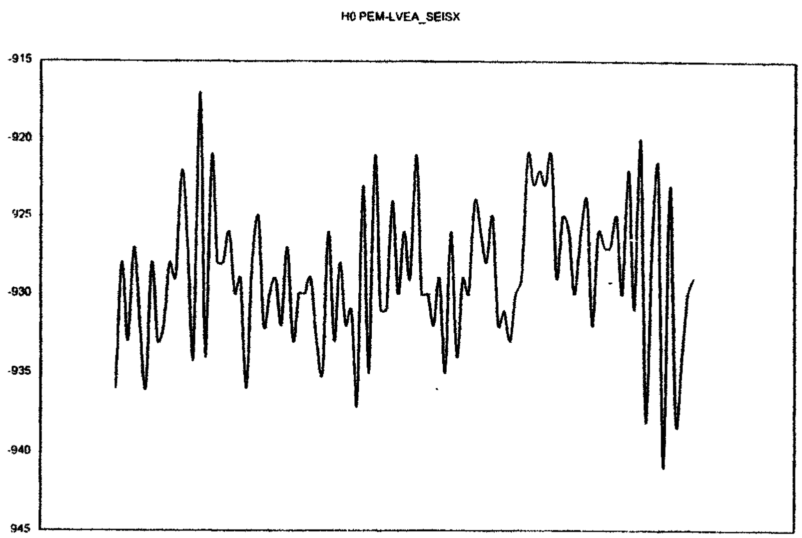
GHS LIGO SST

May 12, 2000



LIGO-G000198-00-W

Gladstone High School and the Laser Interferometer Gravitational Wave Observatory are pleased to welcome you to

An Evening of Science

A presentation of student research through the SST program of the Pacific Northwest National Laboratory

<u>*Welcome and Introductions*</u>

Bob Stewart, Gladstone School District Superintendent

<u>*Greetings from Pacific Northwest National Lab*</u>

Royace Aikin, PNNL Educational Programs Specialist

<u>*Greetings from the High School*</u>

Pia Leonard, Gladstone High School Principal

<u>*Acknowledgements*</u>

Dale Ingram, Gladstone High School

<u>*Introduction of Student Research*</u>

Jed Wilson, Gladstone High School

<u>*Student Research from the Perspective of LIGO*</u>

Dr. Fred Raab, LIGO Hanford

Student Projects

The Microseism

Jamie Ellington and Karen Vann

Microseisms are a family of low-frequency seismic processes. These vibrations will interfere with LIGO's extremely sensitive instrumentation. Understanding the literature research on microseisms was essential to the development of Gladstone's research program this year.

Development of the LIGO/GHS Microseism Data Accumulator

David Wells

All of Gladstone's work on the microseism has relied on our ability to receive data from LIGO seismometers in the microseism frequency band. A computer routine and the Internet are the tools that have delivered these data to GHS since August of 1999.

Development of Analysis Strategies for Microseism Data in the High School

Andy Gaynor, Jeff Lowe

What do you do with 100 microseism data points per day from the Internet? Using MS Excel, students on the analysis team have constructed a variety of plot types to extract information from the seismic measurements.

What Does the Microseism Data Say to Us?

Abby Scheel

Using the graphing strategies described above, students can now study the patterns and trends in the microseism data over time. While the microseism appears to be stable on a scale of minutes, it can change significantly over a period as short as 12 hours.

Analyzing the Amplitude of a Test Signal in the Microseism Data Stream

Dustin Taylor

Data that is treated electronically must be examined and tested with as much scrutiny as that which is gathered by hand. By applying a test signal to LIGO's seismometer data channels, LIGO staff members gave Gladstone students an opportunity to examine the acquisition system's amplitude response in these channels.

Performing a Fourier Analysis of LIGO Seismic Data

Stephanie Brown and Alicia Oliver

Time-based seismometer data is very complex. At Gladstone we are only interested in one frequency slice of this complex data stream. Fourier analysis is the method that we use in a computer to transform the time-based information to frequency information. Fourier analysis lies at the heart of our analysis of LIGO data.

Using a Web page to Communicate Research Results

Erin Hewett

How can the Gladstone SST team report the results of its work to the LIGO staff? The same way we receive it – over the Internet. Framing research reports on a Web page requires knowledge of the HTML language along with the ability to find and use authoring tools from the Web. PDF files are a convenient format for the development of Web documentation.

How Susceptible is LIGO to Average Global Earthquake Activity?

Integrated Science I (Riley Clark and Tyler Poyser)

Hundreds of Earthquakes occur around the world each month. Earthquake activity is another potential interference for LIGO. Identifying the locations and frequencies of these quakes can affirm some interesting ideas about the structure of the earth's crust.

How Rapidly does the Energy of an Earthquake Dissipate as the Quake Travels through the Earth?

Jed Ralls

Knowing how the energy of an earthquake decays as a function of travel time is an important part of estimating the average effect that quakes will have on LIGO's operation. Comparisons of the intensities of a single quake on seismometers at various locations can help us address this question.

Searching for Evidence of Earthquakes in the LIGO Microseism Baseline

Kierstin Schmidt

Large earthquakes can usually be seen in the microseism data. Can small ones be seen as well? How far from LIGO must a quake of a given magnitude occur to avoid shaking the interferometer? A multi-layered analysis strategy using Excel is helping us answer this question.

Atmospheric and Oceanic Influences on the Microseism

Whitney Whelan and Sachiko Shimizu

The microseism amplitudes vary over time. Are there external factors that cause these variations? Weather variables and ocean wave activity are possible suspects. Web-based sources can supply the raw data needed to examine this question.

Writing Custom C programs for Microseism Analyses

Brandon Clover, Heather Jones, Brent Redinger, Phil Kulak

Custom programs for Gladstone's data analysis can result in higher efficiencies of our computing processes, and can lead to opportunities for automation. By learning to program in C, students have created a variety of research tools.

Building, Testing and installing Operating Systems on a Windows/Linux Dual-Boot Computer

Tim Vu

The Linux operating system is a powerful and inexpensive alternative to Windows that allows students to use UNIX-based applications in their research. It is indeed possible to develop a reliable dual-boot system without completely losing one's sanity.

The Role of the Oscilloscope in Signal Processing

Jordan Ng and Scott Klar

Conventional DC and AC meters provide useful but limited insight into the behavior of circuits. The oscilloscope is a more powerful tool for signal analysis. Oscilloscopes are the instruments of choice for the analysis of oscillating circuits.

Fundamentals of Digital Circuitry

Mark Hardzinski and Patrick Sears

Digital systems are now part of nearly every piece of research instrumentation. Inexpensive computers have pushed digital technology to center stage in science and engineering. Students must understand the basic contrasts between analog and digital circuits to become successful users of digital devices.

Fundamentals of Fiber Optic Circuits

Stephanie Moore

Optical fiber is a highly efficient means of transmitting signal information. This technology requires specialized fittings and connectors because of the extremely small fiber radii. Transducers are needed to convert electric signals to light and vice-versa if fibers are to be used as conduits for electric signal information.

Building a Seismometer

Mukul Dave, Megan Lawrence, Amber Owens

A seismometer is a device that utilizes the inertia of a large mass to measure movement that occurs in the surroundings. Designing and building a seismometer requires planning, creativity, attention to detail and a diverse set of individual skills.

Detecting Seismometer Output

Kyle Cole

Once the seismometer and the detector are constructed, a strategy for calibrating the entire device must be pursued. An analog-to-digital converter creates the possibility of treating the data with a computer, but also brings a host of troubleshooting issues to the calibration process.

Characterizing Accelerometers

Paul Bunce, Mike Baranick

Accelerometers are similar to seismometers in several respects (both are fully capable of lying to you, for example). Simple accelerometers are easy to build, but are of limited sensitivity. More sophisticated devices require the operators to deal with a variety of hardware and software issues. Accelerometers can be a useful tool for examining the vibration behavior of large structures such as walls and floors.

Measuring Interference Patterns

Mike Landis, Kyle Lewis

Wave interference lies at the heart of the physics of LIGO. Interference patterns can be readily observed in the laboratory. Geometrical calculations can produce values for the wavelengths of light from interference patterns.

Special Relativity

David Wells, Jed Wilson

A relativistic point of view is necessary if one is to understand LIGO's scientific mission. Einstein's theory of special relativity requires one to remove the perceptual barriers that arise from our existence in a slow-moving world governed by fixed time. Relativity considers events that happen near the speed of light. In such an environment, time and distance are no longer invariant.

Acknowledgements

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The list of individuals who have assisted us this year is extremely long. Many are employed at the high school, a number are in the local community, and in some are from across the nation. Our thanks go to all who have been so generous and supportive.