Thermal Noise Interferometer (TNI)

Eric Black
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Current status

- Been taking data since 12/01.
- Currently using Fused Silica Mirrors.
- South Arm Cavity has been close to design sensitivity. North Cavity noisier.
- Recent focus on improving reliability, noise in North Arm Cavity.
- Daytime operation with fast lock acquisition recently achieved.
- Noise, laser power recently balanced between arm cavities.
- South cavity noise degraded after balancing.
Plans for 2003

- **Fused Silica:**
  - Measure coating thermal noise, net thermal noise for low- and high-Q substrates.

- **Sapphire:**
  - Measure thermal noise (Braginsky noise?) in sapphire, report to downselect committee.

- **Non-Gaussian noise:**
  - Measure non-Gaussian noise in fused silica, sapphire if time permits. (May be suspension dominated.)

- **Quantify fundamental *and technical* noise sources.**
- **Quantify photothermal effect in coatings.**
Technical Risks and Opportunities

- Low noise is hard!
  - Shot noise below $1e-19m/\sqrt{\text{Hz}}$ requires precise alignment, good visibility.
  - Best configuration for scattered light difficult to reproduce. (This means we don’t yet understand it.)
  - Electronic crosstalk sporadically problematic. Electronic noise does not necessarily always go down when we change a module!

- What unknowns are waiting for us in sapphire?

- Opportunity: Seismic retrofit to measure suspension thermal noise? (Probably later than 2003.)

- Opportunity: May find and quantify noise sources relevant to LIGO-I.
Schedule issues

- Initial noise levels have been better than expected.
- Further noise reduction slower than expected.
- Initial lock-acquisition was *much* more difficult than expected.
- Changes in downselect date compensate for schedule slips.
Cost baseline and issues

- All planned hardware already acquired. We are now in “science mode.”
- Further upgrades must be purchased as needs, dominant noise sources are identified.
- Electronics: miscellaneous upgrades. (estimate 20k$ -- some from cds?)
- Computing/data acquisition for non-Gaussian work. (<6k$)
- Optics: miscellaneous expansions and upgrades from vendor stock. No custom items planned for 2003. (estimate 15k$)
Staffing baseline and issues

- **Faculty:**
  - Ken Libbrecht (1/6 salary, time greater)
  - Seiji Kawamura (visitor, ~1/4 time)

- **Staff:**
  - Eric Black (1/3 salary, time greater)

- **Graduate Student:**
  - Shanti Rao (1/1 salary, photothermal exp.)

- **Undergraduates (all SURF, possible future returns):**
  - Kyle Barbary
  - Adam Bushmaker
  - Fumiko Kawazoe
  - Sharon Meidt