematical Physics
Submitted in response to a Baylor OVPR
Program Announcement

Current Acceleration of the Universe in String/M-Theory and Highly Efficient and Effective Computer Simulations
Submitted in response to a NSF Program Announcement.

Research Updates - Recent Presentations

A journey from an exponential function to parallel-splitting computations, Q. Sheng, Invited Mathematical Colloquium, Department of Mathematical Sciences, Middle Tennessee State University, April 4, 2007.

A journey from an exponential function to parallel/split computations, Q. Sheng, Baylor Engineering And Research Seminar, College of Engineering, Baylor University, August 31, 2007.

A Spiral Science Curriculum from the Laboratory to the Field: A Science Intervention in an Elementary School," Edith Davis, presented at the Association of Teacher and Educators, San Diego, California, Feb. 19, 2007.

An Educational Convergence, G. Leman, presented to the Texas Economic Development Council, Houston Texas, September 28, 2006.

Charging of Fractal Dust Agglomerates in a Plasma Environment, L.S. Matthews and T.W. Hyde, presented at the 34th IEEE International Conference on Plasma Science (ICOPS), Albuquerque, New Mexico, 2007.

Colliding Branes and Formation of Spacetime Singularities, A. Tziolas and A. Wang, presented at the 2007 Joint Fall Meeting of the Texas Sections of the APS and AAPT, October 18-20, 2007, College Station, Texas.

Collision of Orbifold Branes and Formation of Spacetime Singularities in String Theory, P. Sharma and A. Wang, presented at the 2007 Joint Fall Meeting of the Texas Sections of the APS and AAPT, October 18-20, 2007, College Station, Texas.

Complex Plasma Studies on Ferromagnetic Dust, Jorge Carmona, Matthew Benesh, Chelsea Chan, Jimmy Schmoke, Michael Cook and Truell Hyde, Presented at the 49th Annual Meeting of the Division of Plasma Physics (American Physical Society), Orlando Florida, 2007.

Comprehensive Investigation of Statistics of Gauge groups of Weakly Coupled Free Fermionic Heterotic Strings, Matthew Robinson and Jerry Cleaver, presented at the Texas Section of the American Physical Society's Fall Meeting at Texas A & M in College Station, 2007.

Computations based on nonlinear dynamic equations on hybrid grids, Q. Sheng, Invited Mathematical Colloquium, Department of Mathematics, Humboldt-Universitat zu Berlin, Germany, July 30, 2007.

Cosmic Dust Bunnies and Laboratory Dust Crystals, L. Matthews, Invited Physics Colloquium presented to the Physics Department at Austin College, Denton, Texas, February 20, 2007.

Continued on next page

CASPER Seminars

Dr. Agnes Kim - Postdoctoral fellow, department of astronomy at University of Texas

Abstract: Good measurement of the cooling rate of the cool pulsating white dwarf G117-B15A has been obtained, and in the near future, we will have cooling rates for other pulsating white dwarfs, including R548. The ability to measure cooling rates offers a unique way to study weakly interacting particles that contribute to cooling, such as axions. This method can potentially be applied to other weakly interacting particles that would be emitted in the interiors of white dwarf stars. Preliminary results on a similar analysis of a hotter pulsating white dwarf, EC20058, to constrain plasmon neutrino emission rates have been made. Obtaining cooling rates of pulsating white dwarfs, requires long base-line high-speed photometric observations of stable pulsators.

Dr. Matthew Goeckner – Associate professor of electrical engineering at the University of Texas at Dallas

Abstract: Plasma chemistry can be thought of as the interactions between three main scientific subsystems; plasma physics, gas phase chemistry/physics and surface phase chemistry/physics. To understand the complexity you need to consider how a given reactive gas-phase specie might interact with a surface. Does it stick, chemically react, promote film growth to/with the surface? How does this interaction change the gas composition? Does an altered gas-phase chemistry alter the plasma? Understanding these interactions is key to producing better models of plasmas, that allow the optimization of complete process systems and improved product yield. After a brief review of the rapid changes occurring at UTD, this talk will examine how various groups are attacking this complex problem and a sample of the results observed to date, with possible future studies and implications for industry.

Dr. Greg Earle - Associate professor of Physics at the University of Texas at Dallas.

Abstract: The bulk flow of the neutral gas in near-Earth space interacts with the plasma medium to produce an interesting array of natural phenomena. Despite its importance, the difficulties associated with measuring these neutral winds in the near vacuum of space have precluded much validation of the theories related to plasma-neutral coupling. UT Dallas has recently developed and tested two new neutral wind instruments for use aboard satellites in low-Earth orbit. The techniques for making these measurements and validating the performance of the instruments in vacuum chamber and sounding rocket experiments will be described in this talk, followed by an example from the DE-2 satellite mission of the 1980s to illustrate the coupling between the plasma and neutral gases in near-Earth space.

Bill Borucki - Space scientist at NASA Ames Research Center

The first step in discovering the extent of life in our galaxy is to determine the number of terrestrial planets in the habitable zone of solar-like stars. Doppler-velocity technique studies have shown many stars have jovian-mass planets, but cannot detect Earth-size planets orbiting solar-like stars. The Kepler Mission is based on observing transits and is designed specifically to determine the frequency of terrestrial planets in the HZ. It will continuously monitor the brightness of 100,000 solar-like stars to detect patterns of transits that provide the size of the planet relative to the star and its orbital period. Combining these measurements with ground-based spectroscopy fixes the stellar parameters, the planet radius, orbital distance, and location relative to the HZ. At the end of the mission, hundreds of terrestrial planets should be discovered in and near the HZ of their stars if such planets are common. Such a result implies that life might be ubiquitous in our galaxy. A null result would imply that we might be the only sentient life.

CASPER Summers

Five teachers and 11 students participated in the 14th annual National Science Foundation (NSF) Research Experience for Undergraduates (REU) and Research Experience for Teachers (RET), hosted by CASPER and Baylor's physics department, from June to August 2007.

During the eight week program, REU Fellows participated in theoretical and experimental projects with Baylor faculty while RET Fellows worked in the lab conducting research projects and developed classroom content to be incorporated into public school classrooms as part of a GEAR UP initiative. RET Fellows also worked with Dr. Trina Wilkerson, School of Education assistant professor, Edith Davis, School of Education doctoral student, Dr. Jewel Lockridge, director of GEAR UP Waco, and participated in several TSTC K-12 workshops.

Between research projects, students, teachers, and faculty gathered for Wednesday Lunch Bunch Seminars and weekly Friday updates. During the Lunch Bunch Seminars, faculty gave brief physics-related presentations, such as, "Hidden Physicists", "Physics Musings", and "The Physics of Trebuchets." During the Friday updates, each participant presented their weekly research results to faculty. Time was also dedicated to assist the students in learning how to access and produce literature searches, write research papers, prepare presentations, and apply to graduate school.

Trips to the Fermi Lab in Chicago and NASA's Johnson Space Center in Houston were also taken this summer by several of the participants. Matt Naglak and Soun-Ja Walters worked in the Experimental High Energy Physics group and had the opportunity to visit Fermi National Accelerator Laboratory or Fermilab, located 30 miles west of Chicago as part of their work with Dr. Jay Dittmann. Fermilab is the home of the Tevatron, currently the most powerful particle accelerator in the world. Within the Tevatron, protons and antiprotons are accelerated to over 99.9999% of the speed of light in a giant four-mile underground ring.

2007 Fellows

REU Matthew Benesh
REU Chelsea Chan
REU Michael Gilbert
REU Jared Greenwald
REU Brandon Harris
REU Gideon Jeffrey
REU Colin Komar
REU Corey LaFontaine
REU Lauren McClelland
REU Matthew Naglak
REU Soun-Ja Walters

RET Shelly Hynes
RET Daniel Mixson
RET Steve Rapp
RET Gary Shetler
RET Christy Tidwell

CASPER would like to thank the following for their participation in the 2007 NSF Research Experience for Undergraduates and Research Experience for Teachers.

Dr. Truell Hyde
Dr. Lorin Matthews
Jorge Carmona-Reyes
Dr. Gerald Cleaver
Mike Cook
Dr. Edith Davis
Dr. Christa Force
Dr. Jie Kong
Dr. Ray Nazzario
Dr. Ke Qiao
Jimmy Schmoke
Dr. Bernard Smith
Dick Campbell
Dr. Greg Benesh
Dr. Dwight Russell
Dr. Jay Dittmann
Dr. Linda Olafsen
Dr. Jeff Olafsen

Lauren McClelland and James Creel traveled to NASA Johnson Space Center in Houston to view the neutral buoyancy tank, high and low fidelity mock ups, and the well-known control room. While at JSC, they were offered the opportunity to enter NASA Control for the Apollo missions and sit in the flight director's chair. They also visited observation rooms where they saw both the shuttle and operating Space Station control rooms. While in the mock up area they saw current and former astronauts running simulations in the shuttle.

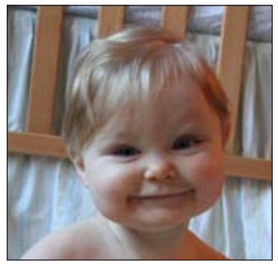
At the end of the summer, each REU and RET participant prepared a poster, gave a 12-minute presentation, and produced a research-quality paper detailing their research results

Matthew Benesh collects data from Cell #2 for his most recent publication.

Personnel Updates

Babies

Zayn Matthews was born June 26, 2007 to Dr. Lorin and Chris Matthews, 6 lbs, 19 inches long. Congratulations!

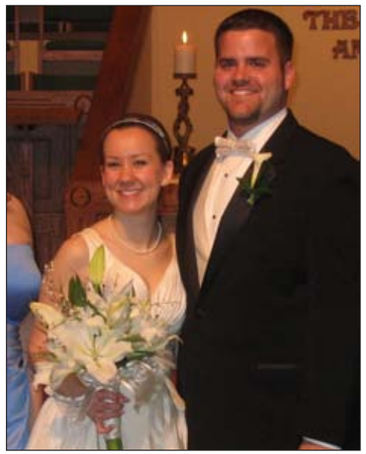


Owen Bennett Swint was born May 16, 2007 to Reuel and Amy Swint, 9 lbs 12 oz, 21 inches long. Congratulations!

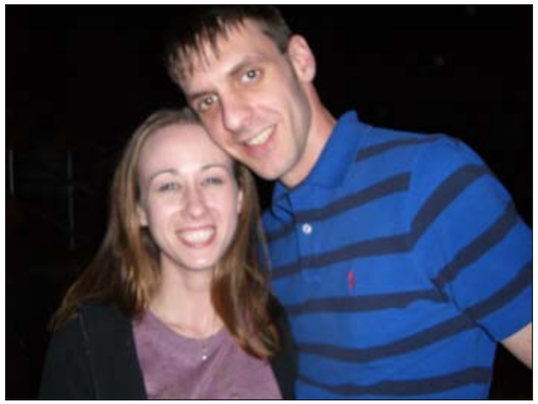
Joseph Vasut was born September 18, 2007 to John and Maggie Vasut, 7 lbs 10 oz, 20 inches long. Congratulations!

Hannah Claire Swint was born March 15, 2008 to Galen and Melissa Swint, 7 lbs., 10 oz and 18.5 inches long. Congratulations!

Weddings



Matthew and Emily Benesh were married March 8, 2008 in Irving, Texas. Congratulations!



Jimmy and Margaret Schmoke were married April 14, 2007 in Mexia, Texas. Congratulations!

Personnel Updates

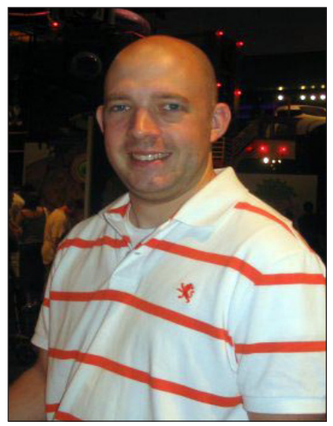
Edith Davis successfully defended her doctoral thesis, “A Study of the Effects of an Experimental Spiral Physics Curriculum Taught to Sixth Grade Girls and Boys” in November and graduated from Baylor in December, 2007. Congratulations!

John Vasut was recently named Advisor of the Year at the 14th Annual Baylor Advisor Appreciation Banquet. John was nominated by the Baylor Chapter of the American Student Dental Association. The nomination letter for the award read in part: “Dr. Vasut encourages our members to always do their best in their classes and is willing to provide tutorial services during his office hours and helps us to network with other professors if he is unable to help us. He also sets a positive example to all of the members by keeping a good attitude and always has interesting stories or facts to tell us.” Congratulations!

Graduations

Matthew Benesh will complete the B.S. in physics and graduate from Baylor University in May, 2008. Congratulations!

Awards, graduate speaker



James Creel, first year CASPER graduate student, was recently named the outstanding physics university scholar at University of Texas, Arlington and inducted into Who’s Who in American Universities and Scholars. Congratulations!

Rui Wu defended his master’s thesis, "Gravitational Collapse and Formation of Black Holes in the Brans-Dicke Theory of Gravity with (2+1) Dimensions," in August 2007 and graduated with a M.S in physics in December 2007. Congratulations!

One of CASPER’s alumni, Dr. Michael Henry, was a featured speaker at a recent joint CASPER/Physics Colloquium. Dr. Henry received his B.S. degree in physics from Baylor University in 2003 and his Ph.D. in quantum information science from MIT in 2007. During his time at Baylor, Michael worked in the CASPER HIDPL developing analysis algorithms for complex plasma data resulting in his coauthorship of the paper, “A Digital Imaging and Analysis of Dusty Plasmas,” published in Advances in Space Research. Many of these routines are still in place (in modified form) within the lab. Michael starts law school next year and plans on becoming a Patent Attorney.

New CASPER Faculty and Staff

Dr. Greg Leman is director of University Entrepreneurship Initiatives and holds the Curtis Hankamer Chair in Entrepreneurship within the School of Business. He holds a Ph.D. and M.S. in Chemical Engineering from the University of Illinois and a B.S. in Chemical Engineering from Purdue. Before coming to Baylor, he held a number of positions within the Great Lakes Chemical Company and the Cabot Corporation. His research interests lie in the area of bringing technology to market and the role that entrepreneurship plays in this endeavor.

Dr. Crista Force is an assistant professor of curriculum and instruction in Baylor’s School of Education. She earned her Ph.D. from Texas A&M University last year and holds a M.S in chemistry from Texas A&M and a B.S in chemistry from Houghton College. Her goal is to inspire future educators to use the standards and current philosophies to create a science classroom that encourages and supports all students’ excitement and inquiry in science.

Dr. Yumei Wu comes to CASPER from the Federal University of Rio de Janeiro, Brazil, where she was a tenured associate professor. She is currently a lecturer in physics and mathematics where she teaches graduate/undergraduate courses and conducts research in Shock Structure in Viscoelasticity and Dynamical Systems and their applications to gravitational collapse and formation of black holes.

Dr. Bernard Smith comes to CASPER from Coastal Carolina University, where he was a visiting assistant professor. Dr. Smith holds a B.S., M.S. and Ph.D. in physics and a B.S. in mathematics from Baylor University. He is currently a research faculty member within CASPER and the project director for CASPER’s Physics Circus. Dr. Smith conducts research in complex plasmas.

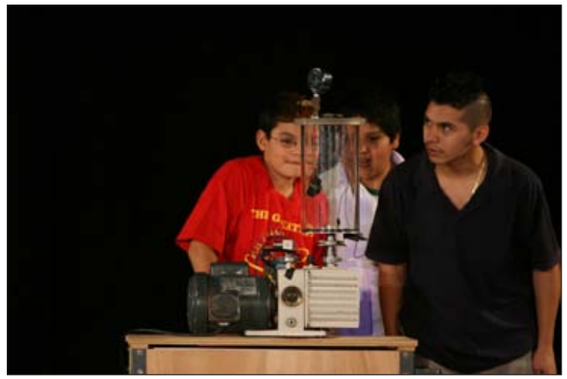
Where is CASPER?

CASPER is currently located in four separate facilities. Theoretical research is conducted in the new $103 million dollar Baylor Sciences Building. Experimental research is conducted at lab facilities located on the campus of Texas State Technical College Waco. These labs are co-located and include the Hypervelocity Impacts and Dusty Plasmas Lab and the Space Science Lab. Experimental Astronomy Research is conducted at the Meyer Observatory. Coursework is conducted in the Baylor Sciences Building, the Hankamer School of Business, the School of Engineering and the School of Education on the Baylor campus, and in the LET/SMT/Nano Department on the TSTC - Waco campus. The Physics Circus is held at the Mayborn Museum.

CASPER Research

CASPER conducts fundamental research in astrophysics, early universe cosmology, experimental astronomy, space physics, superstring / M theory, complex (dusty) plasma physics, hypervelocity impact (shock) physics and laser hypervelocity impact simulation physics. These are related to near-earth orbit concerns for spacecraft and satellite integrity as well as semiconductor development and nanofabrication. The HIDPL/SSL has several microparticle accelerators, a laser hypervelocity impact simulation bay and two GEC RF Reference cells configured to study complex (dusty) plasmas.

CASPER's Physics Circus Makes Waves



The Physics is Right!

The lights are flashing and the music is playing. Students pour into the game show holding their ticket and 3-D glasses to take their seats. A number is called and the students tentatively look down at their ticket to see if it was their number.

"Come on down!" proclaims the announcer, repeating the number. A student cautiously stands up, walks towards the stage and is happily greeted by the game show host. This process repeats three more times. The Physics Circus has begun.

"What is the distance from the earth to the sun in millions of miles?" asks the host.

The students take their turn answering the question, with help from the audience, and the number closest to the actual distance, 93 million miles, without going over, wins. Each student wins a prize, but the student with the closest answer is allowed to remain on stage to play the next game on "The Physics is Right."

The thermographics game is rolled on to the stage and the winner of the first round gets to play. The task is simple – match the appropriate activity like eating ice cream or running a marathon, to the "thermographic" face. The timer starts, and the student eagerly matches the activities with the colors as the audience cheers him on. Everyone is into the game now!

Soon, the announcer calls out another number. This time the students eagerly look at their tickets to see if they might be the one to get to go on stage. Throughout the event, students are on the edge of their seats, innocent the whole time that they are learning and exploring physics.

More than 1500 students attended the seventh annual CASPER Physics Circus at the Mayborn Museum, March 12 – 30, 2007, to be entertained and educated on "The Physics of Waves."

The 6th and 7th graders learned about the different kinds of waves, how they move and where they exist in our everyday lives , including the waves comprising light, radio, television and sound. Students went up on stage during each demonstration for a hands-on approach, and in the end could distinguish between transverse, longitudinal, standing and torsional waves.

Following the production of the Physics Circus, students walked through the "Physics Fun House" area to see, touch and ask questions about a variety of additional science-related exhibits. The fun house has more than two dozen exhibits, including the Van De Graff simulator, which when touched, makes the participant's hair stand on end.

The Physics Circus is an exciting learning experience where original, entertaining physics demonstrations and hands-on activities covering TAKS objectives are made available to middle school students. The Physics Circus is a CASPER / GEAR UP Waco initiative and is funded in part through an $11.2 million grant from the Department of Education. For more information, visit www.baylor.edu/physicscircus.