Advanced LIGO

Update on Advanced LIGO Suspension Controls Prototype Developments

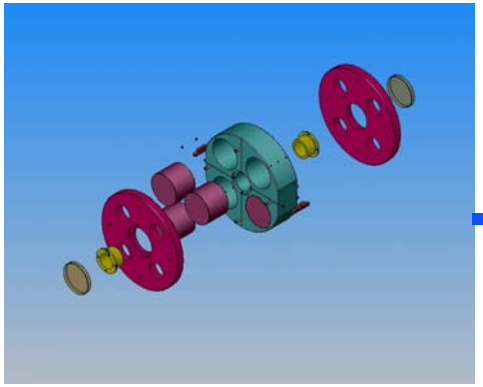
Janeen Romie

LSC, March 2005

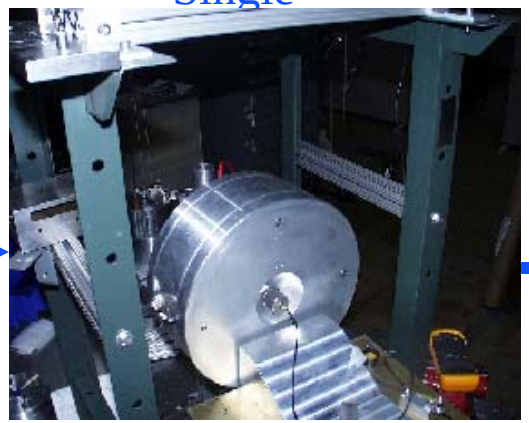
- **LIGO LAB**: CIT: H. Armandula, M. Barton, D. Coyne, J. Heefner, M. Mageswaran, K. Mailand, J. Romie, C. Torrie MIT:P. Fritschel, K. Mason, R. Mittleman, L. Ruet, D.Shoemaker LHO: B. Bland, D. Cook LLO: J. Hanson, H. Overmier, O. Spjeld, G. Traylor
- **GEO600**: GLASGOW: G. Cagnoli, C. Cantley, D. Crooks, A. Cumming, E. Elliffe, A Grant, A. Heptonstall, J. Hough, R. Jones, I. Martin, M. Perreur-Lloyd, M. Plissi, D. Robertson, S. Rowan, K. Strain, P. Sneddon, H. Ward UNIVERSITAT HANNOVER: H. Lueck
- **STANFORD UNIVERSITY**: N. Robertson (also GEO/Glasgow)
- **RUTHERFORD APPLETON LABORATORY**: J. Greenhalgh, T. Hayler, I. Wilmut
- **THE UNIVERSITY OF BIRMINGHAM**: S. Aston, D. Hoyland, C. Speake, A. Vecchio
- **STRATHCLYDE UNIVERSITY**: N. Lockerbie

Quad Controls Prototype Build

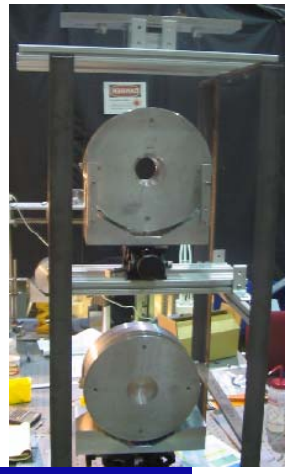
Composite test mass



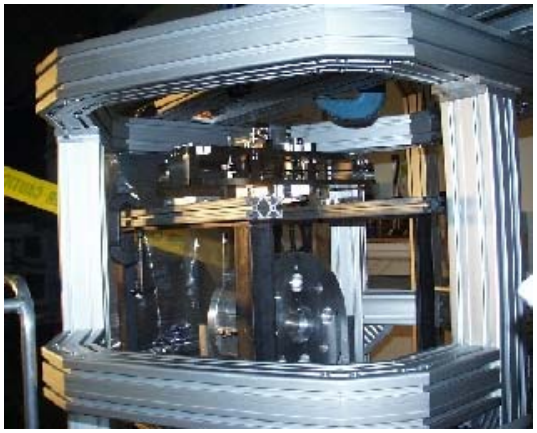
Single



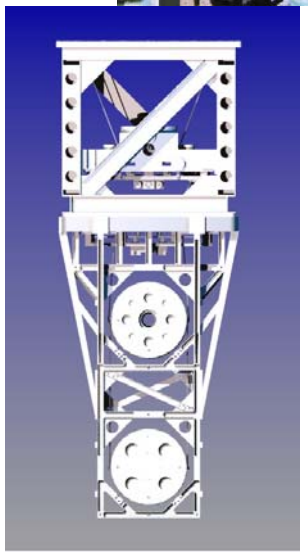
Double



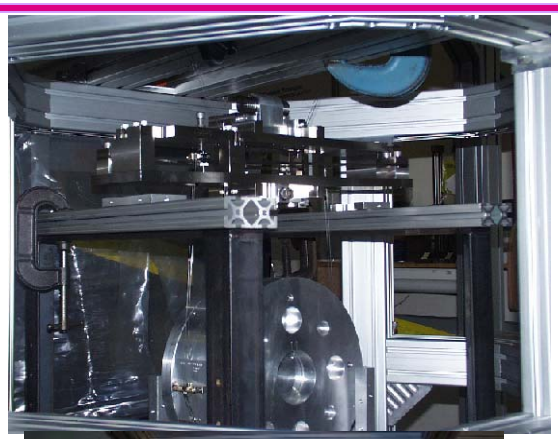
Triple

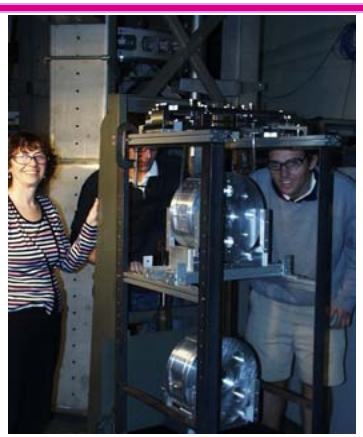


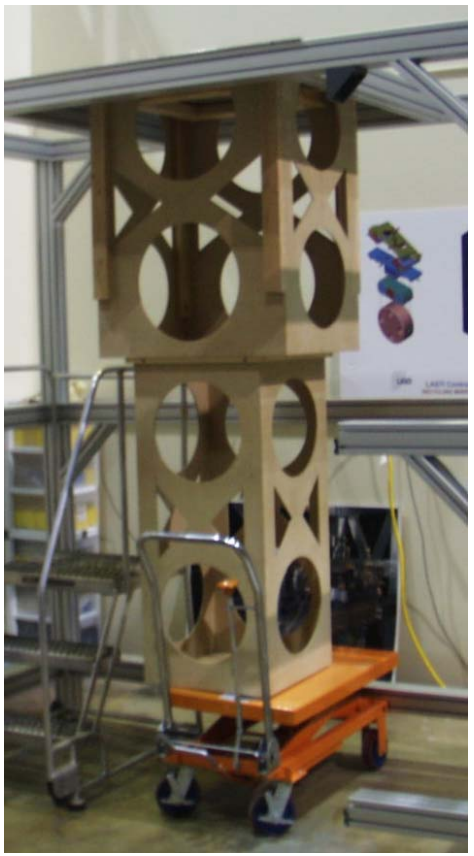
add reaction chain

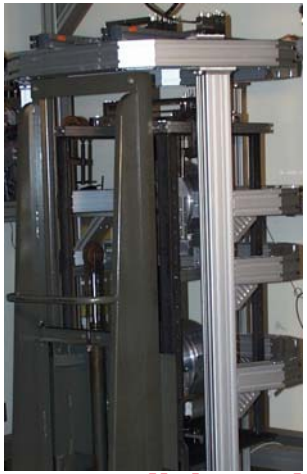


Sub-assembly & procedure/tooling development leading to the prototype build





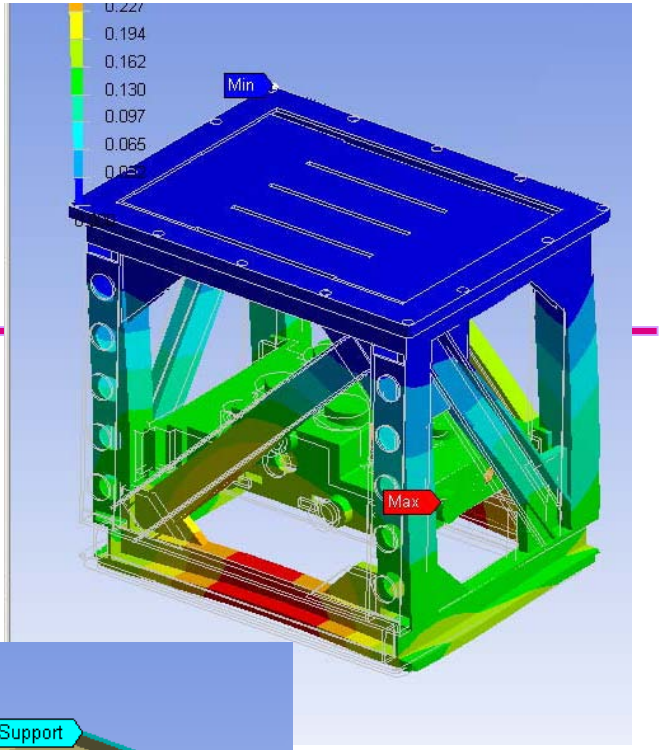


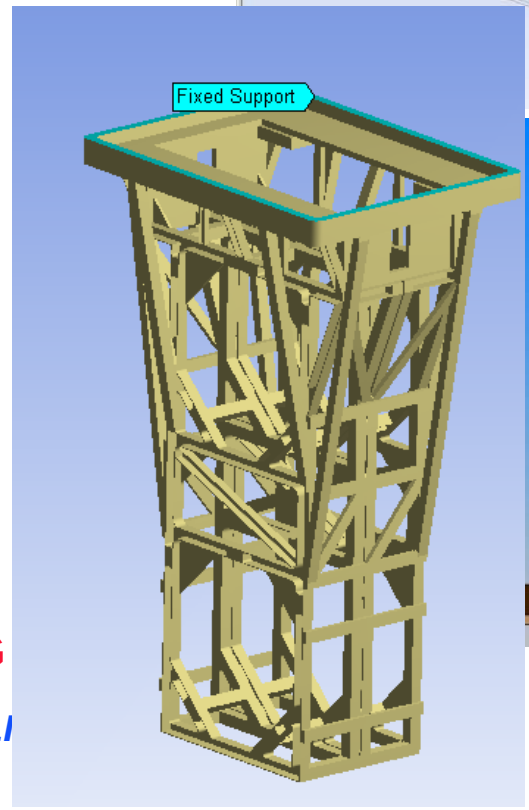


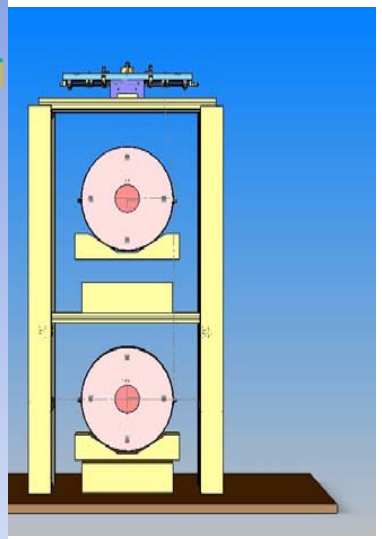
- See talk by Calum Torrie for SUS at Tuesday's SWG

Quad Controls Prototype

- Suspension structural design process
  - » Coordinate SUS team members on structure design that meets coupled dynamics goals:
    - – 200 Hz upper, 100 Hz lower, 100 Hz together
  - » Iterate design after FEAs*
  - » Maintain detailed mass budget and C of G calculations for quad for use by SUS and SEI
  - » Transfer models to SEI/Dennis Coyne for coupled dynamics modeling to validate design







* See talk by Tim Hayler for SUS at Tuesday's SWG

Quad Structure Testing at the ETF

Examples of upper and lower quad structures will be mounted at Stanford ETF (2-stage active platform) for measurement of coupled resonances & control behavior

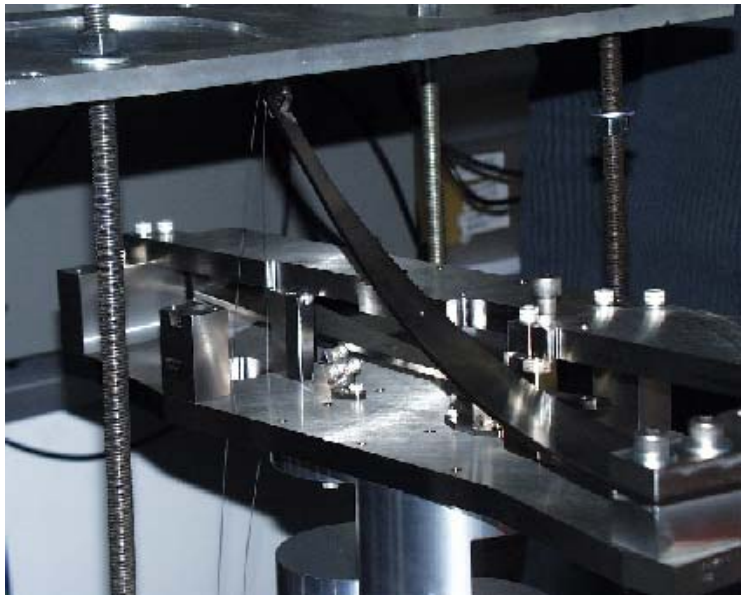
- Resonance tests will be carried out at Caltech prior to this.

Initial LIGO LOS structure now at ETF for initial tests prior to quad structure availability

[B. Lantz & M. Lincoln]

Quad Controls Prototype Blades

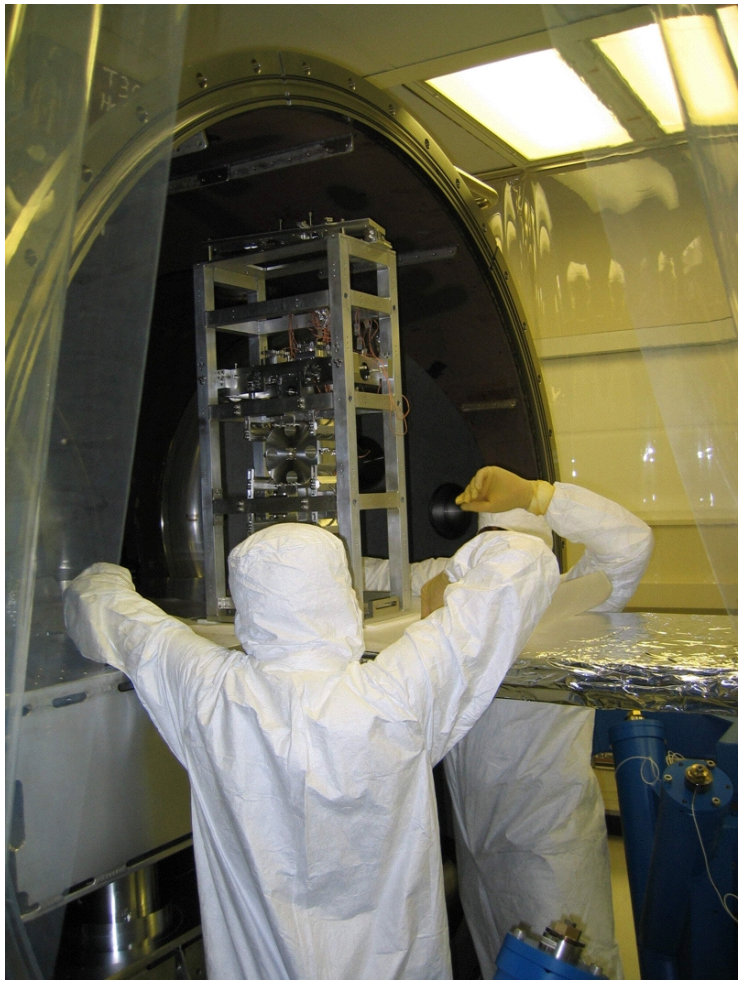
- Investigation of seismic & thermal noise peaks from blade internal modes, T050046
  - » Lowest set of blades may need damping from thermal noise considerations
  - » Other blades may also need damping for seismic noise considerations
  - » Eddy current damping to be tested in controls prototype
- Blade characterization
  - » Height – unloaded, loaded, repeatable
  - » Frequency check – internal mode and bounce
  - » Dimensional check
  - » Blade & clamp selection for prototype

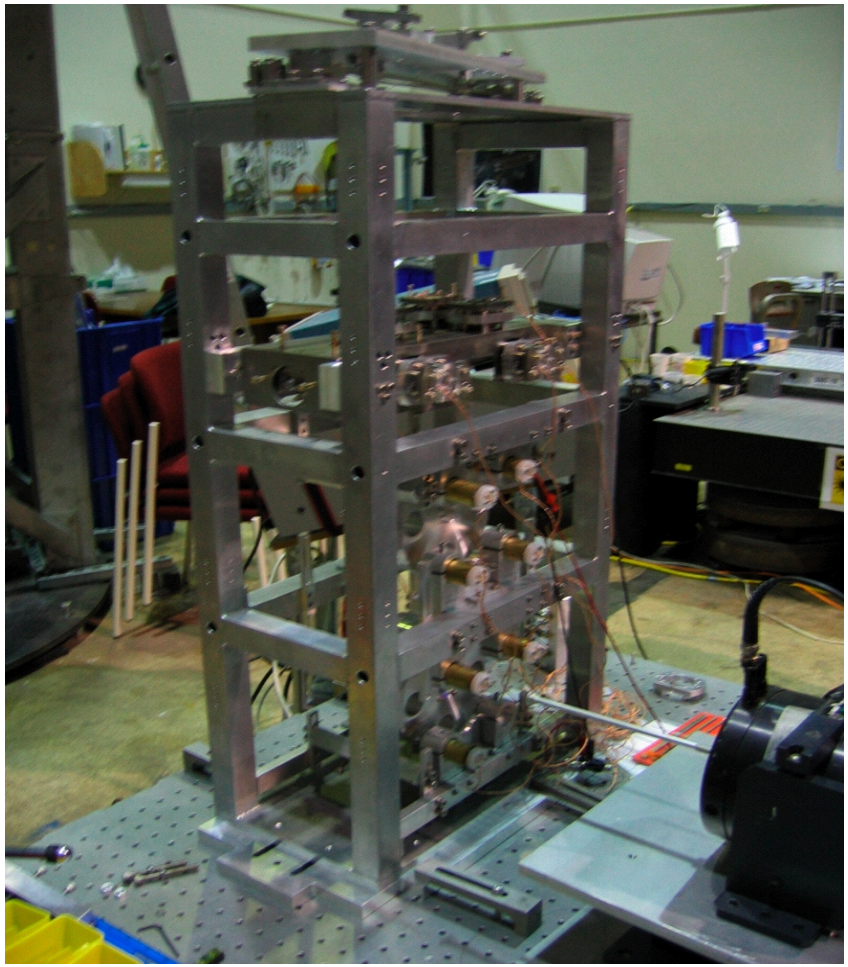


Quad Controls Prototype

- Quad design task management
  - » Weekly Design Meeting, Mondays @ 8am, http://www.ligo.caltech.edu/~ctorrie/, under Design
  - » T040016-05 Quad Task List spreadsheet for subassemblies/responsibilities
    - – Overall assembly
    - – Suspended masses
    - – Structure
    - – Jigs and fixtures
    - – Glass concept
    - – Modeling & software
    - – Springs
    - – Installation Fixtures
    - – Electronics
    - – Documents
- Data management for collaboration
  - » PDMWorks vault: pdfs, SolidWorks, ProE, step translation files, photos
  - » Work structure in vault mirrors task list, T040016

Triple Suspension (mode cleaner) Testing at LASTI





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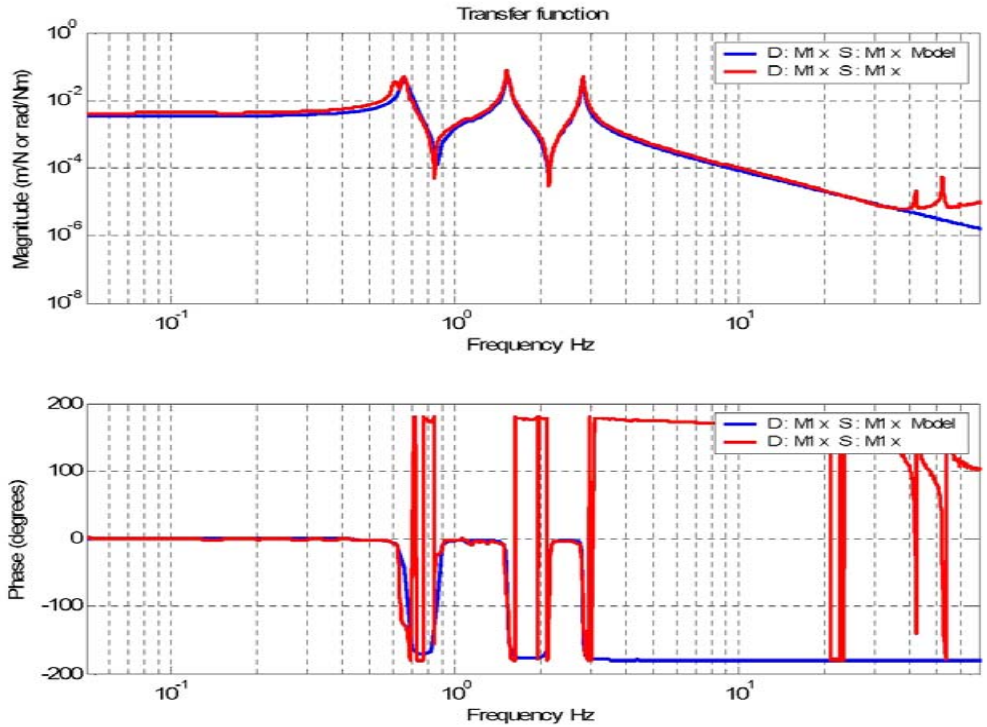
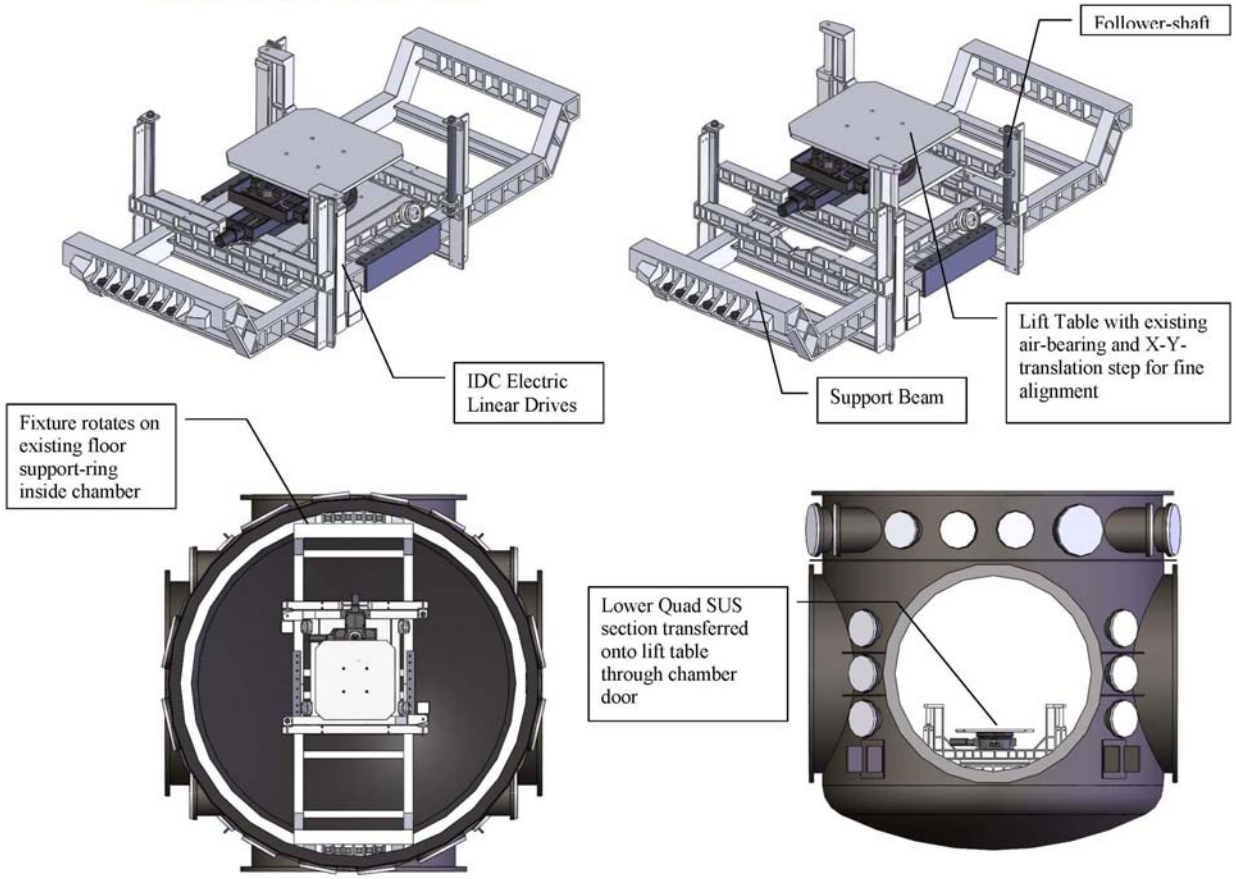


All measured transfer functions and frequencies agree with model.

Installation Fixture Design

Quad Installation Fixture, In-Chamber

- **Used to translate and lift quad structure (and potentially other table mounted components) to the SEI Table**



Installation Fixtures Design

Articulated Arm

- Transport of the quad lower assembly into the BSC chamber and onto the in-chamber quad installation fixture
- Likely useful for installing other SEI table components.