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Date: Wed, 16 Jul 2008 16:02:33 -0700
To: Tom Carruthers <tcarruth@nsf.gov>,
"Beverly Berger <bberger@nsf.gov>" <beckett@ligo.caltech.edu>
From: Phil Lindquist <lindquist_p@ligo.caltech.edu>
Subject: Large Facilities Projects Monthly Report (End of June 2008)
Cc: "Phil Lindquist" <lindquist_p@ligo.caltech.edu>,
Jay Marx <marx_j@ligo.caltech.edu>,
"Stan Whitcomb \(E-mail\)" <whitcomb_s@ligo.caltech.edu>,
Linda Turner <turner@ligo.caltech.edu>,
"Thomas B. Lucatorto" <toml@nist.gov>, dcc@ligo.caltech.edu,
Albert Lazzarini <lazz@ligo.caltech.edu>,
Dave Beckett <beckett@ligo.caltech.edu>,
Dave Reitze <reitze@phys.ufl.edu>, dmuhammad@ligo-la.caltech.edu

Subject: **Large Facilities Projects Monthly Report (End of June 2008)**
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General

The LIGO Laboratory Program Advisory Committee (PAC) met on June 24 and 25 at the LIGO Hanford Observatory. The topics covered included presentations on the status of enhanced LIGO. The management team for Advanced LIGO also provided a project status. David Reitze and a number of LIGO Scientific Collaboration members provided an overview of LSC activities including updates on data analysis, the LSC interaction with the numerical methods community, and the Astrowatch observations that are in progress in the interim period between S5, the fifth science run, and enhanced LIGO operations.

LIGO Scientific Collaboration (LSC)

The second LIGO-Virgo meeting of 2008, a data analysis meeting, was held in Orsay, France, June 9-12. Approximately 90 people attended. Highlights included a discussion of the plans by the search groups for preparations for the sixth science run, S6, a status report on S5 analyses and papers, and a discussion of methods for developing external collaborations with other astronomers for performing coordinated triggered searches. A meeting of the LIGO-Virgo Data Analysis Council took place, with a focus on developing priorities for analysis projects.

The press releases accompanying the submission of the S5 Crab Spin Down Limit paper were picked up by several science web sites including the American Physical Society (http://www.aps.org/; under "Latest News").

Vuk Mandic has been re-elected as one of the co-chairs of the Stochastic Search Group. In agreement with the LIGO-Virgo Memorandum of Understanding (MOU), we made the transition to a chair/deputy chair structure in the LSC. However the chair and deputy chair will continue to share the leadership role and the groups will continue to function as they have in the past.

Brian O'Reilly has stepped down as the chair of the LSC Calibration Committee. The Calibration Committee will have two new co-chairs: Keita Kawabe (instrument co-chair) and Xavier Siemens (h(t), code co-chair).

Publications

Published or accepted for publication

- The S5 paper "Beating the Spin-Down Limit on Gravitational Wave Emission from the Crab Pulsar," has been accepted for publication in Astrophysical Journal Letters.
- The S3 CBC paper "Search of S3 LIGO Data for Gravitational-Wave Signals from Spinning Black Hole and Neutron Star Binary Inspirals," has been accepted for publication in Phys. Rev. D.

Approved for submission by the Executive Committee

- The LIGO-GEO S4 paper "First Joint Search for Gravitational-Wave Bursts in LIGO and GEO600 Data," for submission to Class. Quantum Grav.
- The S5 SGR paper "Search for Gravitational Wave Bursts from Soft Gamma Repeaters," for submission to Phys. Rev. Lett.

Both will posted on the arXiv after a one week final comment period.

Education and Outreach

Livingston Observatory

Student Programs

- The LIGO Science Education Center (SEC) hosted a Louisiana State University (LSU) Math Circle Math Summer Camp for advanced math students.
- The Livingston Observatory also hosted 25 LSU Research Experience for Teachers (RET) Large Balloon Project and Biology Project students.

Teacher Programs

- We conducted five teacher Professional Development (PD) workshops. We trained 153 teachers over seven days.

Education Research

- The RET Program is correlating the new Louisiana Comprehensive Curriculum for Science with LIGO Science Concepts and Activities.

Public Outreach

- We conducted three public tours of the LIGO and LIGO SEC facilities. Nearly 150 visitors have attended the Friday public tours this month.
- In addition, we hosted a meeting with Fred Raab and Washington State school board superintendents to gain support for a future Hanford Observatory SEC project. Three Science Curriculum specialists from parishes around Livingston attended the meeting with the Washington superintendents.
- We participated in an interview with a local magazine reporter about LIGO's impact on the local community and the educational value added.

Hanford Observatory

For the second year, the Hanford Observatory partnered with Pioneer Middle School in Walla Walla and Washington State University (WSU) GEAR UP for a "Space and Technology Boot Camp II," a two week program, four hours each day, during which students undertake projects in basic electronics, PERL scripting and LIGO seismic data analysis via the I2U2 Web interface. Six teachers from Walla Walla provided instruction at the camp with support from the Hanford Education and Outreach coordinator. Students visited the observatory on the first day of the program to tour and to see electronics, programming, and data analysis in action. They returned on the last day of the program with display boards that documented their work at the school over the two-week span. Their poster session was attended by a number of observatory staff who enjoyed the opportunity to have informal discussions with the students.

Enhanced LIGO

We activated the Hanford four-kilometer interferometer Horizontal Access Module (HAM) active internal seismic isolation (ISI) system, and configured and tested the damping and isolation control loops. The system rapidly met or exceeded top-level performance goals for stability and isolation performance, and is undergoing detailed characterization to support an accelerated Advanced LIGO subsystem review. The seismic isolation team is also preparing to port these successful control laws to the identical Livingston four-kilometer interferometer ISI system in July.

Meanwhile progress continues on evaluating performance of the enhanced LIGO 35W laser at Hanford on the full four-kilometer interferometer. A brief vacuum vent is planned this month to improve beam dumps and install scattered light baffles, which are deemed necessary to reach full laser power and full phase sensitivity. We also installed and characterized upgraded Thermal Compensation System (TCS) CO2 laser systems. These will be required to manage interferometer thermal loads at full enhanced LIGO circulating power. Finally we assembled and tested the output mode cleaner (OMC) for the Hanford four-kilometer interferometer in the site optics lab, and installed the control electronics to prepare for a scheduled August installation of the OMC.

Noise hunting on the four-kilometer OMC/DC readout system at Livingston is yielding significant gains, with (for example) a binary neutron inspiral range of about seven MegaParsecs achieved (within about a factor of two of best previous S5 performance). Detailed characterization of couplings from environmental and instrumental noise terms appears consistent with model predictions.

Preparations are nearly complete for a vent at Livingston to complete the end test-mass magnet retrofit (already done on the Hanford four-kilometer interferometer) and to install scattered light baffles and beam dumps, in preparation for achieving high power operation at that site. The Livingston four-kilometer interferometer 35W laser and high-power electro-optic modulator are staged for installation while the machine is vented.

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 -- We achieved initial operation this month of the in-vacuum internal seismic isolation (ISI) prototype for the auxiliary optics (HAM) chambers at the Hanford Observatory. We created control laws for the servos and achieved significant suppression of seismic noise. Tuning of the system continues.

We are using the Livingston system as a passive platform for enhanced LIGO commissioning as planned. The test-mass (BSC) chamber isolation system at the MIT LASTI test facility is also being "tuned" and several degrees of freedom of control have been tested.

Suspensions -- We continued work on the welding and fiber-pulling system at the MIT LASTI facility. The prototype Quadruple Test Mass Suspension is mated to the test mass (BSC) seismic isolation system, providing an accurate dynamic load for seismic isolation tuning. We encountered difficulties in the fabrication of blades for the second output mode cleaner suspension, destined for the Hanford Observatory, and borrowed blades from an existing prototype as a work around. This will allow us to proceed with assembly and installation of the second suspension, while addressing the blade fabrication procedure separately.

Pre-Stabilized Laser -- We continue characterization of the system at Hannover, Germany, and use of the lasers in enhanced LIGO.

Input Optics -- We continued the design of the Advanced LIGO and enhanced LIGO input optics and prepared for the installation of the next phase of the enhanced LIGO hardware. We prepared documentation, in the form of an article, on the motivation for adopting stable recycling cavities, and the article was submitted for publication.

Core Optics -- The metrology lab at Caltech has improved the noise level on the scatterometer and started characterizing some optics recently coated by LMA Lyon, a likely vendor for Advanced LIGO coatings. We visited a pathfinder vendor, Tinsley, to discuss progress and schedule.

Auxiliary Optics -- We are installing the Thermal Compensation System for enhanced LIGO. The design of the stray light control for Advanced LIGO is progressing, and we are testing ideas via fabrication and installation of enhanced LIGO baffling. The initial LIGO optical levers are being evaluated to explore incremental improvements for Advanced LIGO.

Interferometer Sensing and Controls -- We are focusing on commissioning the DC readout as realized for enhanced LIGO. We have made progress in identifying and reducing noise sources.

Data Acquisition System -- A new data acquisition computer configuration has been installed at Hanford. Testing with separate data broadcaster, FrameWriter, and NDS computers (all x86 based machines) is in progress.

System Engineering and Integration -- These are now Advanced LIGO Project activities.