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Subject: Fwd: Re: Large Facilities Projects Monthly Report (End of December 2008)

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Subject: **LIGO End of December 2008 Highlights
(LIGO Cooperative Agreements NSF PHY-0107417 and NSF PHY-0757058)**

Reference: **LIGO-M090001-00-P**

LIGO Scientific Collaboration (LSC)

The University of Maryland hosted the final LSC-Virgo meeting of 2008 in December. The focus of the meeting was data analysis, with two days of face-to-face meetings by the LSC-Virgo search groups and two days of presentations. Roughly 110 people attended. Much of the first day was dedicated to preparations for the next LIGO/Virgo science run (S6/VSR2), including search group latency requirements and status of online analysis development, as well as discussions of online vetoing and data quality flagging. In addition, many completed or maturing S5 (the science run completed at the end of 2007) results were presented, as were plans for developing external collaborations with a wide class of astronomical modalities. One of the highlights of the meeting was the "opening of the box" on several Gamma-Ray Burst searches.

Publications

- The S5 first-year, low mass compact binary coalescence paper, "Search for Gravitational Waves from Low Mass Binary Coalescences in the First Year of LIGO's S5 Data," was approved for submission to Phys. Rev. D. (This paper will be posted on the ArXiv in January at <http://arxiv.org/abs/0901.0302>).
- The S5 stochastic isotropic search paper, "Listening for Gravitational Echoes of the Universe with LIGO," was approved for submission to *Nature*, subject to revisions in the manuscript.

Education and Outreach

Livingston Observatory Science Education Center (SEC)

The Livingston Science Education Center continued to provide school visit experiences for six schools, four of the visits finished up the Copper Mill Elementary School research for Dr. Lisa Szetcher of Tulane University, and two of the visits were from local Livingston Parish Schools. The total attendance for the six visits was 251 students. We also conducted two home school visits for a total of 39 students and parents. Dr. Sany Yoshida conducted the tour with Rhett Allain, Physics Professor at Southeastern University, whose family was involved in the home school.

We had good success this month with our Docents Cohort I participation. Six Docents participated in four of the school visits, and three Docents participated in our first Saturday Open House. We had an attendance of 25 visitors for our first Open House, and look forward to scheduling our next gathering this spring.

Hanford Observatory Outreach

The breadth of LIGO science and engineering provides a number of connection points for activities with schools and students. Over the last year, LIGO has engaged with K-12 students from many areas of study: general science, earth science, physics, optics/astronomy, chemistry, computer programming, electronics, mathematics, language arts, visual arts and college/career preparation. Our hope is to add music and industrial arts to this list in 2009.

Enhanced LIGO

We installed the last two stray light baffles in the Hanford end stations during two short chamber vents just before the holiday break. This completes all programmed in-vacuum hardware installation except for the removal of a diagnostic beam sampler at each site.

We also continued our progress in understanding and improving the performance of the DC readout at both sites. Parametric sensitivities to fluctuations in laser intensity, direction, and frequency have been measured and the results incorporated into a comprehensive interactive noise model. We also tested the coupling of the output mode cleaner response to alignment fluctuations.

Advanced LIGO

This is a summary of activities conducted under Operations Support for the LIGO Laboratory, along with contributions from other collaborating institutions with the NSF or international support for Advanced LIGO Development. It complements the Advanced LIGO Project Activities summary in the Advanced LIGO Project Monthly Report.

Seismic Isolation

Test Mass Seismic Isolation system: We have been performing a set of measurements of the mechanical modes of the combined seismic isolation-suspension system so as to pursue some unexpected peaks and some that have wandered in frequency. No firm conclusions as yet, but the information is rich and will allow improvements to be made. Also, auxiliary sensors on the seismic isolation optics table have demonstrated the potential utility of a different servo configuration and may point to improvements in the seismometer mounting system.

HAM chamber isolation system: We tested the new crossbeam design for the external supports. The design does indeed both increase resonant frequencies and increase the damping due to improved coupling to the Hydraulic External Pre-Isolator actuators. This design will be adopted for Advanced LIGO.

Suspensions

The Preliminary Design Review for the triple suspensions has concluded successfully. In parallel, analyses have suggested design changes that will improve the stiffness of the cage for the smaller triple suspension, resolving the principal shortcoming of that design.

Pre-Stabilized Laser

We continue to use the 35-watt lasers in enhanced LIGO. We also continued research into photodiodes for precision intensity stabilization.

Input Optics

The University of Florida group, with LIGO Laboratory support, continued the design of the Input Optics system. Experiments on parallel modulation (Mach Zehnder) continued, as did investigation of absorption in Advanced LIGO modulator Rubidium Titanyl Phosphate (RTP) crystals. We initiated work on Advanced LIGO Mode Cleaner pre/initial alignment requirements; this will include the placement of video cameras and quadrant cameras to ease the initial alignment until the mode cleaner resonates, and the provision of beam position diagnostics for the mode cleaner thereafter.

We analyzed the thermal effects at low power for Advanced LIGO - given a smaller beam size of 5.3 cm compared to the baseline beam size of 5.5 cm - indicating no constraints from that consideration. We prepared for testing of coating damage

at very high intensities to determine our safety margin (expected to be comfortable).

Core Optics

We continued the modeling of the optical system as a function of beam sizes in preparation for the polishing specification.

Auxiliary Optics

Implementation of the planned intensity servocontrol is in progress for enhanced LIGO, as the improvements in overall performance have uncovered the noise generated by these compensation lasers (as anticipated). We have installed the Thermal Control System (TCS) viewport protection at Livingston and have been implementing the laser safety interlocks for the viewport temperature and chiller flow.

Design efforts for the stray light control continue, along with prototype tests of damping systems for suspended baffles.

Interferometer Sensing and Controls

We continued commissioning the DC readout as realized for enhanced LIGO and preparing for a demonstration of sensing topologies in the Caltech 40-meter facility.

Data Acquisition System

Layouts of racks are in detailed design; optimization is possible to allow the best communication between related processes (e.g., the Hydraulic External Pre-Isolator and the Internal Seismic Isolation system, which is supported by it).

A mini-run of enhanced LIGO provided the opportunity for coordinated tests of detector characterization software, detector monitoring tools, and the underlying software and hardware base.

System Engineering and Integration

These activities are now part of the Advanced LIGO Project and reported there.