

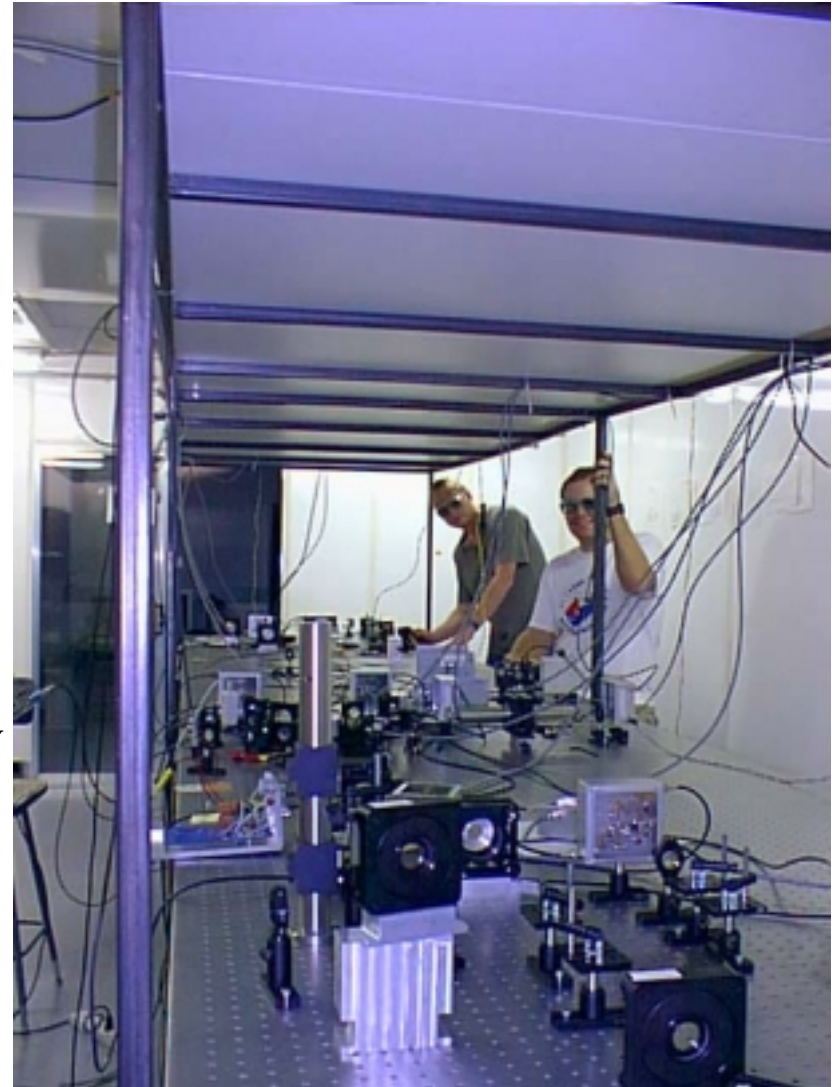
# R&D in LSC

David Shoemaker Aspen 22 February 00 LIGO G000010-00-R

- Slight renaming of talk to cover huge LSC effort
- Delightful that the project categories are not the only projection
- Some overlap between ‘projects’ (but not as much as after this meeting)
  - GEO activities discussed there
- comments (like activities) focussed on LIGO II work
- more visionary work going on...
  - QND readout schemes
  - Cooled optics
  - ...

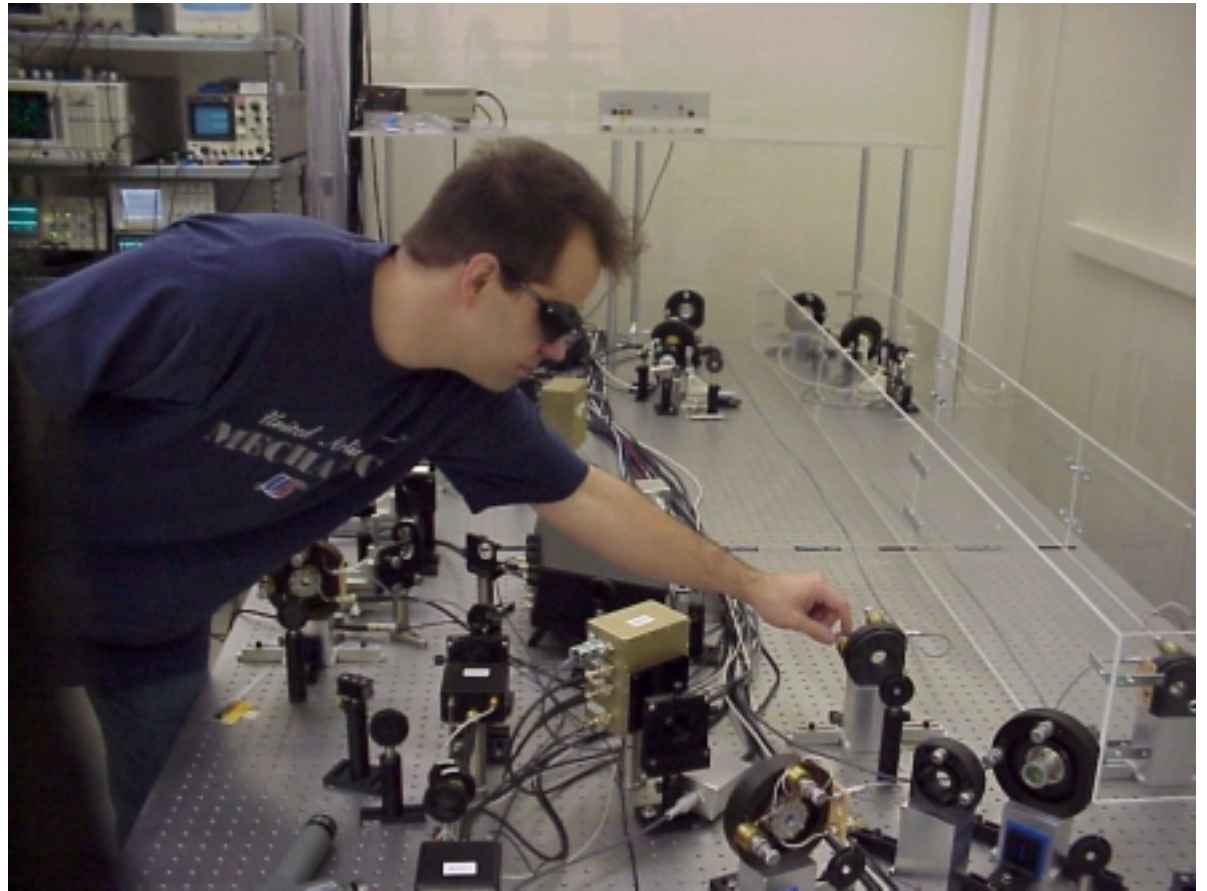
# Configurations: Dual Recycling (Univ. Florida)

- Servo topology for locking 5 degrees of freedom developed and numerically modeled
- Tabletop experiment completely developed (including optics, electronics, etc.) Have achieved locked operation of signal recycled Fabry-Perot arm cavity Michelson (without power recycling).
- Have extended the FPDR servo topology for strawman LIGO II design.



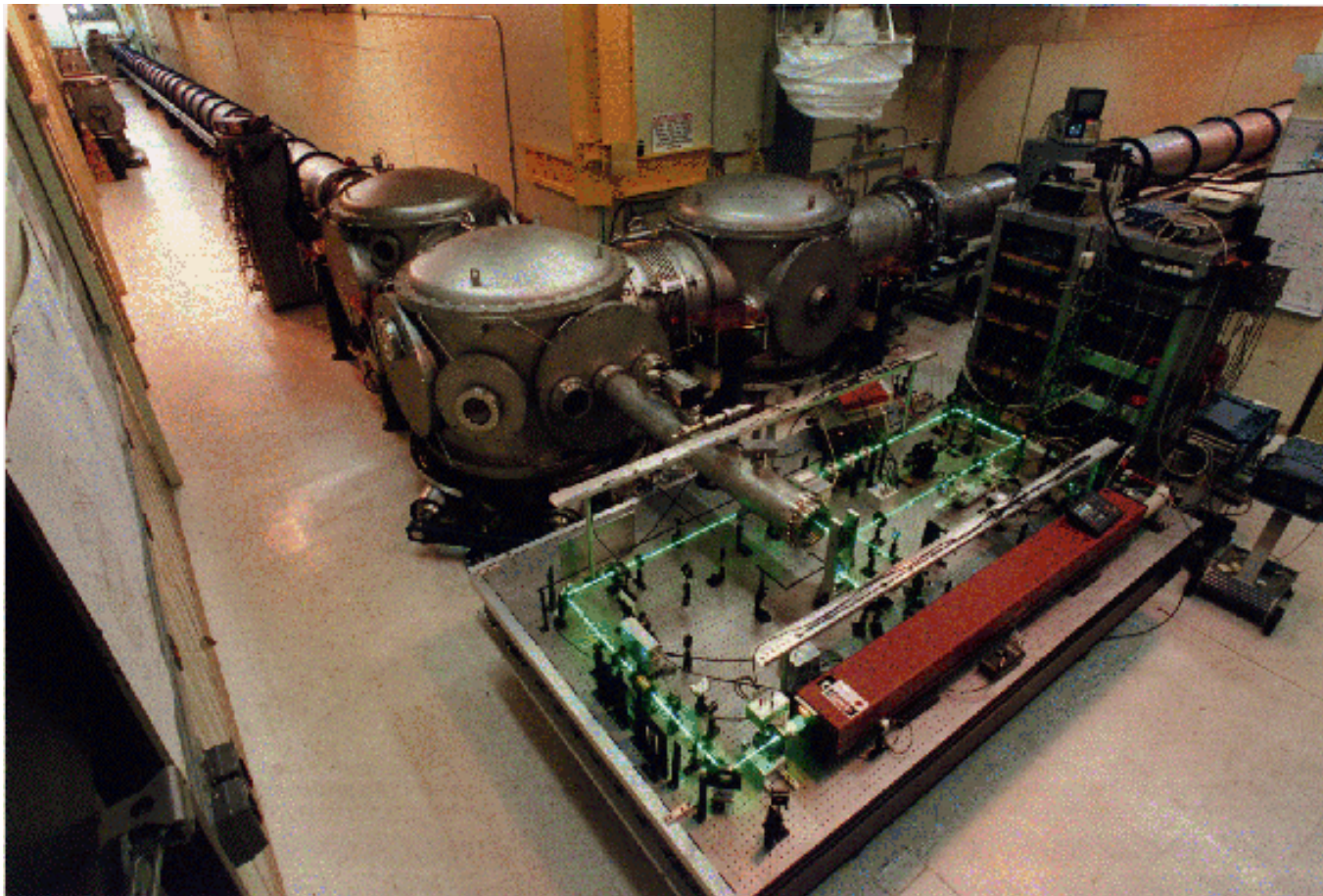
## Configurations: RSE (Caltech)

- successfully locked a LIGO I type interferometer, as well as a dual recycled Michelson (no arms), using our proposed signal extraction scheme for the control of the signal mirror
- Presently attempting to lock up the full RSE interferometer
- working on calculations to set limits on the laser and oscillator amplitude and phase noise



# Configuarations: 40m engineering prototype (Caltech)

- To be a complete LIGO II configurations and controls test
- building modifications soon to start
- detailed planning for rebuild underway



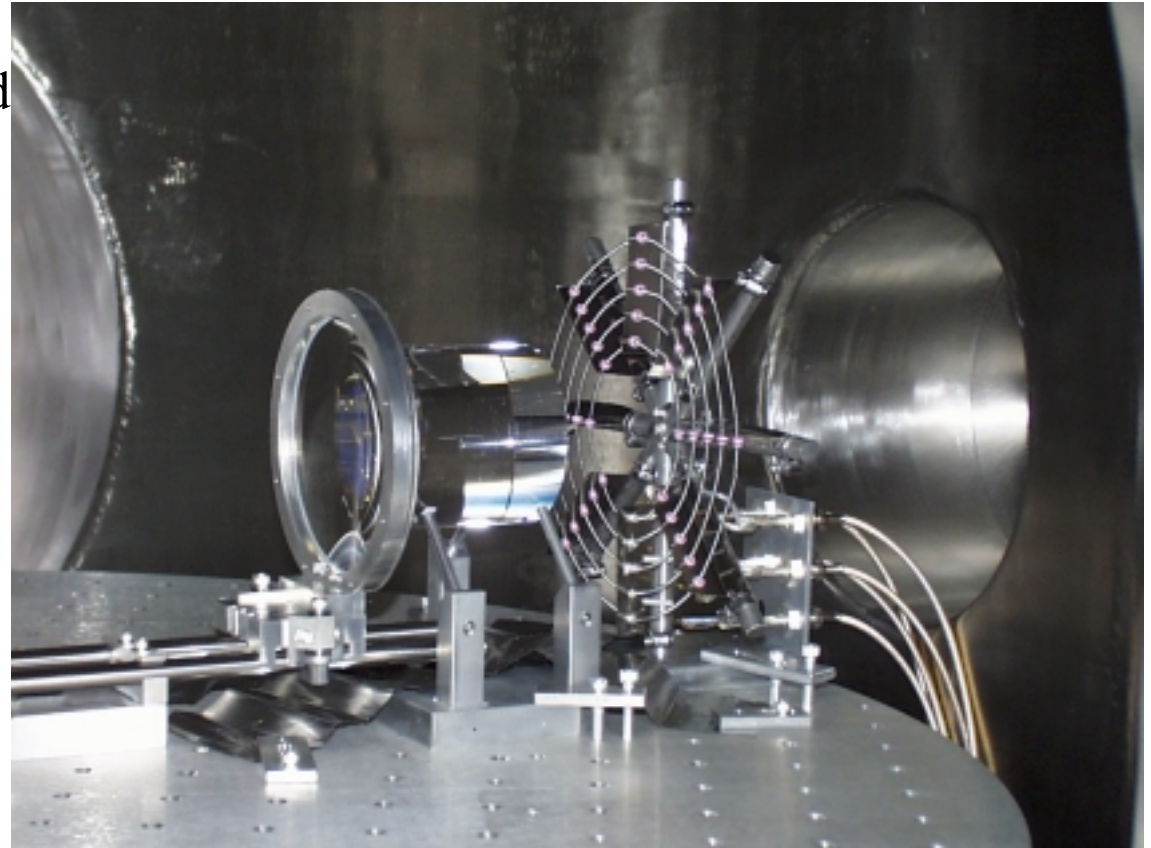
# Lasers/Optics: Sapphire development (Stanford/Caltech)

- large pieces in production
  - small pieces in characterization
  - optical properties to be determined,  
fed back to fabrication
- 
- Photo: LIGO II Test Mass  
(diamond setting)



# Lasers/Optics: Thermal compensation (MIT)

- initial experiment completed and successful
- intentional 'lensing' seen
- preparing for next phase heating with CO2 laser scanning of heat source to demonstrate more
- flexible approach



- Modeling of thermal effects (Stanford/hp)

# Lasers/Optics: High-power elements

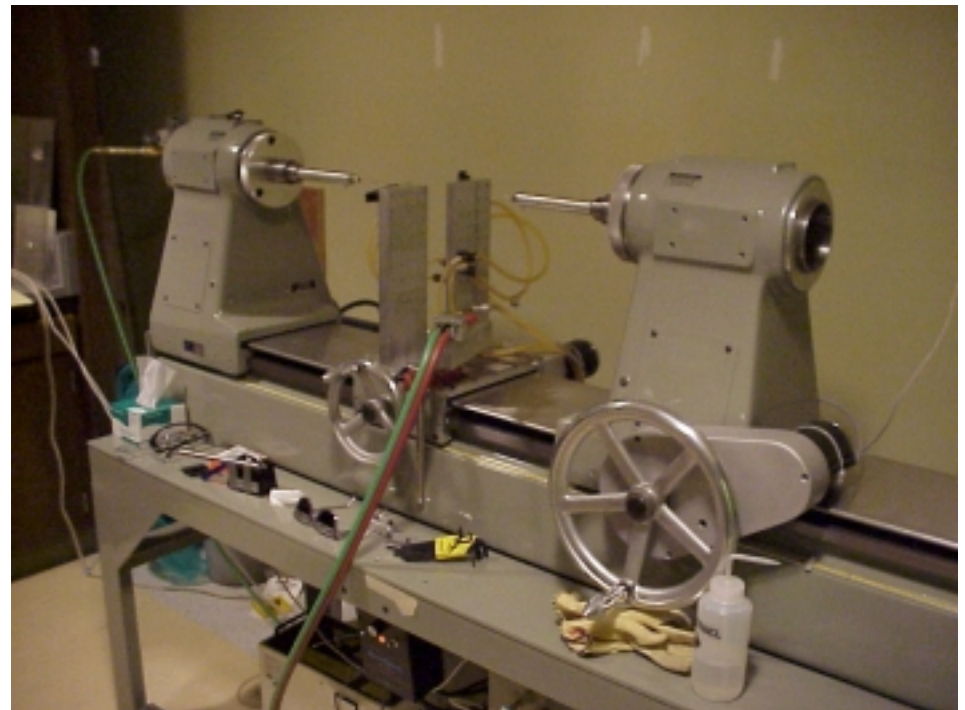
- Components: University of Florida
  - Proof of principle demonstration (at 10 W) of novel high power Faraday isolator architecture capable of  $> 30$  dB isolation at 100+ W power levels.
  - Investigations of further minimizing thermally-induced stress birefringence using alternate TGG crystal orientations
- Photodiodes: MIT/Stanford
- PSL: Stanford
  - Currently installing current supplies for our new 808 nm diode lasers. Total power of about 800 watts.
  - Building the temperature controllers for the diodes and characterizing the wavelength versus the temperature for all of the diodes.
  - The new edge pumped slab heads are in fabrication and the Nd:YAG slabs are being polished.
  - Working on the saturated amplifier noise measurements.

# Suspensions and Isolation



- Material losses:  
Stanford, Caltech, Syracuse
  - ringdown
  - relaxation approach

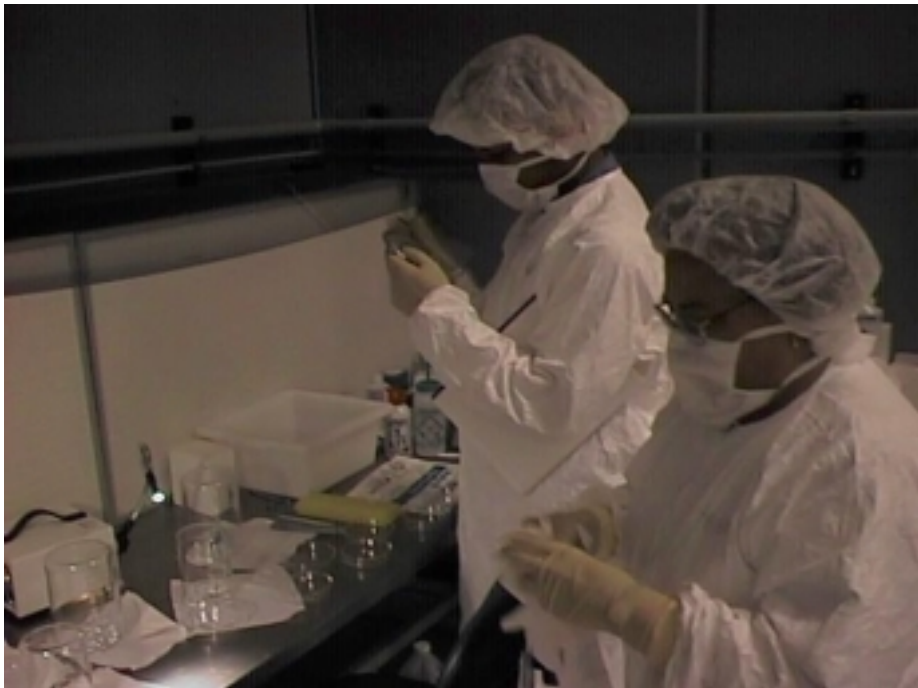
- Attachments: Stanford, Caltech
- Fiber Development: Caltech





# Suspension: Assembly techniques

- Hydroxy-catalysis bonding at Stanford



# Suspensions: Studies of Imperfections (Penn State)

- GEO contributing suspension design for LIGO II (as you have heard!)

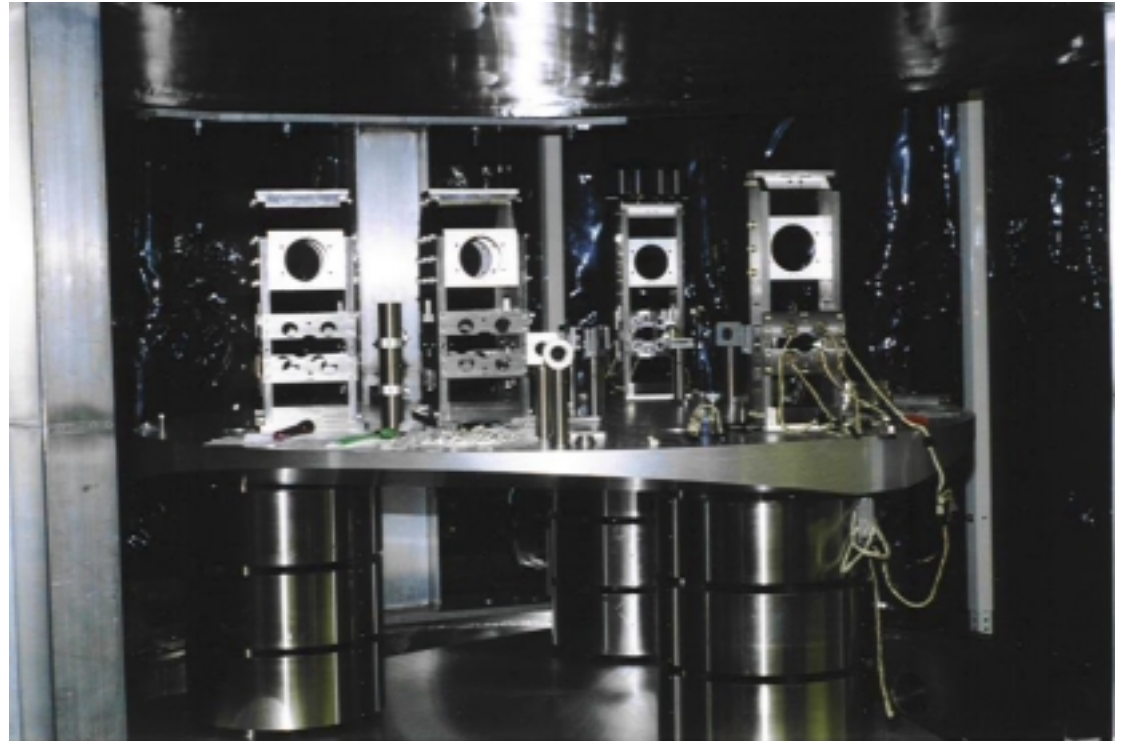


- Steel and aluminum prototypes to test quality of models and sensitivity to manufacturing/material limitations
- Characterization of LIGO I suspensions, development of ‘diagonalization’ procedures

# Thermal, Thermoelastic, and 'Excess' Noise

- Continued program at MSU in material properties, approaches
- MSU, CaRT analysis of thermoelastic noise in Sapphire
- Monitor of violin string excitation in development at Syracuse

- Thermal Noise Interferometer at Caltech nearing first lock
  - will pursue Sapphire and verification of Thermoelastic noise

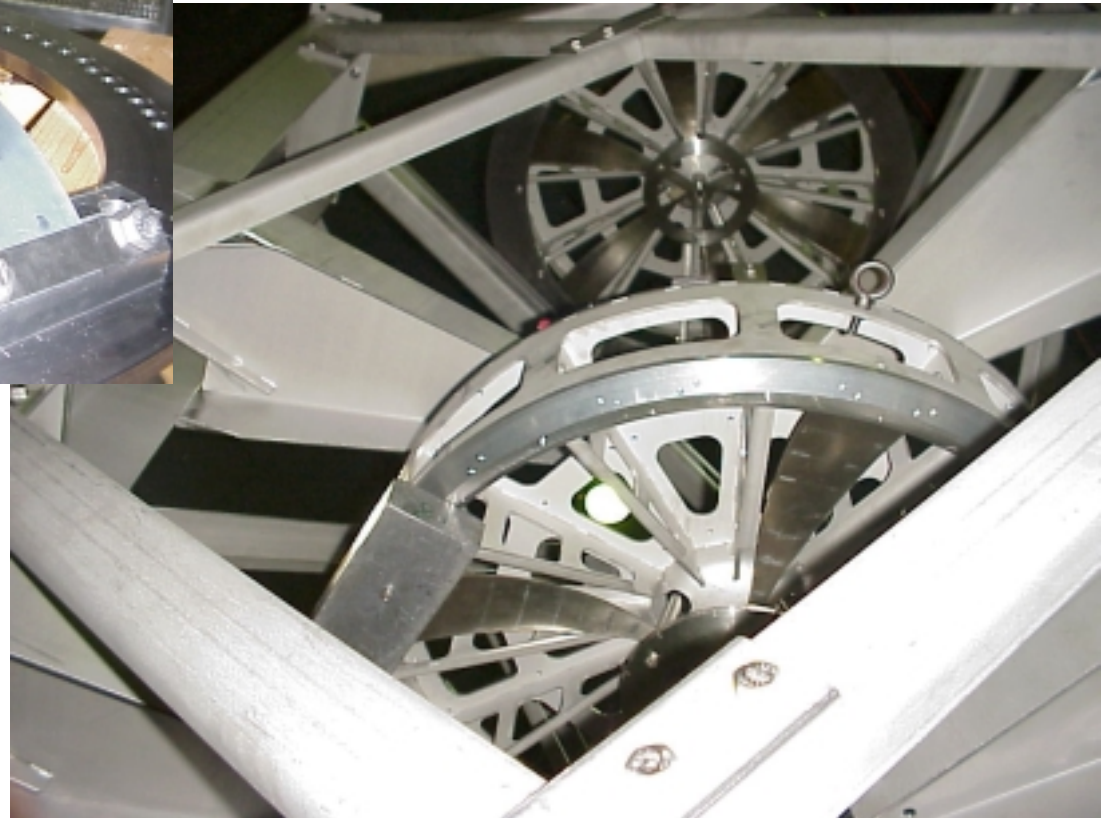
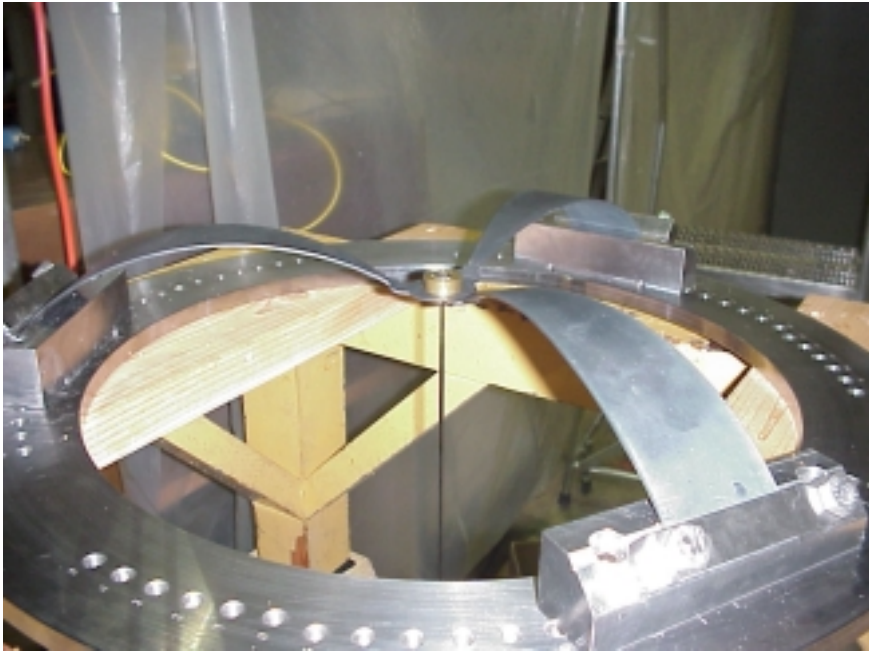


# Sus/Isol: Excess Noise

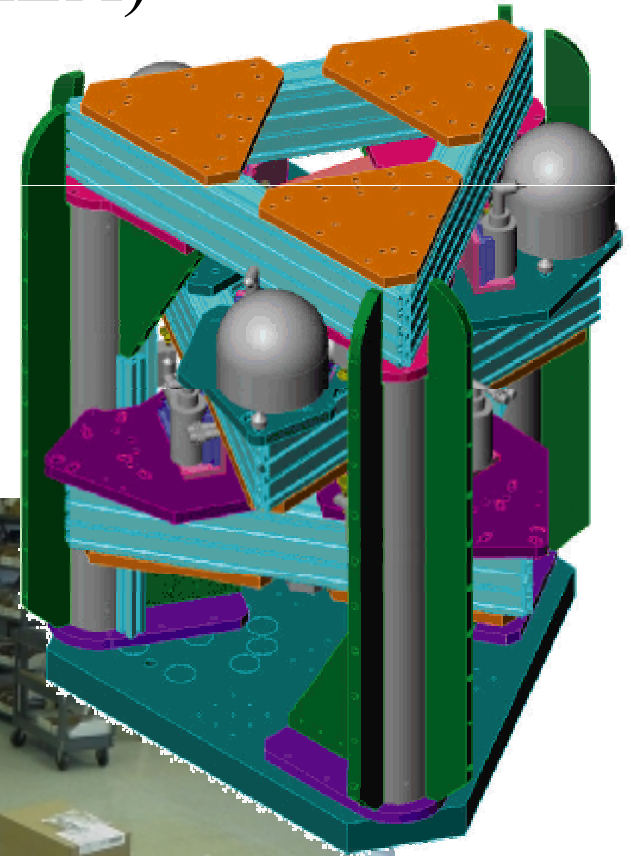
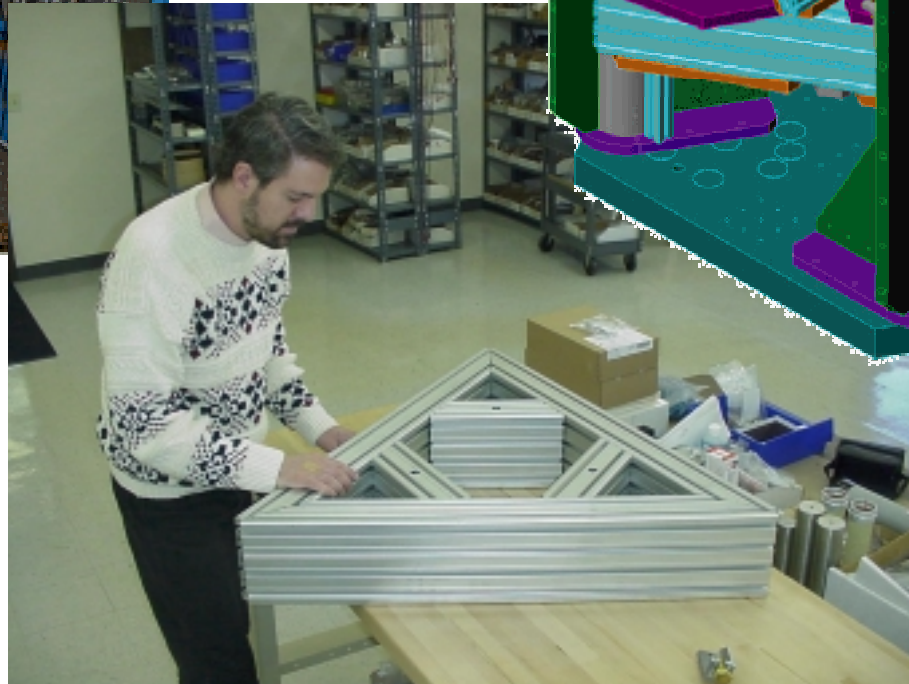
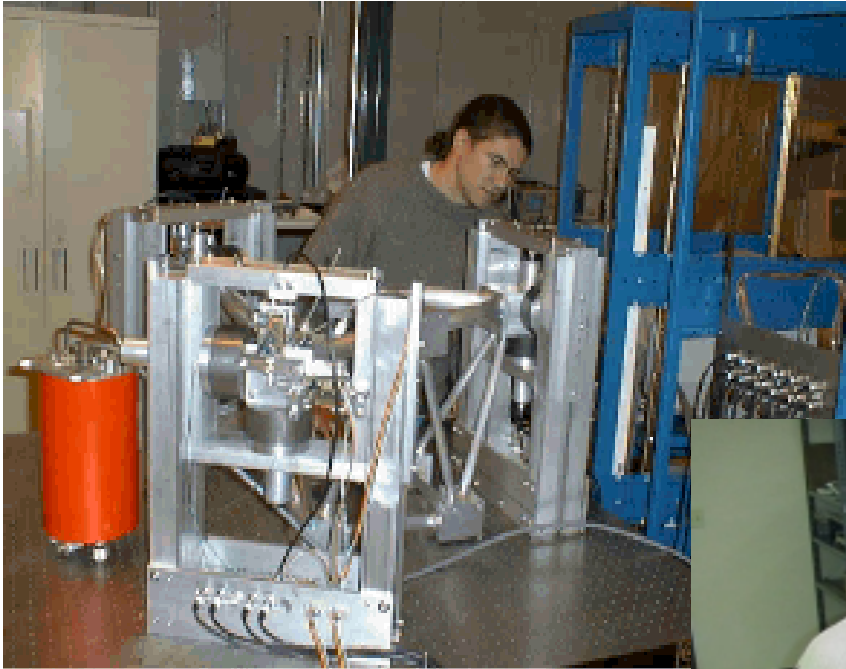
- Facility for testing components under construction at LSU
  - creak/stress release monitors



# Isolation approaches: 'Soft' (Caltech, Tokyo, Pisa, LLO)



# Isolation approaches: ‘Stiff’ (LSU/MIT/Stanford/JILA)



# Isolation/Suspension System Tests: MIT/All

- Vacuum System ready
- internals in preparation

