

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. Short versions of the full promotional video are also available for download on the CASPER Website (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 of the shirts, check out the website at www.baylor.edu/physicscircus or call 710.3763.

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\$500,000 GRANT AWARDED STATEWIDE PARTNERSHIP LED BY TSTC, BAYLOR & ZYVEX CORPORATION

The Texas Workforce Commission recently awarded a \$500,000 grant to a statewide partnership led by Texas State Technical College-Waco (TSTC), Baylor University and Zyvex Corp., in which Baylor's Center for Astrophysics, Space Physics and Engineering Research (CASPER) plays a significant role. The Baylor-TSTC partnership, through CASPER's experimental research capability, will provide future nano-manufacturing scientists and technicians with real world experience as a central part of their preparation for entry into the newly developing nanotechnology manufacturing workforce.

Gov. Rick Perry, who announced the funding, said, "I anticipate this program to be extended and replicated by other nanotechnology companies, colleges, and universities throughout the State of Texas giving Texas nanotechnology workers and employers a key competitive advantage against companies located throughout the Pacific Rim." Zyvex, a nanotechnology firm located in Richardson, is the lead industrial partner, providing valuable equipment support for CASPER researchers and forward-looking input for TSTC's technical curriculum development. The CASPER internship program can now serve as a springboard to tech-

nical internships for students at Zyvex, providing valuable support to a statewide "gold standard" for advanced manufacturing technical field experiences.

Dr. Truell Hyde, vice provost for research at Baylor and CASPER director, said the state and technology industry have recognized the value of Baylor research combined with TSTC workforce development. "It's a relationship that has worked very well within CASPER, and that success helped the new partnership receive funding," he said.

In addition to internships for Baylor and TSTC students, Hyde said the funding paid part of the cost for an S100 nano-manipulator, a \$250,000 manipulation and testing tool used for micro-, meso- and nanoscale research, development and production applications. The instrument is located in CASPER's Hypervelocity Impacts and Dusty Plasma Lab (HIDPL). Zyvex funded the remainder of the instrument's cost as part of the grant agreement.

The research portion of the Nanotechnology Workforce Development Initiative (NWDI) is currently being conducted at the HIDPL, located on the TSTC campus where the Baylor-TSTC partnership provides Baylor undergraduates, graduate students, post-doctoral fellows and faculty research teams with full technical support utilizing TSTC-Waco student

Zyvex continued on pg. 2



Gov. Rick Perry and
Dr. George Skidmore

Universities Space Research Association

Membership Awarded

by Judy Long

Baylor University was recently awarded membership in the Universities Space Research Association, a private non-profit organization established by the National Academy of Sciences. The independent consortium, established in 1969, is comprised of 97 U.S. universities offering graduate programs in space sciences or aerospace engineering.

USRA member institutions act together as a council providing research and program guidance to NASA, with NASA grants and contracts funding most USRA activities. Baylor's representative to the council is Dr. Truell Hyde, vice provost for research and professor of physics.

Hyde said membership will open multiple doors for establishing research collaborations between Baylor and other member institutions. Hyde also serves as director of Center for Astrophysics, Space Physics and Engineering Research (CASPER).

"We are certainly excited that we were admitted on our first try. The USRA offers wonderful opportunities both for student education and research collabo-

ration with other USRA member institutions, such as Yale, Caltech and the University of Texas," Hyde said.

"The USRA has been a driving force behind much of the cutting-edge space science education and research in the U.S., and we are very pleased to be a member," Hyde said.

The educational alliance exists primarily to help universities and other research institutions to "cooperate with one another, the government of the United States and other organizations toward the development of knowledge associated with space science and technology." The association serves as a link between NASA and the academic community.

USRA provides a mechanism through which universities can cooperate effectively with one another, with the government, and with other organizations to further space science and technology, and to promote education in these areas. The group also recognizes outstanding researchers in earth science disciplines and offers scholarships to students of member institutions.

Zyvex cont. from page 1

interns and faculty. Baylor and TSTC students working with the S100 and two plasma reference systems are pursuing current CASPER research to determine the physics behind micro- and mesoscale structure formation within complex plasmas. This research is laying the groundwork for advanced nanotechnology field experiences for participating students at both Baylor and Zyvex.

Hyde said short courses built around nano-research and training were also developed throughout the funding period and tested by Baylor undergraduate and graduate students this past summer.

State officials expect NWDI to support economic development in the advanced manufactur-

ing sector by attracting new businesses to Texas. The Texas Workforce Commission anticipates the project will play a significant role in this effort by supplying the researchers and technicians necessary to develop the new class of services and products created by the nanotechnology industry.

James R. Von Ehr II, Zyvex founder and CEO, said, "It's imperative that we have a well trained, innovative workforce to bring the promise of nanotechnology to fruition here in Texas and in the United States. This program is a major step to helping us meet the challenges of this competitive global economy and achieve that goal."

by Judy Long

In Memoriam

Nanotech Pioneer, Nobel laureate Richard Smalley dead at 62

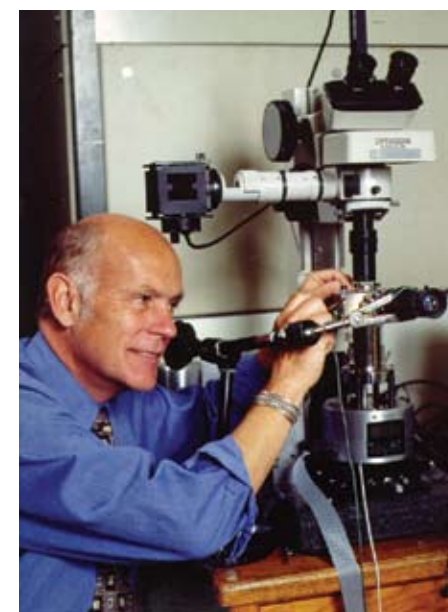
Nobel laureate Richard Smalley, co-discoverer of the buckyball and one of the best-known and respected scientists in nanotechnology, recently died in Houston after a long battle with cancer. He was 62.

Smalley, who joined Rice University as a faculty member in 1976, shared the 1996 Nobel Prize in Chemistry with fellow Rice chemist Robert Curl and British chemist Sir Harold Kroto

for the discovery of buckminsterfullerene, or "buckyballs," a new form of carbon.

Smalley was the Carl Sagan of nanotechnology, routinely testifying before Congress.

"We are about to be able to build things that work on the smallest possible length scales, atom by atom, with the ultimate level of finesse," Smalley told the U.S. House of Representatives while testifying in 1999 in support of the National Nanotechnology Initiative (NNI). "These little nanothings, and the technology that assembles and



manipulates them -- nanotechnology -- will revolutionize our industries and our lives."

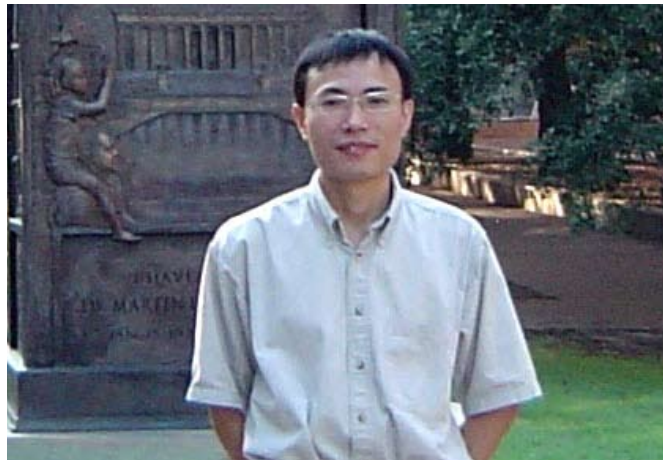
"In my view, this was a singular event in the history of nanotechnology," said Neal Lane, senior fellow in science and technology at Rice University's Baker Institute for Public Policy. "It not only created a whole new field of 'fullerene chemistry,' it immediately made feasible the notion of making things from the bottom up, just as physicist Richard

Feynman had predicted 50 years earlier."

Dr. Smalley was born June 6, 1943, in Akron, Ohio, and spent most of his youth in Kansas City. He was inspired toward science by the launch of Sputnik, as were many others of his generation. In an autobiography written for the Nobel committee in 1996, Smalley credited his high school chemistry teacher, Victor Gustafson, as a key inspiration and remained an outspoken proponent of science education until his death. He will be sorely missed.

(Material Adapted from www.rice.edu)

Personnel Updates



CASPER Welcomes New Post Doc

A new postdoctoral scholar, Dr. Yungui Gong has joined CASPER to work for Dr. Anzhong Wang. Dr. Gong graduated from the University of Texas at Austin in May of 2001 with a degree in theoretical physics. Since graduating he has worked at Fujitsu Microelectronics in Gresham, Oregon, Oregon Graduate Institute in Beaverton, Oregon and Chongqing University of Posts and Telecommunications in Chongqing, China. Dr. Gong will be working primarily within CASPER's cosmology group on a variety of research topics including dark energy. CASPER is pleased to welcome its newest member to the team.



Congratulations
to
Chris & Lorin Matthews on the
arrival of their twins,
Sterling Steen
and
Allyriane,
born on January 18, 2005.



Congratulations
to
Meihong Sun and
Daniel H.K. Wong
on the birth of their daughter,
Ariel K. Wong,
born on July 20, 2005.

Research Updates

Selected Recent CASPER Seminars



Dr. Douglas Ming
Space Scientist
Astromaterials
Research and
Exploration Science
Office
NASA
Johnson
Space Center

*“Mineralogical and Geochemical Indicators
for Aqueous Processes at the Mars
Exploration Rovers Landing Sites”*



Dr. Donald Koetke
Senior Researcher
Professor of Physics
Valparaiso University

*“A Novel Search for a Neutron Electric
Dipole Moment”*



Dr. Matt Choptuik
University of
British Columbia
Vancouver, BC, Canada

*“The Einstein/Intel Connection:
Some Things Numerical Relativity Has
Taught Us About General Relativity and
A Hint of What’s To Come.”*



Bob Helms
Dean, Erik Jonsson
School of Engineering
& Computer Science
The University of
Texas at Dallas

*“Partnerships for Research, Education, and
Regional Economic Development-
The New Paradigm?”*

Research Updates

Recent Publications

“Developments in Superstring Cosmology,” G. Cleaver, Advances in Space Research, Vol 35, pp 106-110, 2005.

Cosmology with Interaction between Phantom Dark Energy and Dark Matter and the Coincidence Problem,” R.G. Cai and A. Wang, JCAP, 0503, 002, 2005.

“Collapsing Scalar Field with Kinematic 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., D14, pp.1049-1062, 2005.

Comment on “Absence of Trapped Surfaces and Singularities in Cylindrical Collapse,” A. Wang, Phys. Rev. D72, pg. 108501,2005.

“Crossing $w=-1$ in Gauss-Bonnet Brane World with Induced Gravity,” R.-G. Cai, H.-S. Zhang and A. Wang, Comm. Theor. Phys., Vol. 44, pp. 948-954,2005.

“No-Go Theorem in Spacetimes with Two Commuting Spacelike Killing Vectors,” A. Wang, Gen. Relativ. Grav. Vol. 37, pp. 1919-1926, 2005.

“Coincidence Problem in an Oscillating Universe,” G. Yang, and A. Wang, Gen. Relativ. Grav. Vol. 37, in press, 2005.

“Gravitational Collapse of Circularly Symmetric Stiff Fluid with Self-Similarity in 2+1 Gravity,” A.Y. Miguelote, N.A. Tomimura and A. Wang, Prog. Theor. Phys. Vol. 114, pp,895-900,2005.

“Self-Similar Collapse of Perfect Fluid with Plane Symmetry,” G. Benesh and A. Wang, Gen. Relativ. Grav., Vol. 37, in press, 2005.

“On Gauge Choice of Spherically Symmetric 3-Branes,” A. Wang, Class. Quantum Grav. Vol. 22, pp. 5231-5241, 2005.

“Gravitational Collapse of a Massless Scalar Field and a Perfect Fluid with Self-Similarity in (2+1) Dimensions,” F.I. Pereira, R. Chan and A. Wang, Int. J. Mod. Phys. D, in press, 2005.

“On Geometrical Interpretation of Non-Abelian D- and F-Flat Direction Constraints” G. Cleaver, D. Nanopoulos, J. Perkins, and J.W. Walker. Submitted for publication in Physical Review D, 2005.

“Stringent Phenomenological Investigation of Heterotic String Optical Unification,” J. Perkins, B. Dundee, R. Obousy, E. Kasper, M. Robinson, C. Sloan, K. Stone, and G. Cleaver, Submitted for publication in Physical Review D, 2005.

“Observable/Hidden Sector Broken Symmetry for Symmetric Boundary Conditions,” B. Dundee, J. Perkins, and G. Cleaver, accepted for publication in the International Journal of Modern Physics A, 2005.

“Structural Phase Transitions of Three-Dimensional Shielded Coulomb Clusters (Finite Yukawa System),” K. Qiao and T.W. Hyde, Submitted for publication in Physical Review E,2006.

“Kuiper Binary Object Formation,” R. Nazzario, K. Orr, C. Covington and T. Hyde, Submitted for publication in Advances in Space Research, 2006.

Recent Publications Continued on Page 12

Personnel Updates

Congratulations!

CASPER GRADUATES LARGEST CLASS TO DATE



John Perkins



Bernard Smith

Four of CASPER's graduate students were awarded degrees during Baylor's August and December 2005 commencement exercises. John Perkins successfully defended his dissertation entitled "Aspects of String Phenomenology at the Self Dual Radius" and was awarded the Ph.D. in physics. Jorge Carmona Reyes successfully defended his thesis entitled "PZT Networking for High-Velocity Impact Detection" graduating with the M.S. in physics. Bernard Smith successfully defended his dissertation entitled "An Experimental Study of Phase Transitions in a Complex Plasma" and graduated with the Ph.D. in physics. Carolyn Boesse successfully defended her thesis entitled "Development of a Digital Optical Diagnostic System for the CASPER GEC rf Reference Cell" and received her M.S. in physics. Congratulations to all!



Jorge Carmona-Reyes



Carolyn Boesse

Research Updates

Recent Awards & Proposals

The Baylor Society for Conversations in Religion, Ethics, and Science
Templeton Foundation Local Societies Initiative, (May, 2005) •\$15,000 •

Nonlinear Dynamics near the Threshold of Black Hole Formation
Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF Program Announcement (September, 2005) • Pending •

Instabilities in Complex Plasmas
Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to NSF Program Announcement (January, 2006) • Pending •

Gear Up Waco: Making College a Reality
Congressional Cost Up Issue (July, 2005) •\$497,000•

NSF ATE NanoTECH Project
Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to

a NSF Program Announcement (April/October, 2005) • Pending •

Photonics Center of Excellence Proposal
(Sub-Award) Principal Investigator Proposal Investigation, Technical, Cost and Management Plan Submitted in Response to a NSF Program Announcement (April/October, 2005) • Pending

Nano Intern Proposal
Principal Investigator Preproposal Investigation, Technical, Cost and Management Plan Submitted in Response to a Zyvex Program Announcement (December, 2004) •\$15,000•

Nanoprobe and Manipulator
Co-Principal Investigator, Funding Through the State of Texas and Zyvex (September, 2004) •\$200,000 Total• (\$150,000 Zyvex & \$50,000 State of Texas)

Nanotechnician Proposal
Co-Principal Investigator, Funding through Wagner Peyser program funded by the State of Texas (September, 2004) •\$500,000•

PUBLICATIONS CONTINUED FROM PAGE 4

“Phase Transitions in a Two-Component Dusty Plasma,” B. Smith, C. Boesse, T. Hyde, L. Matthews, J. Reay, M. Cook, J. Schmoke, Submitted for publication in *Advances in Space Research*, 2006.

“Dynamics of a Dust Crystal with Two Different Size Dust Species,” L. Matthews, K. Qiao and T. Hyde, *Advances in Space Research*, in press, 2006.

“Structures and Phase Transitions of a 1D Confined Plasma Crystal,” K. Qiao and T. Hyde, *Advances in Space Research*, in press, 2006.

“Effect of a Multi-Sized Dust Distribution on Local Plasma Sheath Potentials,” M. Sun, L. Matthews and T. Hyde, *Advances in Space Research*, in press, 2006.

“Structural Phase Transitions and Out-of-plane Dust Lattice Instabilities in a Vertically Confined Plasma Crystal,” K. Qiao and T. Hyde, *Physical Review E*, Vol. 71, 026406, 2005.

“Numerical Investigations of Kuiper Belt Binaries,” R. Nazzario and T. Hyde, *Lunar and Planetary Science XXXVI*, #1254, Lunar and Planetary Institute, Houston (CD-ROM), 2005.

“Construction of a PZT Sensor Network for Low and Hypervelocity Impact Detection,” J. Carmona Reyes, M. Cook, M. Cooper, J. Schmoke, J. Reay, L. Matthews and T. Hyde, *Lunar and Planetary Science XXXVI*, #1127, Lunar and Planetary Institute, Houston (CD-ROM).

Research Updates

Recent Presentations

“**String/M Cosmology for 2005**,” G. Cleaver, Presented at the International Institute for Christian Studies, July 14-16, 2005.

“**Interview, article on String Theory and Cosmology**,” G. Cleaver, *Baptist Standard*, May 26, 2005.

“**Understanding our Universe: Current Status and Open Issues**,” A. Wang, Presented at CASPER Seminar, Baylor University, December 2, 2005.

“**Current Acceleration of our Universe and Dark Energy in the Models of Superstring/M-Theory**,” A. Wang, Presented at Elementary Particle Physics Seminar, Baylor University, October 19, 2005.

“**Self-Similarities and Black Hole Critical Phenomena**,” A. Wang, Presented at Beijing Normal University, Beijing, China, July 26, 2005.

“**Gravitational Collapse and Critical Phenomena: Analytical Approach**,” A. Wang, Presented at Institute of Theoretical Physics, Chinese Academy, Beijing, China, July 21, 2005.

“**Theoretical Models of Dark Matter and Dark Energy**,” A. Wang, Presented at Center of Astrophysics, Zhejiang University of Technology, Hong zhou, China, June 17, 2005.

“**Dark Matter, Dark Energy, Black Holes, and Their Formation in Our Universe**,” A. Wang, Presented at CASPER seminar, Baylor University, April 29, 2005.

“**Kink Stability of Isothermal and Self-Similar Perfect Fluids**,” A. Wang, Presented at Elementary Particle Physics Seminar, Baylor University, March 22, 2005.

“**Experimental Methods in the-Casper Reference Cell**,” B. Smith, Presented at CASPER Seminar, Baylor University, March 4, 2005.

“**Void Structure in Complex Plasmas**,” T.W. Hyde, J. Kong, L. Matthews, J. Reay, M. Cook and J. Schmoke, presented at the 47th Annual Meeting of the Division of Plasma Physics (American Physical Society), Denver, Colorado, 2005.

“**Structural Phases in Complex Plasmas**,” T.W. Hyde, B. Smith, K. Qiao, L. Matthews, J. Reay, M. Cook and J. Schmoke, presented at the 47th Annual Meeting of the Division of Plasma Physics (American Physical Society), Denver, Colorado, 2005.

“**Dynamics in Saturn’s F Ring: Orbits of Charged Grains**,” L. Matthews, M. Sun, G. Bryngelson and T. W. Hyde, presented at the 47th Annual Meeting of the Division of Plasma Physics (American Physical Society), Denver, Colorado, 2005.

“**Construction of a PZT Sensor Network for Detecting Impacts**,” J. Carmona Reyes, M. Cook, M. Cooper, J. Schmoke, J. Reay, L. Matthews and T. Hyde, presented at the Thirty Sixth Lunar and Planetary Science Conference, Lunar and Planetary Institute, Johnson Space Center, Houston, Texas, 2005.

“**Instabilities Within Complex Plasmas**,” B. Smith, J. Kong, L. Matthews and T.W. Hyde, presented at the 32nd IEEE International Conference on Plasma Science (ICOPS), Monterey, California, 2005.

Outreach Spiral Physics

Edith Davis, CASPER

The Purpose

International studies show that students in the United States rank near the bottom of industrialized countries in math and science achievement. One reason other countries are performing better than the United States in math and science is that they employ a rigorous curriculum and begin teaching their students at an age younger than students are taught in the United States. A study of 12th grade students conducted as part of the Third International Mathematics and Science Study (TIMSS) compared student achievement in math and science in 41 industrialized countries and ranked the United States fourth from the bottom, with only Lithuania, Cyprus, and South Africa faring worse. ("National Science Policystudy, Part 1: Math and Science education: Maintaining the interest of young kids in science", 1998).

CASPER is currently conducting a pilot study to gather preliminary data to investigate the effect of teaching physics in the 5th and 6th grades using an experimental Spiral Physics Curriculum. Typically, schools in the United States begin teaching such a traditional physics curriculum at the high school level. The pilot study includes surveys of school administration, teachers, and parents in order to gather information on the present science curriculum, school demographic information, students' academic and behavioral attributes, and the academic progress of the children.

The Concept

The basic concept of a spiral curriculum is one in which there is an iterative revisiting of topics, subjects or themes throughout the course. A spiral curriculum is not simply the repetition of a topic taught. It instead requires a deeper understanding of the course material, with each successive encounter building on the previous one.

The primary features of a spiral curriculum include:

(1) Revisiting Topics. Students revisit topics, themes or subjects on a number of occasions during a course.

(2) Increasing levels of difficulty. Topics visited are addressed in successive levels of difficulty. Each return visit has added objectives and presents fresh learning opportunities leading to the final overall objectives. Every visit brings:

- New knowledge or skills relating to the theme or topic
- More advanced applications of areas previously covered; and
- Increased proficiency or expertise through further practical experience.

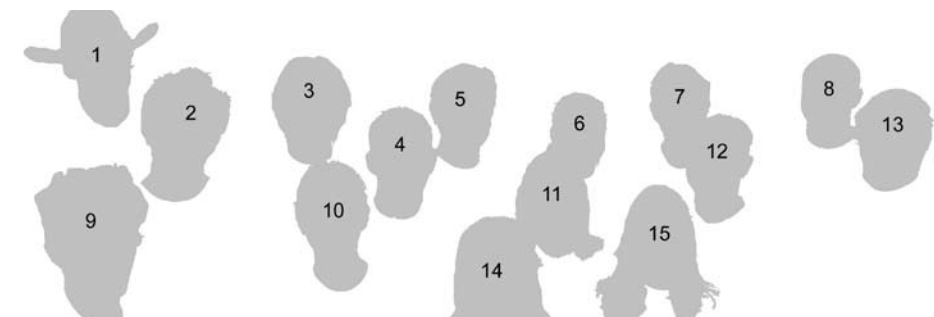
(3) Increased competence of students. The student's competence increases with each loop, until the final overall objectives are achieved. This progressive gain in competence can be tested through standard assessment procedures. (Harden & Stamper, 1999)

The Study

A two week pilot study of the spiral physics curriculum and testing instrument was conducted in June, 2005. This pilot study constituted a trial run for the spiral physics curriculum which is currently being implemented in the Waco and China Spring Independent School Districts. The Beta Test participants consisted of 5th and 6th grade students from Brazos Middle School, Cesar Chavez Middle School and G.L. Wiley Middle School.

The pilot proved to be helpful in refining the final experiment with preliminary findings showing that science achievement appeared to increase for both the traditional and spiral curriculums but that the Spiral Physics curriculum produced higher overall achievement results. It is important to note that these results are not statistically valid due to the small sample size. Stay tuned for further updates on this important CASPER project!

CASPER SUMMERS FELLOWS 2005



1. Lawrence Herskowitz, State Univ of New York at Albany (REU)
2. Douglas Urban, Dartmouth (REU)
3. Benjamin Grabow, University of Tulsa
4. Jared Miner, State University of New York at Buffalo (REU)
5. Rick Hartley, Tennyson Middle School (RET)
6. Kelly Burgess, Knox College (REU)
7. Gary Shetler, Silver Lake Regional High School (RET)
8. Louis Ezenabo, Frank Cody High School (RET)
9. Adam Hajari, Auburn University (REU)
10. Jennifer Elle, University of Idaho (REU)
11. Desiree Miles, Texas State Technical College (REU)
12. Jared Templeton, Texas State Technical College (REU)
13. Dr. Steve Rapp, Linwood Holton Governor's School (RET)
14. Elsinore Alexander, Emory University (REU)
15. Ginger Bryngelson, Northern Illinois University (REU)
16. Kishan Yerubandi, Auburn University (REU)- Not pictured

CASPER SUMMERS 2005

SPONSORED BY THE NATIONAL SCIENCE FOUNDATION,
BAYLOR UNIVERSITY AND CASPER

During the summer of 2005 the CASPER Summers program had twelve 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 faculty within CASPER (the Center for Astrophysics, Space Physics, and Engineering Research) and the Baylor Physics Department.

Each week 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 information on applying to and choosing a graduate school. The Weekly Update meetings alternated between the REU's and RET's summarizing that week's research activities and informational seminars on topics such as how to use internet resources to search for journal articles or to prepare effective papers, posters, and presentations.

The students were required to post weekly updates on Bearspace before the Friday meetings, in which they outlined the tasks they'd accomplished that week and their goals for next week. This became a popular forum for venting frustration with tedious experiments and failed computer algorithms. The "Additional Comments" section also allowed a platform for planning weekend activities, critiquing books and bands, and chronicling the exciting extracurricular activities of the Fellows. This led the directors of the REU program to ponder on such topics as, "Why is the skin on Ben's fingertips starting to peel, and where did the new chair in the computer lab come from?"

High school student Gideon Jeffrey also joined the REU's and RET's in the CASPER lab. This not only gave him the opportunity to learn about physics research, but also allowed him to learn what it is like to major in physics in college and pursue a graduate degree in a scientific field.

At the end of the program, the REU's and RET's wrote an eight to ten page article covering their summer research. Participants also gave a PowerPoint presentation and summarized their work in a 3' x 4' full-color poster. The culminating event was the end-of-program party and dinner at Uncle Dan's barbecue, where each participant was presented an award symbolizing their unique summer research experience, such as the "Greatest Catch" award to RET Gary Shetler for catching hundreds of tiny aluminum and chrome steel balls during drop tests on the impact detector plate, and the "Best Lyrical Composition" award to REU Kishan Yerubandi for his original physics love song, "You Are My Higgs" (which incidentally was performed and recorded by the "Best Musician," award winner REU Adam Hajari, at a local coffee house, Common Grounds).

*"The Baylor REU program was a great way to get involved in research as an undergraduate. Not only did I learn a lot about my specific area of research, but I also learned how to write a journal worthy paper, make a poster, and present my results. The facilities are great and the faculty is amazing."
-Adam Hajari, REU*

Outreach Rapoport Academy

Kim Orr, CASPER

"The Rapoport Academy is designed to foster learning through rigorous academics as well as through activities that link concepts and content to experiences..." (www.rapoportacademy.com). It was in the spirit of this mission that Kim Orr was asked in the spring and fall of 2004 to go into the classroom and provide an educational experience that would support the 5th, 6th, and 7th graders' formal science education.

Throughout this period, students learned about the many facets of the space program including how objects originally created to make the astronauts' lives easier could now be found in our everyday lives and what it takes to get the space shuttle into orbit. One favorite lesson involved students pretending to be astronauts deciding what food to take with them on their next mission. The students had to either hold their noses, blindfold themselves, or both while tasting Jell-O to experience what it would be like to eat it in space. They also had to figure out what

flavor they were tasting while doing all of this.

One of the most rewarding activities completed by the students consisted of a project where each student was required to pick an object in our solar system and research it. This not only offered the students an opportunity to learn how to conduct research via the internet but also learn how to create a scientific report to present to their fellow classmates and teacher. The students were required to write formal papers, create PowerPoint presentations, or produce a poster on their subject. The results of this project were amazing with one student even writing a story including aliens living on one of the outer planets with details such as what gases they breathed and how they managed to move around in such a high gravity environment. Once the students realized that Physics is more than just large numbers and words (it's also the little everyday things) they began to take a real interest in what the subject of Physics has to offer.



Edith Davis



Kim Orr

The Greatest Physics Circus on Earth!

The Show

Keeping with the primary goal of encouraging area students to pursue math and science studies, the 2005 CASPER Physics Circus immersed students into a learning environment that integrated the physics of waves, electricity, sound, light and color. Basically, *"The Greatest Physics Circus on Earth,"* was fun and educational, exciting and educational, loud and educational, and highly interactive and educational. Notice the pattern?

The show opened with performers preparing for a whacked out game show featuring *Professor Casper*, an eccentric Nobel-prize winning physics professor. Although these attributes were all fictional, with the amount of information and knowledge that *Professor Casper* embraced, one of his students might someday be a Nobel-prize winner. Throughout the show the Professor was required to recall his past experiments while demonstrating physics phenomenon to a pesky *Spy* that was desperately trying to steal his secrets. The *Spy* accidentally setting fire to the Professor's notebook set in motion the walk down memory lane for the Professor while the burning book brought the audience alive.

Both the Professor and the Spy were played by Baylor Theatre Performance graduates. John-Michael Marrs was cast as *Professor Casper* and Cody Abercrombie was cast as *the Spy*. Both gave outstanding and hilarious performances. Baylor Theatre graduate Margaret Holmes, and Baylor senior student Julia Alford were cast as Professor Casper's stage assistants and alternated show appearances. Another Baylor graduate, Jonathan Walton, served as stage manager while Daniel Inouye and Daryl Worley, both Baylor Theatre grads refreshed previous scripts to combine aspects from earlier shows and acted as the show's producers. Lori Phillips served as the game show announcer and lighting specialist. Willie Hudson, Texas State Technical College Waco employee, served as graphic designer and sound specialist. Other supporting positions were manned by CASPER HIDPL (Hypervelocity Impacts, and Dusty Plasmas Laboratory) interns and faculty as well as staff volunteers from TSTC Waco. Baylor's Ambassadors, a student organization, volunteered many hours and lots of energy to serve as ushers and general helpers.

A Student Ranks the Electromagnetic Forces in the Game Show



Come on Down!

Throughout the show, audience participants were called to "come on down" to contestants row where they bid on physics related items such as an astronaut double chocolate ice cream bar, a "forever" space flash light, a spacesuit-clad stuffed monkey, a NASA chicken dinner, a NASA youth-sized flight suit, or a NASA space blanket. The contestant with the closet bid – over or under – advanced to the stage to learn more about physics from *Professor Casper* and the *Spy*. Once on stage, contestants could win prizes by competing in on-stage games such as paint and color mixing, ranking the electromagnetic forces from weakest to strongest, and identifying and matching thermographic images with corresponding descriptions. Additional audience members were solicited to demonstrate experiments with *Professor Casper* and the pesky *Spy*. No audience member was exempt from participation, including parents and teachers.



Wave Motion-Up Close and Personal! Students Act as a Propogating Medium

A Hair-Raising Good Time! A Student Tries CASPER's Van de



The Fun House

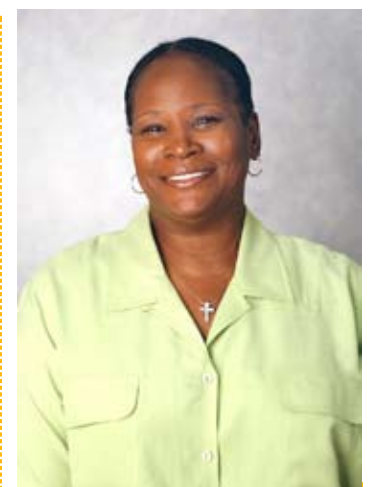
After the show, the exhibit hall of the Physics Circus was the place to be if you wanted to get that "hands on" experience. In the exhibit hall, students were encouraged to touch, experiment, try out, and basically get a "feel" for physics. It was a hair-raising experience as students tried out the Van de Graaf - a machine that demonstrates the physics of static electricity. "Hair standing on end" became a reality for students and teachers alike.

Another favorite was the "Black Hole," a four-foot funnel which realistically demonstrates increasing kinetic energy through super balls spinning rapidly through a potential well into nothingness.

Students also enjoyed creating images of their faces, hands, and other objects on the "Pin Impression" board. This large wall comprised entirely of glass cylinders produces a realistic example of the manner in which the Hubble Space Telescope employs a CCD camera to gather light in the form of pixels, creating an image of what the lens sees. The pin board, like the image on the CCD, starts off black with the image appearing gradually as light hits the camera's sensor.

Kiosks demonstrating hand batteries, tuning forks, color mix windmills, and singing rods were also included in the physics fun house. One favorite of these displays was CASPER's Jacob's Ladder. During the 1930's this display first appeared in Frankenstein movies. As electricity travels up two conductors producing ionized air, the arc of electricity gets brighter and brighter. Spooky!

The CASPER Physics Circus is held at Baylor's Mayborn Museum Complex. Kindergartners through high school students from private, home school and various Independent School Districts attended the show. Close to 1200 students and 200 adults (parents and teachers) were captivated by the theatrical performances and the engaging presentation of physics demonstrations. Information about the Physics Circus was provided by Brenda Suggs.



Brenda Suggs