

Suspensions/Isolation

Science/Integration 23 May 97 dhs

LIGO Adv R&D proposal carries outline of research

- Overall plans and schedules
- LIGO activities in domain
 - > double pendulum suspension
 - > active isolation
 - > thermal noise
 - > advanced isolation

January '97 Aspen workshop: Formation of Ad-Hoc Working Group

- meeting of interested parties
- discussions of present/nearterm activities
 - > LIGO: LIGO I; requirements; plans for thermal noise measurements
 - > GEO double pendulum design: final design this spring
 - > JILA: ambitious active seismic isolation system: 6 dof, 2 stages
 - > Stanford: fiber development, bonding techniques, control system studies
 - > Syracuse (and Moscow): substrate material losses
 - > Penn. State: sensor, actuator and servo studies
 - > Caltech/Drever: magnetic suspensions

Working Group

Common activities focussed around LIGO evolution

- 2003 LIGO II advanced subsystems
 - > double pendulum explicit path
 - > moderate improvements in Q
 - > associated control changes (e.g., external active system)
- 2007 LIGO III advanced LIGO
 - > large masses, high Qs, low F seismic isolation
 - > too early for conceptual designs
 - > 'what is crossover frequency with gravity gradient limit?'
- interest in coupling activities more tightly
 - > linked schedules, joint activities

Working group

Spring APS meeting: second meeting

- ~25 persons, some there just for Suspensions etc.
- technical discussions rather than organizational issues
- presentations: gravity gradient noise, ground noise at LIGO sites, point design spreadsheets, low-frequency limit to interferometry, control analysis of the JILA active isolation system, design considerations for LIGO suspensions, notes from visits to GEO lab, detailed transfer function modeling, status of the GEO600 suspension design, materials for suspensions, and experiment to make a direct measurement of substrate thermal noise and excesses, magnetic suspensions, silicon and sapphire bonding methods
 - > notes to appear on LIGO Web site (or ask dhs)
- basic plan outlined in Adv R&D proposal supported
- action items developed
 - > would like to distribute key LIGO environment, design documents

Next meeting

- in fall
- probably in conjunction with a first LSC meeting
- Summary: functional working group, targeted on LIGO needs;
- LIGO Lab playing a central role

MIT Lab proposal

LIGO plans range of activities in suspensions etc.

- modeling
- design
- table top testing
- high-sensitivity measurement of prototypes
- qualification

MIT proposes to become center for this research

- in particular, for full-scale measurements
- expect some activity also at CIT
- Mike will discuss facility
- focus here on medium-term plans impacting MIT facility
- small-scale experiments, modeling, associated (MIT/CIT)

Research to have strong collaborative element

- of course and first: within Lab (CIT/MIT)
- important to bring more hands to bear on problems
- significant activity in GEO, stanford, JILA, Pennstate, syracuse...
- desirable to have facilities within LIGO Lab

Responsibility and constraint

- requires human and physical infrastructure
- will lead to limits to time for bluesky research in a vacuum facility

Outline of plan

2003 Double pendulum advanced subsystem is focus

Near-term

- development of requirements
- establish boundary conditions and interfaces
 - > present stacks?
 - > present optics size?
- establish criteria for choosing configuration
 - > number of masses/reaction masses
 - > actuation philosophy: act on test mass?
 - > thermal noise

FALL 98

- perform up-front proof-of-principle tests as modeling indicates:
 - > actuator noise/dynamic range
 - > control hierarchy
 - > suspension fiber resonances; wire sensing/damping schemes
 - > Qs for translational (H,V) and rotational modes
 - > some can be performed in individual tanks of vacuum system
- build initial prototypes
 - > full-scale
 - > possibly targeting only control, or Q, or seismic filtering

Outline of plan

SUMMER 99

- test in suspended cavity(ies) in MIT facility
- control and isolation transfer function test targeted
- length and alignment

SUMMER 00

- test of multiple suspensions
- acquisition characterized

SUMMER 01

- test of complete FP-MI ifo, double suspensions
- full displacement sensitivity
- possibly also testing optical configurations
 - > (post-modulation?)

SUMMER 02

- qualification of suspension design
- final design
- fabrication