



Proposal Plans for LIGO Scientific Collaboration

Mahidol University
International College
Thailand

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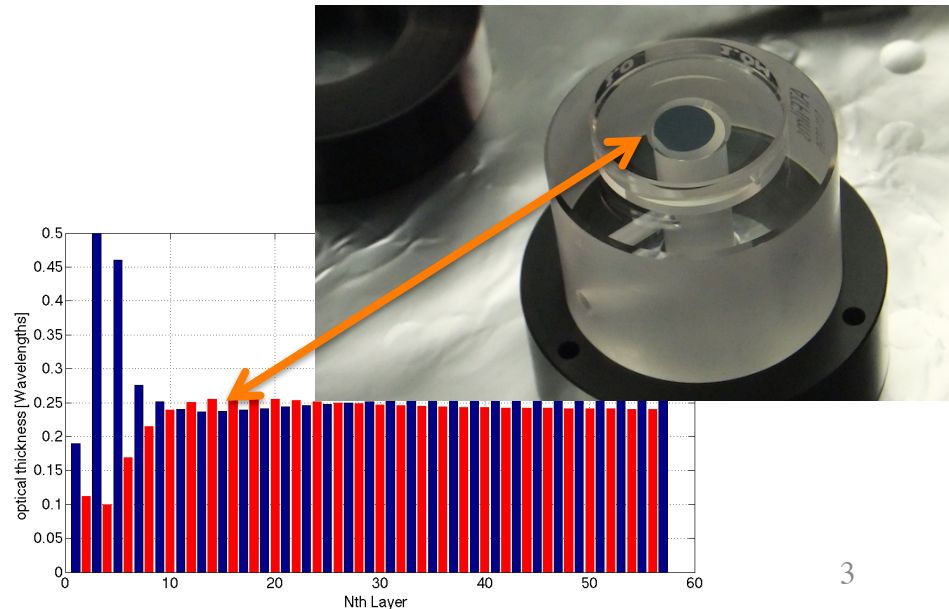
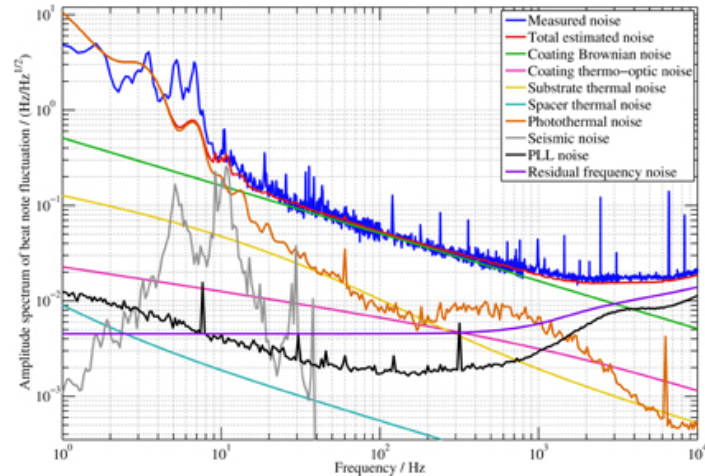
Mahidol University International College, Thailand.

- 30-min drive from Bangkok.
- Liberal Arts School
- Total Students: 3000+
- Physics Students: 12-15



Previous Work

- Thermal Noise Measurement from $\text{SiO}_2/\text{Ta}_2\text{O}_5$ Coatings. [1]
- Photothermal Noise Optimization for AlGaAs coatings. [2]

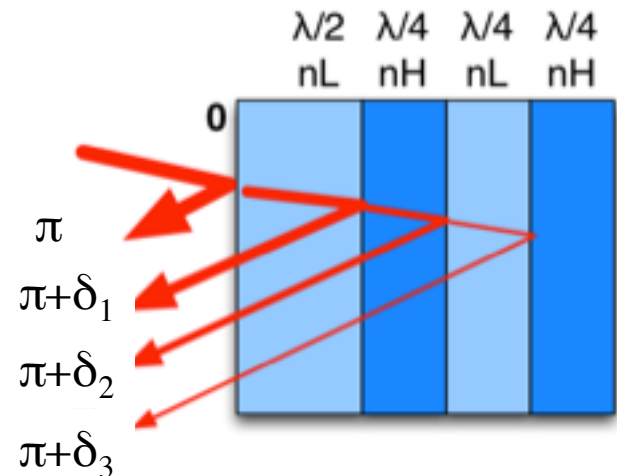


[1] Metrologia **52**, 17

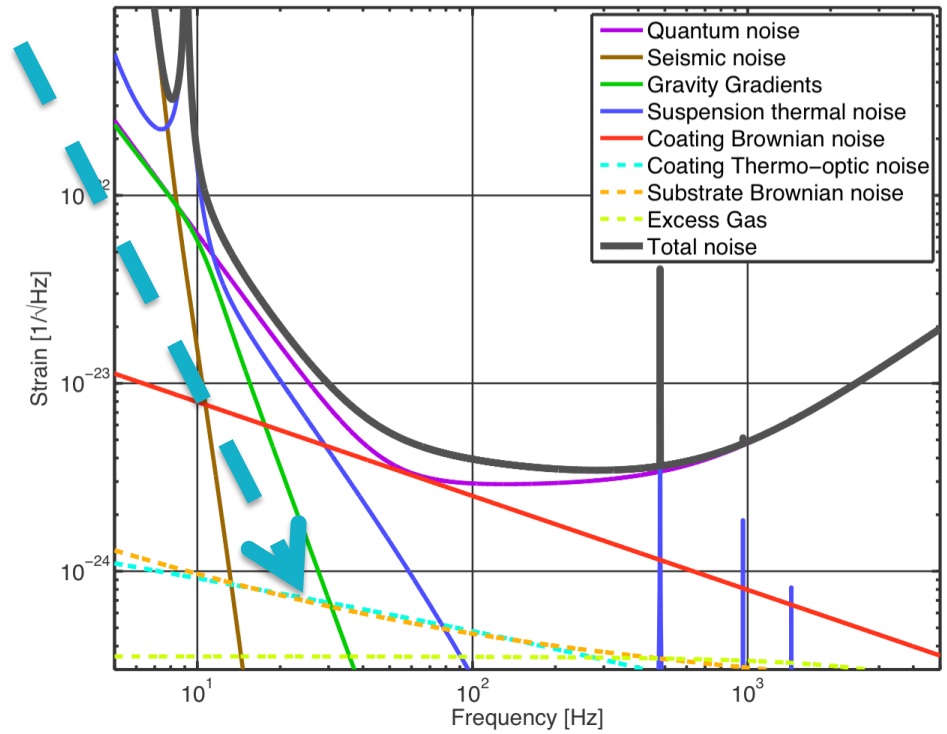
[2] Metrologia **53**, 860

Review: Thermo-Optic and Photothermal Noise

- **Thermal expansion coefficient α** changes the position of the mirror surface.
- **Thermo refractive coefficient (dn/dT) or β** changes the phase of the reflected beam.



- Called **Thermo-Optic** Noise if driven by Thermodynamics fluctuations (combination of Thermo-elastic (TE) and Thermo-refractive (TR)).
- Called **Photothermal** Noise if driven by temperature change due to absorption from laser's power.
- By designing Coatings layer thickness to cancel the effects from α , β . Both noise can be minimized.



aLIGO Noise Budget 125 W input power

(1) Thermo-elastic Noise in Coatings with residual stress

- Thermoelastic noise calculations in coatings have not included residual stress in the coatings [1,2].
- However, if materials is **under stress**, it has another dissipation due to temperature dependence of the materials' Young's moduli [3].
- **Plan:** To investigate the effect of residual stress in coatings for better understanding of thermo-elastic noise.

[1] Fejer et al, Phys. Rev. D 2003

[2] Braginsky et al, Phys Lett A 2003

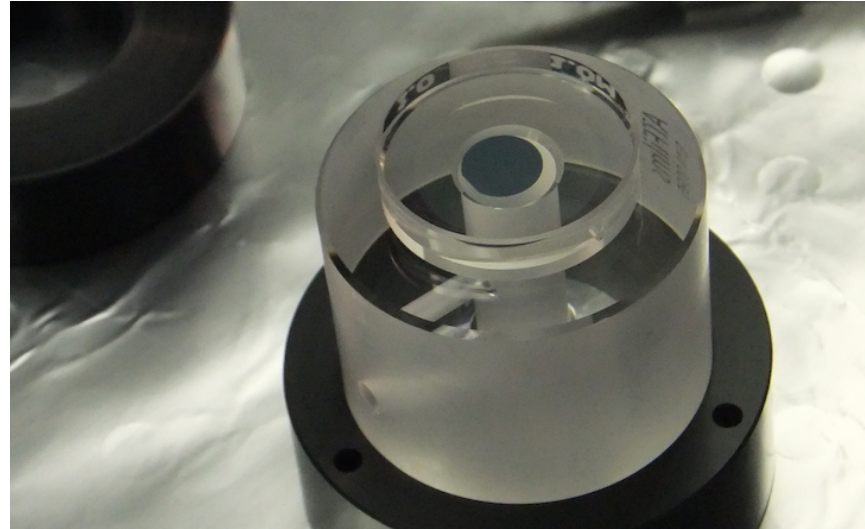
[3] Cagnoli, Willems, Phys Rev B, 65 2002

Possible Applications

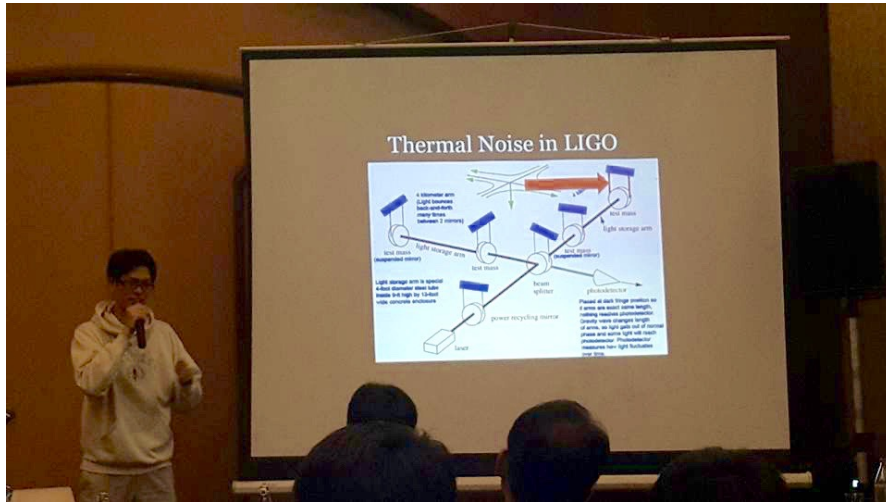
- **Photothermal noise reduction for amorphous coatings:** If we can tune residual stress in the coatings
 - may be possible to reduce photothermal noise
 - maintaining quarter wave structure.
- **Upper Limit of Stress in AlGaAs Coatings:**
 - Most likely, AlGaAs coatings will be optimized for TO noise.
 - determine the acceptable stress level for fabrication process.

(2) Mechanical Loss in Optical Contact

- Recent usage is for AlGaAs coatings on SiO₂ substrate.
- The coating-substrate bond is closer to the beam. Noise in the bond will contribute more to the measurement.
- **Plan:** To setup a measurement facility to test Q factors on various bonding methods.



Educational and Public Outreach



- Invited speaker at universities/ high schools
Topics range from GW detection to life as a physicist.



- Translating news and articles from ligo.org into Thai.



Thanks for your attention