



Thermal Noise Interferometer  
Advisory Board Review

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## Recent

- Optimized coatings
  - In coordination with Sannio, Italy group and LMA (Lyon, France)
  - End of 2yr project (expected 1yr, but met with fabrication delays (bubbles))
  - Results consistent with Sannio models
  - Analysis in progress to determine material loss parameters (silica in question), whether or not thermo-optic noise components add coherently or in quadrature
- Coating-loss homogeneity
  - Addresses long-standing spot-size issue of relevance to big interferometers
- Ring dampers
- Calibration
  - Discrepancy of ~20% between direct (TNI) and indirect (Q) measurements of coating thermal noise needed to be resolved.
  - Akira will present in detail.
- Lab move
  - Caltech division requested

## Current

- Doped, optimized coating measurement
  - In coordination with Sannio, Italy and LMA (Lyon, France)
  - Coating design contingent upon analysis of undoped, optimized results (in progress)
- Photothermal recommissioning after lab move (Tara)
  - Thermomechanical properties of coatings needed to model noise floor of AdvLIGO, AdvIRGO, etc.
  - Could take data with a few weeks notice.
- Shot-noise analysis and mitigation
  - Necessary (and possibly sufficient) for a direct measurement of  $dn/dT$  in coatings.
  - Akira will talk about this in detail.
- Analysis of SOPRA ellipsometry data on  $dn/dT$  in thin-film tantala
  - In coordination with Andri Gretarsson (Embry-Riddle)
  - Greg Ogin will talk about this in detail.
- Updating BENCH to include coating optimization
  - In coordination with Innocenzo Pinto (Sannio, Italy), Clare Bayley and Gregg Harry (MIT)
  - Greg Ogin will talk about this in detail.

## Future

- Gold barrel coatings
  - In coordination with David Blair's group (UWA)
  - They measure parametric gain at Gin-gin.
  - We measure thermal noise and Q suppression at the TNI.
- Direct measurement of thermo-optic noise
  - May be achievable with proposed shot-noise improvements (Akira)
  - Almost certainly achievable with new mirrors that increase arm-cavity finesse
- Photothermal measurements of  $\alpha(1+\sigma)$ ,  $\kappa$  in advanced coatings
  - Have already done periodic si-ta
  - Can measure in doped, optimized, or any combination
  - Other materials?
- Photothermal measurement of thermo-optic response in coatings
  - Separate thermomechanical and thermorefractive components
  - Yields  $dn/dT$  with existing hardware
- Charge noise measurement, mitigation-scheme test?

## Questions

- Which size optics to use for barrel-coating measurements?
  - TNI size: 4" diameter by 4" thick right cylinders
  - Gin-gin size: 4" diameter by 2" thick right cylinders
  - Modify suspension to accept Gin-gin-sized optics, or use TNI optics?
- Is a direct measurement of thermo-optic noise important enough to justify buying a new set of (high-finesse) mirrors, if shot-noise improvements do not uncover it with existing optics?
- How soon can we expect samples for photothermal measurements of  $\alpha(1+\sigma)$ ,  $\kappa$ ?
  - Sample delivery now (probably) drives schedule on this experiment.