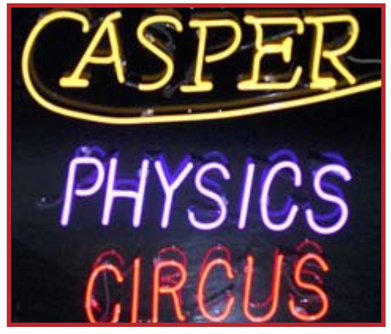
## CASPER Promotional Video and Brochure

The long-awaited CASPER video is now available in several formats for informational and recruiting purposes. CASPER contracted with KWBU to produce the digital promotional video with footage from all areas of the CASPER endeavor. The video was distributed to every high school within a six country area and highlights CASPER research, REU, RET, and High School scholars summer research programs as well as the immensely popular CASPER Physics Circus. Short versions of the video specific to the different areas are available on our website. (www.baylor.edu/CASPER)

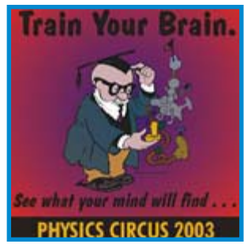



## Physics Circus T-Shirts on Sale

Please contact Amy Skaggs at 710-3763 to order your CASPER Physics Circus t-shirt! Sizes: S, M, L, XL, XXL, and XXXL

For more information, check out the Physics Circus Website.
**http://www3.baylor.edu/physicscircus/**


Front

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INSIDE THIS ISSUE:



CASPER
Astrophysics & Space Science Theory Group
Early Universe Cosmology & Strings Group
Hypervelocity Impacts & Dusty Plasmas Lab
Space Science Lab

## CASPER Adds Anzhong Wang, Meihong Sun, and Tibra Ali

Three new scholars join the CASPER faculty, bringing with them such diverse research interests as critical phenomena, black holes, string theory, turbulent boundary layers, and Contour Dynamics. Newest to Baylor is Anzhong Wang who holds his doctorate from the University of Ioannina in Greece. His extensive teaching and research experience includes appointments in Brazil, Greece and China. He is currently working on three different research topics. Dr. Wang's first area of interest concerns critical phenomena, the phenomena exhibited near the threshold of black hole formation during gravitational collapse. Dr. Wang has been working in this area for several years, and this year (2003) has constructed analytical solutions that represent such a critical collapse. He is also investigating the problem by focusing on observational consequences of critical collapse in astrophysics, employing data from several international gravitational-wave detectors. Another area of interest for Dr. Wang is in brane-world scenarios. Brane-world scenarios were first proposed in 1998/99 and are designed to solve several outstanding problems, such as, the hierarchy and cosmological constant problems. According to these scenarios, our four-dimensional universe is actually a surface (3-brane) embedded in a higher dimensional spacetime (bulk). Dr. Wang is primarily interested in gravitational collapse on 3-branes and perturbations of cosmological models of branes. Finally, Dr. Wang is also researching black holes and their formation—a topic which has attracted a lot of attention recently in gravity-gauge theories of TeV gravity.

In addition to Dr. Wang, the CASPER faculty has added a postdoctoral research assistant, Dr. Tibra Ali. Dr. Ali recently finished his doctoral defense at Cambridge University. His current research represents an outgrowth of his thesis entitled "M-theory on seven manifolds with fluxes." The first of Dr. Ali's two current research projects is in collaboration with Dr. Gerald Cleaver. Dr. Ali and Dr. Cleaver are attempting to find an M-theoretic formulation of the heterotic free fermionic string theory that Dr. Cleaver and his collaborators have been working on for a number of years.

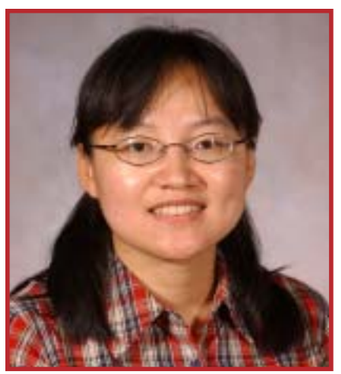
Additionally, Dr. Ali is working on M-theory as it relates to the seven manifolds of G2 holonomy. In recent years String/M-theorists have realized that by compactifying eleven-dimensional M-theory on seven dimensional manifolds (as long as the manifolds have G2 holonomy) one can get semi-realisitic physics in four dimensions. This is a relatively new field since it has been only recently that the existence of manifolds with G2- holonomy (called G2 spaces) has been proved.

Finally, Dr. Meihong Sun joins the CASPER faculty from the Engineering department, where she is an Assistant Professor. She received her Ph.D. from Northwestern University and her M.S. from the University of Iowa. Dr. Sun's extensive research experience has included such areas as mixing and entrainment into a turbulent boundary layer and the interaction of a columnar vortex with ambient axial flow. Her current research includes modeling of transport and mixing processes in turbulent boundary layers; coupling between small and large scale structures in turbulent boundary layers; and scaling of entraiment in turbulent boundary layers. Dr. Sun is working with CASPER's theory group to explore the modeling of plasma sheaths in astrophysics and complex plasmas.

CASPER is pleased to welcome its new members to the team.

Anzhong Wang

Tibra Ali



Meihong Sun

# CASPER Research Updates

## Recent CASPER Publications

"Parameter Space Investigations of Free Fermionic Heterotic Models," G. Cleaver, published in the proceedings of the First International Conference on String Phenomenology, 2003

"NAHE-Based String Models with SU(4)xSU(2)xU(1) SO(10) Subgroup," G. Cleaver, A. Faraggi, and S. Nooij, submitted to Physical Review D, 2003.

"Coagulation in Dust Clouds Immersed in Transient Plasma Environments," L. Barge, L. Matthews, and T.W. Hyde, submitted for publication in Advances in Space Research, 2003.

"Effects of the Charge-Dipole Interaction on the Coagulation of Fractal Aggregates," Lorin Matthews and T.W. Hyde, accepted for publication in IEEE Transactions on Plasma Science, 2003.

"The Dispersion Properties of the Out of Plane Transverse Wave in the 2D Coulomb Crystal," Ke Qiao and Truell W. Hyde, Physical Review E, Vol. 68, No. 4, pp. 046403, 2003.

"Charged Grains in Saturn's F-Ring: Interactions with Saturn's Magnetic Field," L.S. Matthews and T.W. Hyde, accepted for publication in Advances in Space Research, Vol. 68, No. 4, pp. 046403, 2003.

"Digital Imaging and Analysis of Dusty Plasmas," C.M. Boesse, M. K. Henry, T.W. Hyde, and L.S. Matthews, accepted for publication in Advances in Space Research, 2003.

"Finite Coulomb Crystal Formation," J. Vasut, T.W. Hyde, and L. Barge, accepted for publication in Advances in Space Research, 2003.

"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, 2003.

"Dusty Plasma Correlation Function Experiment," B. Smith, J. Vasut, T. Hyde, L. Matthews, J. Reay, M. Cook, and J. Schmoke, accepted for publication in Advances in Space Research, 2003.

"Numerical Simulations and Analysis of Thermally Excited Waves in Plasma Crystals," K.Qiao and T.W. Hyde, accepted for publication in Advances in Space Research, 2003.

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

"Dispersion Relations for 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.

"Gravitational collapse of self-similar perfect fluid in 2+1," A.Y. Miguelote, N.A. Tomimura, and A. Wang, submitted to Physical Review D, 2003.

"Critical collapse of cylindrically symmetric scalar field in four-dimensional Einstein's theory of gravity," A. Wang, submitted to Physical Review D68, 2003.

"Topological charged black holes in high dimensional spacetimes and their formation from gravitational collaspe of a type I fluid," Y. Wu, M.F.A. da Silva, N.O. Santos, and A. Wang, submitted to Physical Review D, in press 2003.

"Comment on Absense of trapped surfaces and singularities in cylindrical collapse," A. Wang, submitted to Physical Review D, 2003.

"No Outer apparent horizons in Einstein's four-dimensional spacetimes with two commuting spacelike Killing vectors," A. Wang, submitted to Physical Review D, 2003.

"A flow visualization study of vortex interaction with the wake of a sphere," M. Sun and J.S. Marshall, submitted to J. Fluid Eng. T Asme, 2003.

"Entrainment and detrainment from a model boudary layer," M. Sun and S. Lichter, submitted to J Fluid Mech, 2003.

"A model for the evolution of turbulent bulges," M. Sun and S. Lichter, submitted to Phys Fluids, 2003.

## Recent CASPER Proposals & Awards

*Complex Plasma Diagnostics*
Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF Project Director Request (November, 2003)

*Summer Undergraduate Research Experience*
Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF REU Program Announcement (September, 2003)

*CASPER STC Proposal*
Principal Preproposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF Science & Technology Center Program Announcement (June, 2003)

*Laser Interface for Colloidal Plasmsas*
Proposal submitted to Texas Space Grant Consortium in response to the 2003/04 Undergraduate Student Researchers Program for Ms. Katy Polk (February, 2003) • **FUNDED** •

*String / M-Theory*
Proposal submitted to Texas Space Grant Consortium in response to the 2003/04 Graduate Student Researchers Program for Mr. Ben Dundee (February, 2003) • **FUNDED** •

*Analysis of Alternatives (AOA) for Nuclear, Biological and Chemical (NBC) Agent Water Contamination Removal Technologies (Baylor Project Director for Collaboration with Advanced Concepts and Technologies International, LLC))* Congressional Cost Up Issue (May, 2003) • **FUNDED** •

*Gear-Up Waco*
Congressional Cost Up Issue (May, 2003) • **FUNDED** •

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

*Gravitational Collapse in General Relativity and Braneworld Scenarios, and Black Holes and Their Formation in High Dimensional Spacetimes*
Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF Announcement (September, 2003)

*Parameter Space Investigations of Heterotic Strings, Dual Models, & M-Theory Embeddings*
Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF Announcement (September, 2003)

*American Scientific Affiliation/Templeton Foundation Lecture Series grant ($6000) to provide for two speakers to visit Baylor during the '03-'04 academic year* • **FUNDED** •



# CASPER Outreach

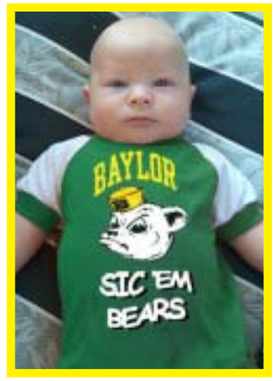
## Congressman Edwards' Sons Visit Physics Circus

Garrison and John Thomas, young sons of Waco's US Congressman, Chet Edwards, accompanied their grandmother, Pat Wood, on a visit to the CASPER Physics Circus. Congressman Edwards' support of CASPER has been consistent throughout its short history, with his latest initiative on CASPER's behalf a cost-up to GEAR UP to provide additional funding for scholarships, physics circus growth and a broadened GEAR UP summer technology camp. Garrison and John Thomas enjoyed the Circus as well as a behind the scenes tour of the Physics Circus Science Theatre.

CASPER Senior Research Technician, Mike Cook explains gas pressure to Garrison and John Thomas Edwards.

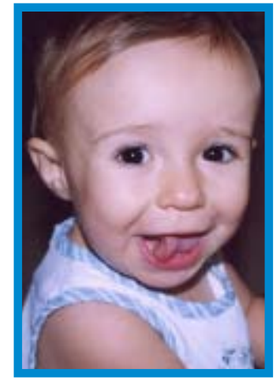
John Thomas works the Foucalt pendulum while his grandmother and Jerry Reay (CASPER's Director of Lab Operations) look on.

# CASPER's Newest Members




***Congratulations*** to Bill and Laura Barge on the birth of their new baby, William Thomas. Will was born on July 7, 2003.

***Congratulations*** to Ray and Vickie Nazzario on the birth of their new baby, Laura Beth. Laura Beth was born on July 8, 2002.



***Congratulations*** to Sam and Kim Orr on the birth of their new baby, Alice. Alice was born on July 11, 2002.

# CASPER Outreach

## 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 and sixth grade program, located on the Quinn Campus. CASPER is subcontracted to produce the final module in this year-long science outreach program, providing the fifth and sixth grade students with customized curriculum in physics and astronomy. This capstone project will be taught by CASPER fellow Kim Orr, a Baylor University physics major. Students will engage in NASA activities on-line, learn basic astronomy, participate in tours of the HIDPL/SSL and enjoy star parties with CASPER fellows.

## Success at College Activity

During the 2003 Physics Circus, the WISD cohort students participated in a College Skills Inventory (CSI), which is designed to identify areas that might affect the success or non-success of their future college education. While they were first resistant to writing as an avenue to fun, the enthusiasm of the facilitators eventually greatly improved their motivation. TSTC counselor Pamelia Hunter, and Social and Behavioral Sciences Department Chair, Sylvia Edwards-Borens were the "dynamic duo" for this assessment exercise. The College Skills Inventory (developed by Novell-Levitz Corporation) is a successful avenue to provide insight into the demands on students entering college. The CSI identifies levels of family support, financial challenges, study habits, and also gauges the success level for degree completion. Results and interpretations are provided to students, school counselors, and the college.

WISD Students participate in the College Skills Inventory.

CASPER graduate student, Jorge Carmona describes how changin the volume affects the velocity of the molecules inside of a closed container.

## Brenda Suggs – Physics Circus Coordinator

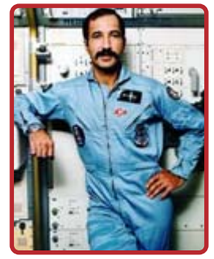
The CASPER Physics Circus welcomed a new staff person this past year, Ms. Brenda Suggs, Director of Special Projects at TSTC. Ms. Suggs fills the position of Physics Circus Coordinator and facilitates the design and completion of hands-on exhibits and Science Theater construction while overseeing all CASPER Physics Circus employees and contractors. This year's Circus went smoothly due in large part to her efforts. Thank you, Brenda, and welcome to the Physics Circus team!

Brenda Suggs



# CASPER Fall Seminars

## Former Astronaut Dr. Wubbo J. Ockels Delivers Lecture on Space Perspectives

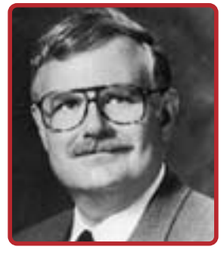


Dr. Ockels gave a lecture on the 28th of August 2003 entitled "Space Perspectives from a Former Astronaut: Envisioning a Sustainable Future" in the Beckham Room of the Bill Daniels Student Center. Dr. Ockels earned his doctorate in physics and mathematics from the Nuclear Physics Accelerator Institute in Groningen, Netherlands. From Oct. 30-Nov. 6, 1985, Dr. Ockels flew as a payload specialist on the space shuttle challenger, the first shuttle with payload duties which were controlled by an astronaut from outside the United States. He served as head of the European Space Agency Office for Education until the summer of 2003 when he was appointed to chair the aerospace engineering department at Technical University, Delft, Netherlands.

Dr. Ockels' research includes real-time software programming and gamma-ray decay of nuclear systems. He also has developed a wind energy apparatus called the laddermill, a kite loop consisting of kites connecting to a cable. The wind drives the loop of kites around a gear, powering a generator and producing electricity.

The lecture was organized and funded by the Vice Provost for Research, CASPER, and the Baylor Institute for Air Science as a part of the 2003 Fall VPR Colloquium Series.

## Dr. Frank Tipler discusses "How the Universe Began and How it Will End"



Dr. Frank Tipler, Professor of Mathematical Physics at Tulane, spoke Friday, September 26, 2003 in the Marrs McLean Science Building. His lecture, "How the Universe Began and How it Will End According to Standard Model Particle Physics," dealt with cosmological observations and firmly tested fundamental physical laws such as quantum mechanics, general relativity, and the second law of thermodynamics. The lecture was sponsored by the Vice Provost for Research, CASPER, the Department of Physics, and the Department of Engineering & Computer Science.

Dr. Tipler is the coauthor of *The Anthropic Cosmological Principle*, and his numerous articles have appeared in such journals as Nature, Physical Review Letters, Physical Review, and the Astrophysical Journal. His most recent book is *The Physics of Immortality*.

## Dr. Asoka Mendis Discusses Dusty Plasmas: A New Interdisciplinary Frontier

Dr. Asoka Mendis is a space physicist who is credited with ushering "Dusty Plasma research into mainstream science," according to editors of a 2001 issue of *IEEE Transactions on Plasma Science,* and this topic was the focus of the October15 lecture at the Marrs McLean Science Building.

Ionized gases laden with fine charged dust, loosely referred to as dusty (or complex) plasmas occur in a wide variety of environments both cosmic and terrestrial with spatial scales and time scales varying by tens of orders of magnitude. They have been investigated by diverse scientific communities ranging all the way from astrophysicists (interested in planetary rings and protoplanetary nebulae) to industrial engineers (involved in the fabrication of microchips and reducing dust formation in Tokomaks). Most recently these studies have found applications even in biotechnology. The scope of the processes involved range from the physics of multicomponent plasmas, with varying degrees of collisionality, through surface physics to the physics of condensed matter. The last arises from a recent development in the field, namely the formation in the laboratory, of dust Coulomb crystals, whose structure and dynamics are spectacularly visible to the naked eye. Despite the large disparity between the spatial and time scales of cosmic and laboratory phenomena, there is an underlying commonality of the basic physical processes.

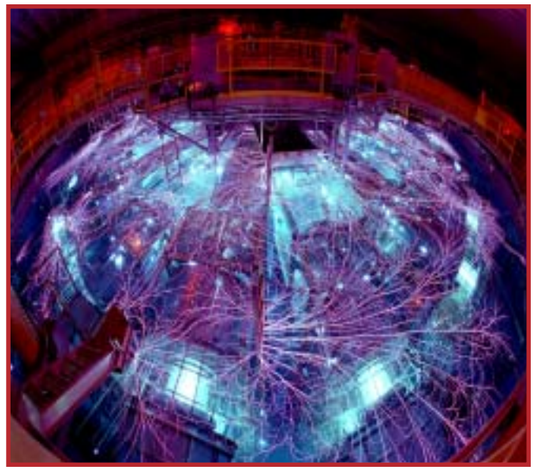
Dr. Mendis earned his Ph.D. and DSc from the University of Manchester. He joined the UCSD faculty in 1969 and retired from his full-time professorships in 1994. Since then, he has continued to do research and work in his campus office on a daily basis.

# CASPER Fall Conferences

## ASSTG Members Present Papers at APS-DPP Meeting in Albuquerque, New Mexico

Five of CASPER's research members attended the American Physical Society 45th Meeting of the Division of Plasma Physics conference held in Albuquerque, New Mexico during the last week of October 2003. The APS DPP Conference is regarded as one of the most significant meetings of theoretical, computational and experimental plasma physicists in the world with over 1500 participants attending. Two papers from CASPER members were accepted for presentation. Dr. Lorin Matthews, CASPER research scientist presented "Effects of the Charge-Dipole Interaction on the Coagulation of Fractal Aggregates" and Mr. Ke Qiao, graduate student within the ASSTG group presented "The Dispersion Properties of the Out of Plane Transverse Wave in the 2D Coulomb Crystal."

While at the APS conference, several members of CASPER were treated to a tour of the Z-Pinch/Z-Beamlet facility at Sandia National Laboratory. Z is closing in on a radiation temperature of 1.7 million degrees with X-1, a larger accelerator scheduled to follow Z, scheduled to produce 16 million joules of energy, more than 1,000 trillion watts of power, and temperatures of more than 3 million degrees. Z produces such massive results while only relying upon wall-current electricity to charge giant capacitor banks. When the accelerator fires, electrical pulses are delivered via 36 transmission cables while highly synchronized laser-triggered switches allow the stored energy to be discharged simultaneously. The resulting enormous electrical pulse of 50 trillion watts strikes a complex target about the size of a spool of thread, consisting of a metal can containing several hundred nearly invisible tungsten wires, each much smaller in diameter than a human hair. The metal can, called a hohlraum, functions like an oven, confining radiation energy released when the wires first explode and then subsequently collapse on themselves. The resulting flood of X-rays are used to conduct research on areas such as colliding neutron stars. Z-Pinch acts in concert with Z-Beamlet (housed in its own building next door) to act as the most powerful laboratory producer of X-Rays in the world. Z-Beamlet was until recently the third biggest laser on earth and was originally built at Lawrence Livermore National Laboratory to serve as a prototype for the National Ignition Facility.





# CASPER Summers 2003

## NSF REU/RET, High School Scholars, CASPER TSTC Interns, and CASPER Undergraduates

**REU Fellows:**

*Ms. Elaine Braman*, University of North Carolina, Wilmington
Experimental Dusty Plasmas
*Ms. Christy Covington*, University of Alabama
Protoplanetary Formation
*Mr. Matthew Dietrich,* Lawrence University
Mach Cone Formation in Dust Crystals
*Mr. Eric Kasper*, Texas A&M University
String Theory
*Ms. Zarmina Kochi*, California State University, Hayward
Effects of Time Dependent Charging on Coagulation
*Mr. Sean Little*, Texas State Technical College
Experimental Dusty Plasmas - LASER Optics for Reference Cell
*Ms. Kimberly Orr*, Baylor University
Protoplanetary Formation
*Ms. Katy Polk*, Baylor University
Restarted GMRES in Lattice QCD
*Mr. Matthew Robinson,* Auburn University
String Theory
*Mr. Kurt Smith*, University of Texas, Dallas
Coulomb Clusters in Complex Plasmas
*Ms. Kristin Stone*, East Tennessee State University
String Theory

**RET Fellows:**

*Ms. Jeanne Allen-Beason*, Waco High School
*Ms. Monica Donohue*, Rogers Middle School
*Mr. Randall Dunkin*, Ohio Valley Career and Technical Center
*Ms. Shelley Johnson,* Vanguard College Preparatory School

**High School Scholars:**

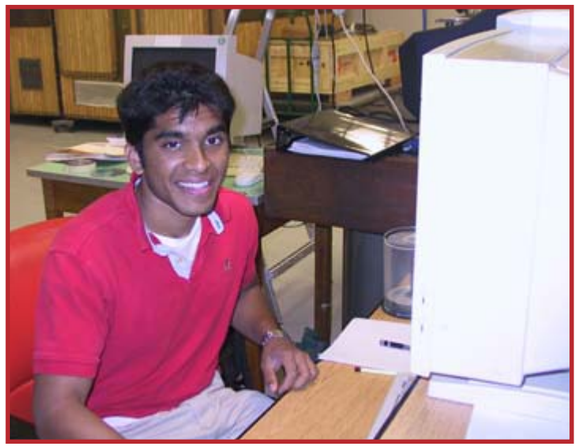
*Mr. Vishal Kadakia*, Oklahoma School of Science and Mathematics
*Mr. Gideon Jeffrey*, China Spring High School

**CASPER Interns:**

*Jewel Martin*
*Rachel Kinerd*
*Hai Pham*
*Vielka Santiago*
*Gary Pettee*
*Robert Baish*
*Katie Harper*

**CASPER Undergraduates:**

*Jonathan Dunbar*
*Amy Webber*
*Katy Polk*
*Clint Spratley*



High School Scholar, Vishal Kadakia, works on the GEC RF Reference Cell.

REU Fellow, Matt Robinson, accepts his Certificate of Completion and award for "Best Weekly Updates".

# CASPER Summers 2003

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

In the summer of 2003 the CASPER Summers program had eleven undergraduate students involved in the ten-week REU program and four secondary school teachers involved in the RET program. The REU and RET participants were actively engaged in theoretical and experimental research with CASPER (the Center for Astrophysics, Space Physics, and Engineering Research) 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 as well as forensic science 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. The final party of the summer was held at Treff's and awards were handed out to each participant.

CASPER NSF REU/RET Fellows - Summer 2003



# CASPER Personnel Updates

## CASPER Member receives NSF Graduate Research Fellowship

CASPER member Michael Henry was recently awarded a Graduate Research Fellowship from the National Science Foundation to pursue graduate work in plasma physics at the Massachusetts Institute of Technology. The purpose of the NSF scholarship is to ensure the vitality of the human resource base of science, mathematics and engineering in the United States and to reinforce its diversity. The fellowship is highly competitive and offers recognition and three years of support for advanced study to 900 outstanding graduate students nationwide in the mathematical, physical, biological, engineering and behavioral and social sciences. The Graduate Research Fellowship is the only program of direct student support offered by the NSF. Mr. Henry conducted his undergraduate research in complex plasma physics in CASPER's HIDPL.

Michael Henry

### Ben Dundee selected as 2003-2004 NASA/ Texas Space Grant Consortium Scholar

Ben Dundee, recipient of the NASA/Texas Grant Consortium Scholar Award, is a second 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.

### May 2003 - Dr. Bruce Lindsay

Bruce Lindsay successfully defended his dissertation entitled "Modeling and Simulations of Protoplanetary Dynamics and Chaotic Interactions of Planetesimals" and graduated in August of 2003 with the Ph.D. in physics. Way to go, Bruce!

### Katherine Polk selected as 2003-2004 NASA/ Texas Space Grant Consortium Scholar

Katy Polk, a student in the Honors College and President of Baylor's Society for Physics Students, has recently been awarded a NASA/Texas Space Grant Undergraduate Scholarship. This award honors outstanding students who have demonstrated skill and excellence in undergraduate academics, and are meant to encourage pursuit of graduate study in the area of space research.

The Lindsay Family

# Physics Circus "Trains Your Brain"

## Physics Fun House

Imagine walking into a room full of exciting displays where the theme is "Please touch!" and "Hands on!" Only in a child's wildest fantasy? No, it's reality at the Physics Circus! This is the philosophy of the designers of the Physics Fun House, CASPER's interactive exhibit hall at the Physics Circus. Students are encouraged to experience science in a "hands-on" way by turning on, adjusting, touching, tweaking, and experimenting with displays to get a "feel" for the physics involved.

Continuing the theme of the Physics Circus, all of the exhibits in the Physics Fun House demonstrated an energy principle in one form or another. A few of the favorite exhibits at this year's event were "Falling into a Black Hole," the "Hair-Raising Experience" of the van de Graaff, and the heat images projected from the thermographic camera.

"Falling into a Black Hole" is a four-foot diameter funnel created by CASPER technicians in which students spiral glow-in-the-dark superballs into the throat of the funnel. An overhead ultraviolet light causes the eye to see the balls spin faster and faster as they seemingly disappear into nothingness. This demonstrates increasing kinetic energy as objects tighten their spin radius. "I like to spiral five or six balls at one time, even in opposite directions," quipped one WISD 10th grader.

The van de Graaff electrostatic generator is an exhibit that has been used each year in the Physics Fun House, but remains a favorite nonetheless. By placing their hands on a metallic dome, students' hair will stand on end due to the collection of electrons on each strand. A mirror is provided so they can witness this strange and wonderful electrostatic effect of building up static charge on the dome.

A new exhibit in the Physics Fun House this year is a thermographic camera which outputs heat images of bodies. Students were encouraged to ride a stationary bicycle connected to a generator and light bulb so they could see how much muscle energy it takes to turn on the light. If they watched their thermographic image while they pedaled, they could also see their faces turn from blue to yellow and then red as they began to heat up. What a fun way to get a workout!


Students experience the van de Graaff electrostatic "experience".

Students watch Rube Goldberg machines.

## High Flyer Airplane Contest

The CASPER Physics Circus would not be complete without the annual design contest. This year's design contest was the "High Flyer Airplane Contest" during which the students were able to experiment firsthand with such physics principles as thrust, lift, gravity and drag to design the ultimate paper flying craft. Awards were given for longest hang-time, longest distance as well as most interesting design. What a great recruiting tool for the Baylor/TSTC pilot training program!

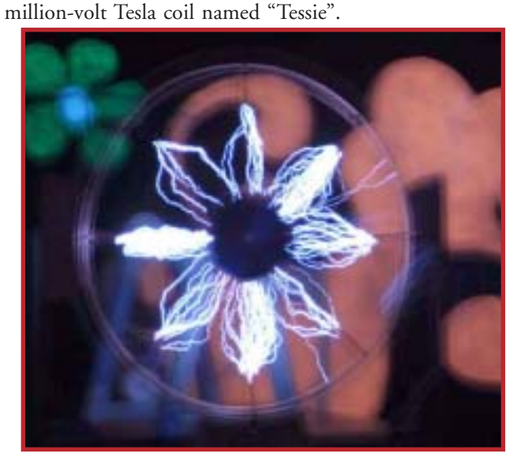
## "Red" and "Blue"

Ask Waco ISD 10th graders what this year's Science Theater at the Physics Circus was all about and you might get these different responses.

"It was an improvisational dance performance."
"It was a music concert with space-age instruments."
"It was a drama about what you can do if you really put your mind to it."
"It was a science lesson about energy."
"It was a story about a one-eyed electric monster named Tessie."
All of these answers are correct.

When most people think about attending a science day or exhibition, they might imagine a purely academic display of science demonstrations by a rather professorial-type character. The designers and engineers of the CASPER Physics Circus know, however, that science is best learned by engaging all the senses, including the sense of wonderment and inspiration.

This year's Science Theater performance, entitled "The Thing in the Basement" was a surreal mixture of cartoonish characters and landscape, contact improvisation dancing, high-tech music and laser light show, as well as spectacular energy demonstrations. The "Red" and "Blue" characters explained conservation of energy along with the various forms of energy using such attention-getters as liquid nitrogen-frozen marshmallows, a giant bowling ball pendulum, a smoky tornado machine, and a million-volt Tesla coil named "Tessie".



The 'Eye of Thor'.

"Red" and "Blue" explain energy.

At the conclusion of the 45-minute performance, Physics Circus Director, Dr. Laura Barge, answered questions from the audience about the demonstrations. Most students inquired about how the Tesla coil could throw lightning bolts several feet long or the temperature of the liquid nitrogen used on stage. "Would it hurt if the lightning hit you?" asked one student. "The output of the Tesla coil is very high voltage but low current. So it wouldn't kill you, but it might not feel too good," replied Dr. Barge.

The "Red" and "Blue" dancers/actors were Ms. Tricia Gourley and Ms. Amy Cone, respectively, from Austin. Technical support staff included Mr. Walter Brantley from Austin as lighting technician, Mr. Willie Hudson of TSTC-IDEAS Center as multimedia producer, Mr. Jimmy Schmoke of CASPER as high-voltage specialist, Mr. Jerry Reay of TSTC-LET-CASPER department as laser light show designer, and Mr. Mike Cook and Mr. Dan Dunham of CASPER as general technical support.

The only question that remains, as one student put it, is "What's next year's show going to be?" Just wait and see!