Triple Update

Calum Torrie/Mark Barton/Janeen Romie

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LIGO LAB: CIT: H. Armandula, M. Barton, J. Heefner, J. Romie, C. Torrie, P. Willems. MIT:P. Fritschel, R. Mittleman, D.Shoemaker LHO: B. Bland, D. Cook LLO: J. Hanson, J. Kern, H. Overmier, G. Traylor

GEO600: GLASGOW: G. Cagnoli, C. Cantley, D. Crooks, E. Elliffe, A. Heptonstall, J. Hough, R. Jones, M. Perreur-Lloyd, M. Plissi, D. Robertson, K. Strain, P. Sneddon, H. Ward GLASGOW/STANFORD: N. Robertson, S. Rowan UNIVERSITAT HANNOVER: S. Gossler, H. Lueck

Triple Update

Triples are the triple pendulum suspensions mounted in the HAM chambers – the mode cleaner (MC) mirrors and the recycling mirrors (RM)

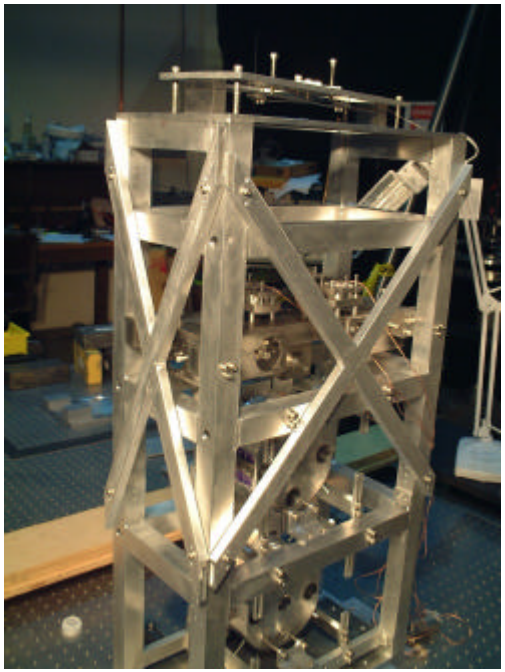
SUS Preliminary Design – 2 Controls Prototype MC triples and 1 Controls RM Prototype

Controls Prototypes demonstrate mech. & controls requirements – use metal masses and metal suspension wires.

Triple Update

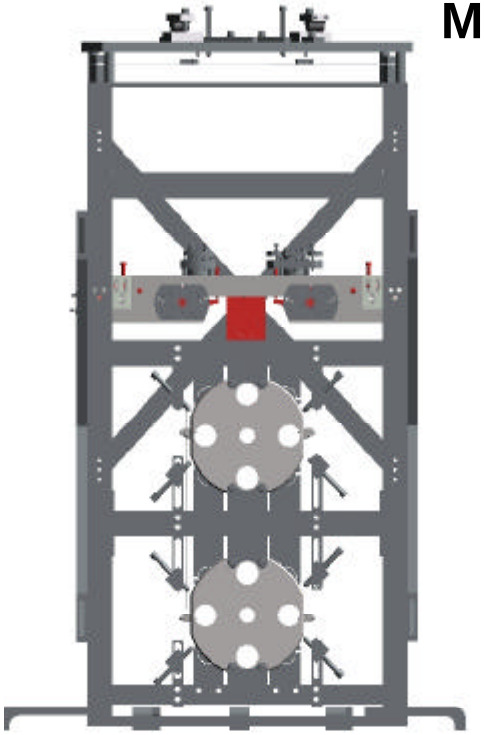
- Mode Cleaner Controls Prototype Suspension
  - » Optic:
    - – 15cm dia x 7.5cm thick
    - – 2.9kg.
    - – Metal for controls, fused silica for noise.
  - » Metal wires for controls, fused silica fibers/ribbons for noise.
  - » No reaction chain
  - » 3 kg, 3kg, 3kg
- Recycling Mirror Controls Prototype Suspension
  - » Optic:
    - – 26.5cm dia x 10cm thick
    - – 12.1 kg.
    - – Metal for controls, fused silica for noise.
  - » Metal wires for controls and noise.
  - » No reaction chain
  - » 12.1kg, 12.1kg, 12.1kg

Mode Cleaner Triple



MODE CLEANER SUSPENSION

Mode Cleaner Triple



Mode Cleaner: - MASS & CG

- **FOOTPRINT**

  220mm x 400mm x 890mm

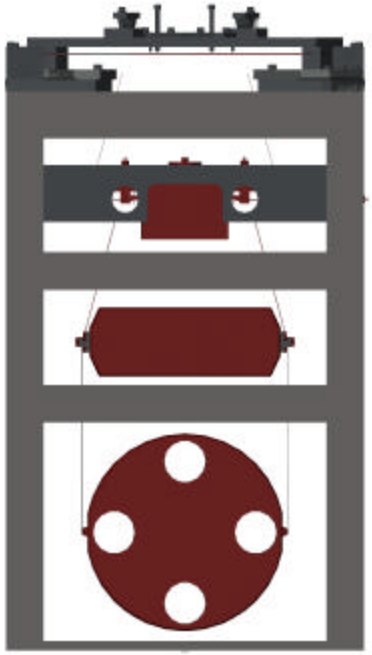
- **MASS**

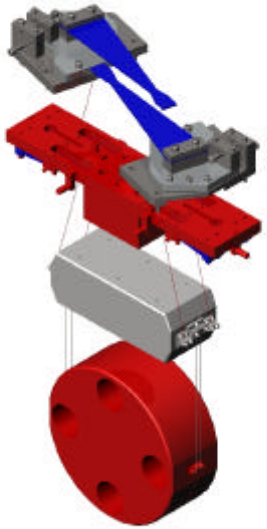
Suspension	= 9 kg
Non-Suspended	= 18 kg
Structure	= 11 kg
+ new	= 20 kg
TOTAL	= 58 kg
TOTAL + 25%	= **72.5 kg**

- **CG**

  The Centre of Gravity is **365 mm** from the bottom of the structure.

Recycling Mirror



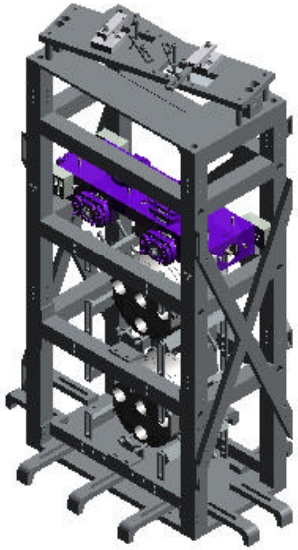


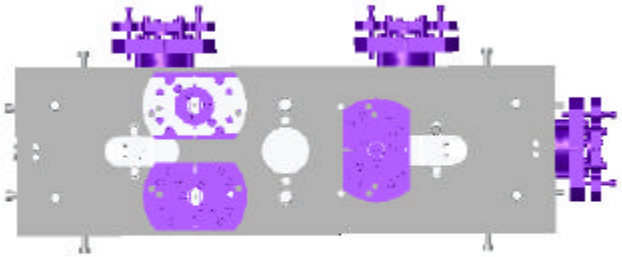
RECYCLING MIRROR

Mode Cleaner Progress

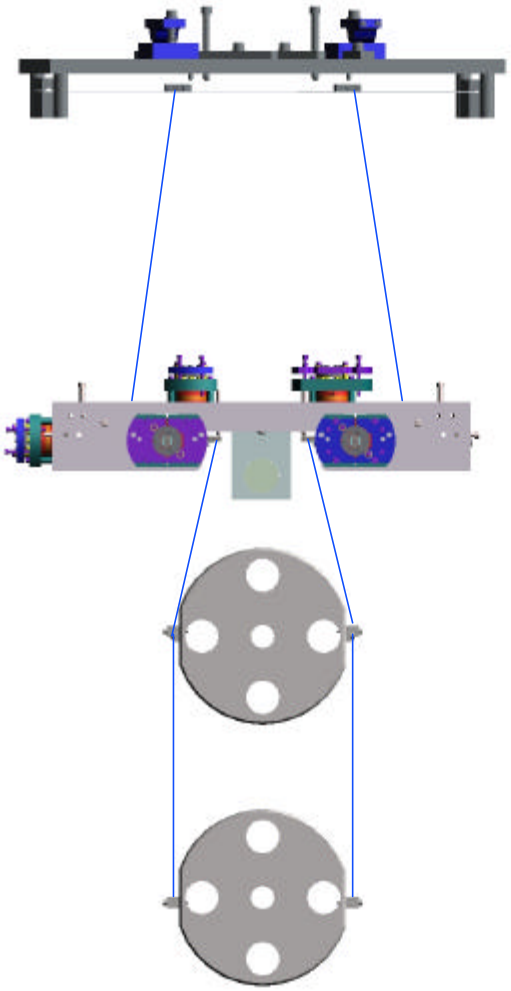
- MC controls
  - » 6 Hybrid co-located sensor/actuators (osems) developed and prototyped by GEO & LIGO Lab for the local controls at the upper mass.
  - » LIGO 1 osems for global control on lower 2 masses.
- 1 Mode Cleaner Controls prototype will be delivered to LASTI for testing.
  - » Installation practice
  - » Initial LIGO/HEPI installation and test

6 co-located sensor/actuators





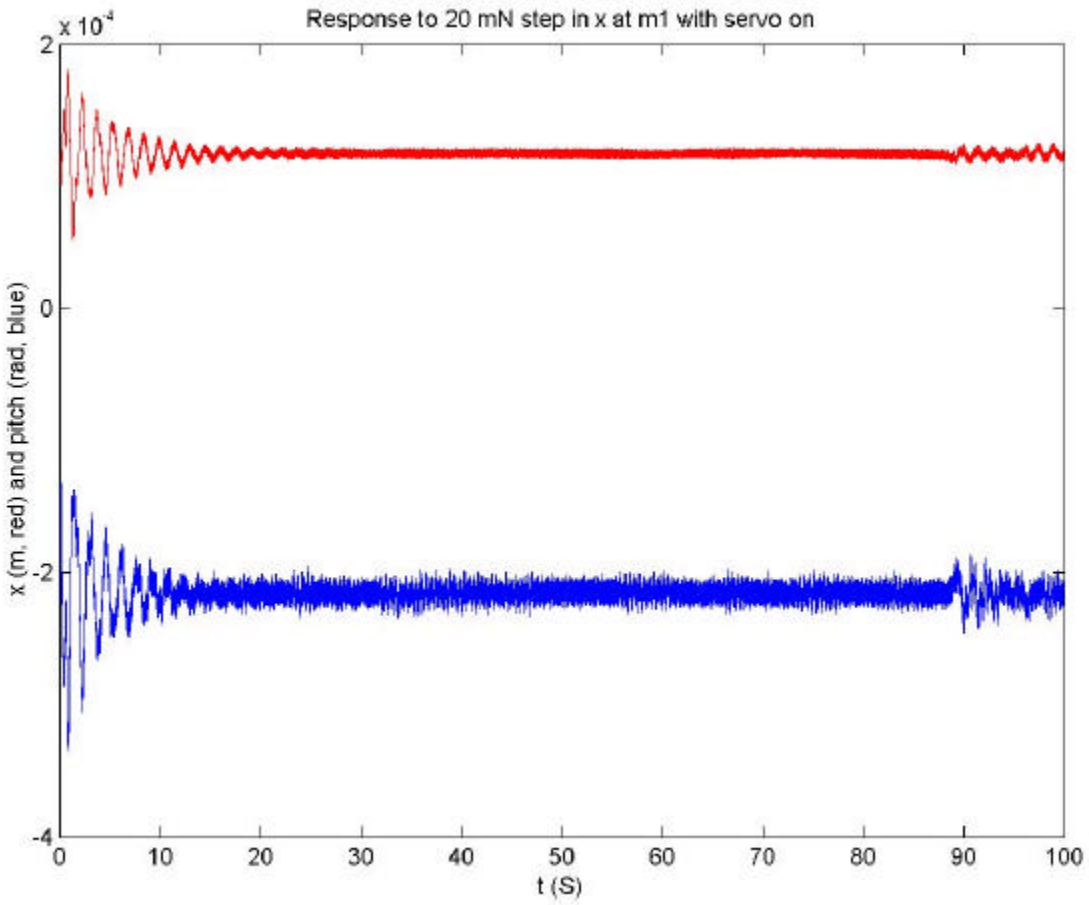
SWITCH TO TALK ON COILS & ECDs



MODE FREQUENCIES

- Onging, measured in red: -
  - » Vertical
    34.5 Hz 4.22 Hz 1.19 Hz
    35 Hz 4.2 Hz 1.1 Hz
  - » Yaw
    1.09 Hz 3.52 Hz 1.96 Hz
    1.09 Hz 3.6 Hz 2.0 Hz
  - » Pitch / Longitudinal
    0.67, 1.06, 1.52, 2.8, 3.6, 4.84 Hz
    2.8, 3.56, 4.84 Hz
  - » Transverse / Roll
    49, 3.8, 2.8, 1.2, 2.13, 1.52, 2.8 Hz

TRANSFER FUNCTIONS



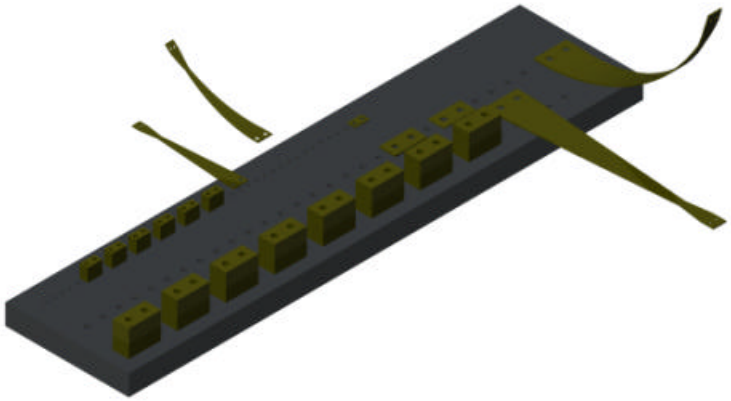
- 20 mN Step in x at the top mass
- Response in x, longitidinal and Q, pitch
- Settling time <10s, as expected
- Compares very well with the model

Triple Update

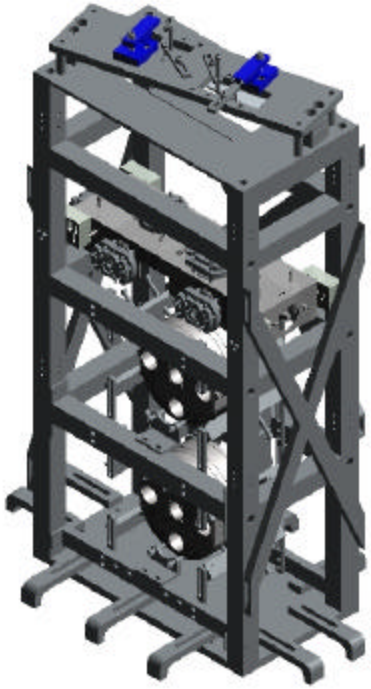
- "Are Reaction Chains needed for AdLIGO HAM Optics" by Phil Willems, LIGO-T020059
  - » Conclusion – no
  - » Based on worst case scenario of RF readout scheme.
  - » Vetted by P. Fritschel/Systems Engineering
  - » Magnets (LIGO 1 size – 2mm dia x 3mm long NEO-35) may be glued on penultimate mass for global control and DC actuation.
  - » Less powerful magnets may be attached to test mass with Vac Seal

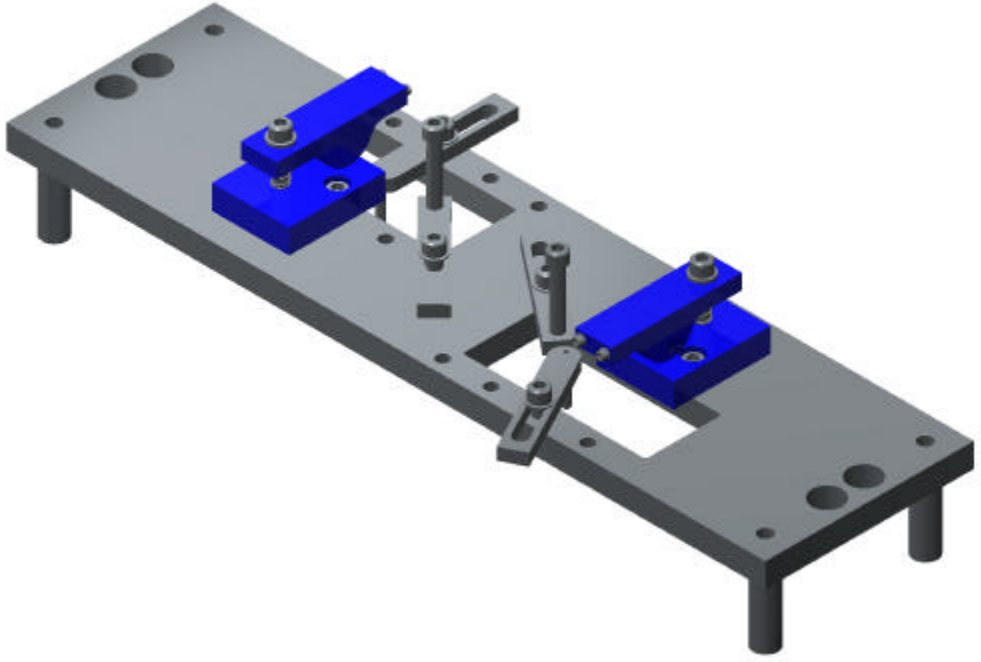
Suspension work

- Numerous adjustment methods have been created, fabricated and tested on the MC.
  - » Vertical adjustments – used in combination
    - – Library of clamps – to match blades after testing.
    - – Winch - See T030068.
    - – Fixed added mass
  - » Moving mass – adjusts pitch & roll position of optic.
  - » Moving wire clamp – fine adjustment of pitch.

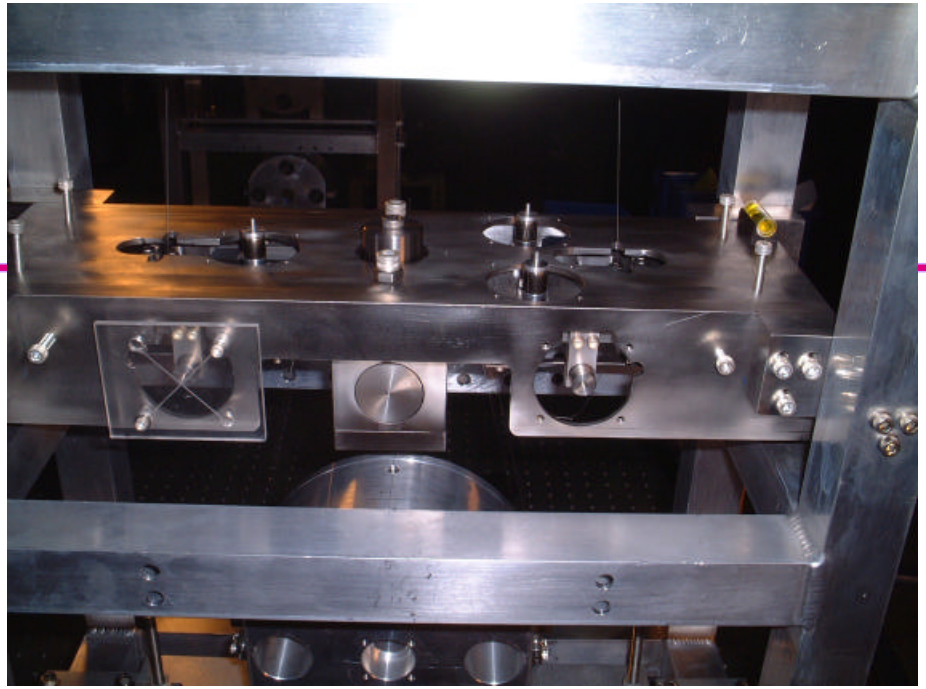


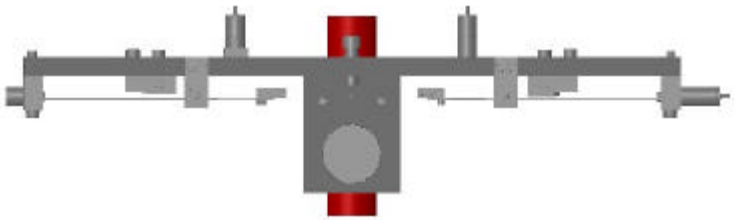
LIBRARY OF CLAMPS



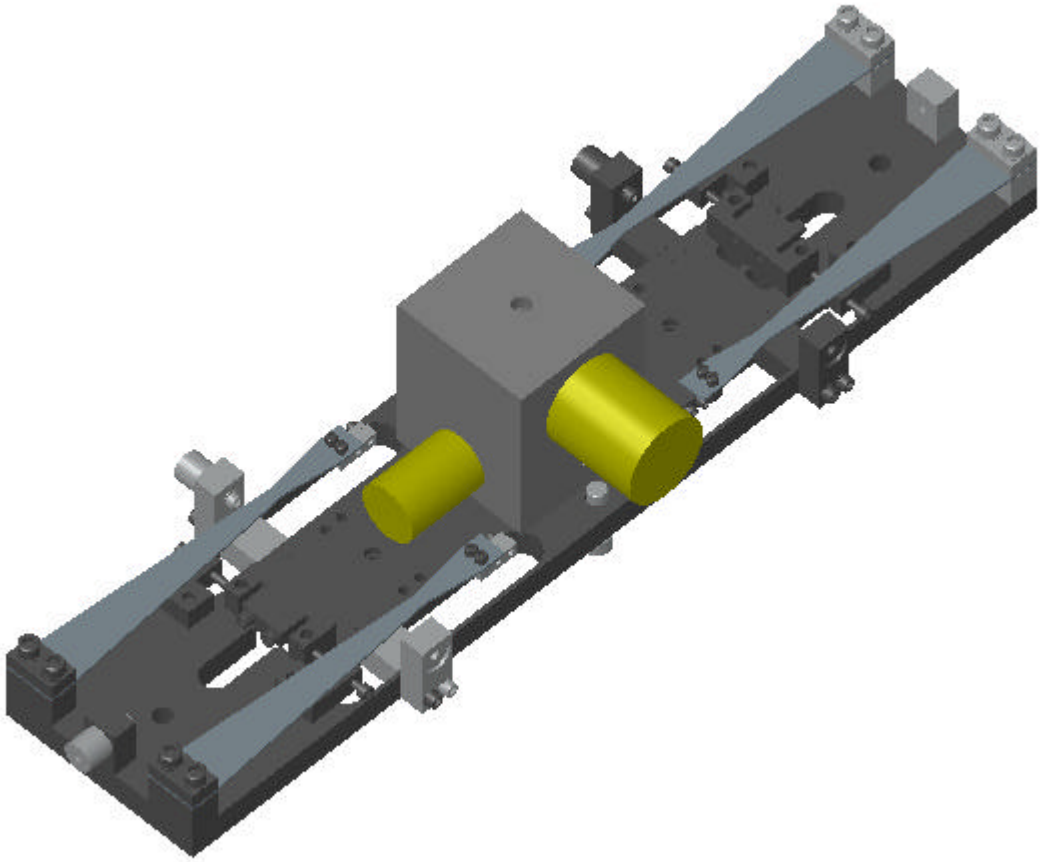


UPPER WIRE WINCH (SHORTEN ONLY)

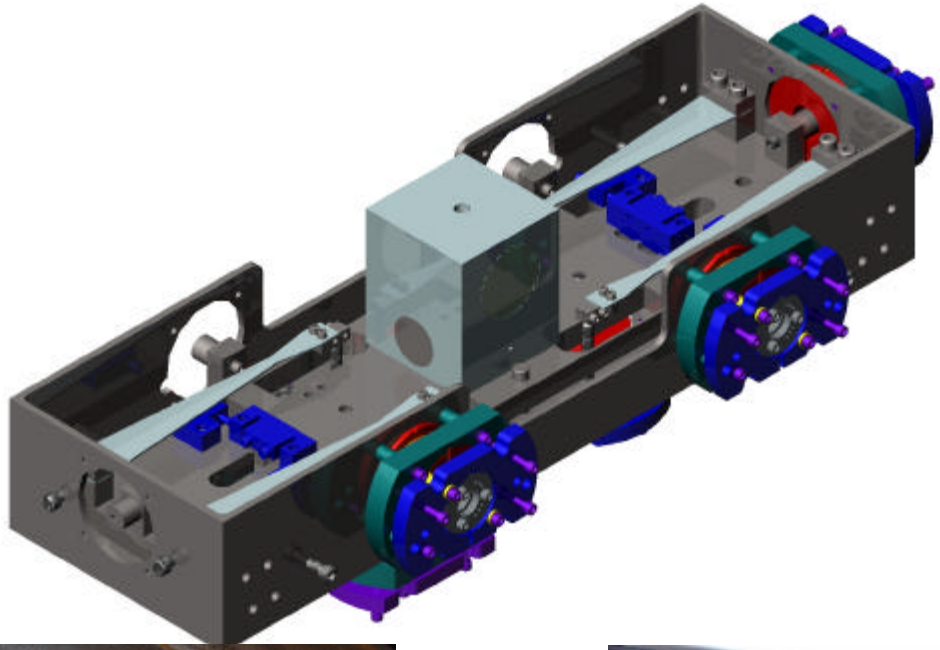


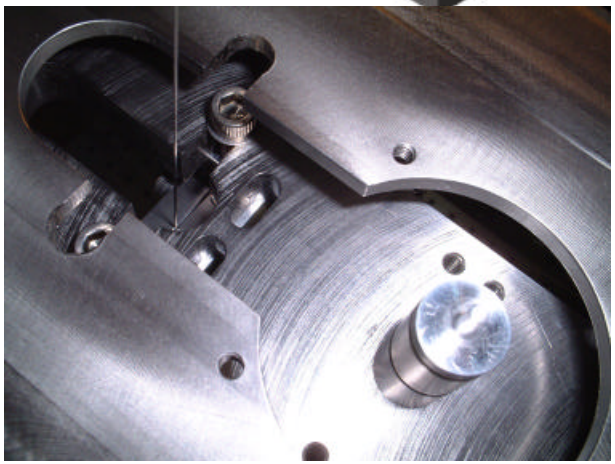


FIXED MASS ON UPPER MASS

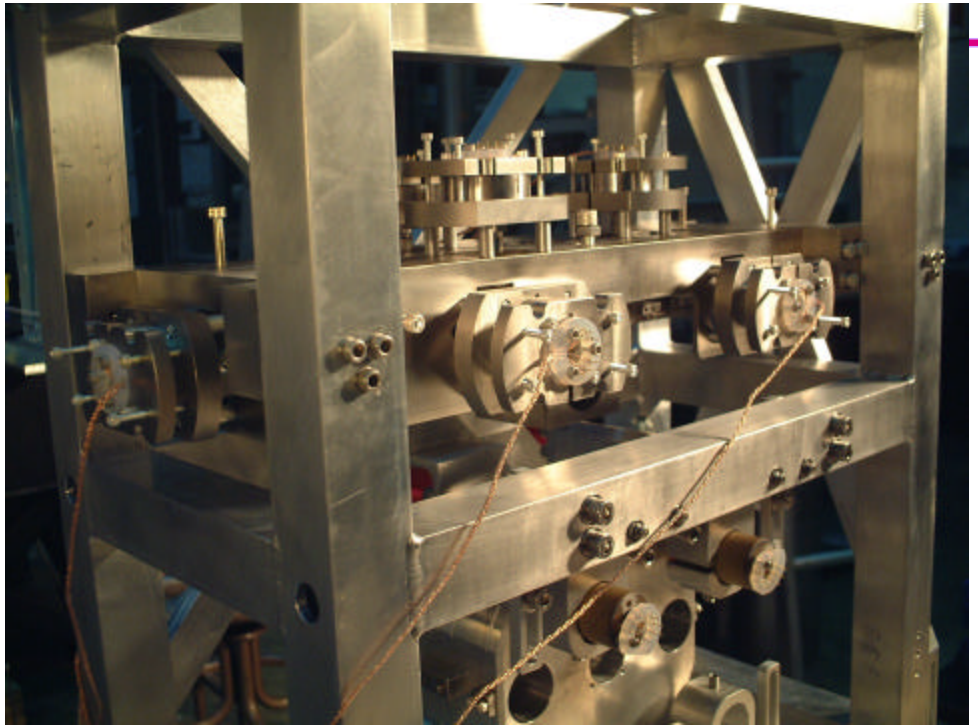


CRUDE PITCH & ROLL ADJUSTMENT

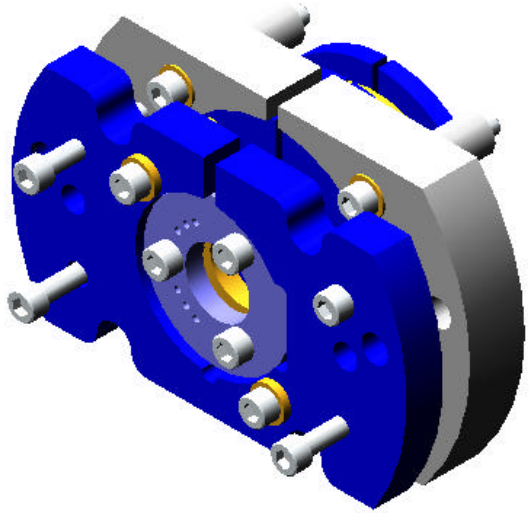


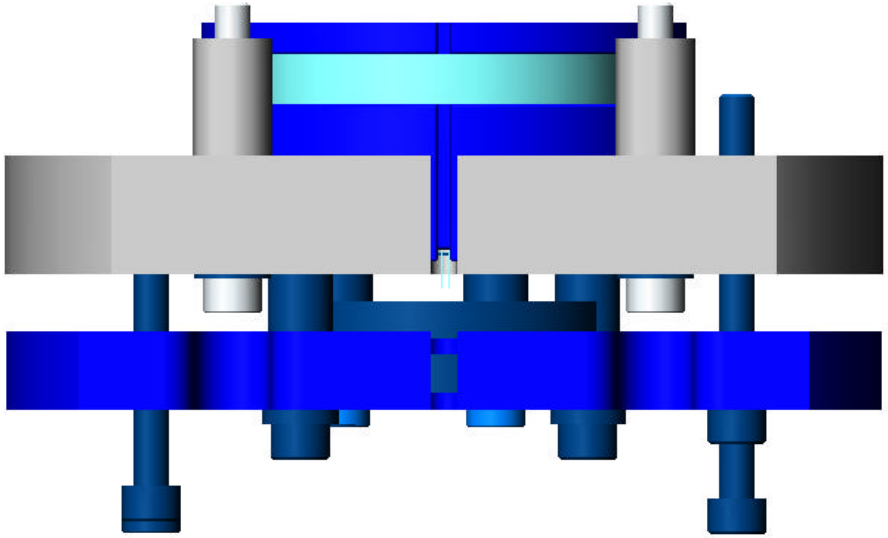


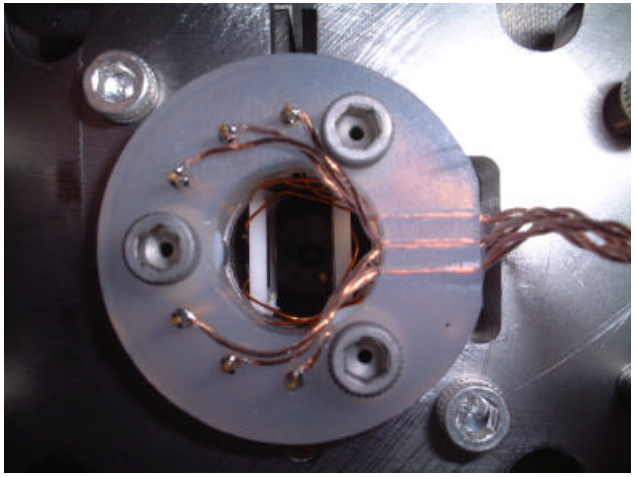
FINE PITCH & ROLL ADJUSTMENT

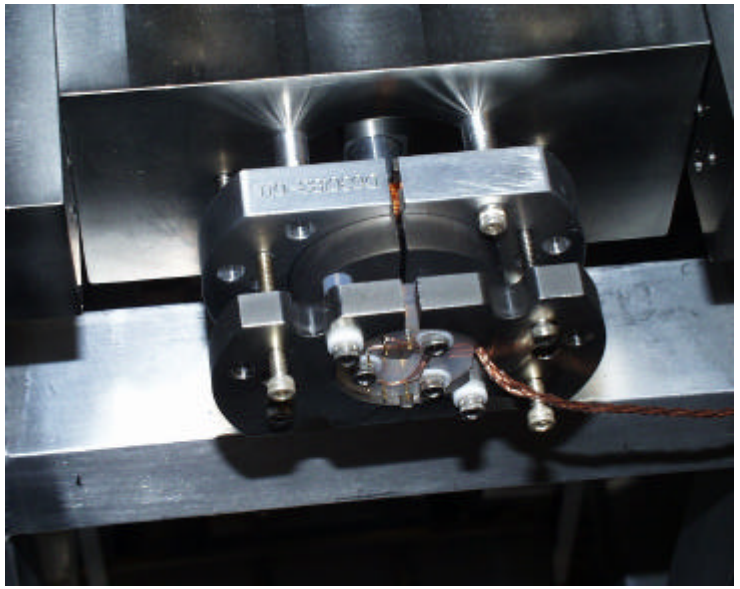


ADJUSTMENT OF TABLECLOTH









ADJUSTMENT OF COILS

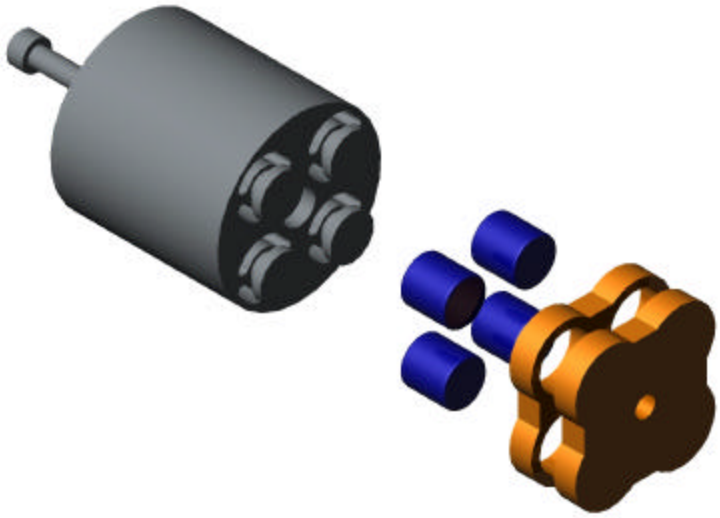
Suspension Work

- Prototype, light-weight, suspension

eddy current dampers have been fabricated and are being tested.

- Blade rotation

– adjusts position yaw & longitudinal position of optic



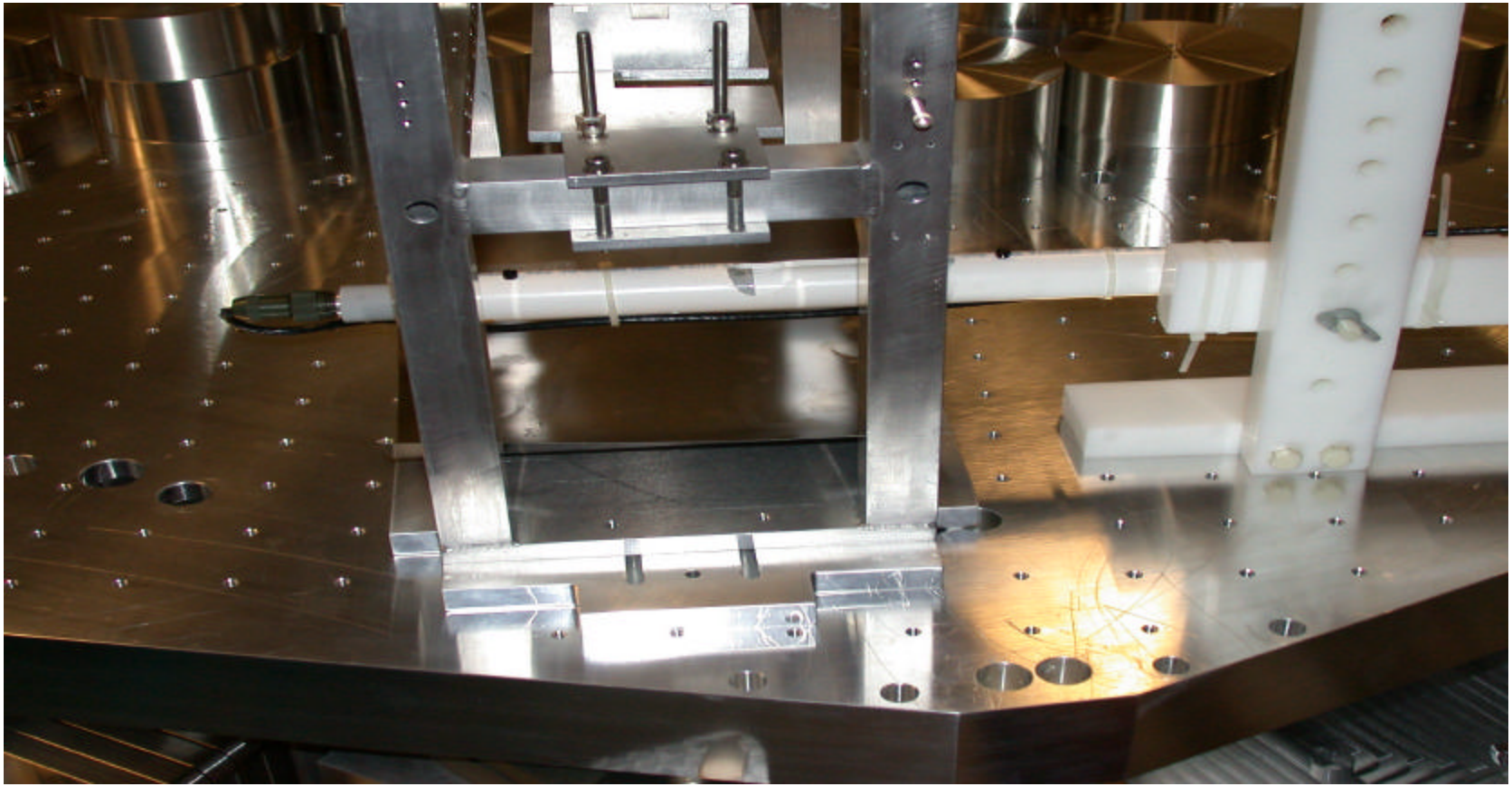
Suspension Work

- MC structure natural mode frequency testing done.
  - » Not stiff enough to meet the 150 Hz req. from SEI
  - » Analysis performed - design close to 150 Hz – FEA on-going
  - » Plan to fabricate stiffer structure and test again.
- Catcher to assemble the optics, ears and fibers is being developed for noise prototype.
- For SEI: updating mass, cg and footprint details.

Magnetic Field Measurements

- Magnetic field measurements done at ETF at Stanford.
  - » Will stray fields from magnetic actuators on the platform induce unacceptable noise forces on actuator magnets in the SUS local/global control system?
    - – With table locked, current was applied to one of each of 4 different types of actuator, and a search made for field and gradient hot spots in the volume above the table.
  - » Preliminary result: strongest fields were from horizontal actuator between the ground and stage 1 of the table.
  - » Rob Schofield is analyzing the data for problems for coil excitation at normal operation

Magnetic Field Measurements



Suspensions

- Short term challenges
  - » Lots of work/Not a lot of time/Not a lot of manpower
    - – Finish up MC work, complete RM design and start fab., complete quad and start fab.
    - – Meetings ongoing to establish manpower loading
  - » Infrasctructure questions
    - – Solidworks and ProE
    - – DCC and Solidworks incompatibility
    - – PDMWorks – hasn't been security-tested yet.