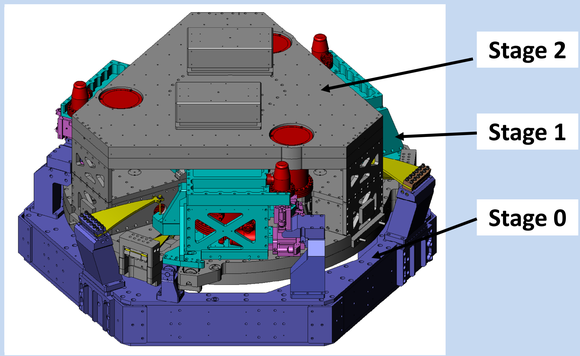
BSC Internal Seismic Isolation (BSC-ISI) and Quadruple Pendulum Noise Prototype (Quad NP) Testing at LASTI

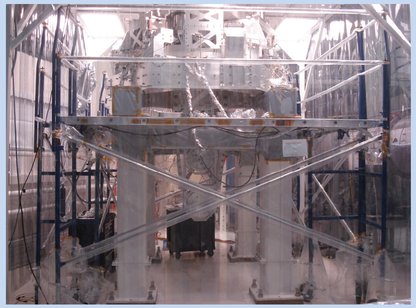
Overview of the BSC-ISI



Left view: Solidworks model of the BSC-ISI. Stage0 (blue), Stage1 (cyan), Stage2 (grey), Blades (yellow), Actuators (pink), Seismometers (red).

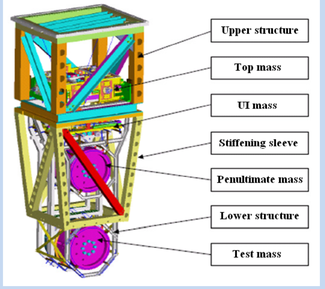
Right view: the BSC-ISI installed at the top of the BSC chamber.

ISI and Quad Together



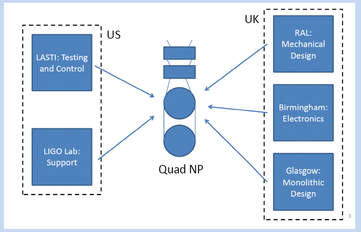
The ISI and quad together on the test stand at LASTI where they were assembled before they went into the BSC.

Overview of the Quad NP



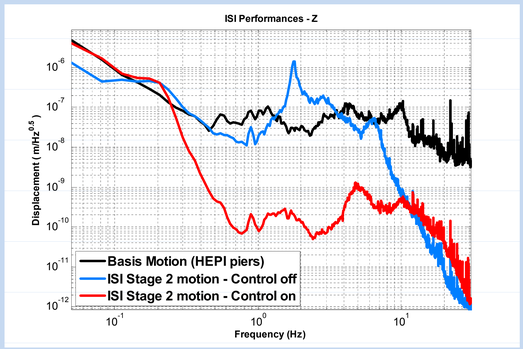
Schematic diagram of the quad

Photograph of the quad hanging in the BSC. Metal dummy masses were in place of the optics for the initial suspension work.



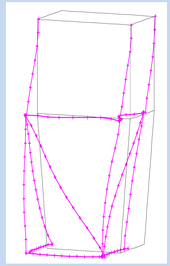
The various groups in the US and UK contributing to the quad.

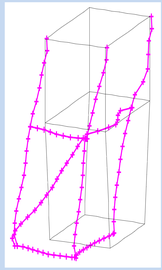
First ISI Control Commissioning:



Isolation performances measured on the BSC-ISI on November 2008. The change from black to blue shows the passive isolation provided by the ISI. Blue to Red shows the active isolation. On these preliminary results the control provided isolation from 0.25Hz to 12Hz. The target for the next control commissioning is 0.1Hz to 20Hz. Black to Red shows the total isolation.

Quad-ISI Modal Testing:

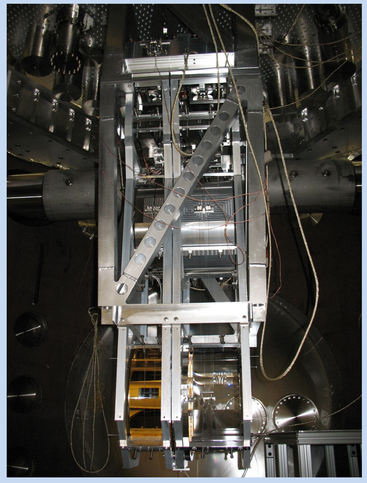




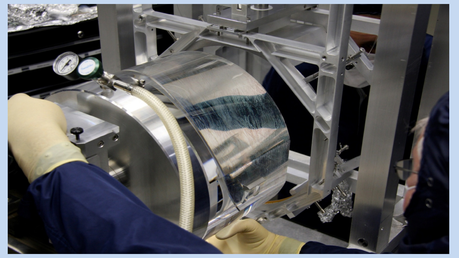
Upper picture: Modal analysis of the quad structure on the ISI. A force sensing hammer is used to measure transfer functions between various points on the structure and the accelerometer location. Information about not only the frequency, but shape of each mode of vibration can be extracted from these measurements. The goal is to identify the modes that limit the ISI's seismic isolation performance.

Upper Left: Measurement of the lowest frequency (81 Hz) flagpole mode of the quad structure measured using the modal testing technique. This picture shows the shape of the deformation of this mode.

Upper right: Flagpole mode of the quad structure in the other direction measured at 91Hz.



Recent Quad Work:

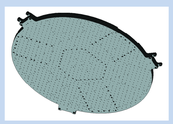


Right: Inserting the silica test mass, January 2009, into the quad structure with the ergo arm.

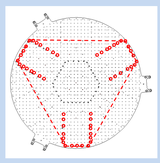
Left: The ITM quad back inside the LASTI BSC after the test mass, compensator plate, and ring heater were installed. In this state the mirror is hanging from piano wire. This wire will be replaced with silica fibers over the summer of 2009.

ISI Modal Identification:

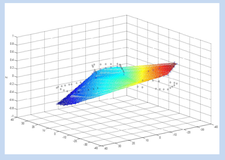
We are studying the deformation of the ISI to figure out which resonances observed in the ISI transfer functions are due to deformation modes. Below an example of measurements made on the optical table.



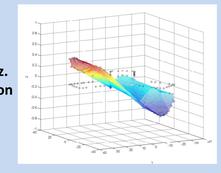
The optical table



Point of measurements



Mode at 97 Hz . The optical table moves like a rigid body.



Mode at 137 Hz. It's a deformation mode.

Upcoming BSC-ISI Work:

Control Commissioning

- Feedback loops: Raise UGF
- Lower the blend frequencies
- HEPI feedback loops
- Sensor correction
- HEPI to Stage1 feedforward

Design

- Reduce the time of assembly for AdL.
- Improvement of the stiffness
- Study the use of braces to damp/stiffen the Quad-ISI connection

Upcoming Quad Work:

Lower Right: the fiber pulling machine used to create the silica fibers that will be welded between the penultimate mass and test mass in the monolithic version of the quad noise prototype. This work is ongoing and scheduled to take place during the summer of 2009.

Other upcoming work involves the quad-triple cavity test where we will setup a single Fabry-Perot cavity between the quad and an input mode cleaner style triple pendulum. This cavity will test hierarchal locking controllers, local damping with aggressive noise filtering, damping of the mirror acoustic modes, the electrostatic drive, the ring heater TCS, and overall seismic isolation. The initial cavity alignment is in progress now.