LSC Six-Month Progress Report

Organization University of Oregon Experimental Relativity Group (UOERG)

Report Date 08/15/1999

Attachment A - LIGO I

Item - Task 7 -

The Oregon group worked on the following LIGO Scientific Collaboration activities during the current 6 month period (February 15, 1999 - August 15, 1999):

MAGNETIC FIELDS

We have continued using our magnetic field generating coils to study the transfer function from the outside to the inside of the vacuum chambers. Our initial efforts have been towards assessing the simplicity of this transfer function. We began by generating a/c magnetic fields on one side of a BSC (Beam Splitting Chamber) at Hanford and measuring the fields on the opposite side. These preliminary cross-chamber measurements will guide our planned measurements inside one or more chambers. Our experiments have addressed four topics:

1) The validity of assuming cylindrical symmetry. Cylindrical symmetry is unfortunately broken by large ferromagnetic support piers. We have found that these piers can increase the cross-chamber attenuation by a factor of two.

2) Superposition of fields. The assumption that superposition holds for magnetic fields may break down because of varying eddy current paths in the BSC. We use two generating coils at different locations to test superposition. We compare readings when both coils are on to the sum of readings when only one is on. We have so far found that superposition works to within a few percent.

3) Frequency dependence. At high frequencies, eddy currents in the chamber walls strongly attenuate magnetic fields. Using a signal analyzer in swept sine mode, we have found that the corner of the frequency vs. attenuation curve is at about 40 hz. Above this frequency the cross - chamber attenuation is about a factor of three.

4) Field strength independence. We have not found any field - strength dependence.

In addition to understanding the response of the chambers to magnetic fields, it is also important to get to know the fields we will be dealing with.

For this purpose we have measured stray a/c fields in and around WBSC-8. Robert Schofield made measurements inside of the chamber when he was helping install the down tube/ support table assembly. We found that outside the chamber fields averaged about 2.5 nT and inside they averaged about 1 nT.

We are planning a more extensive series of measurements inside BSC-7. We have just submitted a contamination control plan for this procedure. For this experiment, we will open ports on opposite sides of the chamber and slide two magnetometers through a tube connecting the open ports. Although the measurements will be made when the chamber is filled with purge air, special precautions are necessary to ensure that we do not contaminate the chamber. The tube is made from fiberglass (to minimize sag over the 15 foot length) and will be covered by a sock made from the same material as the clean-room (bunny) suits. We have made feed-through flanges that hold the tube and protect the conflat flange knife edges. It will be necessary to have a clean room enclosure over the chamber for these experiments. These measurement are tentatively scheduled for May 28 to June 1st. We have completed a dry run on a phantom BSC.

WEATHER MONITORING

We have completed our first release of the weather station device driver and EPICS system interface. We have designed a control room screen for the corner weather station. The LIGO weather is now available on the web.

While developing the system, we realized that the current system is not set up to monitor wind gusts, which may be important sources of mechanical oscillations in future interferometers. The current system will average wind speed for 2.5 seconds and read out once every 4 seconds. We are studying alternatives for more precisely measuring wind gusts.

We have also been helping Anthony Rizi at Livingston set up a weather monitoring system.

DUST MONITORING

Dust Monitoring is the most important PEM system at the moment and the cleanliness of the chambers now will affect the performance of future LIGO interferometers as well as that of the first. Since February 1st we have written a device driver for the Ligo dust monitoring system, incorporated it into the EPICS system, designed

a control room monitoring screen, and, with the help of many others, set up the corner station monitoring system that consists of ten dust monitors. This dust data is also now available on the web.

We also designed an extension system for monitoring dust inside of the actual vacuum chambers during installations. Internal monitoring had not been part of the original plan because the monitors themselves might be a source of contamination if placed in the chambers. The shop has delivered the intake extension hardware but it has not been tested.

OTHER PHYSICS ENVIRONMENT MONITORING (PEM)

We have also been involved with the PEM group in several other projects:

1) Measuring the changing tilt of the concrete slab as WHAM - 7 was pumped down. The difference in tilt was about 5 microradians. This tilt will affect laser alignment

2) Helping test chamber shakers and accelerometers.

3) Helping install tilt meters and seismometers.

4) Tracking down sources of seismic vibrations.

5) Tracked the source of spurious signals on the piezo shakers.

GENERAL EXPERIENCE AT HANFORD

Robert has also gained experience by helping with other systems besides PEM:

1) Helped install seismic isolation systems in HAM-10, BSC-8 and BSC-4.

2) Helped install and adjust the first core optic of the interferometer: the recycling mirror in HAM-9.

COSMIC RAY STATION

Considering alternative detector configurations.

The most feasible mechanism for a direct cosmic ray effect
comes most likely from a shower which is generated very
nearby to the test mass from a high-energy primary particle.
A shower initiated in, say, the top of the BSC, could deposit a
large fraction of the primary energy into the test mass.
A monitor placed to intercept such local events would maximize
the possibility of measuring some cosmic ray effect.
If indeed, it were found to be worrisome, say, for LIGO II
(the paper by Giazotto, eg, with LIGO parameters inserted,
indicates this possibility), then clearly the monitor
could be duplicated.

Proposing to place the monitor below one of the test mass chambers.
(The 4 km end stations might be best.)

DATA ANALYSIS

Studying simluations of two site binary-neutron inspiral signals
with the GRASP routines

Data characterization group - participated in discussions and plans
for effort, including concepts for reduced data sets and tape systems.