LOUISIANA STATE UNIVERSITY PHYSICS & ASTRONOMY NEWSLETTER

2006 **Winter/Spring** **Vol. 3, No. 1**

CHAIRMAN'S WELCOME . . . *by Roger McNeil*

Welcome to our winter 2006 newsletter. While only a short time has past since our last newsletter (we are striving to put out two newsletters per year from now on), it has been an eventful period for our department, LSU and the State of Louisiana. We can sum up the Fall of 2005 with one word: "Hurricane". Two major hurricanes blew through the State in a single month. The names Katrina and Rita will not soon be forgotten. However, I am proud to report that LSU and the Department stepped up to serve many faculty and students displaced by the hurricanes. In particular,

- Approximately 3,500 students displaced from New Orleans colleges and universities were temporarily matriculated into LSU-Baton Rouge.
- In our department, 4 upper level physics majors took LSU Physics classes.
- Approximately 80 "Katrina Students" were enrolled in special introductory laboratory and lecture course sections.
- Three graduate students (from the University of New Orleans and Tulane) were temporarily employed as Teaching Assistants to help teach new laboratory course sections (Sten Thornburg, Athanasios Chalastaros, and Daniel Furst).
- UNO Professors Greg Seab and Carl Ventrice and Xavier Professors Murthi Akundi and Jessica Graber were employed as temporary instructors for lecture and lab sections for these "Katrina Students". These faculty were accommodated for a time in the houses of our department's faculty, as there was no available housing in Baton Rouge for most of the fall semester.

The cost of these extra sections and temporary instructors was absorbed by the department at the same time that higher education in the State was being dealt a budget "Rescission" and subsequently passing it down to LSU, the College of Basic Sciences and the Department of Physics and Astronomy. These moneys were eventually returned to the department. But the impact of the hurricane was severe both financially to the department and also to its faculty. Professor Robert Svoboda's home in New Orleans sustained damages (see photo on Page 8) and he and family are on leave at Lawrence Livermore National Laboratory, while the house is rebuilt.

Despite these major events, the Department moved on with its own plans for the future. The department currently has one faculty search taking place in the area of medical imaging physics. We hope to hire a faculty member in this area to strengthen the medical physics research and teaching and to support the application for the program accreditation. This is also an active time of year for recruiting of students both to our undergraduate and graduate programs. We held successful open houses for both graduate and undergraduate students.

We will give a full report of our students in our next issue of the newsletter. We are having a great year with our students receiving national scholarship awards and performing exceptional research. For example, see the article in this issue about Pluto. Luke Smith is one of our undergraduate physics majors.

The Arlo U. Landolt Astronomical Observatory was dedicated on March 30 with a reception that featured attendance from LSU Chancellor Sean O'Keefe as well as many faculty, students and friends of Arlo. A plaque was unveiled that was mounted on the telescope that reads: "In recognition of Arlo U. Landolt - Setting Standards for Astronomy at LSU and around the World".

The department and college are beginning an active fundraising campaign this year. We already have good news that LSU Physics Alumnus Byrd Ball and Alice Ball have doubled the Ball Family Professorship for a total endowment of $200,000. We have several funds that are deserving of support including the **Greg Hussey Undergraduate Scholarship**, the **Joseph Callaway Graduate Fellowship**, the **Ganesh Chanmugam Dissertation Award**, the **Telescope Fund**, the **Medical Physics Fund**, the **Theory Fund**, and the **Department's Development Fund**. These funds will help to provide important discretionary dollars to the college and department, encourage and also further distinguish our accomplished faculty as leaders and partners in LSU's growth and success. We hope you will consider joining our efforts to build a tradition of giving in the Department. If you would like to contribute, please fill out the back page of this newsletter.

NEWSLETTER STAFF

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Roger McNeil, Chair
Phil Sprunger

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Karen Richard

Catching Waves:

LSU Scientists, Students Play Major Role in Groundbreaking Gravitational Wave Research

- - LSU HIGHLIGHTS, SUMMER 2005

If a tree falls in the woods and no one hears it, does it make a sound?

Most people have heard this well-worn philosophical question, but there is a new variation that may not be as familiar: If black holes collide in deep space, can it be heard in the woods of Livingston Parish, LA?

As it turns out, scientists from LSU, the California Institute of Technology, and several other universities may have an answer to this new question someday soon.

Some 24 miles from the LSU campus, in a location that could be called "off the beaten path," the sprawling facility known as the Laser Interferometer Gravitational-Wave Observatory, or LIGO, sits on a massive tract of land, hidden from public view by acres of dense forest.

In this unlikely location, researchers and technicians from a group called the LIGO Scientific Collaboration spend their days on the cutting edge of scientific discovery, monitoring parts of the universe that are unquestionably "off the beaten path." Using lasers rather than telescopes, the staff of this unusual observatory "listens" to the heavens, waiting to "hear" something that will set the scientific world on its ear — gravitational waves.

Produced by violent events in the distant universe, gravitational waves are "ripples" in the fabric of space and time. Though the concept may sound like something from Star Trek, it actually comes from the mind of Albert Einstein, who predicted the existence of these waves in the early 20th century as part of his theory of general relativity.

According to current scientific thought, the waves are the product of massive cosmic events, such as the collision of black holes or shockwaves from the center of supernova explosions. Like waves in a gigantic pond, these ripples in space-time fabric travel toward Earth, carrying information on the very nature of gravity.

"The places in the universe where gravitational waves are emitted, are the most 'wild' and interesting," said Joseph Giaime, LSU associate professor of physics and astronomy and Chief Scientist at LIGO. "Gravity is so strong there that it is twisting spacetime around and things don't behave in the way we are used to or taught. Thus, Einstein's theories become necessary (for understanding the phenomena)."

"It's absolutely exciting science," said Giaime. "It's right here in our back yard and LSU students, faculty, and employees are fully involved."

What is LIGO?

The LIGO project, first conceived in the 1970s and supported by a grant from the National Science Foundation, is the brainchild of researchers from the California Institute of Technology and the Massachusetts Institute of Technology. A large and growing group of other universities are taking part in the project. This group is known as the LIGO Scientific Collaboration, and LSU is a charter member.

In addition to the LIGO facility located in Livingston Parish, there is another facility in Hanford, WA. Essentially, the two facilities work hand-in-hand as a "single" observatory.

The concept behind the project is based on the effects of gravitational waves. Basically, the waves "warp" space, stretching it in one direction and shrinking it in another. Giaime explained that the LIGO facilities use a process called laser interferometry to detect the tiny changes in the shape of spacetime

(left to right) Louisiana State Rep. Dale Erdey, District 71; State Sen. Clo Fontenot, District 13; Gabriela Gonzalez, Associate Professor of physics at LSU; Joseph Giaime, Chief Scientist at LIGO and Associate Professor of Physics at LSU; and LSU Chancellor Sean O'Keefe stand on top of the Massive LIGO Louisiana facility.

LSU Scientists, Students Play Major Role in Groundbreaking Gravitational Wave Research, *(Cont. from Page 2)*

that occur when gravitational waves pass through the planet.

LSU and Gravitational Wave Study

LSU has been a key player in the LIGO research project for some time, and much of the credit goes to Physics and Astronomy Professor Warren Johnson and Physics Professor Emeritus William Hamilton. These two LSU researchers have been leaders in gravitational-wave-detection research for decades.

Long before the construction of LIGO began, Hamilton and Johnson began developing a wave-detection device of their own. That device is a two-ton, gravity-wave bar antenna known as ALLEGRO, which is one of only five such gravitational-wave detectors in the world and is still located on LSU's campus.

While Hamilton and Johnson worked to develop the ALLEGRO device, they also became involved in the early stages of the LIGO project. Together with then-LSU Chancellor James Wharton, they were integral in ensuring that one of the LIGO observatories would be built in Livingston Parish.

As part of its involvement in LIGO, LSU's Physics and Astronomy department began to build a strong group of faculty focused on the experimental and theoretical study of gravitational issues.

On the experimental study side, there is Giaime, an MIT graduate who helped design and install parts of the LIGO detector system. He was named "Chief Scientist" at the Livingston location in 2004. In addition, there is Gabriela Gonzalez, who previously worked on the LIGO project at MIT. She specializes in analyzing the data collected by the LIGO detectors and co-chairs one of the LIGO Collaboration's data-analysis working groups.

The Louisiana LIGO facility is located in a remote, flat location, relatively isolated from man-made noise. It has two massive, two-and-a-half mile long arms that form an "L" shape and contain steel pipes emptied of air. Laser light traveling through these arms is used to measure changes in the curvature of space.

LSU's group of faculty focused on the theoretical study has grown in recent years. The group is led primarily by two physicists, Jorge Pullin and Luis Lehner, who work in the field of numerical relativity. Faculty and students in this arena work to solve some of the difficult equations posed by the theory of relativity, which provides the foundation of LIGO's research.

"LSU has pursued a harmonious approach to LIGO research, combining experiment and theory," said Pullin. "Apart from the experimentalists working at the LIGO site, LSU has created the largest numerical relativity group in the United States."

Other "stars" from the worlds of physics and astronomy have recently arrived at LSU, attracted in part by the proximity of the LIGO observatory. One such star is Edward Seidel, a physicist recognized worldwide for his work on numerical relativity, black holes, and high-performance computing. More recently, Manuel Tiglio also joined the LSU Physics and Astronomy faculty, as part of the numerical relativity group at the new Center for Computational Technology, which is led by Ed Seidel.

"There are an increasing number of LSU people involved in LIGO," said Giaime, adding that LSU students and post-doctoral researchers also work at LIGO Livingston.

The Future

LIGO has had a series of scientific data-taking runs since 2002, and is now in the middle of its fifth such run (S5). Published results from the first several runs have not indicated any gravitational wave detections, but improved sensitivity obtained for S5 gives LIGO scientists cause for optimism. The current plan is to continue observations for more than a year, perhaps interrupted by short breaks for detector improvements.

"We don't get to choose when the sources for our data come to us, so we need to observe as much as we can," said Giaime.
The goal of observing more will be met next fall, when LIGO will crank up its technology again and kick off a fifth observational run. This time, however, the goal is to observe for a six-month period. After that, Giaime said, there will be continuous observation for the next several years.

Ultimately, none of the scientists know if they will ever actually detect a gravitational wave, but it doesn't dampen their enthusiasm. The potential reward for their work is simply too great.

LSU's Warren Johnson may sum up the attitude of the researchers best.

LSU Scientists, Students Play Major Role in Groundbreaking Gravitational Wave Research, *(Cont. from Page 3)*

"We got into this because the scientific payoff, if we succeed, is so great that it's worth spending our whole careers on it," Johnson said, referring to his years of work with William Hamilton. "The personal payoff is knowing that we really can build this boat. Whether there's a new world on the other side of the ocean, we don't know, but we're going to sail anyway. The journey alone is enough for me. That's success."

Landolt Astronomical Observatory
- - November, 2005

The observatory on top of Nicholson Hall was first opened in 1939. The telescope is a refracting telescope with the lens having a diameter of 11.5-inches. The maker of the lens and the telescope was Alvan Clark & Sons. Clark was the premier maker of refracting telescopes and indeed is universally acknowledged to be the world's all-time best maker of refractor telescopes. LSU is lucky and proud to have such a classy instrument. Long-focus refractors give a high-quality high-magnification view which is perfect for looking at the Moon and planets. Wonderful amounts of detail can be seen on the planets, including Mars' volcanos and polar caps and morning-fogs as well Jupiter's Great Red Spot and fine divisions in Saturn's rings. For the Moon, we can see large and small craters, huge impact basins and low volcanic domes, with the views being wonderful and makes one think of flying low over the surface of the Moon. The 11.5" Clark telescope is also good for looking at double stars and bright nebulae around the sky.

From the late 1940's to the 1970's, the telescope was used for taking many astronomical photographs for various purposes including scientific studies. However, for scientific purposes, the telescope can no longer compete, as its aperture is too small and the light pollution from the city makes for a very bright sky.

From 1939 to the early 1990's, the telescope was used for regular Public Nights as well as LSU classes of many types. Many people around Baton Rouge fondly remember coming out to see the wonderful sights with this excellent scope. The growing light pollution has little impact on visual views of the Moon and planets, as these are intrinsically bright targets.

In the early 1990's, the observatory fell into disuse and some disrepair. The causes are just the normal ones that primary users retired and moved away, while its scientific utility was lost.

From the mid-1990's until 2005, the observatory was essentially unused with the dome getting in poor shape. But the Clark telescope and lens don't 'decay', so in 2005 a group in the Physics and Astronomy Department worked long hours repairing and refurbishing the telescope.

Most of this was in scraping and repainting everything, polishing the brass tube, replacing the doors and windows, and making a variety of repairs. The Clark lens was untouched. So finally, in early November 2005, the Department had a Grand ReOpening with a Public Night at the time of Mars' closest approach. After almost two decades of inactivity, the Clark telescope is again showing beautiful views of the sky to students and Baton Rouge residents.

At the time of the Grand ReOpening, it was realized that the observatory did not have a name. The obvious name for the observatory was to honor Professor Arlo U. Landolt for long being the core of the astronomy program at LSU. With his long years of serving as the Secretary of the American Astronomical Society, Dr. Landolt is the most recognizable of American astronomers. And his long work at providing standard stars (used for calibrating photometry as is vital for ~10% of modern astronomy) is by far the most-cited paper in all astronomy. Given his long and very strong contributions to LSU astronomy, American astronomy, and world astronomy; it is appropriate to dedicate the observatory as the "Landolt Astronomical Observatory" as a small recognition of his work.

Landolt Astronomical Observatory

- - November, 2005 *(Cont. from Page 4)*

Public Observing Nights

Once a month, on the Saturday nearest the First Quarter Moon, with a 'rain date' on the next day (Sunday) at the same time. Don't come if it is mostly cloudy, as there won't be any celestial body to see. Admission is free and you need not bring anything. The observatory was built long ago and is not handicapped accessible.

• Sat, May 6 - 9:00-10:00 CDT
Sunset-8:00 -Saturn, Mars, Moon

SUMMER BREAK

• Sat, Aug 26 - 8:30-9:30 CDT
Sunset-7:30 -Crescent Moon, Jupiter

• Sat, Oct 7 - 8:30-9:30 CDT
Sunset-6:45 -Moon

• Sat, Oct. 28 - 8:00-9:00 CST
Sunset-6:30 -Moon

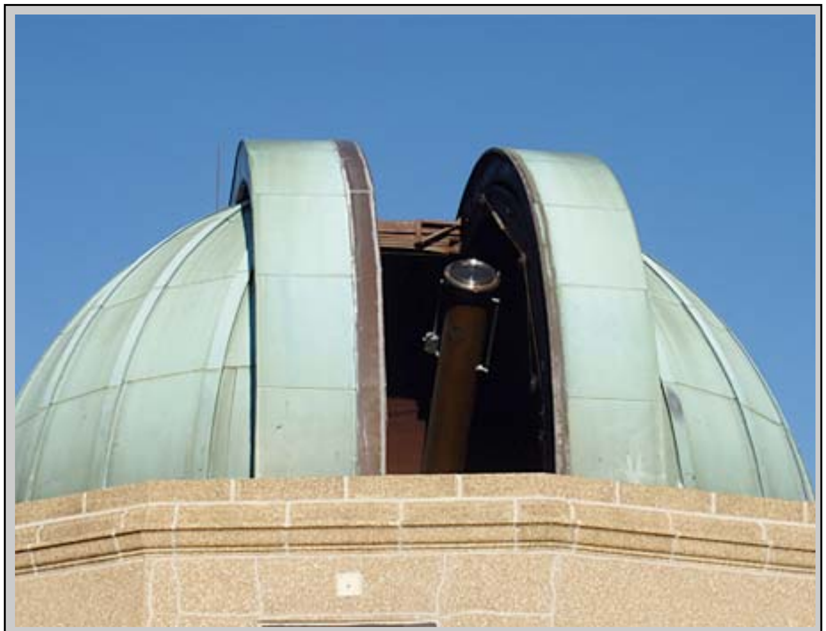
• Sat, Dec 2 - 7:00-8:00 CDT
Sunset-5:15 -Moon

• Sat, Dec 30 - 7:00-8:00 CDT
Sunset-5:15 -Moon

Dedication and presentation of the keys to the observatory to Dr. Landolt was held on Thursday, March 30 by LSU Chancellor Sean O'Keefe.

See the Landolt Astronomical Observatory web page for pictures of the event.

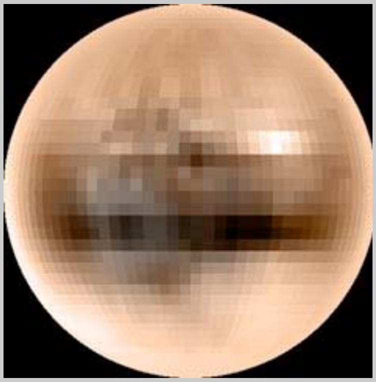
The image of the moon to the right was taken by graduate student, Jarrod Marsh on February 9, 2006 through the 11.5" Clark refractor telescope.



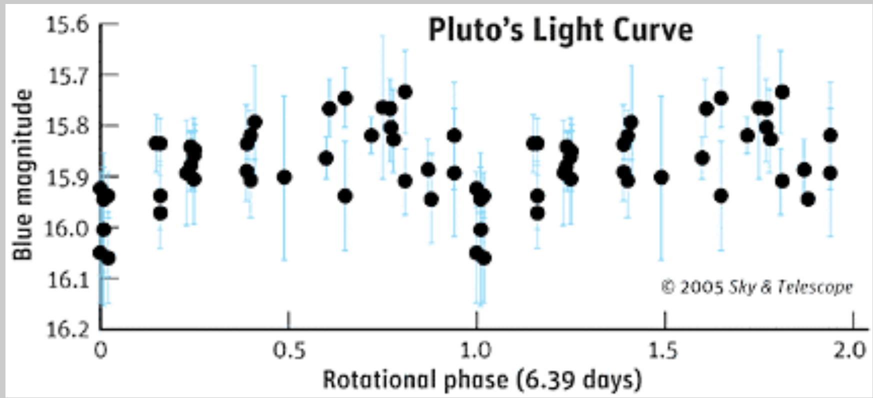
Pluto Reexamined*

- - By Robert Naeye, Sky & Telescope, June 10, 2005

http://skyandtelescope.com/news/article_1527_1.asp



This true-color map shows how Pluto's surface varies in reflectivity. Eliot Young and his colleagues created this map from data obtained at the McDonald Observatory in Texas during periods when Pluto was being partially eclipsed by its moon Charon. Because the two worlds are tidally locked, the map only shows Pluto's Charon-facing hemisphere. ***Courtesy Eliot Young (SwRI) / Richard P. Binzel (MIT) / Keenan Crane / NASA.***



Luke T. Smith and Bradley E. Schaefer created this light curve from photographic plates taken in 1933-34. The light curve clearly shows Pluto's changing brightness over its 6.39-day rotation period. But overall, Pluto was 0.05 magnitude fainter than expected in the early 1930s.
Source: Luke T. Smith and Bradley E. Schaefer (LSU)

After Clyde Tombaugh discovered Pluto in 1930, the planet drew considerable scrutiny. Unfortunately, modern analysis shows that many Pluto observations from the 1930s and 40s were unreliable. Measurements of Pluto's brightness made from photographic plates were off by as much as 1 magnitude because of errors in measuring the brightnesses of comparison stars. Only with the introduction of photoelectric photometers in the 1950s could astronomers produce measurements of Pluto's changing reflectivity (light curves) that are accurate by modern standards.

But astronomers would like to know Pluto's true brightness during those earlier times. Luke T. Smith and Bradley E. Schaefer (Louisiana State University) have reexamined photographic plates of Pluto taken with several different telescopes in 1933-34. By using modern equipment to make more accurate measurements of stars images on the same plates, and by measuring the brightness of these stars with a telescope in Chile, Smith and Schaefer have produced an accurate light curve for the planet in the years shortly after its discovery.
The two astronomers then compared Pluto's brightness to models developed by Marc W. Buie (Lowell Observatory). "We thought Pluto would be brighter than it actually was," says Smith, who presented the results at last week's American Astronomical Society conference in Minneapolis, Minnesota. After accounting for Pluto's greater distance from the Sun in the 1940s and Earth's viewing geometry, Pluto turns out to be 0.05 magnitude (5 percent) dimmer than Buie's model predicts.

The key to explaining Pluto's faintness during this period probably lies in the planet's unusual spin axis, which is tipped by 120 degrees relative to the plane of Pluto's orbit. In the 1930s, Pluto's southern hemisphere was pointed almost directly toward the Sun, whereas in more recent decades, Pluto's equator has been aimed toward the Sun. In 1933-34, Pluto was approaching the Sun on its highly eccentric orbit at a distance of 40 astronomical units. With the planet's southern hemisphere basking in perpetual sunlight, frosts of volatile compounds such as methane probably vaporized to form a rarified atmosphere, and then condensed on the darker and colder northern hemisphere, which was hidden from view. With less ice on its Sun-facing side, Pluto would have grown slightly darker.

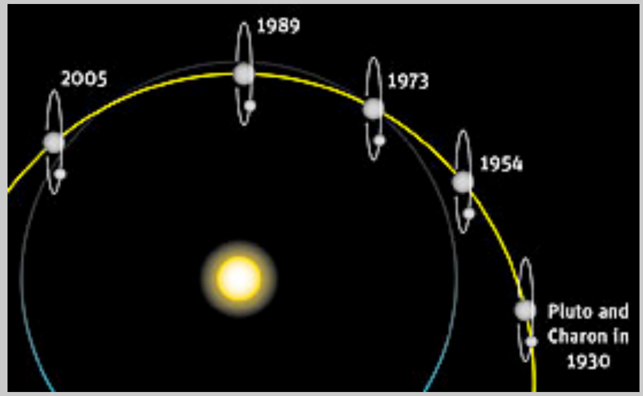
Pluto Reexamined* *(Cont. from page 6)*

- - By Robert Naeye, Sky & Telescope, June 10, 2005

http://skyandtelescope.com/news/article_1527_1.asp

"We have seen implications of atmospheric changes from frost formation and vaporization directly as changes in its light curve," adds Smith. "We know Pluto has an atmosphere, but there's a lot of work to understand how Pluto's atmosphere changes."

*EDITOR'S NOTE - Luke Smith is an Astronomy undergraduate working with Prof. Bradley Schaefer.



As Pluto orbits the Sun, it shows different faces to Earth which partially accounts for its changing brightness. But Pluto's highly eccentric orbit also causes significant brightness changes. When Pluto comes close to the Sun, it sprouts an atmosphere. The gases freeze back on the surface of Pluto and its moon Charon when Pluto is far from the Sun. The relative sizes of Pluto's orbit around the Sun and the Pluto/Charon orbit are not to scale. Go to the URL above and click on the image to view a full-scale version of this diagram.
Source: Luke T. Smith and Bradley E. Schaefer (LSU).

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- The new LSU logo -

Ball Family Professorship Inauguration

On Friday, October 14, 2005 at 5:00 PM in the LSU Union Vieux Carre' Room, a reception was held commemorating the establishment of the first Ball Family Professorship. Pictured above are Byrd and Alice Ball, originators and patrons of the Ball Family Professorship, along with Kevin Carman, Dean of the College of Basic Sciences, and Professor Roy Goodrich, second recipient of the endowed professorship.

PHYSICS & ASTRONOMY PEOPLE -

Hurricane Katrina hits our faculty

Robert Svoboda, Physics and Astronomy Professor, shows the maximum water level mark at his home in New Orleans. His home sustained large-scale damage due to the subsequent flooding. Dr. Svoboda is currently on leave at Lawrence Livermore National Laboratory.

RETIREMENTS

Richard Imlay,
Professor, August 2005

Gayle Kirwan,
Instructor, January 2006

-New to our Department-

Marian Florescu,
Postdoctoral Researcher

Hugo Cable,
Postdoctoral Researcher

Kurt Jacobs,
Postdoctoral Researcher

Björn Zimmermann,
Postdoctoral Researcher

James Clem,
Postdoctoral Researcher

WELCOME!

NEWS !

- **Jorge Pullin** was appointed Managing Editor of the International Journal of Modern Physics D.
- **Dmitry Uskov** and **Ravi Rau** developed a very compact solution of time dependent operator equations in quantum physics.
- The Louisiana Board of Regents gave their final **approval** to the creation of the **Horace C. Hearne, Jr. Institute of Theoretical Physics**.
- **Nicholas Van Meter**, Senior Undergraduate Physics Major, was named as a 2006 Goldwater Scholar.

For more information on these and other news items, go to

http://www.phys.lsu.edu/dept/news

WELCOME ! INCOMING GRADUATE STUDENTS
Spring 2006

- **Arivand Chiruvelli - M.S., Particle Physics**
  BS, Osmania University, India

- **Ricky Hesston - M.S., Medical/Health Physics**
  BS, Indiana University, Bloomington, IN

PHYSICS & ASTRONOMY ALUMNI !

Please help us update our alumni database -

We are very interested in how you are doing and where your career has taken you. Please take a few minutes to respond with news about yourself to be included in our Alumni database.

The Department of Physics and Astronomy maintains a database of all our alumni - Ph.D., M.S., and B.S.

The following information is needed and can be submitted by e-mail to *alumni@phys.lsu.edu* :

- Full name *(including maiden name)*
- Home address and telephone number
- Current employment information, title, e-mail
- Graduation information *(semester and year graduated, degree level and major)*
- Career and Personal News

OR

Over the world wide web at the following URL -

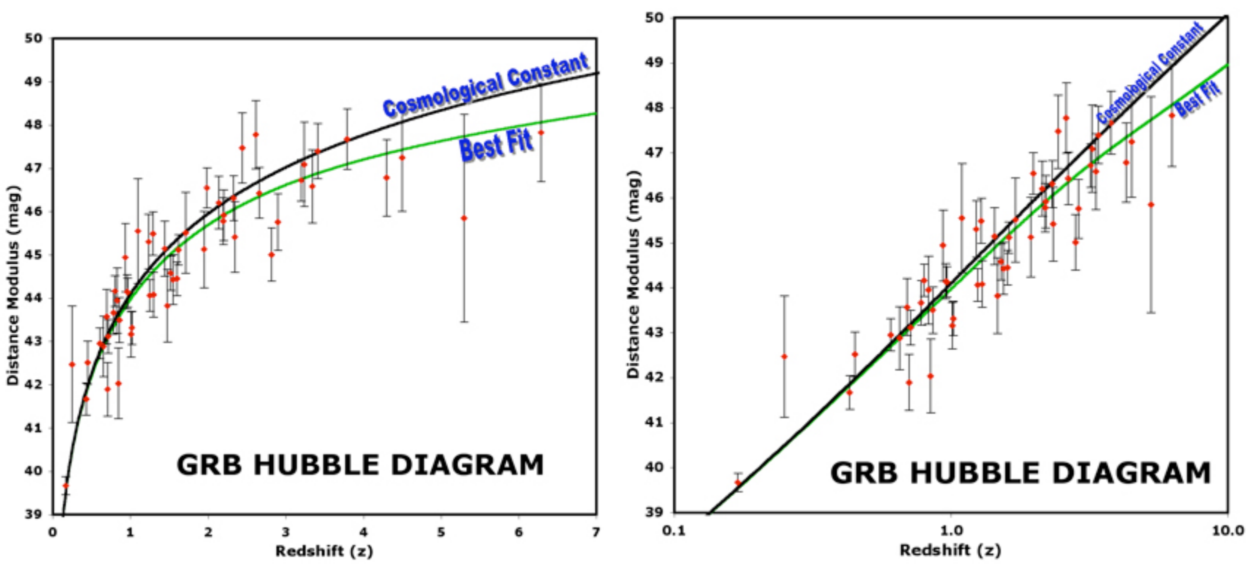
Gamma Ray Bursts and Implications for the not-so-constant Cosmological Constant

Announcement at the 207th Meeting of the American Astronomical Society

Abstract from the American Astronomical Society meeting in Washington, D.C., for talk 157.06 on 11 January 2006

The Hubble Diagram to z = 6.3 with swift Gamma Ray Bursts, Bradley Schaefer

A Hubble Diagram is presented based on 172 distance measures involving 52 Gamma-Ray Bursts out to redshifts of 6.3. The observed shape of the Hubble Diagram is a measure of the expansion history of the Universe, which will include the effects of the 'Dark Energy' that dominates over matter. Gamma-Ray Bursts can be seen to high redshift, and this uniquely allows for tests as to whether the Dark Energy changes with time. If Einstein's Cosmological Constant is a good representation of cosmology, then the equation of state of the Dark Energy won't change in time over the age of the Universe. The observed Hubble Diagram can be compared with the shape predicted by various models, including the model where the Cosmological Constant is a constant. The result is that the Cosmological Constant is rejected at a moderate confidence level. That is, apparently, Dark Energy changes with time. As with all such results, a consensus final conclusion can only be reached after the result is duplicated by independent experiments. To this end, over the next two years, the satellites Swift and HETE will discover another ~50 bursts that can be placed on the Hubble Diagram and this will serve as an independent test of the claim. The result also highlights the Gamma-Ray Burst Hubble Diagram as a new front-line technique to measure Dark Energy and the high-redshift Universe.

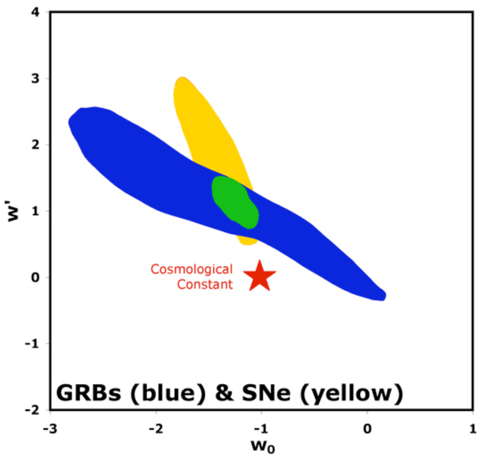


GAMMA-RAY BURST HUBBLE DIAGRAM: On this Hubble Diagram (here depicted with both a linear and a logarithmic horizontal scale), the 52 observed bursts and their best fit model (shown as a green curve) can be compared to the case where the Cosmological Constant is indeed constant (shown as the black curve). The 12 bursts with the highest redshift are all below the 'constant' case, and this is the indication that the Dark Energy changes with time.

Gamma Ray Bursts and Implications for the not-so-constant Cosmological Constant

Announcement at the 207th Meeting of the American Astronomical Society

(Cont. from Page 10)



ALLOWED REGION EXCLUDES THE COSMOLOGICAL CONSTANT: An observed Hubble Diagram can be used to place constraints on the allowed cosmology, here represented by two parameters called w0 = -1 and w' = 0 (indicated with the red star). The yellow region shows the allowed parameters based on supernovae alone, the blue region shows the constraints from Gamma-Ray Bursts alone, and the green region is the joint allowed region. These regions all represent the 'one-sigma' (67%) confidence level. The red star falls outside the blue and green regions, and the implication of this is that the Cosmological Constant appears to be rejected.

For more information on this research, please visit - *http://www.phys.lsu.edu/GRBHD/*

Max Goodrich Distinguished Lecture Series

Douglas D. Osheroff
Stanford University

1996 Nobel Laureate in Physics

January 23, 2006 - presented the Max Goodrich Distinguished lecture, "How Advances in Science are Made"

January 24, 2006 - presented a special Departmental General Seminar, "The Effects of Impurities on the Superfluid 3He Phase Diagram"

View the abstract for this talk at

http://www.phys.lsu.edu/dept/events/abosheroff2.html

CONGRATULATIONS GRADUATES !

Summer 2005 -

Bret Earl Hall (BS)
Suzannah Cathleen Lazar (BS)
Kenneth Bernstein (MS)
Laurie Anne Kelly (MS)

Fall 2005 -

John Barrett Deris (BS)
Christopher Jorgan Weaver (BS)
Mark Andrew Sauerwein (MS)
Nicholas Jabari Ouma Lee (Ph.D.)
Karly Mariah Pittman (Ph.D.)
Aniruddha Yadav (Ph.D.)
Weichang Zhao (Ph.D.)

DONATION FORM
Thank you for your support!

Private support has always been important in providing the margin of excellence for our students and faculty. In today's challenging economic times, LSU relies even more on our alumni and friends to make a vital investment in the future. Donations for the benefit of the Department of Physics and Astronomy will be used to enhance our teaching program and facilitate scientific discoveries that shape the future.

If you would like to make a tax-deductible gift for the benefit of the LSU Department of Physics and Astronomy, please complete this form and return it with your check to the address below. Your contribution check should be written payable to:
"LSU Foundation – Department of Physics and Astronomy".

If you prefer to use a credit card for your donation, you may either fill in the details below, or you may submit your gift online by visiting www.lsufoundation.org. Under the Giving Opportunities heading, select Contribute Online.

Contributions can be mailed to:

Roger McNeil, Chair, Department of Physics and Astronomy
Louisiana State University
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With your support, we can continue to make a profound and lasting contribution to our students, our community, and the world. All gifts are tax-deductible to the extent allowed by law.

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Department of Physics & Astronomy

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