

# The Thermal Noise Interferometer

Measuring Displacement Noise in Advanced Suspended Interferometers

Ken Libbrecht, Eric Black, Luca Matone, Shanti Rao, Kevin Schulz  
LIGO/Caltech

## Objectives:

### ► Characterize Advanced Detectors

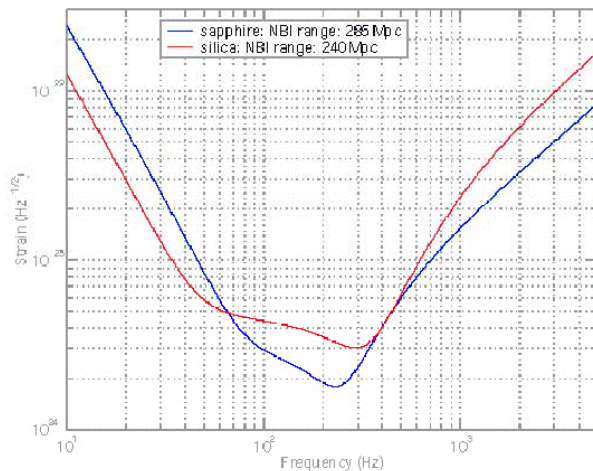
Verify Thermal Noise Models

Measure Non-thermal Noise Properties

### ► Physics of Fundamental Noise Sources

Isolate and Study Physics of Noise Sources

Reach (and Exceed) the SQL



Thermal Noise models not adequately  
Verified at LIGO levels

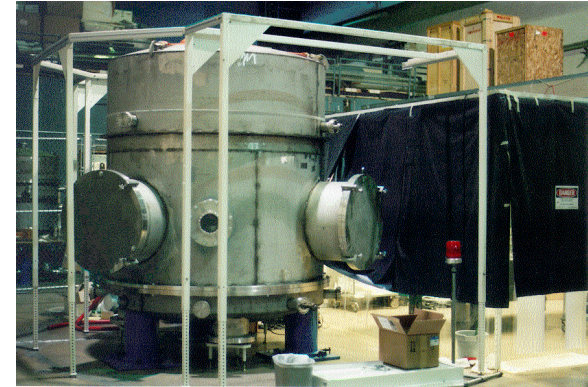


# TNI Design Elements

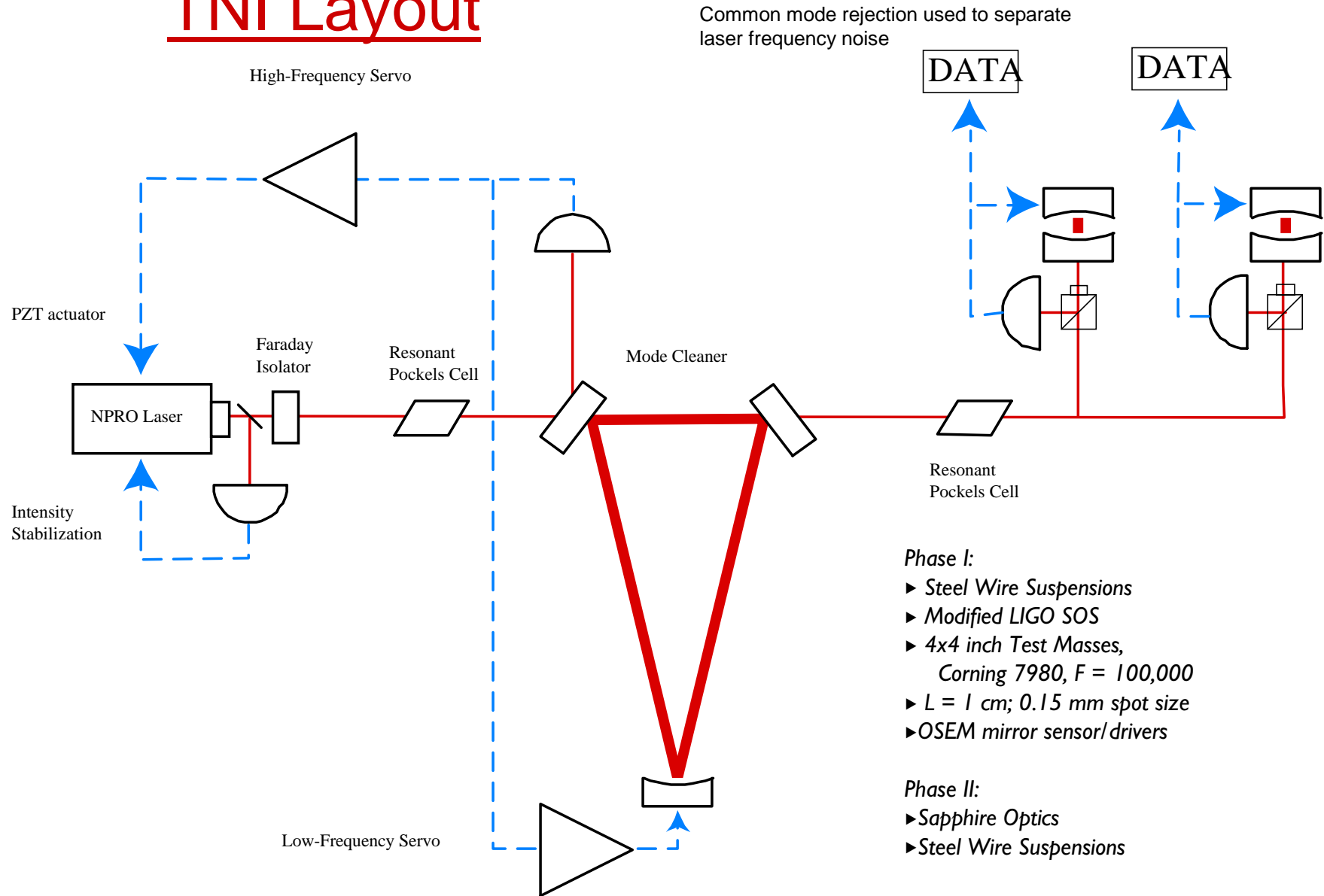
The many advantages of using a short cavity length ( $L \approx 1\text{cm}$ )

- ▶ *Short Cavity Storage Time*
  - ⇒ *Use High Finesse Cavities*
  - ⇒ *No Power Recycling*
- ▶ *Independent Cavities*
  - ⇒ *No Recombination*
  - ⇒ *Independent Controls*
- ▶ *Reduced Optical Pointing Requirements - no WFS*
- ▶ *Reduced Laser Stability Requirements*
- ▶ *Common Support for Test Masses*
  - ⇒ *Reduced Seismic Noise*
  - ⇒ *Lower Suspension Recoil Thermal Noise*

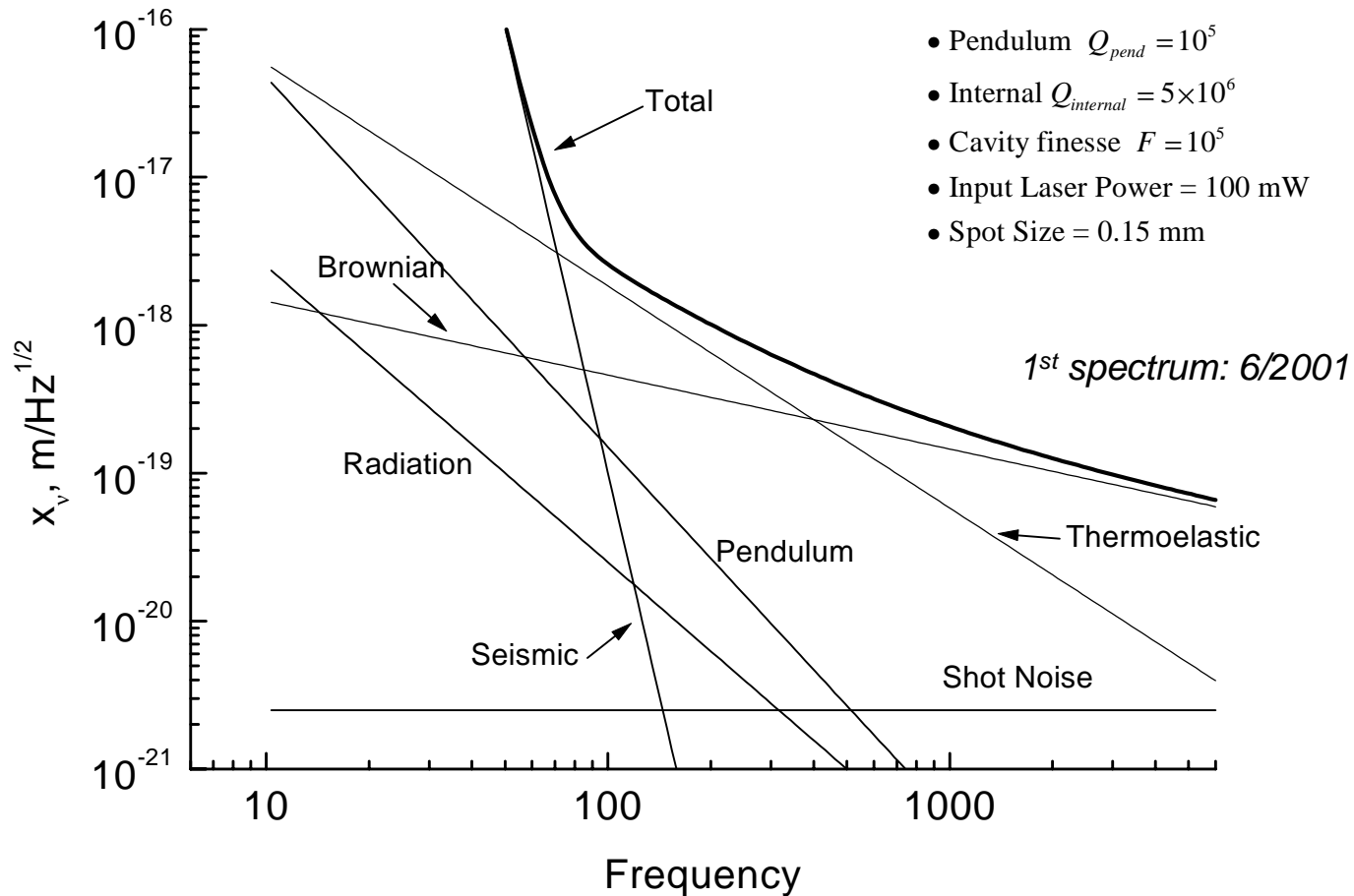
*But...Smaller laser spot size ⇒ Higher Internal Thermal Noise*



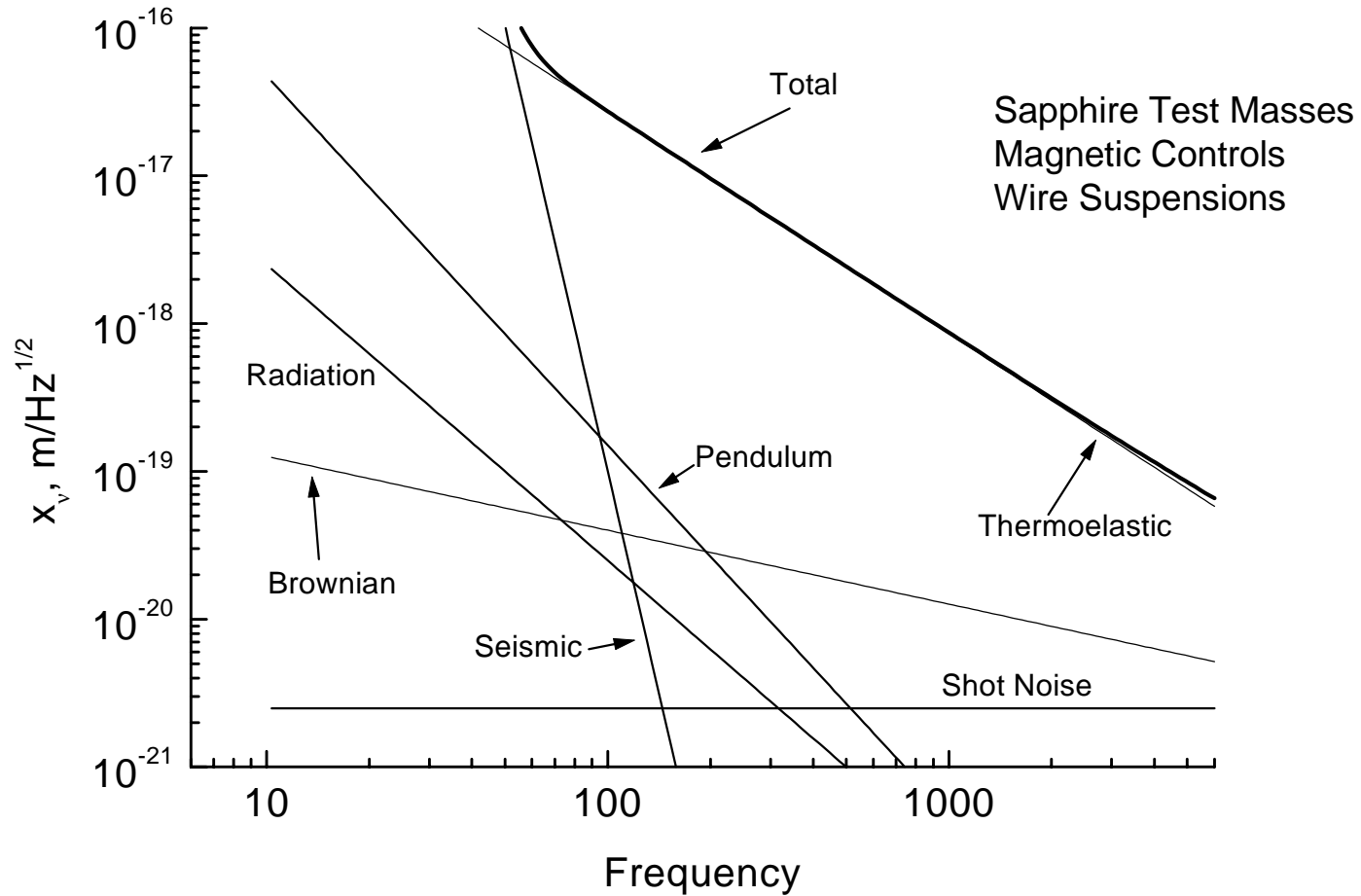
# TNI Layout



# TNI Phase I Expected Spectrum



# TNI Phase II Expected Spectrum



TNI View inside vacuum chamber

