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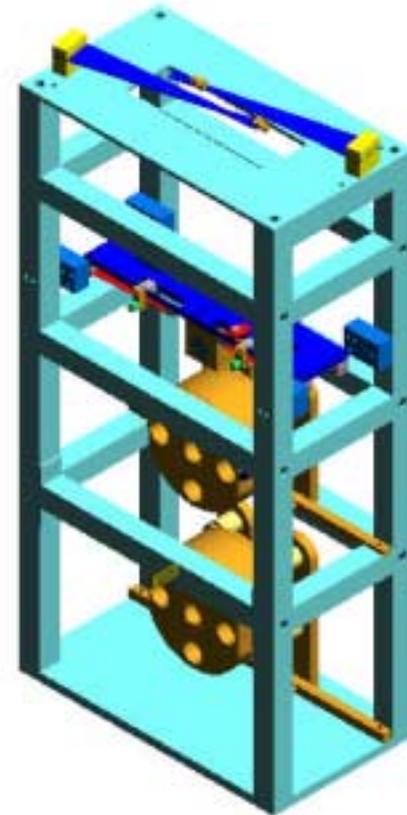
# Advanced LIGO Suspensions Update

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LIGO/Caltech

LSC Meeting, Hanford, August 20 2002

# Mode Cleaner Prototype Now Being Assembled

- λ Based on GEO600 signal recycling mirror design
  - » Triple pendulum suspension
  - » Two sets of vertical blade springs
  - » Fused silica fibers suspend mirror
  - » All local control applied to top mass
- λ Global control only used on nontransmissive optic

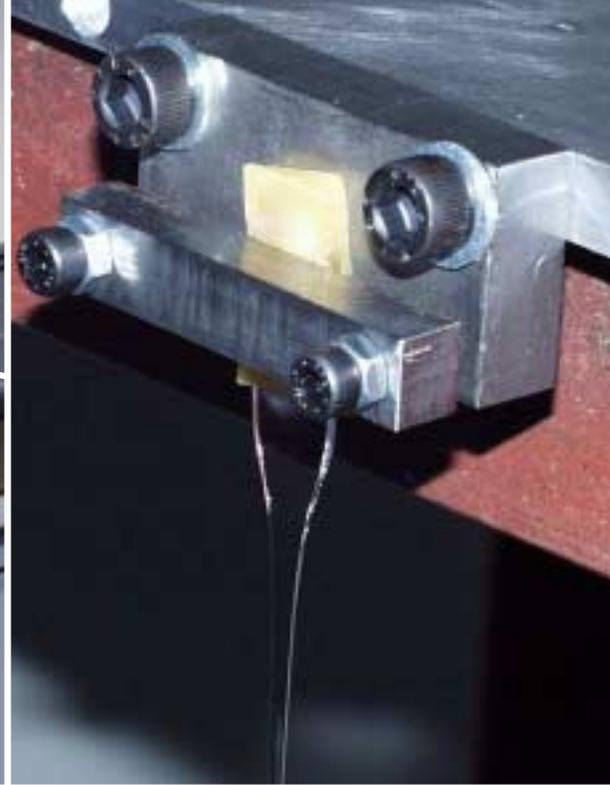


# Some Features of Mode Cleaner Prototype Design

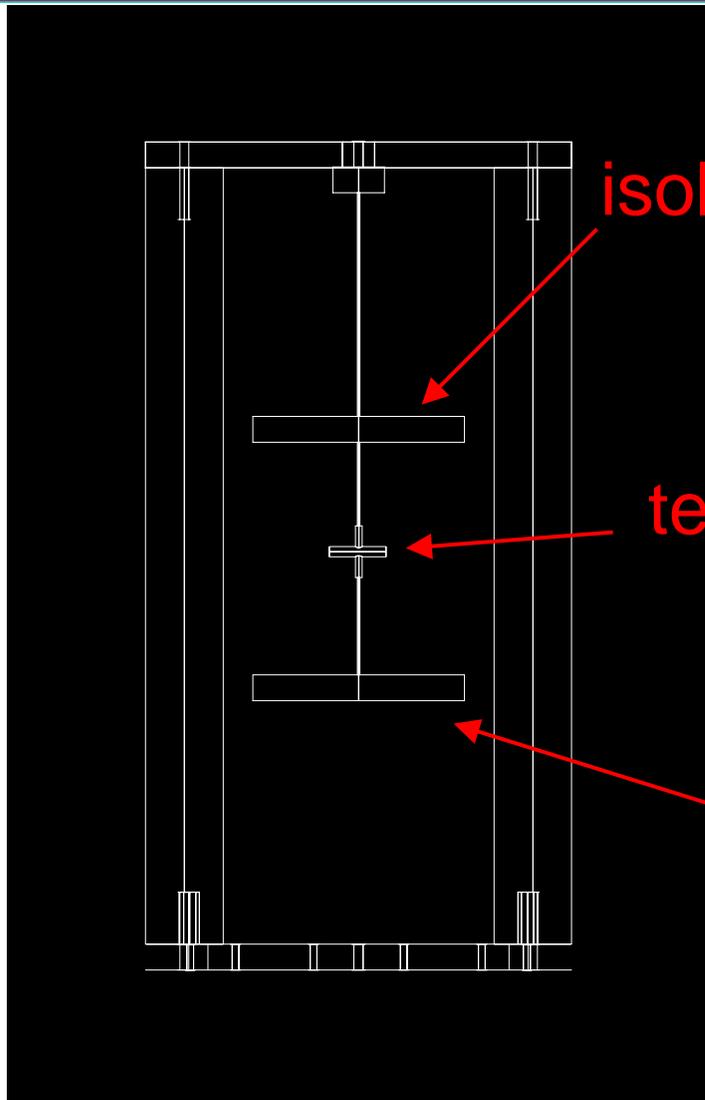
- λ Magnets for all local and global control:
  - » Global control force estimate yields  $<1\mu\text{N}$  force needed at mirror
  - » Very weak magnets can provide this without significantly coupling ambient magnetic noise
  - » Need to evaluate coupling with SEI platform and EM preisolators, but coupling likely worse at penultimate mass due to greater required force
- λ No reaction chain for actuators
  - » Voice coil/magnet actuators are sufficiently astatic not to require additional isolation
- λ Prototype uses active damping but eddy current damping appears superior for final design

# Fused Silica Suspensions

- λ Violin mode thermal noise- and possibly some excess noise- observed at Syracuse
- λ Both ribbons and dumbbell fibers now being prototyped and tested for strength:
  - » Ribbons show strength up to 1.5GPa in tension
  - » Two AdLIGO ribbons supported 20kg in air for eight weeks
  - » AdLIGO dumbbell fibers bent to breaking show 3-5x required strength, tension tests commencing
- λ Slow, steady progress in achieving high Q



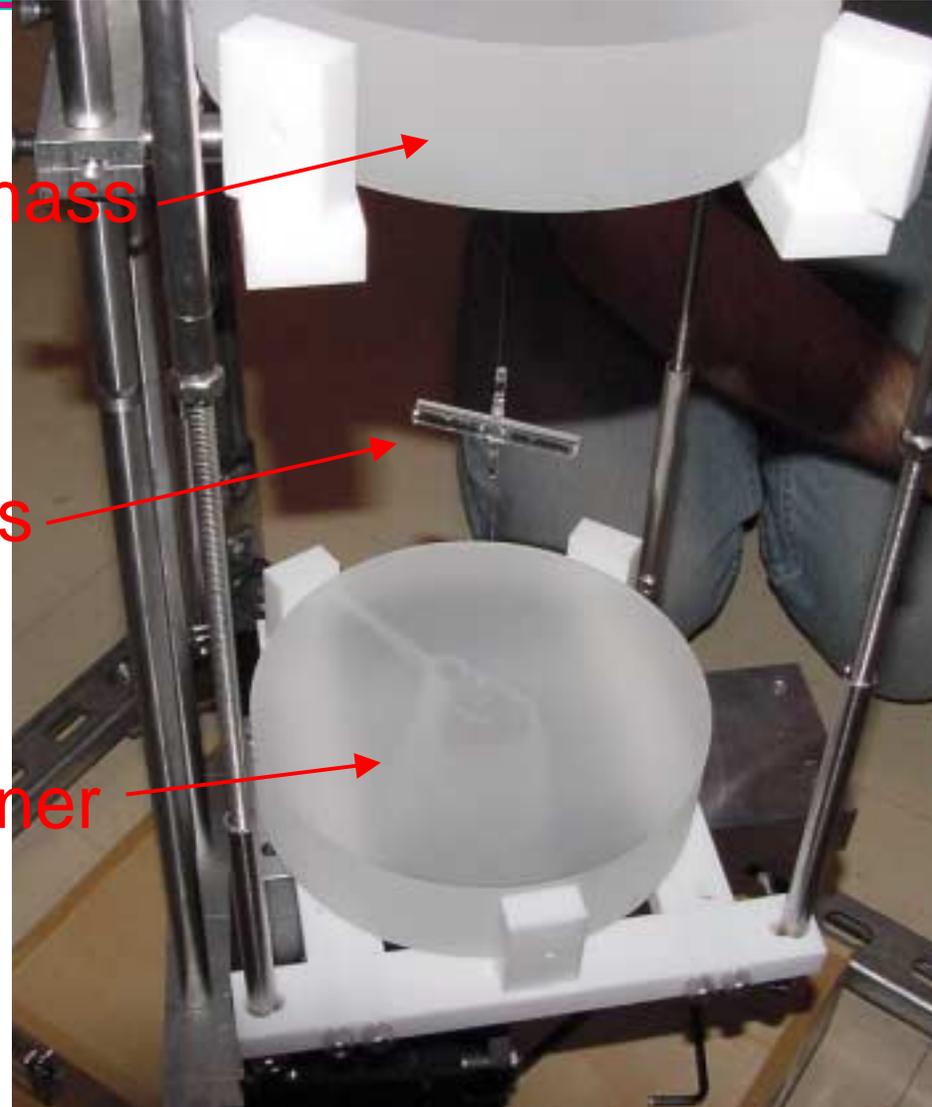
# Vertical Bounce Experiment



isolation mass

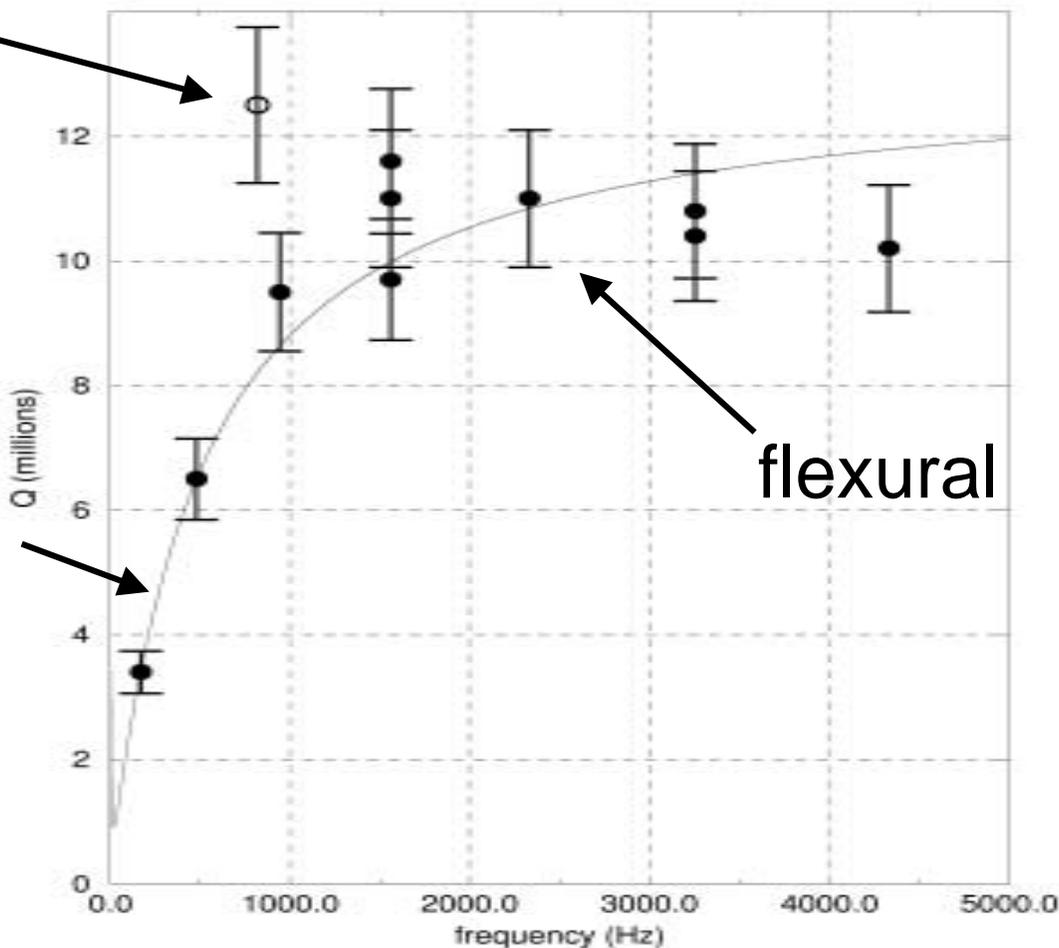
test mass

tensioner



# Q's of Silica Fibers

vertical bounce



thermoelastic peak  
(absent in vertical bounce)

flexural

# Silicate Bonding

- λ Strength of silica/silica bonds and silica/sapphire bonds proven suitable for AdLIGO
- λ Strength of silica/ultra-heavy lead glass bonds recently measured and found suitable for heavy penultimate masses (though with small sample set)
- λ Strength of silica/SF4 bonds (another heavy glass) being prepared for measurement
- λ Experiment to measure creep in silicate bonds underway

# Spontaneous Charging of Test Masses

- λ The Moscow group continues to observe rapid charging of their suspended mass every few months coincident with large change in pendulum Q.
- λ Cosmic rays are suspected.

