

A Brief Overview of LIGO Outreach August, 2004



Our goals

- **Bring visitors of all ages to the Observatory sites**
- **Strategically support educational programs at all levels, elementary through university**
- **Leverage LIGO intellectual and physical assets through collaborations with local and regional institutions and initiatives**
- **Form relationships with underserved constituencies in the regions of the sites**



LIGO-G040427-00-W

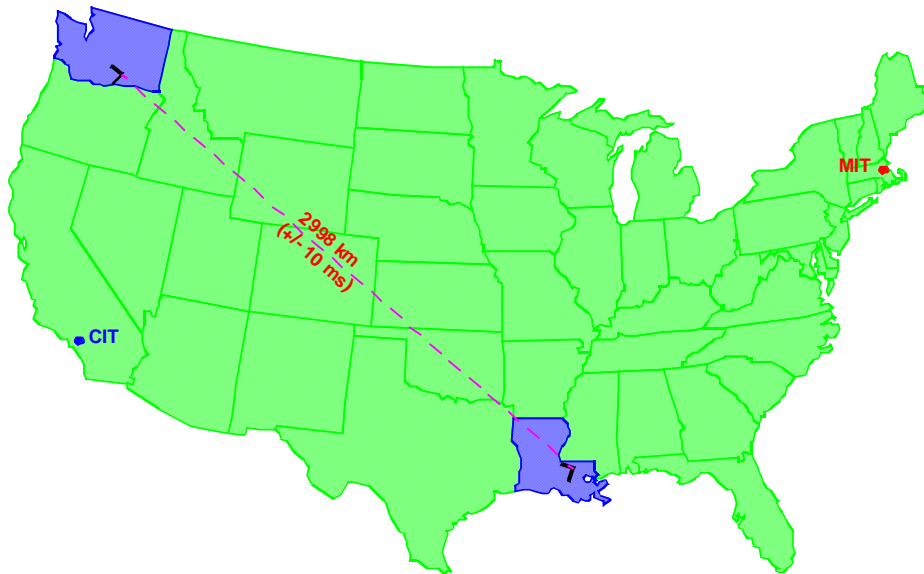


LIGO Outreach 08_04



Where we've been

Several factors have shaped the outreach programs at the sites



- ❖ The site leaders have generally shared a view of how to do outreach
- ❖ Individual staff members bring particular interests and backgrounds to outreach
- ❖ Livingston has a greater population density close to the site
- ❖ Hanford's nearby population is unusually literate in science & technology
- ❖ Formal and informal education resources differ in the local areas

Both sites utilize Local Educator Networks to help focus and clarify our outreach efforts

- The LEN's are composed of individuals/institutions who share an interest in science education and outreach

<i>Name</i>	<i>Affiliation</i>	
Royace Aikin	Science Education Programs	Pacific Northwest National Laboratory
Terri Andre	Science Education Programs	CREHST Museum
Rene Corrales	Scientist	Pacific Northwest National Laboratory
Lynne Dolph	Teacher	Yakima Nation Tribal School (High School)
George Garlick	President	Garlick Enterprises
Roy Gephart	Scientist	Pacific Northwest National Laboratory;
Stan Hughes	Teacher	White Swan High School
Dale Ingram	Teacher	Gladstone High School
Mary Moore	Teacher	Jason Lee Elementary School
Judy Morrison	Faculty, Teaching, and Learning	Washington State University, Tri-Cities
Tim Olson	Faculty in CS and Engineering	Salish-Kootenai College
Keith Plewman	Teacher	McLaughlin Middle School
Brock Wells	Teacher	Robert Olds Junior High School

Both sites maintain active research programs for university students

- **The LIGO REU/SURF program involves ~20-30 undergrad research interns per summer for 10-week appointments**
 - ❖ **Student participants come from Caltech and a variety of other universities**
 - ❖ **The students gain research experience and often make valuable contributions to LIGO**
 - ❖ **LHO hosts a meeting for the interns at summer's end at which they present their work and enjoy several social activities**



LLO: General Public

- Tours for community groups by appointment



LLO: K-12 Students

- This has been the largest visitor pool for LLO
- The site averaged one field trip per week in 2003-2004
- Site Admin Bonnie Wooley has worked the field trips with help from other LLO staff. New Livingston EOC John Thacker will assume primary responsibility for trips and other outreach activities



Several hands-on exhibits have been important parts of the field trips



A number of schools have contributed to the decoration of the beam tube enclosures



**Observatory staff have also traveled to schools within
~50 miles, judged science fairs and participated in
other community events**



LLO: K-12 Teachers

- Teachers have come to the site for summer internships
- These opportunities have focused on the development of site exhibits and web resources
- Visiting teachers have gained research skills and brought LIGO science back to their classrooms



LLO has also hosted and participated in teacher training activities



LSU is an important partner in the area and is an active site for LIGO research



Louisiana State University
LSU



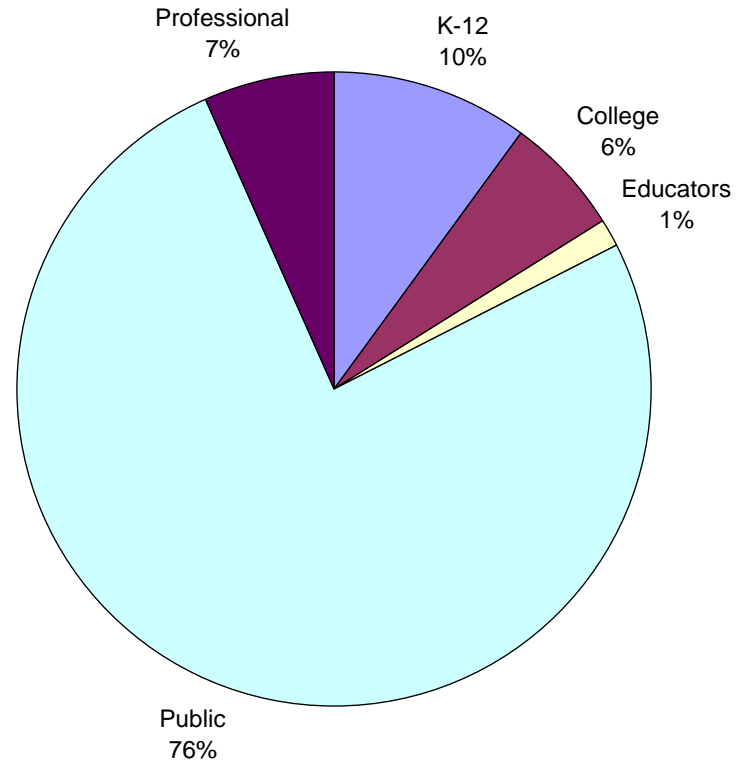
Southern University has become our key collaborator on science education projects at the K-12, university/preservice and inservice levels in Louisiana



LHO: General Public

- This sector comprises the majority of LHO visitors, with many coming from the professional community of the Tri-Cities

LIGO Hanford Visitors
(Total = 2978)



Tours for Community Groups by appointment



'Second Saturday' drop-in tours each month

Ad-Hoc Tour Dates for 2003

Our ad-hoc tours are given the 2nd Saturday of every month at 1:30 pm. If you would like to come by yourself, with friends or with family (bring the kids!) to join an ad-hoc group for a LIGO presentation and tour, then pick a date and just show up. If you expect to bring a crowd (>15 people) please e-mail your intentions to ingram_d@ligo-wa.caltech.edu, giving us the date and how many people you intend to have in your party. If future dates were to change, the change would be listed here, but we have had no changes in the past three years in this schedule.

DATE	TIME
Saturday, January 10, 2004	1:30 PM
Saturday, February 14, 2004	1:30 PM
Saturday, March 13, 2004	1:30 PM
Saturday, April 10, 2004	1:30 PM
Saturday, May 8, 2004	1:30 PM
Saturday, June 12, 2004	1:30 PM
Saturday, July 10, 2004	1:30 PM
Saturday, August 14, 2004	1:30 PM
Saturday, September 11, 2004	1:30 PM
Saturday, October 9, 2004	1:30 PM
Saturday, November 13, 2004	1:30 PM
Saturday, December 11, 2004	1:30 PM

Booked Dates for Private Group Tours and Meetings

Annual Public Lectures

LIGO PUBLIC LECTURE
with John Archibald Wheeler and Kip Thorne

Battelle Auditorium Monday, August 14 7:45 PM

John Archibald Wheeler, "the man who wrote the book on gravitation", and former lead assistant for the first photonics production reactor built at Hanford, will return to Richland for a public lecture with LIGO scientist Kip Thorne. Wheeler has worked with outstanding scientists such as Einstein, Dirac, Fermi, and Oppenheimer and with his students, like Kip Thorne and Richard Feynman, has explored the nature of space, time, gravity, and the quantum world. The talk will review Wheeler's contributions to Hanford's past and, through LIGO, its future.

FREE ADMISSION

LIGO PUBLIC LECTURE
"The Birth of the Universe"
by Professor Marc Kamionkowski,
California Institute of Technology

Battelle Auditorium Sunday, August 12, 2001 7:30 PM

Since ancient times, people have wondered how the universe began and what its fate will be. In modern times, this inquiry has led to new insights into the nature of space and time and matter and energy. By the mid-1900's, developments in General Relativity and Particle Physics pointed to a pronounced "Big Bang" that evolved into our present universe. Since light from the Big Bang was first detected in the 1960's and the first images of the infant universe emerged in the 1990's, these images strikingly confirm our concepts of the universe and our place within it.

FREE ADMISSION

LIGO Public Lecture

How Many Dimensions Are There to the Universe?
Professor Eric Adelberger, University of Washington

Nearly 100 years ago, Einstein made the revolutionary discovery that the universe had at least four dimensions - three of space and one of time. This new understanding affects commercial products like the electricity produced by converting matter to energy in nuclear reactors and the warping of time between clocks on GPS satellites and those on earth. Gravity reflects the character of space and time in environments as familiar as an elevator or as strange as a black hole. Could the universe have more dimensions, yet to be discovered?

Professor Eric Adelberger will describe how extremely delicate measurements of gravity can uncover possible clues to whether such extra dimensions exist.

Battelle Auditorium Sunday, August 18 7:30 PM

FREE ADMISSION

LIGO Public Lecture
ASTROPHYSICS MEETS THE MILLENIUM
Professor Virginia Trimble, University of California at Irvine and University of Maryland

Is the universe finite or infinite? Is there anything special about our star, the sun, or our planet like Earth, except of course that we live here? Does the stuff out there in the cosmos behave in ways we can understand using the science we know on our bit?

People have been asking these and similar questions for thousands of years. The talk will explore how the answers have evolved with time and how new ideas, like superstrings, were developed, new technology (like LIGO), and new kinds of people like astrophysicists are helping us to find the answers.

Battelle Auditorium Tuesday, November 11 8:00 PM

FREE ADMISSION

LIGO Public Lecture

Fulfilling Einstein's Vision: Searching for Gravitational Waves
Professor Peter Saulson, Syracuse University

Light waves shape our understanding of nature and our development of technology. Einstein's Theory of General Relativity predicts that another type of waves, gravitational waves, should share certain properties of light. But gravitational waves should differ from light in several fascinating ways, and these differences might bring entirely new insights to our understanding of the universe.

The development of extremely sensitive instruments such as LIGO gives us optimism that gravitational waves may soon be directly detected, opening new horizons in physics and astronomy. Professor Saulson will describe the challenge of sensing these faint ripples in space and time, and he will share what we stand to learn from their discovery.

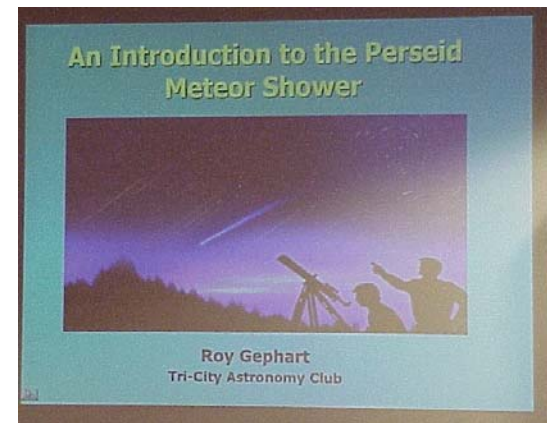
8:00 PM
Wednesday, August 18, 2004
Chief Joseph Middle School
504 Wilson (off Jadin), Richland
Free Admission

Public astronomy events with the Tri-City Astronomy Club

- ❑ Mars Madness
- ❑ National Astronomy Day
- ❑ Perseid Viewing



*Photo courtesy of Molly Van Wagner,
Tri-City Herald*



*Hubble Space Telescope photos
courtesy of NASA and STScI*

Participation in TRIDEC (Tri-City Industrial Development Council)



LHO: K-12 Students

Field Trips

- ❖ LIGO Explorer field trip activities
- ❖ Hands-on Exhibits
- ❖ Companion classroom activities on 'Teachers Corner' (Web site)



Field Trip Package for the LIGO Hanford Observatory - Microsoft Internet Explorer

Address: http://www.aprns.csbtech.edu/teachers_corner/lessonexplorer/fieldhandouts

A HANDOUT FOR STUDENTS

LIGO The LIGO Explorer

To the student: This activity sheet will take you through a number of the exhibits at the LIGO Hanford Observatory. Here's what you should do:

- Find an exhibit (you can do them in any order)
- Locate the section for the exhibit in this packet
- Read the procedure for the exhibit
- Do the procedure
- Answer the questions
- Have fun exploring the science of LIGO!

Scoping the Stars

Location: In the Auditorium (This exhibit is under construction and may not be ready during your trip)
 Procedure: Point the narrow opening of your spectroscope at the various light sources that are in the room and look into the scope through the diffraction grating (the slide on the other end of the box). Look at the patterns inside the box. Compare the patterns of different light sources to each other

Questions

1. What type of spectral pattern do you see when you look at white light?
2. How do the patterns from the colored lights differ from the pattern of the white light?
3. If all you could see was a spectral pattern and you couldn't see the light that produced the pattern, could you figure out the color of the light from the pattern? Explain.

A Shadow - More than Meets the Eye?
















Lesson - Microsoft Internet Explorer

Address: http://www.aprns.csbtech.edu/teachers_corner/lessons.html

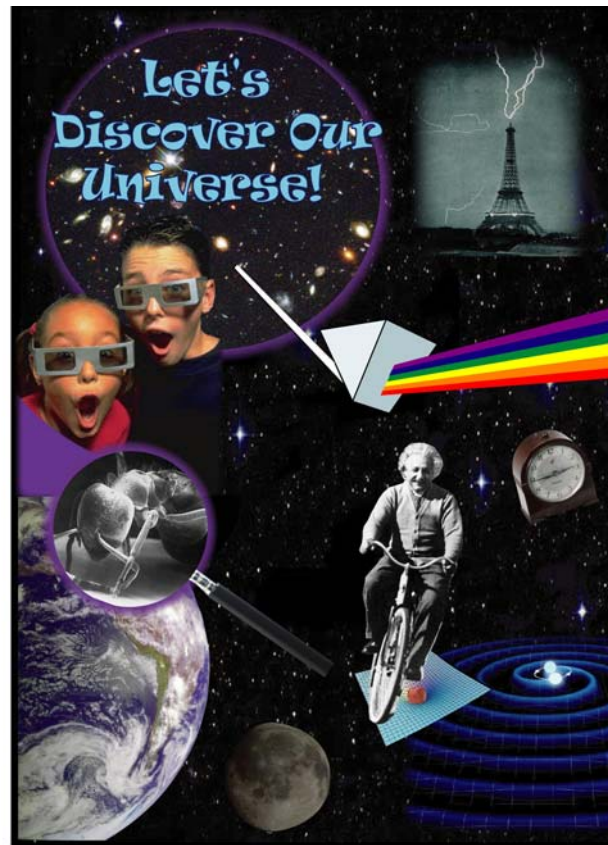
Hanford Observatory
Teachers Corner

Classroom Activities, Lessons and Projects Related to LIGO Science

The links in the table below will take you to packages of lessons whose outcomes are referenced to science standards in both Washington and Oregon. The grade range for each package can be determined from the table. Some have versions for both middle and high school levels. The packages are linked to a set of additional activities that students would do at the LIGO Hanford site as part of a field trip. The on-site LIGO activities will hopefully provide an avenue for students to apply what they have learned in the classroom lessons to the 'real world' of science research. The classroom packages are also written to be meaningful as stand-alones in the event that a field trip to LIGO does not occur.

Package	Grades 5-8	Grades 9-12
Helpful Hints for Using these Packages		
The LIGO Star Chart		
The Scientific Method with a Pendulum		
Build and Use Your Own Michelson Interferometer		
Build and Use a Simple Spectroscope		
Powers of Two		
Scaling the Earth's Atmosphere		
Feedback to LIGO about the Packages		

A classroom poster will soon be ready for distribution



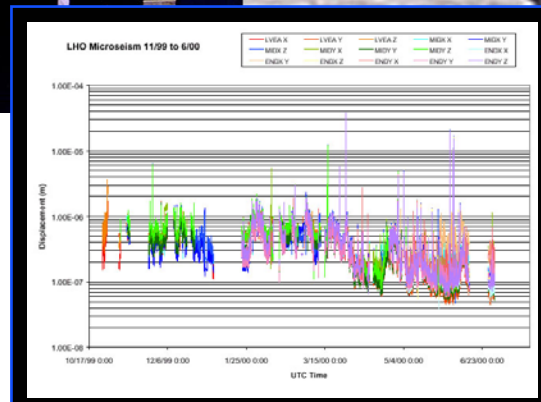
(Draft Copy without credits)

Partnerships with schools

- Geneva High School



SST Program (1999-2001): Kamiakin High School and Gladstone High School



The Gladstone High School connection continues

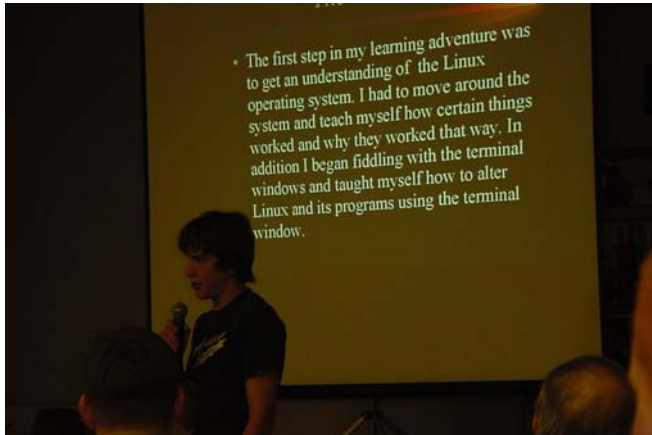


LIGO
GHS

GHS + LIGO
Student(s) = Results

An Adventure
In High School
Physics

• Home • News • Tutorials • Data Analysis • Geophysics • Computing • Instrumentation • Program Information • Contact •



- Summer Internships





Important area partners for LHO are PNNL, WSU Tri-Cities, the Tri-City Astronomy Club and the CREHST Museum



Pacific Northwest National Laboratory

...delivering breakthrough science and technology



Where we are going

- **The recent major NSF outreach grant will bring us together with several partners to impact science education in Louisiana**
 - ❖ LIGO – Develop and run a 10,000- ft² science center at the site
 - ❖ Southern University – Bring LIGO science into the science and education curricula; utilize the science center for teacher training
 - ❖ LA Gear-Up – Utilize LIGO and the science center to develop inservice training programs; assist with development and enhancement of field trips; perform outreach into schools to help make connections to the LIGO site
 - ❖ Exploratorium – Supply hands-on exhibits to the center; work with the other grant partners in the successful utilization of the exhibits; provide teacher training workshops on the use of exhibits in science instruction



LIGO-G040427-00-W



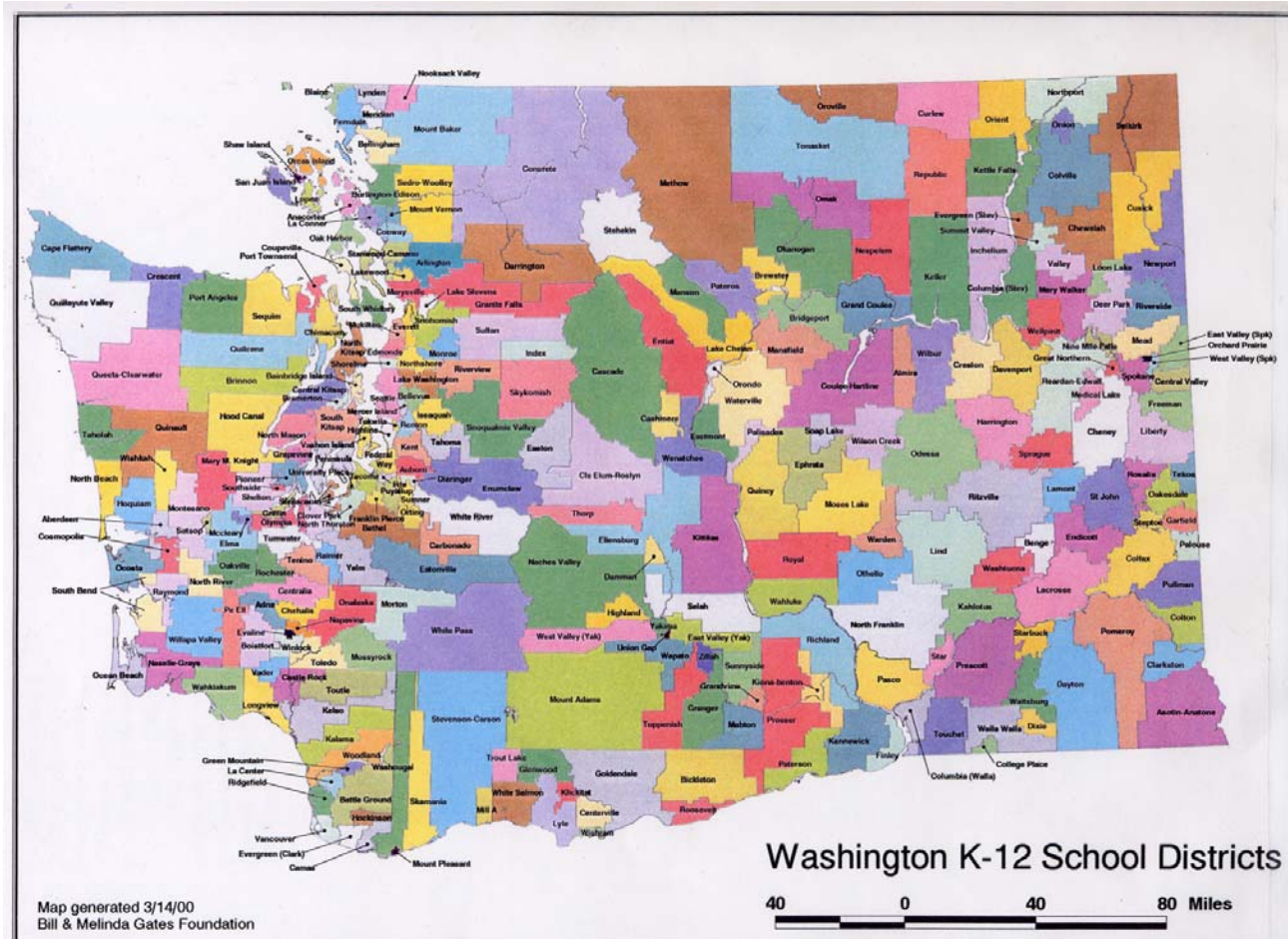
LIGO Outreach 08_04

The Science Center at LIGO Livingston will connect teachers & students to LIGO science

- ❑ The center is scheduled to open in November, 2005
- ❑ Livingston EOC John Thacker will supervise the center's staffing and program development
- ❑ LIGO scientists and engineers will contribute to the center's exhibit content and science instruction



LIGO Hanford will continue to cooperate with our partners to develop innovative ways of serving our region's mix of cities and rural areas



Our rural areas have high percentages of Spanish-speaking households, increasing the challenge to our outreach program

