Discussion on thermoelastic noise
Aspen, 23 Feb 00

Talking points by David Shoemaker

LIGO-G000015-00-R

understanding of basic thermoelastic mechanism

- how bad is it?
  - First talk (Sam Finn) used LIGO I beam sizes
  - scales with r^-3/2, can gain factors of 2 reduction from those curves
- (is fused silica a better choice given other sapphire development difficulties?)
  - fused silica not less expensive, and presently not as good
- papers:
  - Braginsky et al., Phys.Lett.A Dec. 13
  - Liu and Thorne, Thermoelastic noise and homogeneous thermal noise in finite sized gravitational-wave test masses, gr/qc
  - Bondu, P. Hello, and J.-Y. Vinet, Phys. Lett. A 246, 227 (1998)

additional compromises to thermal noise

- other mechanisms (young's mod vs thermal expansion?)
  - Geppo Cagnoli sketches idea (elsewhere in Workshop VGs)
  - Bill Kells: ‘scintillation’ in substrate (Thursday morning)
- coating losses
  - conflicting experiments at present
- attachments - silicate bonding, differential expansion
- actuators - electrostatics ok?
- suspension fibers: close look at noise mechanisms

experimental tests

- Qs
- anelastic relaxation - especially interesting for Sapphire
- photoelastic measurement of thermoelasticity?
- direct measurements - how to best to coordinate?
  - TNI
  - VIRGO
  - ACIGA
  - TAMA
  - LASTI
  - Hannover
- other sapphire material parameters
  - conductivity, etc.

trades in interferometer design given this noise source

- size - radius, thickness (form?)
- simplifications of suspension/attachments due to higher noise
- mass of optic
- relaxation of seismic noise/technical noise
- delay lines/higher modes for at least prototype tests

alternative materials - long term options

- characterization of sapphire (etc.) at a variety of temperatures
- back to fused silica?
- silicon etc. for end mass? (cool to 140 deg???)
- diffractive optics