LIGO

Optics and Laser Research at MIT

David Ottaway

LIGO Laboratory

MIT

PAC 12 Meeting June 02

LIGO-G020270-00-R

LIGO

Overview

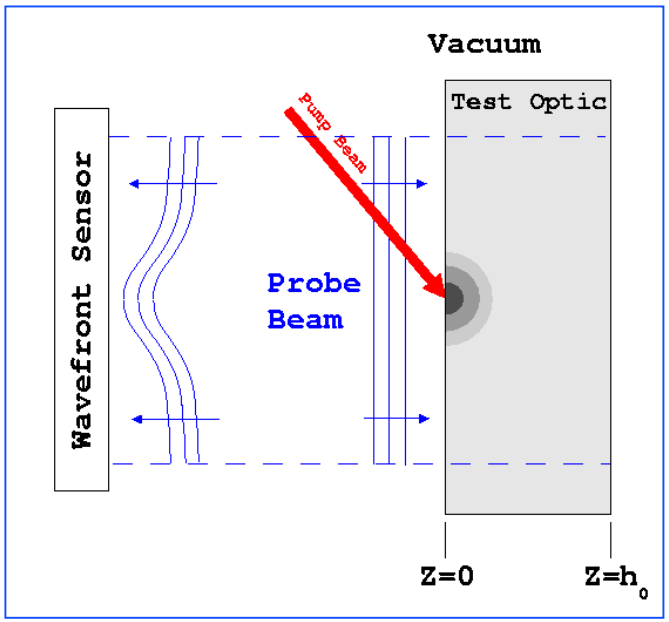
1. Thermal compensation and material thermal mechanical properties (Ryan Lawrence)
2. LASTI PSL Program (Jamie Rollins)
3. Sideband profiling program (Keisuke Goda)

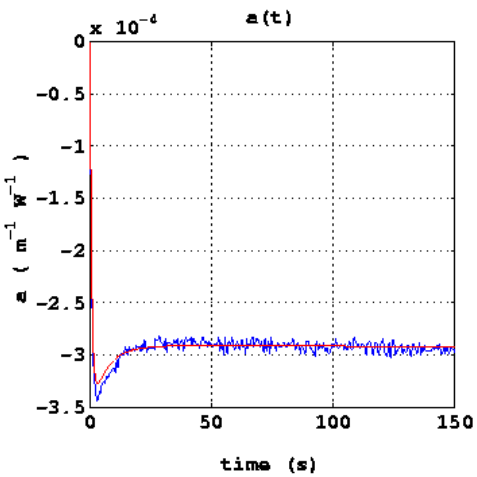
LIGO

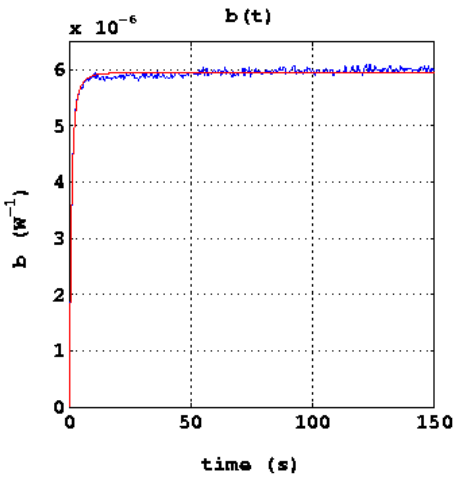
Adaptive Thermal Compensation

- Essential for Advanced LIGO sensitivity to be realized
- Two parts to thermal compensation:
    1. Coarse compensation of thermal lensing using heating ring and shielding
    2. Small scale compensation using scanning CO_2 laser
- Accurate measurement of sapphire and fused silica thermal mechanical properties enable accurate models

Thermophysical Parameters Measurement (295-320 K)



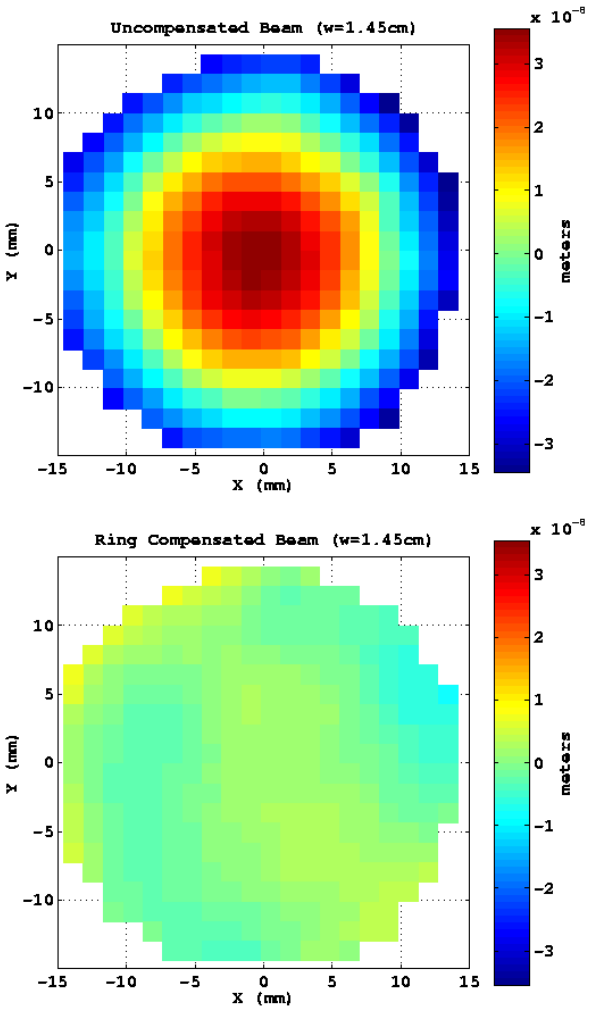


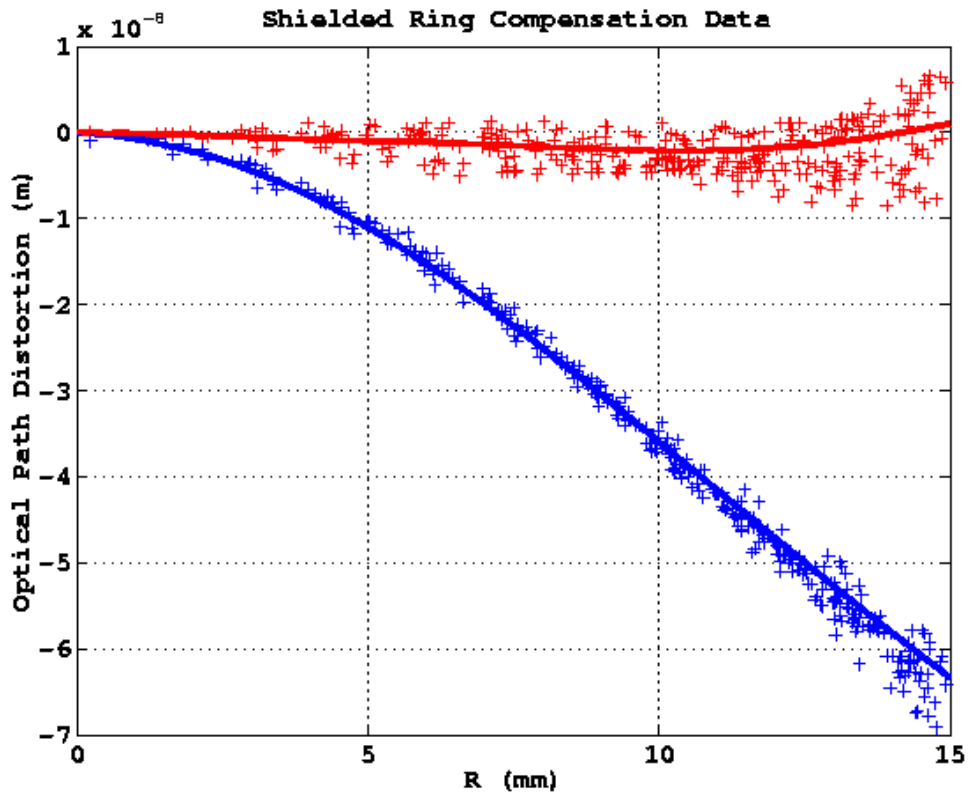


Fused Silica (Corning 7940)			
Parameter	Value	Error	Units
dn/dT	8.7	0.3	ppm/K
α	0.55	0.02	ppm/K
k_{th}	1.44	0.02	W/m/K

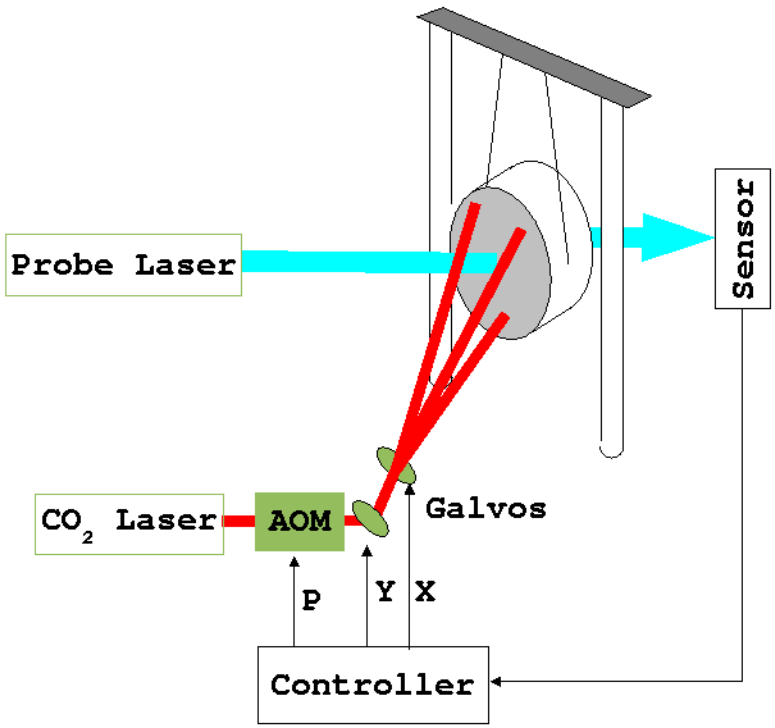
Sapphire (C and A axes)			
Parameter	Value	Error	Units
dn/dT	7.2	0.5	ppm/K
α_a	5.1	0.2	ppm/K
α_c	5.6	0.2	ppm/K
k_a	36.0	0.5	W/m/K
k_c	39.0	0.5	W/m/K

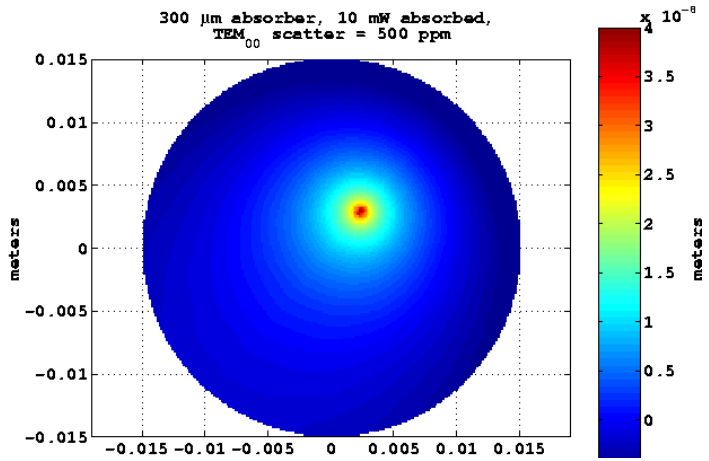
Heater Ring Thermal Compensation

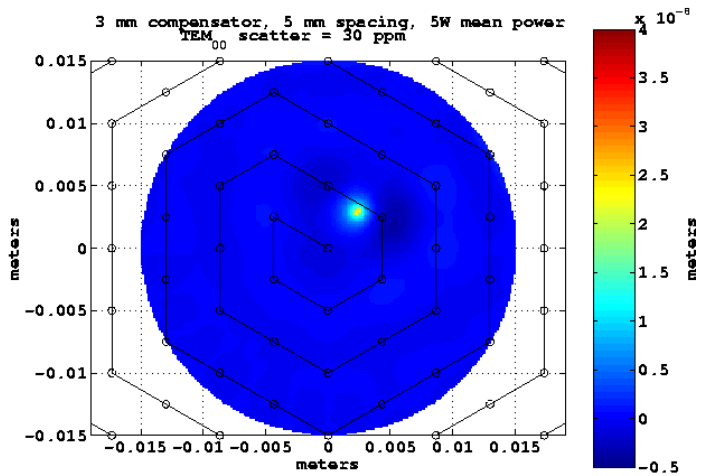




Thermal Compensation of Point Absorbers in Sapphire





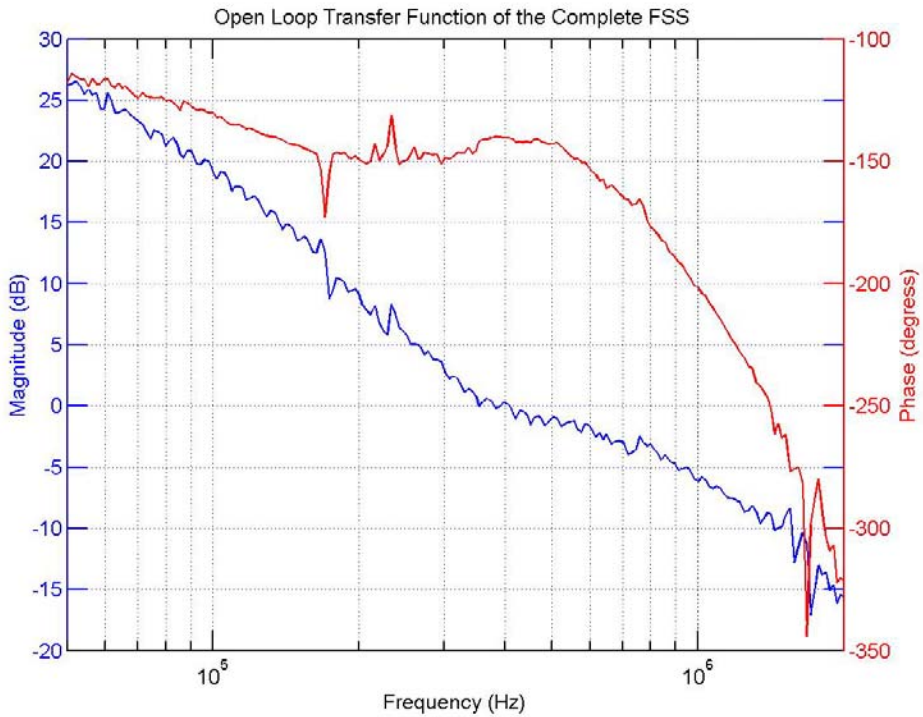


LASTI PSL Development

- **Intensity stabilization**
  Tough requirements for LASTI and Advance LIGO
  2 10^{-9} 1/⌧Hz at 10 Hz

- **Preparing for LASTI mission**

- **LIGO 1 Support**
  System is the fundamentally the same as the site PSLs



Off site development work
Includes FSS re-work, bandwidths in excess of 1 MHz, uses electronic design developed by J. Hall

LIGO

Sideband Measurement

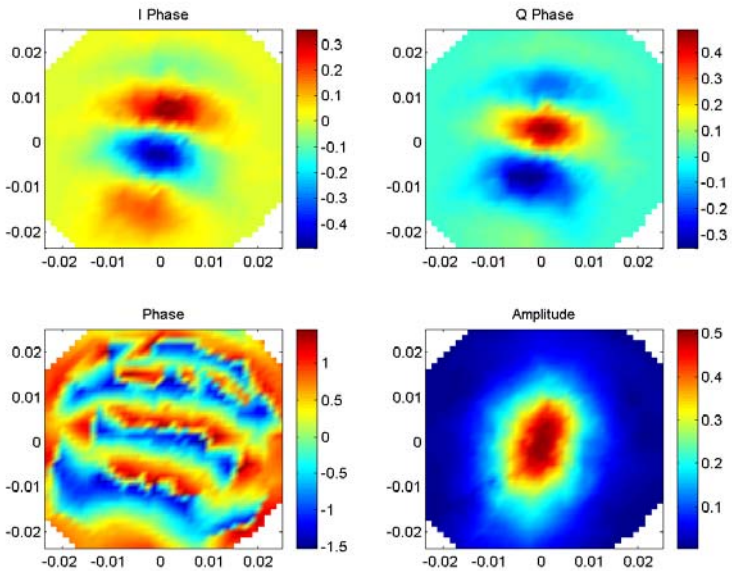
Motivation: Sideband fields in LIGO 1 Interferometers contain information about the state of the mirrors that is lost to the carrier

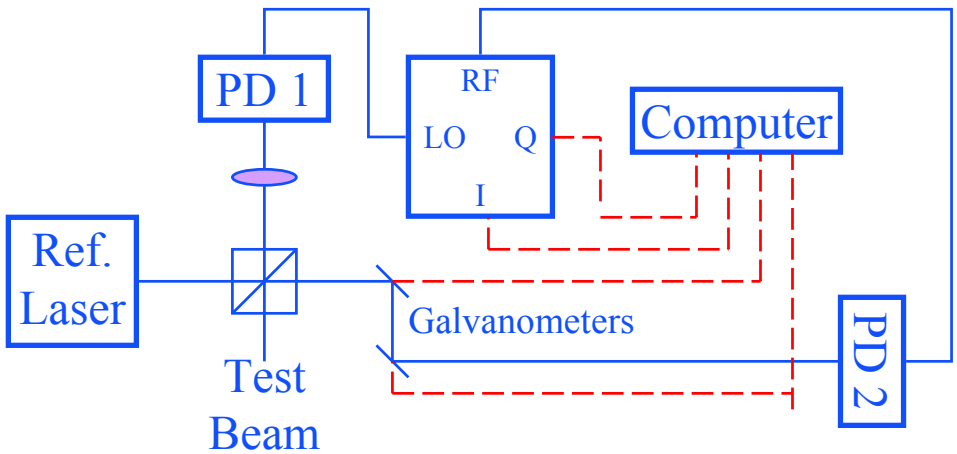
Difficulty: Sideband fields are small compared with the main carrier so direct field profile is difficult

Solution: Heterodyne phase image of the laser field in the presence of a large carrier field

The Experiment

- Scanning galvanometers controlled by computer
- LO signal spatially averaged beat signal of the combined field
- Cavity filter used for preliminary experiment





Original phase camera by Rana Adhikari