

## CASPER Promotional Video

CASPER videos are now available in various lengths ranging from an eight-minute promo piece to 30-second commercial spots. These videos come in multiple formats and can be used for either informational or recruiting purposes. CASPER contracted with KWBU to produce the digital promotional videos with footage from all areas of the CASPER endeavor. The promo video has already been distributed to every high school within a six county area and highlights CASPER research and the REU, RET, Intern and High School Scholars summer research programs as well as the immensely popular CASPER Physics Circus. Short versions of the full promotional video are also available for download on our website. ([www.baylor.edu/CASPER](http://www.baylor.edu/CASPER))

## Physics Circus T-Shirts on Sale

A limited number of current and past Physics Circus t-shirts are available for sale through the main CASPER office. Sizes run from S to XXL. For more information or to view pictures showing the front and back of the shirts, check out the Physics Circus website at <http://www3.baylor.edu/physicscircus> or contact us at 710-3763 to order your CASPER t-shirt.



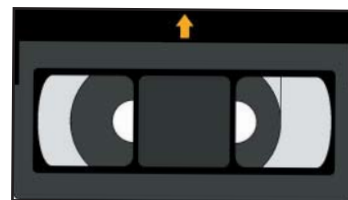
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## CASPER's HIDPL awarded a \$200,000 S100 Nanomanipulator System

The Texas Workforce Commission recently announced that a proposal for developing research and training at the nanoscale submitted by Baylor, TSTC and Zyvex would be funded starting late 2004. As a result of the partnership between CASPER and the Zyvex Corporation based in Richardson, Texas, CASPER's primary cell will be equipped with Zyvex's S100 nanomanipulator system by the end of the year. The S100 is a manipulation and testing tool for micro-, meso- and nanoscale research, development and production applications and features up to four positioners that can be equipped with a host of robotics tools allowing for in-chamber electrical characterization, failure analysis, materials evaluation and physical property measurements. This ability is provided by a suite of NanoEffector tools and accessories which can be employed to probe, grasp, bias, oscillate and manipulate objects and materials at the micro-, meso- and nanoscale while maintaining three degrees-of-freedom. NanoEffector probes have a tip radius of less than 10 nm and are capable of manipulating nanoscale materials and making electrical contact to nanometer surface features.

Working with Zyvex, CASPER researchers are currently developing a new 'head' for the S100, which will allow manipulation of complex plasma crystals, clusters and dust coulomb balls in a manner never before possible. This new instrument should provide

the ability to properly establish the perturbations necessary for producing DLW's within complex plasmas, which is essential for studying overall system response and stability. Once a DLW is established, the corresponding dispersion relation within the complex plasma can be

examined and then used as a sensitive diagnostic. Additionally, the ability to manipulate the system at the 'particle level' while at the same time measuring and characterizing the forming nano crystal or cluster should produce the data required for a proper understanding of new nanoscale processes. The ability to probe, perturb and physically manipulate individual grains within such systems will also

provide research data invaluable to determining the underlying physics and chemistry involved since it will allow for a host of new experiments; for example, single particles or chains within the crystal could be imaged or perturbed using the S100 and fiber delivery of optical radiation. Even more interesting, clusters (crystals / balls) could be built up from individual particles allowing formation mechanisms and interparticle forces to be evaluated throughout the process. Finally, the ability to manipulate systems at the 'particle level' is essential to creating nanostructures and then assembling them into nanosystems, thus exploring manufacturing processes at the nanoscale.

With S100's currently only at MIT and Baylor, the S100 will provide CASPER with experimental capabilities unparalleled in any other current complex plasma lab for years to come!





## The HIDPL Installs a Second GEC rf Reference Cell



### CASPER Accepted as a Member of the Coalition for Plasma Science

CASPER was recently accepted as a member of the Coalition for Plasma Science. The invitation to apply for membership grew out of a chance meeting between CASPER's director, Dr. Truell Hyde and John de Looper of the CPS at a recent meeting of ICOPS where CASPER members presented their research results.

The Coalition for Plasma Science is a group of institutions, organizations, and companies that have joined forces to increase awareness and understanding of plasma science and its many applications and benefits for society. CPS goals include: (1) Uniting the plasma science research community behind a common message about the value and importance of its research

Experimental researchers within CASPER's HIDPL have reached another important milestone in their efforts to understand complex (dusty) plasmas: a second GEC rf Reference cell is under construction within the lab and is scheduled for completion during the fall of 2004. This second reference cell will join the existing cell to provide CASPER experimentalists with unprecedented opportunities for research in complex plasmas. Once fully operational, the second cell will allow testing and diagnostic development at a level currently impossible due to potential down time on the cell. It will also allow for a systematic study of the overall phase space inhabited by colloidal complex systems, an emerging research area in the field. When combined with CASPER's recent partnership with Zyvex, exciting discoveries in complex plasmas and nanofabrication are sure to be just around the corner!

via publications, presentations and special events; (2) Promoting a strategy of educational outreach aimed at the K-12 level; and (3) Broadening support for ongoing plasma science research and educational efforts within the scientific community, at colleges and universities, at the national laboratories and in the business and industrial communities.

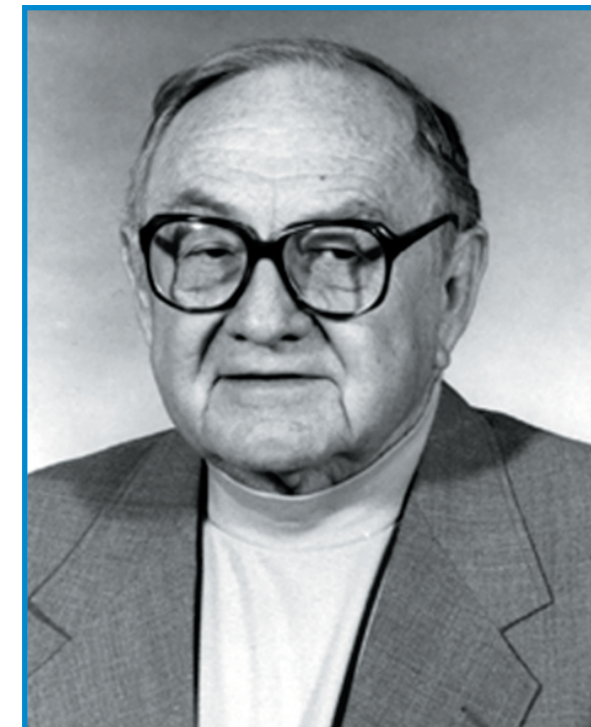
CPS members include a host of organizations ranging from universities and national labs to private corporations and professional societies. Representative members include the American Geophysical Union, American Physical Society, American Vacuum Society, the IEEE, Berkley, Cornell, MIT, Princeton, UT Austin, UCLA, USC, GE, General Atomics, Sylvania, SAIC and Los Alamos, Sandia and Lawrence Livermore.

## Wesley Merle Alexander, Ph.D.

March 9, 1926 - October 3, 2004

CASPER notes with great sadness the homegoing of Wesley Merle Alexander, who passed away Sunday, October 3, 2004. Dr. A (as he was affectionately known to his students) was the founding faculty member in space sciences at Baylor and the originator of the Space Science Lab, out of which CASPER later evolved. Dr. A was a man of many talents and interests graduating with two bachelor degrees (1949, 1952) and two Masters degrees (in Physics and Music, both in 1953) all from Baylor University before obtaining his Ph.D. degree from the University of Heidelberg in Germany. Dr. A spent eight years working for NASA's Goddard Space Flight Center before returning to Baylor as a Professor of Physics. During his professional career, he was Principal Investigator on a host of flight missions including Explorer I, Vanguard III, Explorer VI, Explorer VIII, the OGO series, the Atlas Able IV Lunar Satellites, Ranger I, Ranger II,

Surveyor, Lunar Explorer 35, Pioneer V, Mariner II, Mariner IV, the Cometary Dust Environment Monitor (CRAF CODEM), the Dust Impact Detection System (DIDSY), the



European Retrievable Carrier, the Particulate Matter Experiment and the Wakeshield Facility projects. Modest versions of the CODEM instrument were also later flown on two shuttle missions during the 90's and CRAF's sister mission Cassini is now in orbit around Saturn. Dr. A was a gentle teacher, integrating both his faith and research into every aspect of his students' instruction.

He was named as the Outstanding Researcher at Baylor in 1992 and retired from the university in 1996. CASPER's best wishes go out to Mary K and Dr. A's family and friends. He will be sorely missed.



# CASPER Outreach

## CASPER Outreach at the Rapoport Academy

The Texas Education Agency recently awarded approximately \$85,000 in funding through its TARGET program to a partnership between Texas State Technical College Waco and the Rapoport Academy Charter School's fifth, sixth and seventh grade program, located on the Quinn Campus. CASPER has been subcontracted to produce the final module in this year-long science outreach program for the past two years, providing fifth, sixth and seventh grade students with customized curriculum in physics and

astronomy. This capstone project is taught by CASPER fellow Kim Orr, a Baylor University physics major. Students engage in NASA activities on-line such as NASAexplores, learn basic astronomy, participate in tours of the HIDPL/SSL and SOPHIA (the Stratospheric Observatory for Infrared Astronomy) and enjoy star parties with CASPER fellows and members of the Central Texas Astronomical Society. They will also be attending the CASPER Physics Circus in the spring of 2005.



Rapoport Academy 5th graders working on laptops.



Rapoport Academy 5th grader

## CASPER's Newest Members



Congratulations to Sam and Kim Orr on the birth of their new baby, Elizabeth Gray. Elizabeth was born on October 13, 2004.



Congratulations to John and Maggie Vasut on the birth of their new baby, Jane Andao. Jane was born on November 23, 2004.

# Selected Recent CASPER Seminars

## Richard Matzner

University of Texas, Austin

Gravitational Wave Detectors (LIGO, LISA) and Predicting Detected Waveforms

ABSTRACT: The gravitational wave detector LIGO (funded by NSF), with others in an international network, is currently in operation; the space based detector LISA (a joint ESA/NASA effort) is planned for launch around 2012. LIGO has already produced scientific results in terms of upper limits on the rate of binary neutron star mergers in our galaxy, on the level of stochastic background gravitational radiation, on the signals from specific pulsars in the galaxy, and on the rate of "unmodeled bursts" in the nearby universe.



## Greg Earle

University of Texas at Dallas

Method and Technologies for Plasma Studies in Space

ABSTRACT: The Earth's ionosphere encompasses the region from about 80-1000 km above the surface. The absolute and relative concentrations of ionic and neutral species vary widely over this range, as do the composition, pressure, and physical coupling processes. Observations of plasma and neutral dynamics in these regions are made using a variety of different orbital, sub-orbital, and ground-based platforms. This talk will describe some of the in-situ instrumentation used for such measurements, and the challenges involved in system integration. A specific experiment to investigate a plasma electrodynamic problem known as midlatitude spread F will be described, along with some of the relevant theories about the causes of the underlying plasma instability.



## Chris Impey

(Harlow Shapley Visiting Lectureship Program, sponsored by American Astronomical Society)

University of Arizona

Quasars as Cosmological Probes

ABSTRACT: Unlike techniques that use galaxies as tracers, strong gravitational lensing and intervening absorption lines can be studied with nearly equal efficiency over the entire Hubble time. Strong lensing provides tests of the dark matter distribution from scales of galaxy nuclei to the scale of groups of galaxies. The lenses themselves give the unique opportunity to study the evolution of galaxies selected by mass. Well-constrained lens models offer direct tests of the parameters of the standard cosmological model, notably the Hubble constant. Quasar absorption lines can be used to trace the evolution of the IGM, using the Lyman-alpha forest, and the enrichment and clustering of galaxy halos, using metal lines. Paired and multiple quasar sightlines provide information on the topology of large scale structure and the spatial geometry of the world model.



## Ian Hutchinson

Massachusetts Institute of Technology

Principal Investigator - Alcator C-Mod Tokamak

ABSTRACT: The magnetic confinement approach to fusion energy is so far most successful in a configuration called the tokamak. The Alcator C-Mod tokamak has the world's highest magnetic field and produces the highest density tokamak plasmas. It thus has a unique role in international fusion research. This talk will consider the forefront of this plasma research program, discussing the development of diagnostic techniques and subsequent deployment of instrumentation.





# CASPER Research Updates

## Recent CASPER Publications

“Structural Phase Transitions and Out-of-plane Dust Lattice Instabilities in a Vertically Confined Plasma Crystal,” K. Qiao and T.W. Hyde, to appear in *Physical Review E*, 2004.

“Effect of a Multi-Sized Dust Distribution on Local Plasma Sheath Potentials,” M. Sun, L. Matthews and T.W. Hyde, submitted for publication in *Advances in Space Research*, 2004.

“Kuiper Binary Object Formation,” R. Nazzario, K. Orr, C. Covington and T.W. Hyde, submitted for publication in *Advances in Space Research*, 2004.

“Dynamics of a Dust Crystal with Two Different Size Dust Species,” L. Matthews, K. Qiao, B. Smith and T.W. Hyde, submitted for publications in *Advances in Space Research*, 2004.

“Phase Transitions in a Two-Component Dusty Plasma,” B. Smith, C. Boesse, T.W. Hyde, L. Matthews, J. Reay, M. Cook, J. Schmoke, submitted for publication in *Advances in Space Research*, 2004.

“Structures and Phase Transitions of 1D Confined Plasma Crystal,” K. Qiao and T.W. Hyde, submitted for publication in *Advances in Space Research*, 2004.

“PZT Networks for Impact Studies Using a One Stage Light Gas Gun,” J. Carmona-Reyes, M. Cook, J. Schmoke, K. Harper, J. Reay, L. Matthews and T.W. Hyde, submitted for publication in *Advances in Space Research*, 2004.

“A Model of Coagulation in Dust Clouds During Grain Charging,” L. Barge, L. Matthews, and T.W. Hyde, accepted for publication in *Advances in Space Research*, 2004.

“Effects of Charge-Dipole Interaction on the Coagulation of Fractal Aggregates,” L. Matthews and T.W. Hyde, *IEEE Transactions on Plasma Science*, Vol. 32, No. 2, pp. 586-593, April, 2004.

“Charged Grains in Saturn’s F Ring: Interactions with Saturn’s Magnetic Field,” L. Matthews and T.W. Hyde, *Advances in Space Research*, Vol. 33, No. 12, pp. 2292-2297, 2004.

“The Dispersion Properties of the Out of Plane Transverse Wave in the 2D Coulomb Crystal,” K. Qiao and T.W. Hyde, *Physical Review E*, Vol. 68, No. 4, pp. 046403, 2003.

“Digital Imaging and Analysis of Dusty Plasmas,” C. Boesse, M. Henry, T.W. Hyde and L.S. Matthews, *Advances in Space Research*, Vol. 34, Vol. 11, pp. 2374-2378, 2004.

“Finite Coulomb Crystal Formation,” J. Vasut, T.W. Hyde and L. Barge, *Advances in Space Research*, Vol. 34, No. 11, pp. 2396-2401, 2004.

“Dusty Plasma Correlation Function Experiment,” B. Smith, J. Vasut, T. Hyde, L. Matthews, J. Reay, M. Cook and J. Schmoke, *Advances in Space Research*, Vol. 34, No. 11, pp. 2379-2383, 2004.

“Dust Grain Orbital Behavior Around Ceres,” R.C. Nazzario, T.W. Hyde and L. Barge, *Advances in Space Research*, Vol. 31, No. 12, pp. 2591-2597, 2004.

“Gravitoelectrodynamics in Saturn’s F Ring: Encounters with Prometheus and Pandora,” L. Matthews and T.W. Hyde, *Journal of Physics A: Mathematical and General*, Vol. 36, Issue 22, pp. 6207-6214, 2003.

“Dispersion Relations of Thermally Excited Waves in Plasma Crystals,” K. Qiao and T.W. Hyde, *Journal of Physics A: Mathematical and General*, Vol. 36, pp. 6109-6115, 2003.

“Numerical Simulations and Analysis of Thermally Excited Waves in Plasma Crystals,” K. Qiao and T.W. Hyde, *Advances in Space Research*, Vol. 34, No. 11, pp. 2390-2395, 2004.

“NAHE-Based String Models With  $SU(4) \times SU(2) \times U(1) SO(10)$  Subgroup,” G. Cleaver, A. Faraggi and S. Nooij, *Nuclear Physics*, B672, pp. 64-86, 2003.

“Ratio of Quark Masses in Duality Theories,” G. Cleaver and K. Tanaka, *Mod. Phys. Lett.*, A18, pp. 1743-1752, 2003.

“Self-Similar Collapse of Scalar Field with Plane Symmetry,” A. Wang, Y. Wu, and Z.-C. Wu, *Gen. Relativ. Grav.* 36, 1225-1236, 2004.

“Collapse of a Scalar Field in 2+1 Gravity,” E.W. Hirschmann, A. Wang, and Y. Wu, *Class. Quantum Grav.* 21, 1791-1824, 2004.

“Shear-free radiating collapse and conformal flatness,” Herrera, G. Le Denmat, N.O. Santos, and A. Wang, *Inter. J. Mod. Phys. D13*, 583-592, 2004.

“Thermodynamics and Stability of Hyperbolic Charged Black Holes,” R.-G. Cai and A. Wang, *Phys. Rev. D70*, 064013-1 -- 064013-14, 2004.

“Gravitational Collapse of Self-Similar Perfect Fluid in 2+1 Gravity,” A.Y. Miguelote, N.A. Tomimura, and A. Wang, *Gen. Relativ. Grav.* 36, 1883-1918, 2004.

“Non-asymptotically AdS/dS Solutions and Their Higher Dimensional Origins,” R.-G. Cai and A. Wang, *Phys. Rev. D70*, 084042-1 - 084042-15, 2004.

“Gravitational Collapse of Massless Scalar Field with Self-similarity of the Second Kind in 2+1 Gravity,” R. Chan, M.F. Da Silva, J. Villas da Rocha, and A. Wang, *Inter. J. Mod. Phys. D.*, in press, 2004.

“Second-Order Corrections to the Power Spectrum in the Slow-Roll Expansion with a Time-Dependent Sound Speed,” H. Wei, R.-G. Cai, and A. Wang, *Phys. Lett. B.*, in press, 2004.

“Gravitational Collapse of Circularly Symmetric Anisotropic Fluids with Homothetic Self-Similarity in 2+1 Gravity,” M.R. Martins, M.F.A. Da Silva, and A. Wang, in *Progress in Field Theory Research*, edited by F. Columbus (Nova Science Publishers, Inc. New York, 2004), in press, 2004.

“Comment on Absence of Trapped Surfaces and Singularities in Cylindrical Collapse,” A. Wang, to appear in *Phys. Rev. D.*, 2004.

# CASPER Personnel Updates

## CASPER Members, Clinton Spratley and Katy Polk, Defend Senior Research Projects

Clinton Spratley successfully defended his senior research project entitled *Image Analysis of Crystal Structures in a Dusty Plasma Cell* and graduated in May of 2004 with the B.S. in physics. Way to go, Clinton!

### Amy Webber selected as 2003-2004 NASA/Texas Space Grant Consortium Scholar

Ms. Amy Webber, a physics major and member of CASPER, was recently awarded a Columbia Crew Memorial Scholarship. The Consortium and the Aviation and Space Foundation of Texas established these scholarships in partnership with NASA in memory of the Space Shuttle Columbia astronauts. The scholarship is designed to recognize high-achieving students and stress excellence in academics, participation in space education projects, participation in research projects, and exhibited leadership qualities.

The Texas Space Grant Consortium (of which Baylor is a charter member) is a group of 35 institutions which includes universities, industrial organizations, non-profit organizations, and government agencies within Texas. Through education and research, the Consortium seeks to inspire Texans to participate in and support NASA’s mission of improving life on our planet, extending life beyond our planet, and exploring the universe.

### August 2004 - Dr. Ke Qiao

Ke Qiao successfully defended his dissertation entitled *A Numerical Study of Dust Lattice Waves and Structural Phase Transitions in Plasma Crystals* and graduated in August of 2004 with the Ph.D. in physics. Way to go, Mike!

Katy Polk successfully defended her senior research project entitled *Crystalline Plasma States* and graduated in May of 2004 with the B.S. in physics. Way to go, Katy!

### Ben Dundee selected as 2004-2005 NASA/Texas Space Grant Consortium Scholar

Ben Dundee, recipient of the NASA/Texas Space Grant Consortium Scholar Award for a second year, is a third year Ph.D. student from Galveston, Texas. He is currently working with Dr. Gerald Cleaver in the Early Universe and Strings Theory Group, and his research interests include phenomenology of Left-Right extensions to the standard model of particle physics in the context of string theory.



Ke Qiao being hooded by Dr. Hyde and Dr. Powers.



# CASPER Personnel Updates

## Hyde Appointed as Editor for Advances in Space Research

Truell Hyde, CASPER's Director, was appointed in the spring of 2004 as the scientific editor for *Applications of Active Experiments for Space and Dusty Plasmas* a thematic research volume within the journal *Advances in Space Research*. *Advances in Space Research* is an international peer-reviewed journal accepting both solicited and unsolicited papers for review in all branches of space physics. Fields covered are: Space Studies of the Earth's Surface, Meteorology and Climate; Space Studies of the Earth-Moon System, Planets and Small Bodies of the Solar System; Space Studies of the Upper Atmospheres of the Earth and Planets, including Reference Atmospheres; Space Plasmas in the Solar System, including Planetary Magnetospheres; Research in Astrophysics from Space; Materials Sciences in Space;

Life Sciences as Related to Space. COSPAR is an interdisciplinary scientific organization concerned with the progress on an international scale of all kinds of fundamental research carried out with the use of balloons, rockets, or rocket propelled vehicles. COSPAR was established by the International Council of Scientific Unions (ICSU), now the International Council for Science during an international meeting in London in 1958. COSPAR's first Space Science Symposium was organized in Nice in January 1960. COSPAR's objectives are to promote international scientific research in space, with emphasis on the exchange of results, information and opinions, and to provide a forum, open to all scientists, for the discussion of problems that may affect scientific space research. These objectives are achieved through the organization of Scientific Assemblies, publications and other means.

## Hyde Appointed to the Jefferson Lab Oversight Committee

Through Baylor's recent acceptance to membership in the Southeastern Universities Research Association (SURA), Truell Hyde, Vice Provost for Research was appointed as a member of the Jefferson Lab Oversight Committee. The Southeastern Universities Research Association (SURA) is a consortium of over sixty universities across the US and operates the Thomas Jefferson National Accelerator Facility (Jefferson Lab) on behalf of the US Department of Energy. Among other things, SURA promotes initiatives in nuclear physics, information technologies, and coastal research. Jefferson Lab conducts research in a variety of fields including fundamental physics and is funded primarily through the Department of Energy.



The Hall B CEBAF Large Acceptance Spectrometer (CLAS) at Jefferson Lab. It completely surrounds its target and collects up to a terabyte of data per day.

# CASPER Research Updates

## Recent CASPER Presentations

"Effect of a Multi-Sized Dust Distribution on Local Plasma Sheath Potentials," M. Sun, L. Matthews and T.W. Hyde, Presented at COSPAR, Paris France (2004).  
"PZT Networks for Impact Studies Using a One Stage Light Gas Gun," J. Carmona-Reyes, M. Cook, J. Schmoke, K. Harper, J. Reay, L. Matthews and T. Hyde, Presented at COSPAR, Paris France (2004).  
"Kuiper Binary Object Formation," R. Nazzario, K. Orr, C. Covington and T. Hyde, Presented at COSPAR, Paris France (2004).  
"Dynamics of a Dust Crystal with Two Different Size Dust Species," L. Matthews, K. Qiao, B. Smith and T. Hyde, Presented at COSPAR, Paris France (2004).  
"Structures and Phase Transitions in a Vertically Confined Plasma Crystal," K. Qiao and T. Hyde, Presented at COSPAR, Paris France (2004).  
"Phase Transitions in a Dusty Plasma with Two Different Size Dust Species," B. Smith, C. Boesse, T. Hyde, L. Matthews, J. Reay, M. Cook, J. Schmoke, Presented at COSPAR, Paris France (2004).  
"Layer Structures and the Vertical Dust Lattice Instability in a Confined Plasma Crystal," K. Qiao and T. Hyde, Presented at the 31st IEEE International Conference on Plasma Science (ICOPS), Baltimore, Maryland, 2004.  
"Phase Transition in a Non-Monodisperse Dusty Plasma," B. Smith, T. Hyde, L. Matthews, J. Reay, M. Cook, J. Schmoke, Presented at the 31st IEEE International Conference on Plasma Science (ICOPS), Baltimore, Maryland, 2004.  
"Latest Developments in String Cosmology," G. Cleaver, Presented at Baylor University Scholar's Day, 2004.

"Dispersion Properties in a Complex Plasma with Varying Size Dust Population," K. Qiao, B. Smith, T. Hyde, L. Matthews, J. Reay, M. Cook, J. Schmoke, Presented at the 31st IEEE International Conference on Plasma Science (ICOPS), Baltimore, Maryland, 2004.  
"Impact Studies Using a One Stage Light Gas Gun," J. Carmona-Reyes, M. Cook, J. Schmoke, K. Harper, J. Reay, L. Matthews, and T. Hyde, Presented at the Thirty Fifth Lunar and Planetary Science Conference, Lunar and Planetary Institute, Johnson Space Center, Houston, Texas, 2004.  
"Heterotic String Optical Unification," G. Cleaver, J. Perkins, B. Dundee, R. Obousy, E. Kasper, M. Robinson, and K. Stone, Presented at the 2nd International Conference on String Phenomenology, Durham, England, 2003.  
"String/M-Theory Cosmology: God's Blueprint for the Universe," G. Cleaver, Presented at the National Faculty Leadership Conference, Washington, D.C., 2004.  
"Kink Stability of Self-Similar Solutions of a Scalar Field in 2+1 Gravity," A. Wang, Presented in TSAPS/AAPT/SPS Joint Fall Meeting, October 7-9, 2004, Baylor University, Waco, Texas.  
"Thermodynamics and Stability of Hyperbolic Charged Black Holes", R.-G. Cai and A. Wang, poster in TSAPS/AAPT/SPS Joint Fall Meeting, October 7-9, 2004, Baylor University, Waco, Texas.  
"Gravitational Collapse and Critical Phenomena," A. Wang, plenary talk in National Conference of Gravitation and Relativistic Astrophysics, Hongzhou, China, May 28-30, 2004.  
"Hierarchy problem and Braneworld Scenarios," A. Wang, plenary talk in National Conference of Gravitation and Relativistic Astrophysics, Hongzhou, China, May 28-30, 2004.

## Recent CASPER Proposals & Awards

### NIRT:BTZ

Nanoscale Science and Engineering (NSE), Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to NSF Program Announcement (November, 2004)

• PENDING•

### Nanoprober and Manipulator

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to the Zyvex Research Program. (November, 2004) • \$200,000•

### Nanofabrication Proposal

(Sub-Award) Principal Investigator Preproposal Investigation, Technical, Cost and Management Plan Submitted in Response to State of Texas Program Announcement (September, 2004) • \$500,000 •

### NSF ATE Nanofabrication Proposal

Principal Investigator Preproposal Investigation, Technical, Cost and Management Plan Submitted in Response to NSF Program Announcement nsf04541 (April, 2004) • Pending •

### Analysis of Alternatives (AOA) for Nuclear, Biological & Chemical (NBC) Agent Water Contamination Removal Technologies - Phase Two

(Baylor Project Director for Collaboration with Advanced Concepts and Technologies International, LLC) Congressional Cost Up Issue (March, 2004) • \$307,911•

### Summer Undergraduate Research Experience

Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF REU Program Announcement (September, 2003) • \$514,951•

### Gear-Up Waco

Congressional Cost Up Issue (March, 2003) • \$53,000•

### Quantum Optics Initiative

(Baylor Subcontract) Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a Request from the Office of Naval Research (November, 2002) • \$198,024•

### 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) • \$883,810•

### Gear-Up Waco

Co-Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a Department of Education AO (April, 1999) • \$12,165,581•

### NSF Photonics Center of Excellence Proposal

(Sub-Award) Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to NSF Program Announcement (April / October 2004) • Pending •



# American Physical Society

## Fall Meeting of the Texas Section of the American Physical Society Held at Baylor

CASPER, the Department of Physics and the Vice Provost for Research recently co-sponsored the fall meeting of the Texas Section of the American Physical Society. The TSAPS conference was held in the new Baylor Sciences Building and occurred along with joint meetings of the Texas section of the American Association of Physics Teachers, the Society of Physics Students Zone 13, and the Forum on Industrial and Applied Physics.

Dr. Truell Hyde, Baylor's vice provost for research and professor of physics, called the conference a superb opportunity for Baylor students to find out what's happening at the forefront of the field without having to leave campus. "Since almost the entire physics department was involved (as well as faculty from chemistry), it also allowed Baylor to showcase its own faculty and students in the venue of the new sciences building," said Hyde, who also serves as director of the Center for Astrophysics, Space Physics and Engineering Research (CASPER). The conference featured prominent physics scholars, including Dr. Rick Trebino, a professor at Georgia Tech who has

developed techniques for generating and measuring ultrashort laser pulses; Dr. Lei Dong, radiation physicist at the M.D. Anderson Cancer Center in Houston; and Dr. Don Page, a prominent physicist at University of Alberta who studied under the renowned theoretical physicist Stephen Hawking. Other well-known speakers include George Skidmore, Chief Scientists at Zyvex Corporation, recently named "Inventor of the Year" by the State Bar of Texas for his contributions to society and the impact of the inventions on Texas economy; Jim Gallas, physicist and owner of Photoprotective Technologies; John Fitch, director of NASA programs at L-3 Communications Integrated Systems; and Dr. B.F.L. Ward, chair of Baylor's physics department and Distinguished Professor.

A special treat came when physics cartoonist Sidney Harris agreed to speak at the Friday evening banquet. Harris's cartoons have appeared in Popular Mechanics, Scientific American and numerous other high-profile science publications.



TSAPS Plenary Conference Speakers and Organizers



Science cartoonist, Sidney Harris

# CASPER Summers 2004

## CASPER REU/RET Fellows, High School Scholars, and Interns

### REU Fellows:

Ms. Maria Davis, Linfield College  
Theoretical and Experimental Complex Plasmas  
Mr. William Greensage, Texas State Technical College  
Fiber Optic Laser Delivery System for Experimental Complex Plasmas  
Mr. Victor Guerrero, Baylor University  
Lattice QCD Using Restarted GMRES  
Ms. Stephanie Hatten, Walla Walla College  
String Theory  
Ms. Katie Harper, Texas State Technical College  
Detection System for Low-velocity Impacts of Space Debris  
Mr. Daniel Kagan, Harvey Mudd College  
Numerical Study of Binary Kuiper Belt Objects  
Mr. Eric Kasper, Texas A&M University  
String Theory  
Mr. Cornwall Lau, Columbia University  
Theoretical Complex Plasmas  
Mr. Cassel Sloan, College of Charleston  
String Theory

### RET Fellows:

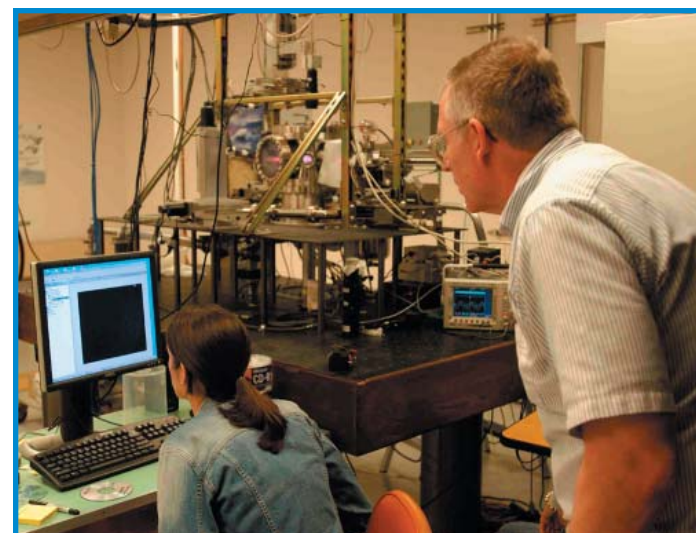
Ms. Shelley Johnson, Vanguard College Preparatory School  
Mr. Gary Shetler, Silver Lake Regional High School

### High School Scholars:

Mr. Eugene Marinelli, Upper Darby High School

### CASPER Interns:

Benjamin Brooks	Desiree Miles
Matt Bruce	Eric Munoz
Meagan Cooper	David Thornton
Marcus Cuellar	Jared Templeton
Aaron Jesseph	



Gary Shetler, 2004 RET participant, examines crystal structure within a complex plasma.



Shelley Johnson, 2004 RET participant and Desiree Miles, CASPER Intern, collect data on the GEC rf cell at the HIDPL.



# CASPER Summers 2004

## CASPER and NSF Bring Undergraduates, Teachers and High School Students Under One Roof

CASPER's NSF REU/RET program was once again renewed for funding by the NSF this year with a start date of June 1st, 2004. A total of \$514,951 was awarded to Dr. Truell Hyde to extend the CASPER Summers program through 2007 making a total of thirteen consecutive years of NSF support. This NSF / Baylor program funds REU and RET fellowships within CASPER and the Department of Physics with the first group of fellows on this grant cycle arriving at Baylor in the summer of 2004.

The CASPER Summers 2004 program had nine undergraduate students involved in the ten-week REU program and two secondary school teachers involved in the RET program. The REU and RET participants were actively engaged in theoretical and experimental research with CASPER or the Baylor Physics Department.

Each week the participants attended CASPER Lunch Bunch Seminars and Weekly Update Meetings, in addition to meeting with their respective research groups. The Lunch Bunch

Seminars covered an array of topics in physics and provided information on applying to and choosing a graduate school. The Weekly Update meetings alternated between the REUs and RETs summarizing that week's research activities along with informational seminars on topics such as vacuum systems, laser diagnostics, how to use internet resources to search for journal articles, and how to prepare effective papers, posters, and presentations.

High school students from two different summer programs also joined the REUs and RETs in the CASPER HIDPL. This not only gave the high school students the opportunity to learn about physics research, but also the opportunity to learn what it is like to major in physics in college or pursue a graduate degree in a scientific field.

At the end of the program, the REUs and RETs submitted an eight to ten page article in standard journal format covering their summer research. Participants also each gave a PowerPoint presentation and summarized their work in a 32 × 42 inch full-color poster.

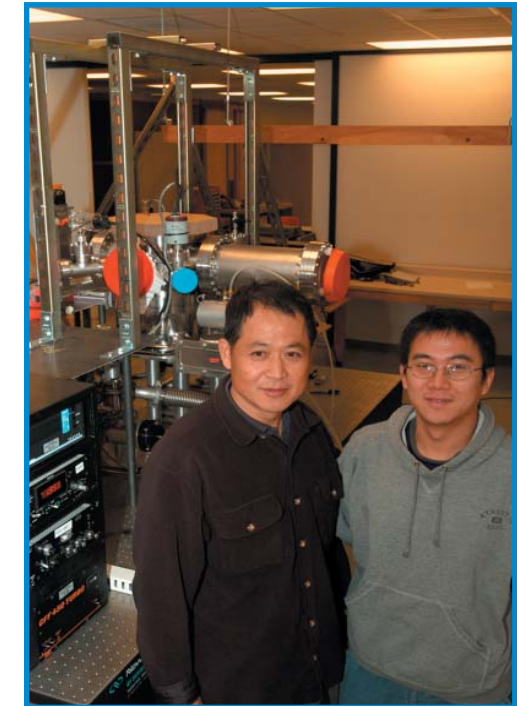


**CASPER Summers Fellows - Summer 2004**

# Newest CASPER Postdocs

## CASPER Adds Two New Postdocs to the Team

Two new postdoctoral scholars have joined CASPER, bringing with them such diverse research interests as dispersion relations, critical phenomena in complex plasmas, and turbulent boundary layers. The CASPER team recently added a postdoctoral fellow to the ASSTG and a postdoctoral fellow to the HIDPL, both of whom will be working for Dr. Hyde. Dr. Jie Kong graduated from Baylor in December of 2000 with a degree in solid state physics. Since graduating he has worked at Ball Semiconductors in Allen, Texas as a CVD engineer and Chorum Technologies in Richardson, Texas as a process engineer. Dr. Kong will be working primarily within CASPER's experimental lab, the HIDPL on a variety of research topics including experimental dusty plasmas. Dr. Qiao recently completed his doctoral defense at Baylor University. His current research represents an outgrowth of his thesis entitled "A Numerical Study of Dust Lattice Waves and Structural Phase Transitions in Plasma Crystals" and includes research topics on the numerical study of dust clusters and dust balls in plasmas. CASPER is pleased to welcome its newest members to the team.



Jie Kong and Ke Qiao in front of CASPER's new GECrf Reference Cell

## CASPER Members Present Papers at ICOPS, COSPAR and LPSC

Members of CASPER's ASSTG, HIDPL and EUCOS research teams were invited to present papers at a number of international conferences during the first half of 2004. In March, members of the HIDPL were accepted to present *Impact Studies Using a One-Stage Light Gas Gun* at the 35th Lunar and Planetary Science Conference held at the Johnson Space Center in Houston, Texas. In May, *Gravitational Collapse and Critical Phenomena and Hierarchy Problem and Braneworld Scenarios* were presented at NCGRA by Anzong Wang. In June, papers by members of both the ASSTG and the HIDPL were presented at the IEEE International Conference on Plasma Science (ICOPS) held in Baltimore, Maryland. Three papers from CASPER members were accepted for presentation: *Dispersion Properties in a Complex Plasma with Varying Size Distribution* authored by Qiao, Smith, Hyde, Matthews, Reay, Cook and Schmoke, *Phase Transitions in a Non-Monodisperse Dusty Plasma* authored by Smith, Hyde, Matthews, Reay, Cook and Schmoke and *Layer Structures and the Vertical Dust Lattice Instability in a*

*Confined Plasma Crystal* authored by Qiao and Hyde. In July, the head of EUCOS, Dr. Gerald Cleaver, presented a paper titled, *String/M-Theory Cosmology: God's Blueprint for the Universe* at the National Faculty Leadership Conference in Washington D.C.. Also in July, CASPER ASSTG and HIDPL members had six papers accepted for presentation at the 35th COSPAR Scientific Assembly in Paris, France. CASPER papers presented at COSPAR included, *Phase Transitions in a Dusty Plasma with Two Different Size Dust Species* by Smith, Boesse, Hyde, Matthews, Reay, Cook and Schmoke, *Structures and Phase Transitions in a Vertically Confined Plasma Crystal* by Qiao and Hyde, *Dynamics of a Dust Crystal with Two Different Size Dust Species* by Matthews, Qiao, Smith and Hyde, *Kuiper Binary Object Formation* by Nazzario, Orr, Covington and Hyde, *PZT Networks for Impact Studies Using a One-Stage Light Gas Gun* by Carmona-Reyes, Cook, Schmoke, Harper, Reay, Matthews and Hyde and *Effect of a Multi-Sized Dust Distribution on Local Plasma Sheath Potentials* by Sun, Matthews and Hyde. Several of these papers have been submitted for publication in a special thematic issue of *Advances in Space Research*.



# The Physics Is Right!

## Come on Down!

physics ('fiziks) – n. the science of matter and energy and their interactions

The 2004 CASPER Physics Circus was composed of enormous substance (matter), exuberant vitality (energy), and was totally “Cohort driven” (interaction). Every aspect of the 2004 Circus centered on the physics knowledge of students and solicited their active participation. Waco ISD high school students played lead roles as contestants in games, challenges, and competitions presented in a game show atmosphere. “The Physics is Right” theme was a true-to-life simulation using a combination of television game show ideologies from the “Wheel of Fortune,” “Jeopardy,” and “The Price is Right” all rolled into one fabulous experience. An eight-foot spinning wheel completed the setting, and just as the theme was a combination of games, likewise the physics topics covered a combination of questions from past Physics Circus Theaters. Students were encouraged to prepare in advance for participation in this year’s Circus by reviewing materials from the past four Circus themes posted to the Physics Circus website: dimensions and metric prefixes, longitudinal and transverse wave, paint color mixing and light color mixing, light prism, light diffraction gratings, sound pitch and sound beats, electricity, magnetism, force of gravity, electromagnetic force, strong nuclear force, weak nuclear force, the unification of forces, stellar death, white dwarf, the Neutron Star, black holes, potential energy, kinetic energy, Quarks (thus the Quark Wheel), and thermography. WHEW!

Students were given the opportunity to “come on down” once their names were announced by the show’s emcee, “Ms. Alice Einstein,” portrayed by Baylor student, Kimberly Orr. Ms. Alice not only introduced “The Physics is Right” contestants, she also introduced the game show host, Professor Paul, portrayed by Paul Hemme, a 2004 Digital Media Design graduate of Texas State Technical College Waco, and described potential prizes. Professor Paul gave the commentary for each bid item, the rules of each board game, and carried on friendly chatter with contestants. Assisting Professor Paul was Madam Currie, played by TSTC Media Communication and Information Technology student, Ms. Margaret Cooke. Madame Currie’s job was to display prizes and game pieces while imitating television icon Vanna White of the “Wheel of Fortune.” Prizes included physics paraphernalia and science related gag gifts as well as gift certificates from local stores.

In true “Price is Right” fashion, contestants bid (in millions or billions of dollars) on larger than life items that included a Stealth Bomber, a NASA Space Shuttle, a NASA Space Suit, the Mars Lunar Rover Lander, or a Giant Tesla Coil. The contestant whose guess was closest to the actual cost in dollars - without going over - advanced onto the stage to play one of four game boards.

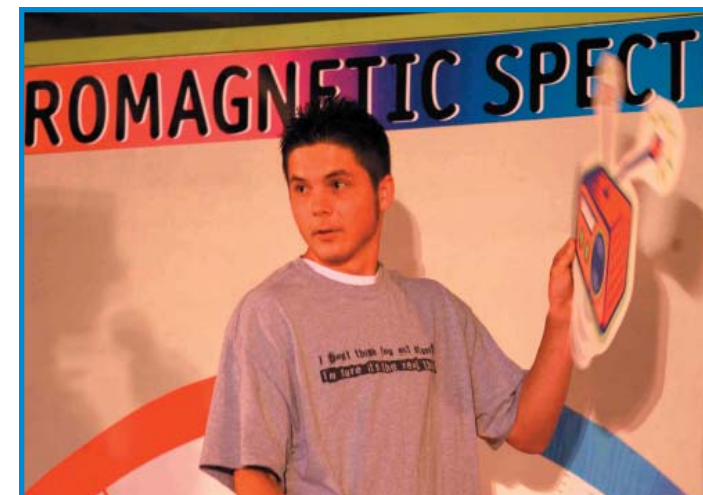


## Win or Lose

“The Physics is Right” game boards included Rank the Forces, which required contestants to correctly sort the fundamental forces from the weakest to the strongest. Contestants playing the Color Mixing game had to choose the correct color derived from combining two other colors. The winner of the Electromagnetic Spectrum correctly matched pictures with their corresponding spectrums. Pictures taken with CASPER’s thermographic camera were matched with associated explanations to win the Thermographics Game. All Win or lose game board players were given the opportunity to compete for a place in the Lightning Round by spinning the Quark Wheel. The audience (teachers and students) yelled proposed answers for cost bids and game pieces with the stage backdrop showing a live-feed of the highly charged activities which allowed contestants and audience alike to view themselves in action.

## Lights, Camera, Action

Audio and visual production was captured by E-Cleff Productions, Inc. and students from the TSTC Media Communication and Information (MCI) Technology. Chris Ermoian, President of E-Cleff Productions, and an instructor in MCI supervised the students from MCI technology. Julie Reay (student producer), Ginny Lee Ellis, Courtney Yaites, and Bonnie Riley (camera operators), Yolanda Rincon (game show LED operator), David Reichert, Charlie Hamilton, Rion Ridley, and Richard Garza (grips and game board technicians) were all students under the direction of Mr. Ermoian. Sound designer was Casey Pittman and light designer was Jack McVey, both of E-Cleff Productions, Inc. Others assisting with the overall production of the Circus were Mr. Willie Hudson of the TSTC Waco IDEAS Center as multimedia producer, Mr. Jimmy Schmoke of CASPER as electronics specialist, Mr. Jerry Reay of the TSTC Waco LET department as laser light show designer and operator, and Mr. Mike Cook and Mr. Dan Dunham of CASPER as general technical support.



## Inventor’s Challenge

Following the Circus was the Inventor’s Challenge. The 2004 Inventor’s Challenge assessed the ability of student teams to design, construct, and troubleshoot a motorized vehicle. The Challenge was judged on design practicality, style, functionality, and teamwork. Students were randomly divided into teams of five for this competition, and team members were strictly required to participate. Each team selected one member team captain, who acted as spokesperson, and could request additional supplies or parts to incorporate into their teams’ invention. Rubber bands, wooden dowels, paper towel tubes, popsicle sticks, plastic straws, aluminum foil, magnets, balloons, yarn, film canisters, strips of fabric, paper clips, safety pins, tape, coat hangers, pins, tacks, batteries, and string are just a small sampling of the supplies and parts teams could request. First, second and third place team winners for each school were awarded. Like prizes (by category) were also presented to each team member.

For the first time in the five-year history of the CASPER Physics Circus, the circus was completely designed for a specific grade level – our eleventh grade Cohorts. The 2004 Circus was designed to encourage Cohorts to study, use their critical thinking skills, and work in groups while at the same time increasing their personal motivation for learning, all things they would need to further an education in the hard sciences. Students loved the new format of the Casper Physics Circus since it allowed them not only to be entertained, but to put into practice what they had learned over the last four years. To say that the CASPER 2004 Circus was a success would be an understatement.

So there you have it, the CASPER Physics Circus for 2004, and “The Physics is Right.”