



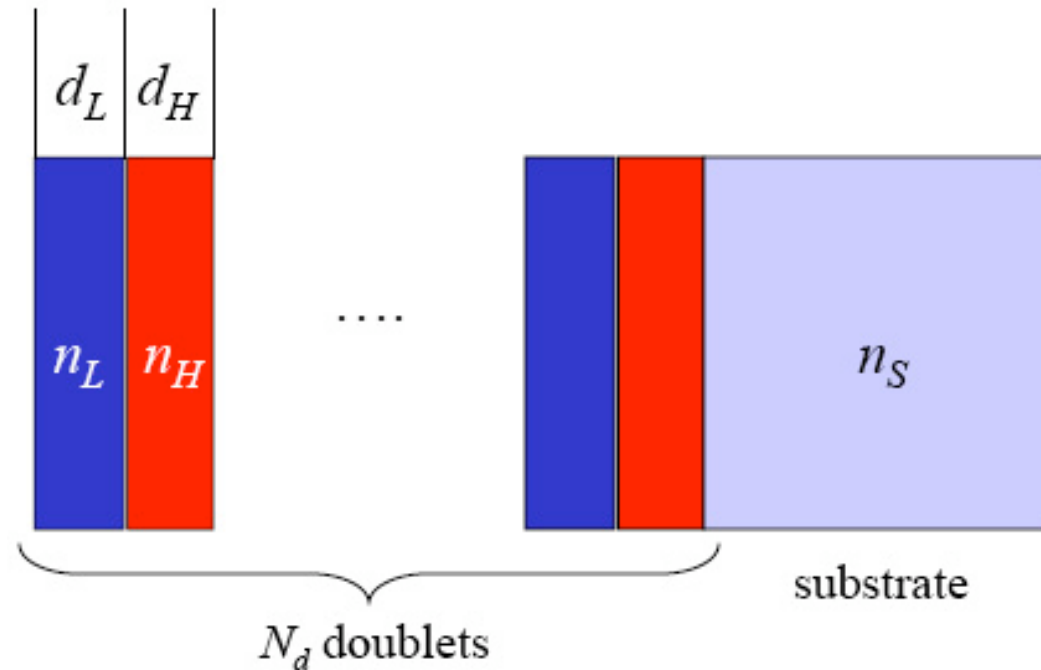
From the TNI:
Optimized Coatings &
Improved Accuracy

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Optimized Coatings

- Collaboration with
 - Vincenzo Galdi and Innocenzo Pinto at Benevento (coating design),
 - LMA at Lyon (fabrication and loss measurements), and
 - Sheila Rowan at Glasgow (loss measurements)
- Instead of $\lambda/4$ layers, reduce the thickness of the more lossy material and increase the thickness of the less lossy material. To maintain reflectivity, increase the number of layers. The tradeoff should lower noise floor.

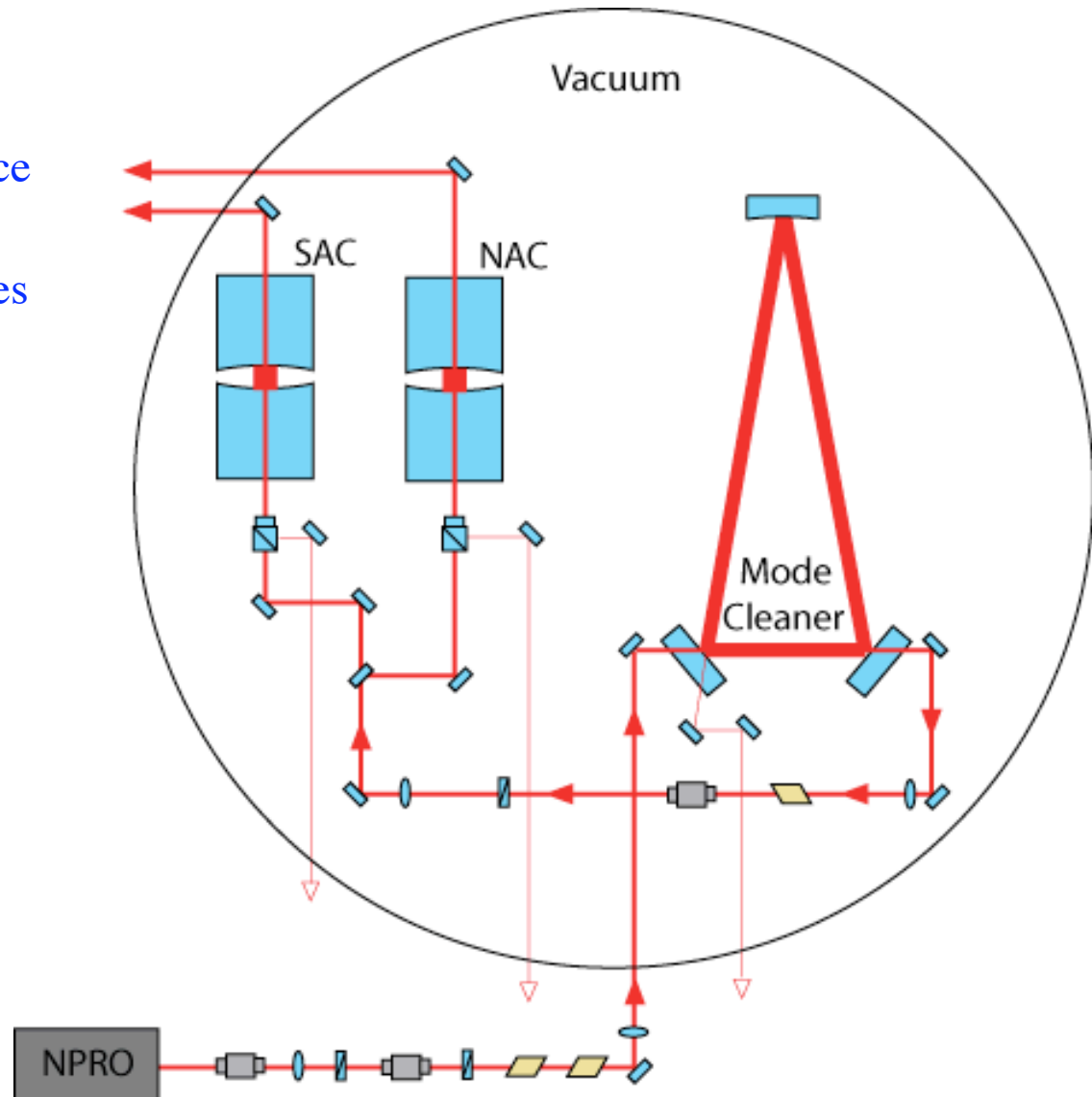


$$d_{L,H} = \left(\frac{\lambda_0}{n_{L,H}} \right) z_{L,H}, \quad z_{L,H} = \frac{1}{4} \pm \xi$$

Innocenzo Pinto

Thermal Noise Interferometer

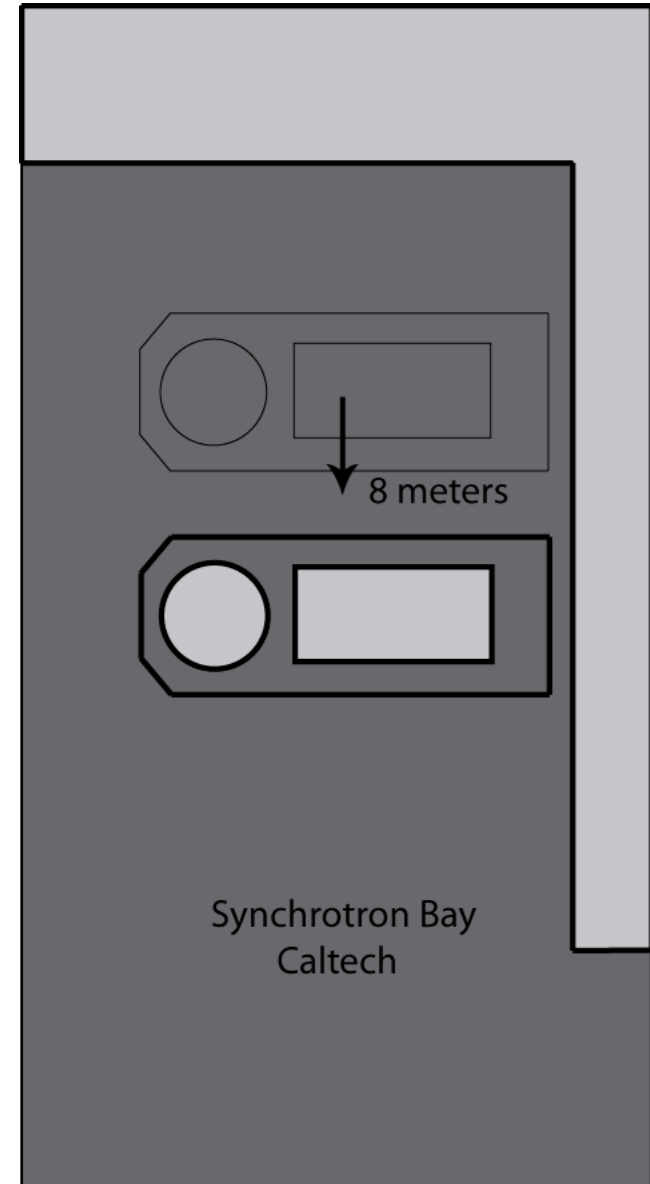
- Short test cavities reduce laser frequency noise
- Small spot size increases thermal noise





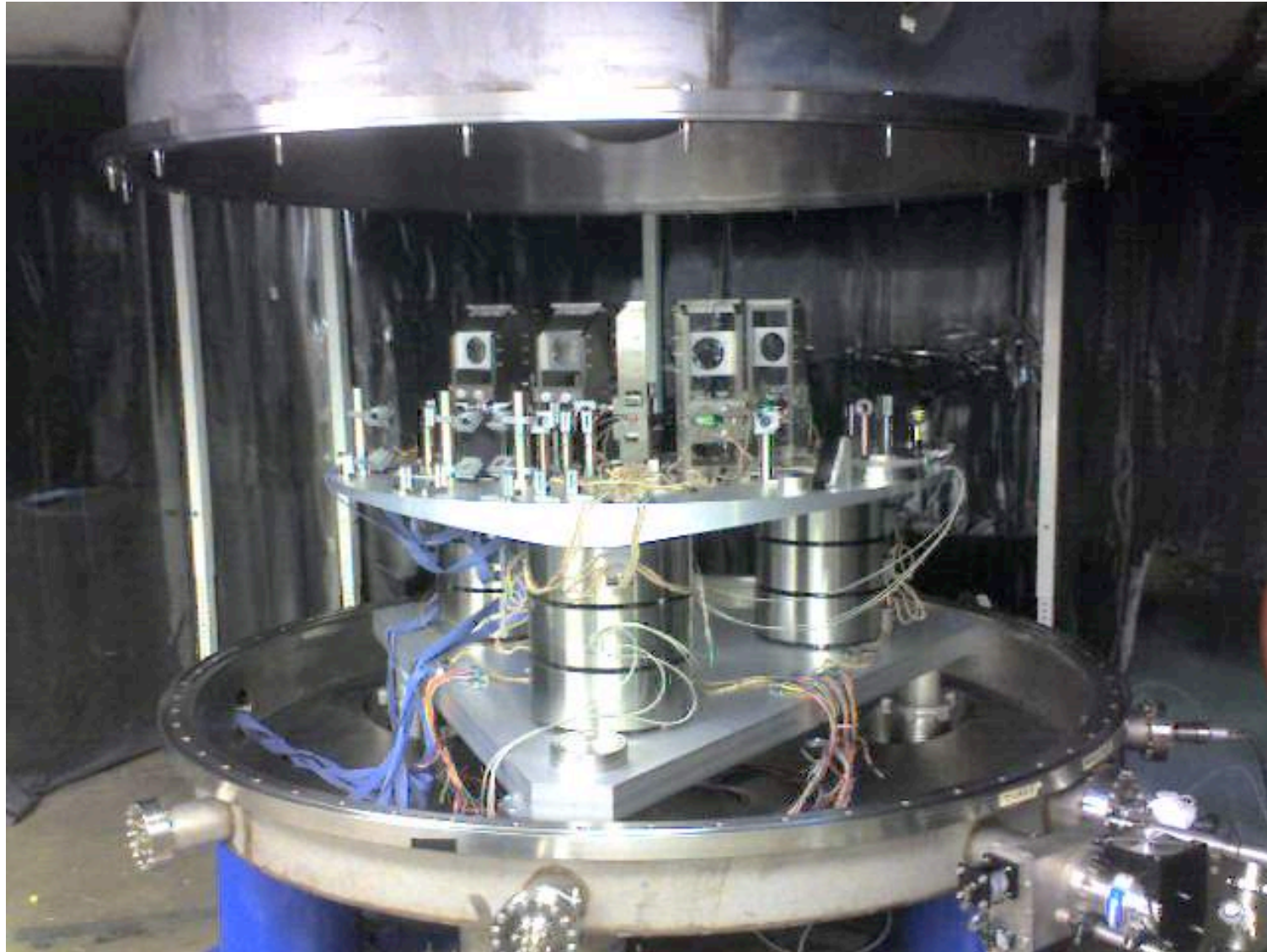
Moving the TNI

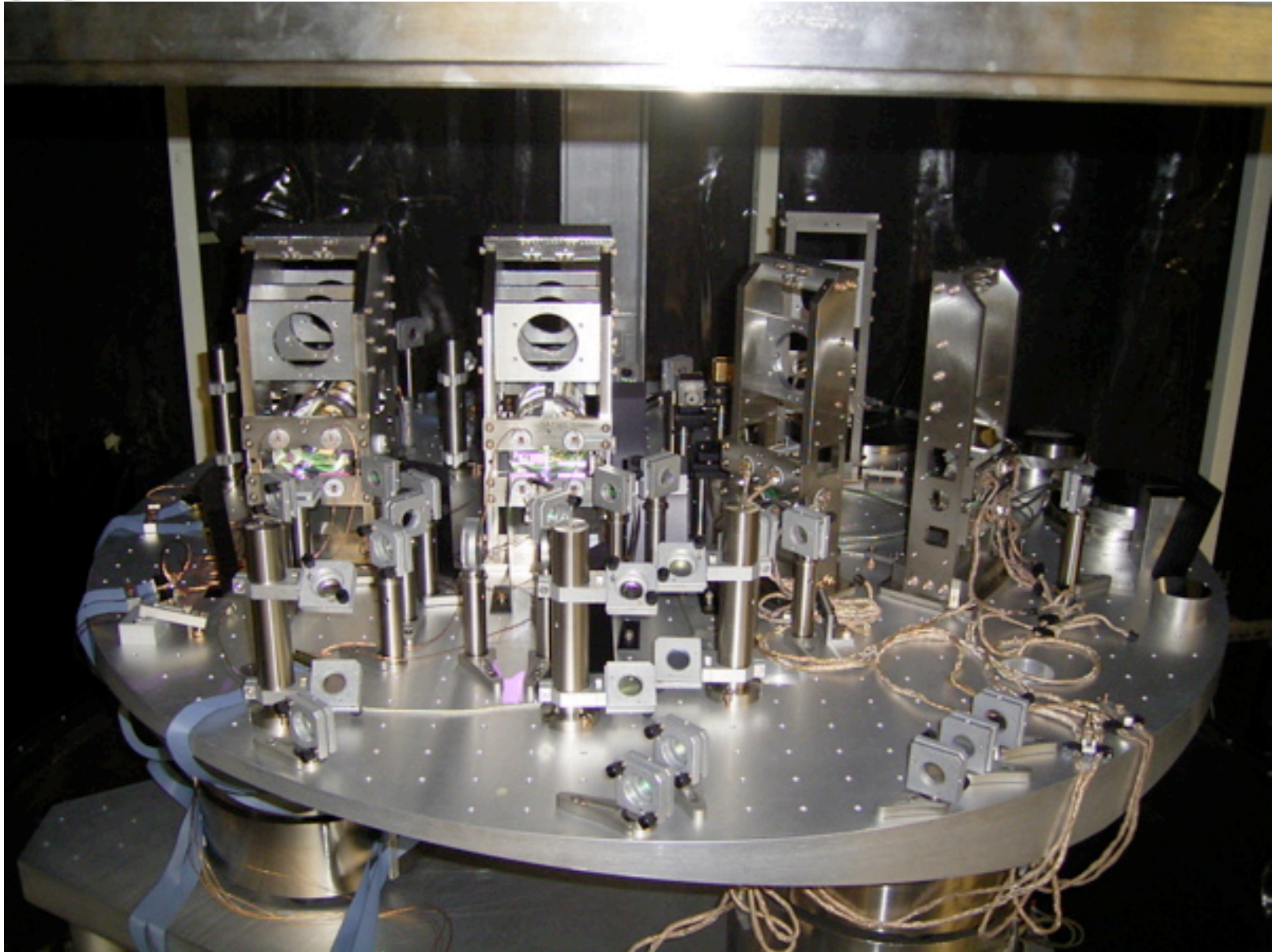
- Unavoidable move began
~ 2 months ago
- Optics disassembled,
vacuum chamber moved,
cleanroom disassembled
moved
- Everything rebuilt at new
location





Start of Move









Moving the Vacuum Chamber

- Weight of Chamber ~ 3 tons
- Diameter = 2 m; Height = 3 m
- Pressure $\sim 10^{-7}$ Torr



 **LIGO**

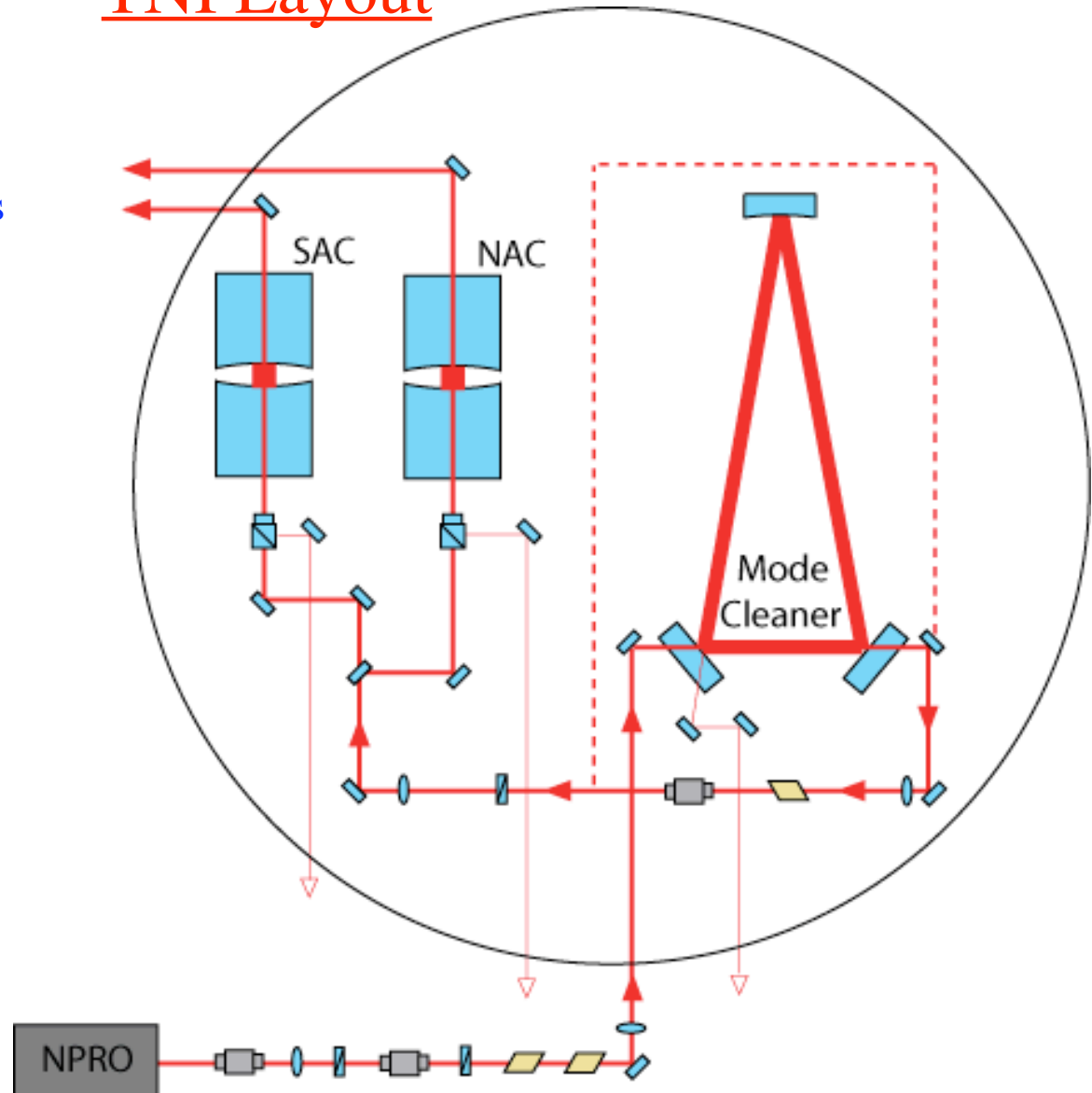






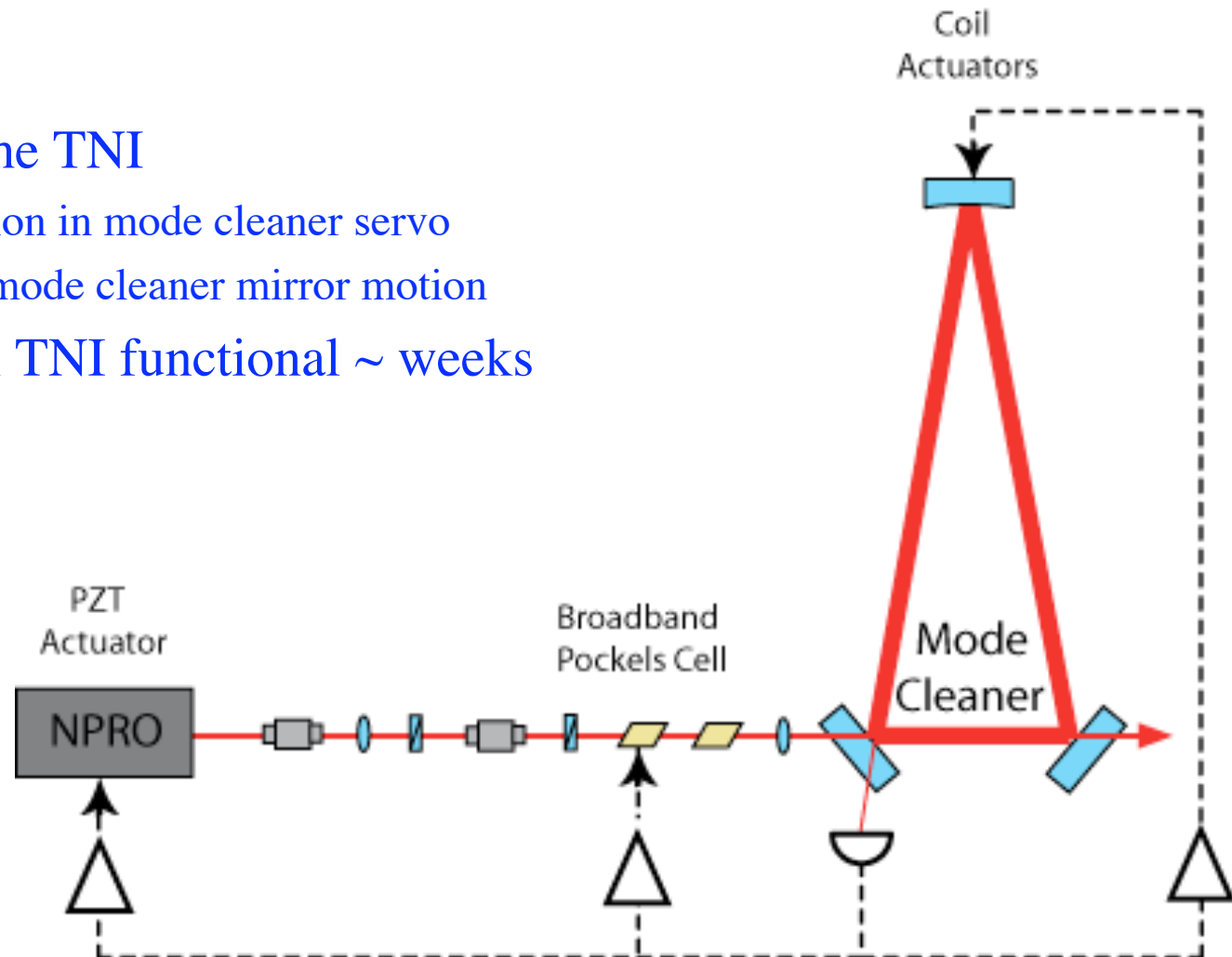
TNI Layout

- Configuration Changes
 - Path between mode cleaner and test cavities was shortened
 - Polarization into chamber was rotated to vertical
 - Pockels cells were moved to a location with lower intensity



Mode Cleaner Servo

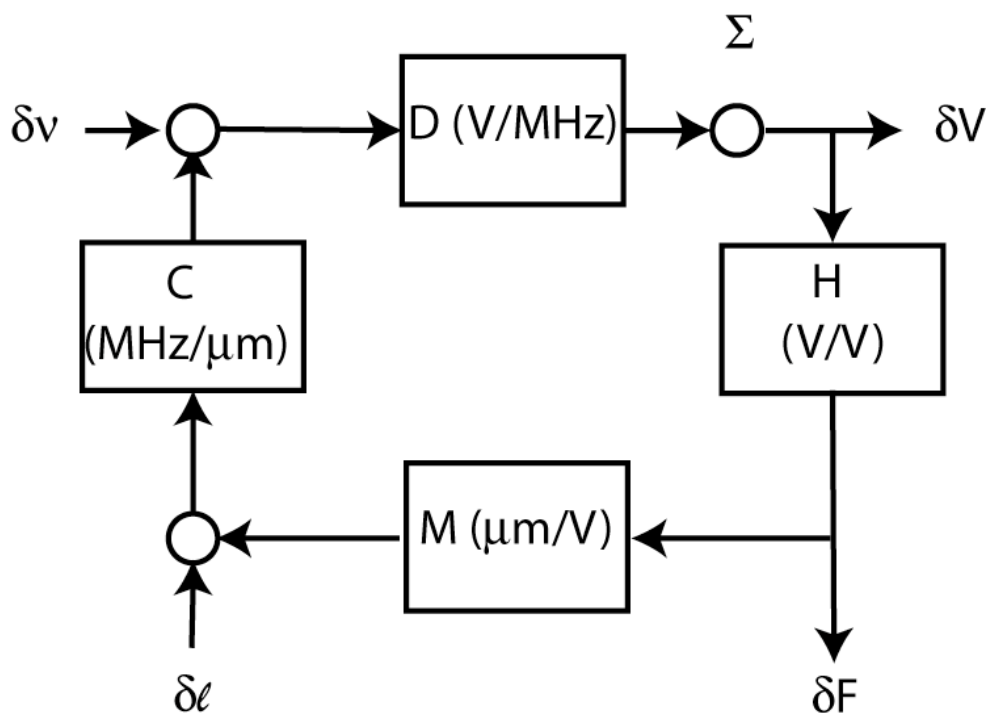
- Issues at the TNI
 - Oscillation in mode cleaner servo
 - Excess mode cleaner mirror motion
- Time until TNI functional ~ weeks





Calibration

Test Cavity Servo

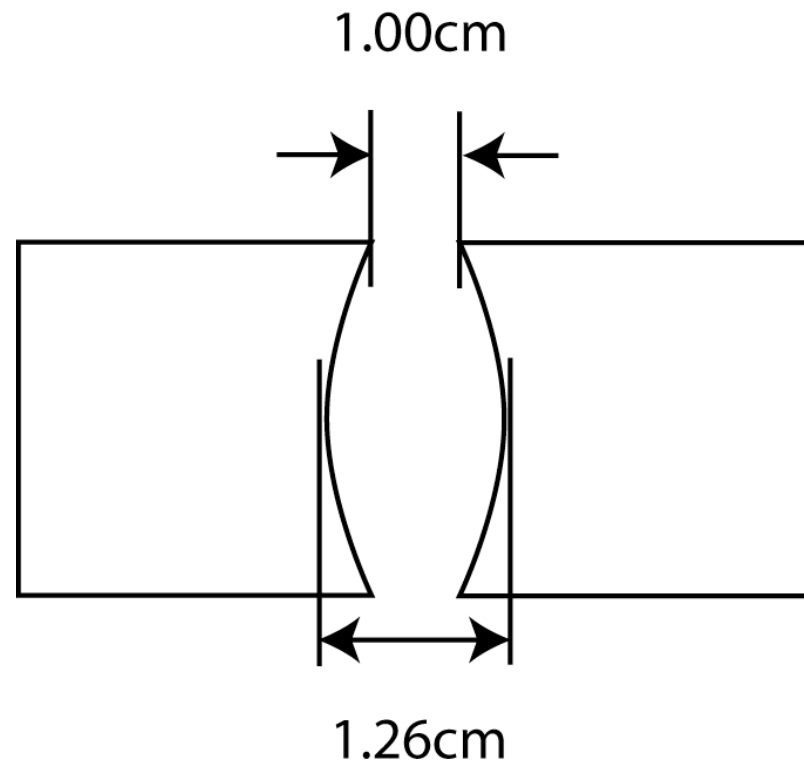


$$\delta l = \frac{1 + DHMC}{DC} \delta V$$

- Good calibration is necessary to accurately convert signal into length noise.

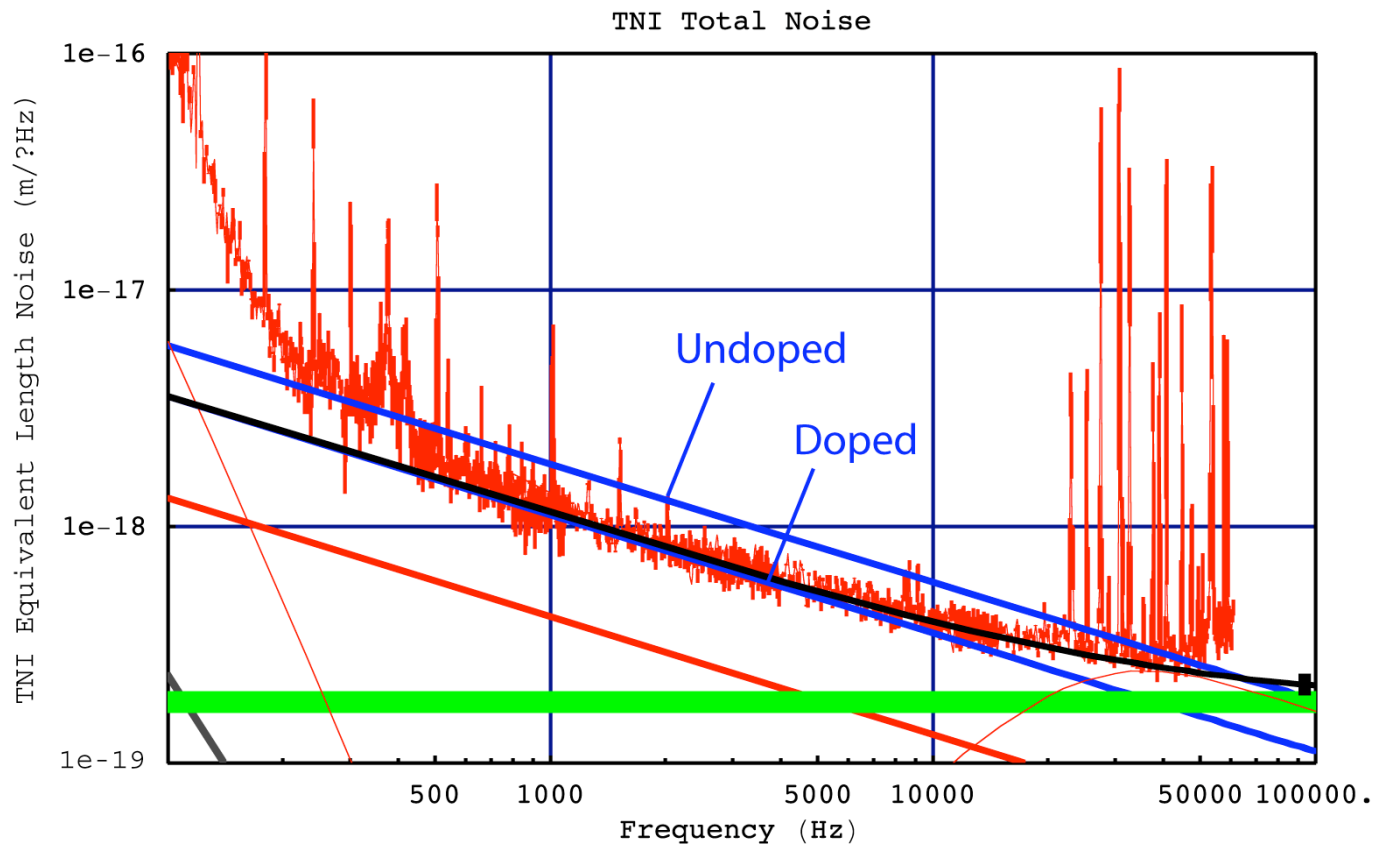
Cavity conversion factor (C)

- $C = v/L$
- 1 m is not that large!
- New L also affects spot size on mirror





Revised loss angles



- Current most accurate calibration has:

$$\phi_{\perp, //} = 3.2e-4$$

for undoped SiTa

$$\phi_{\perp, //} = 2.3e-4$$

for Ti-doped SiTa

a 30% reduction from doping.



Summary

- The move of the TNI has delayed the measurement of the thermal noise in optimized coatings
- We expect these results in a few weeks
- Calibration of the instrument is more accurate than ever