advancedligo

AdLIGO HAM ISI PDR
Pt. 1: System Overview

Oct. 10, 2008, Brian Lantz, for the SEI team

3 Presentations:

1) System overview - Brian Lantz

2) Performance - Jeff Kissel

3) Production phase - Brian O'Reilly

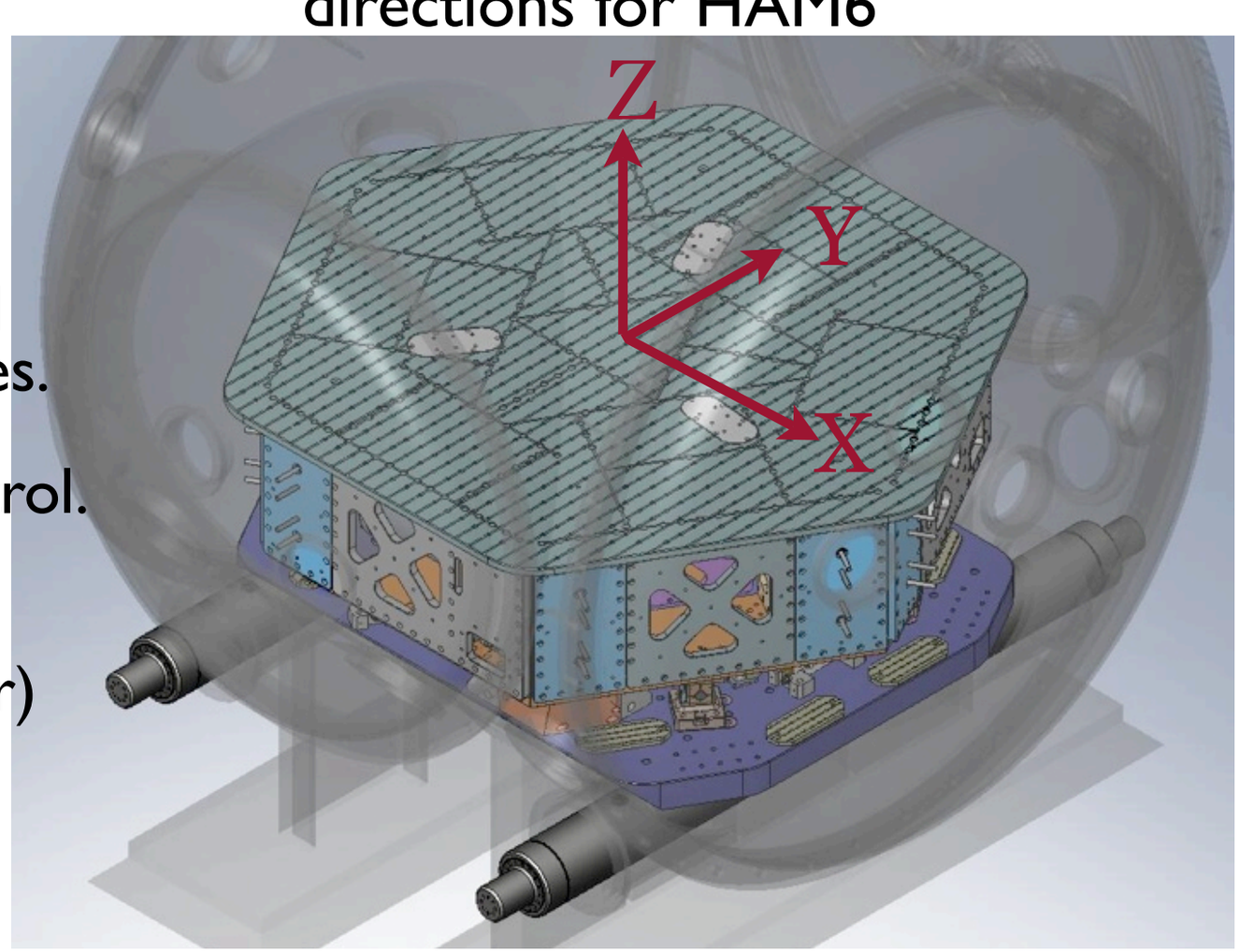
System Overview-topics

- Too much material to cover in 20 minutes
  - this is a framework to hang questions on
- Odd PDR situation, we have 2 installed for ELI
  - and we like them, plan only minor changes
- Design approach
- Mechanical design
- Cleaning and assembly
- Basic tests
- Installation
- Issues

Design approach

- Single stage active/ passive isolation and alignment system
  All 6 DOFs are isolated and controlled.
  - most performance at 10 Hz and above is passive
    Natural freqs:
    X&Y ~ 1.3 Hz, Z~ 1.8 Hz,
    RX & RY ~ 1.0 Hz, RZ ~ 0.8 Hz
  - active systems provide isolation between 0.1 and ~20 Hz
    uug freq ~ 25 Hz.
- Use displacement sensors at low freq
  use inertial sensors at high frequencies.
- Design the system to be easy to control.
- Controllers are designed to be SISO.
  (maybe do fancy stuff in addition, later)
- Base on our experiences with the Stanford Tech. Demo.

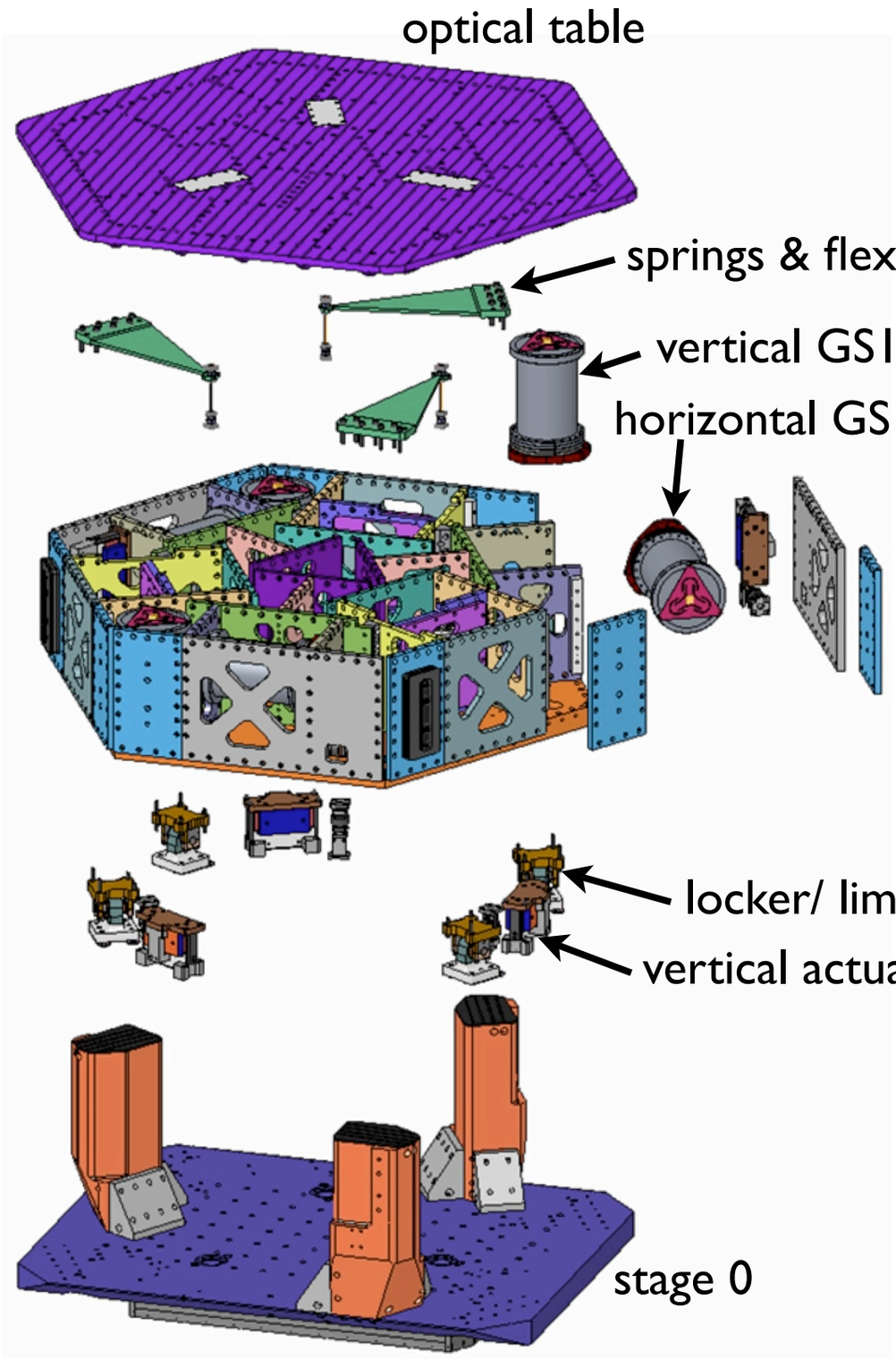
directions for HAM6

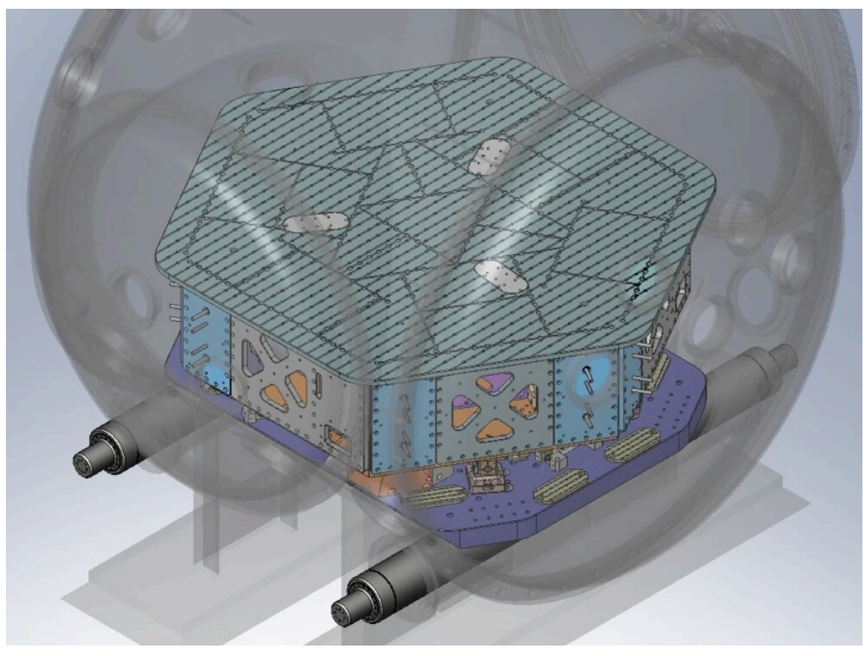


Mechanical Design

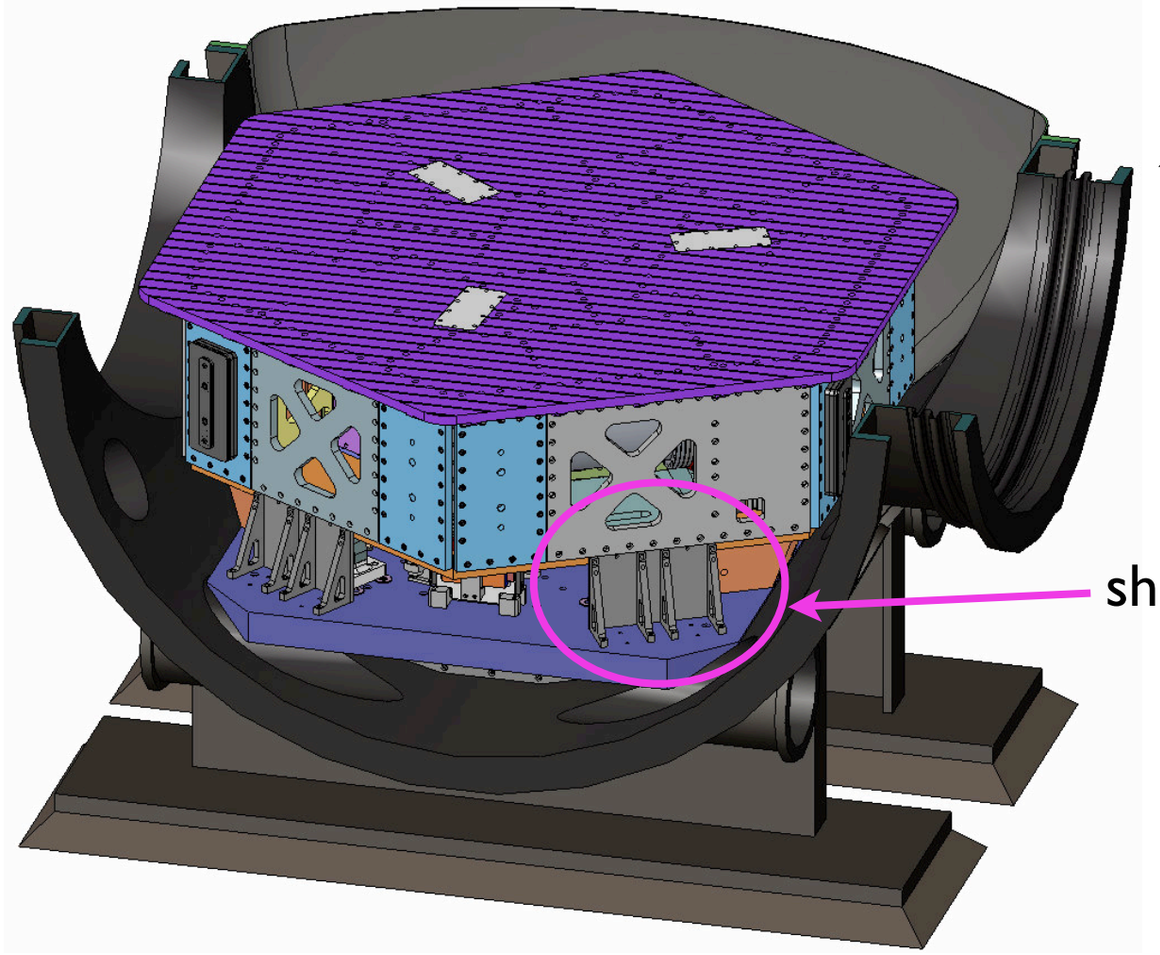
Stiff bolted aluminum structure

springs about 7% stiffer than expected, puts payload at about 650 kg (design was 510 kg payload + 63 kg trim)





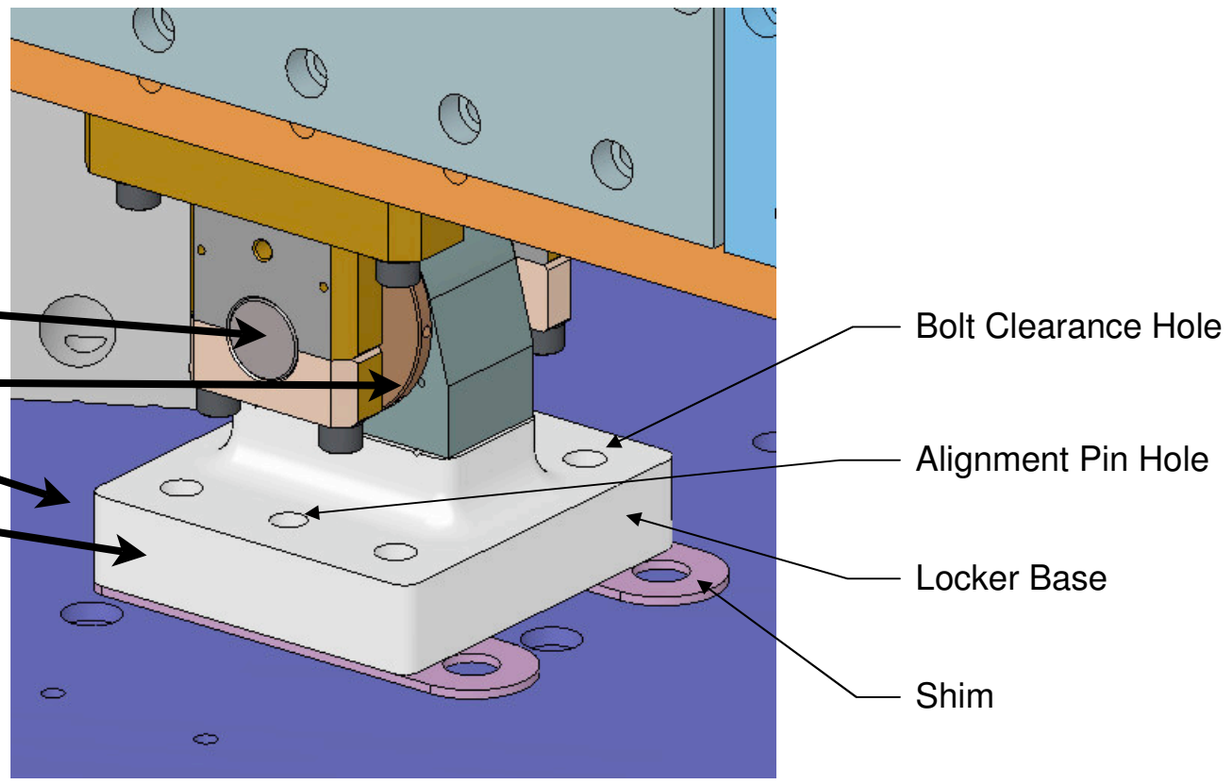
Mechanical Design



For storage and transport, we don't use the locks, we use the shipping braces.

lock/ limiter detail

a shaft with a ball is attached to stage 1
and goes through a stepped cylinder
attached to stage 0.
The cylinder is threaded into a base.
screwing it one way locks,
and the other way releases, the stage.
limits motion in vertical and sideways directions

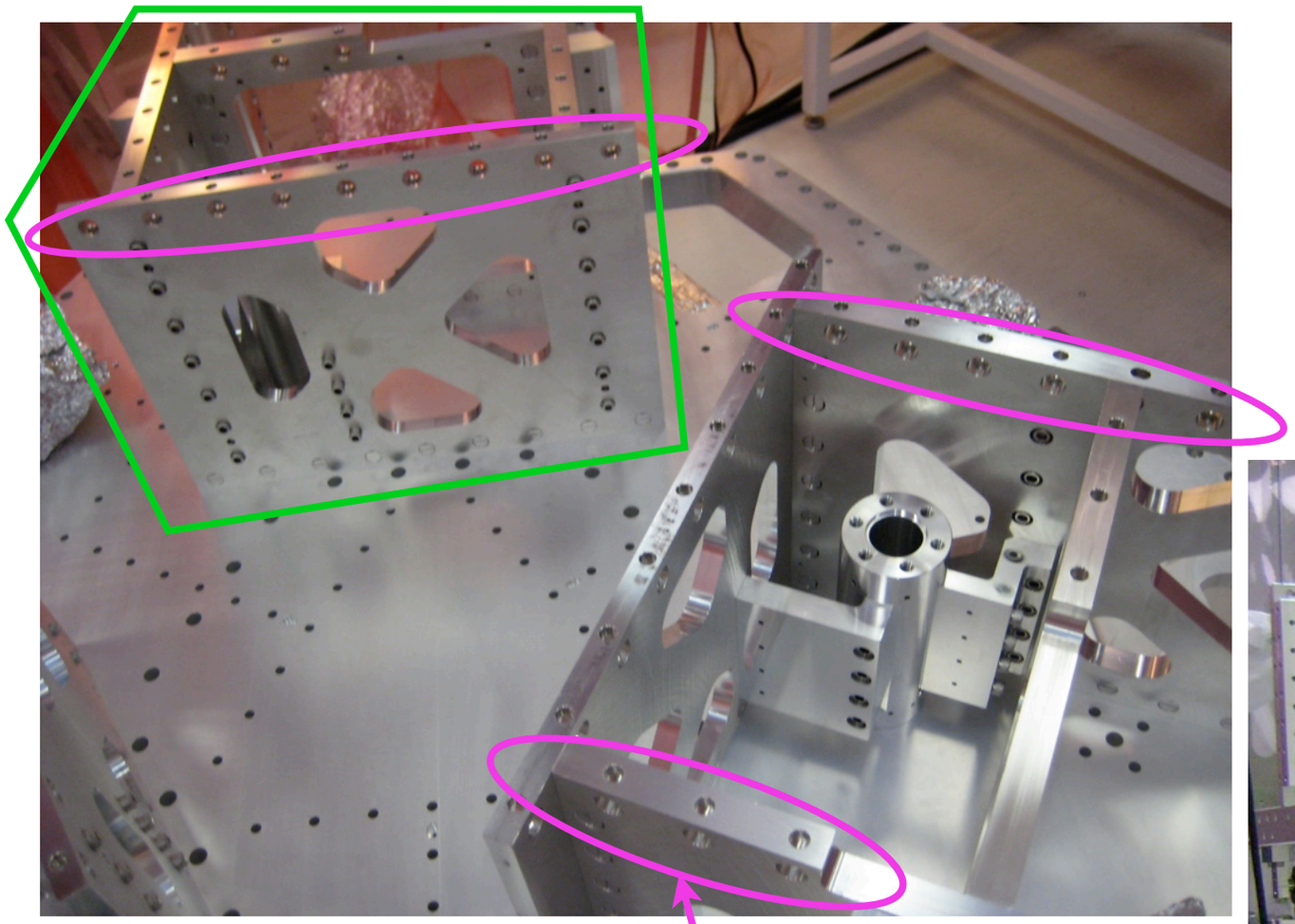


Cleaning

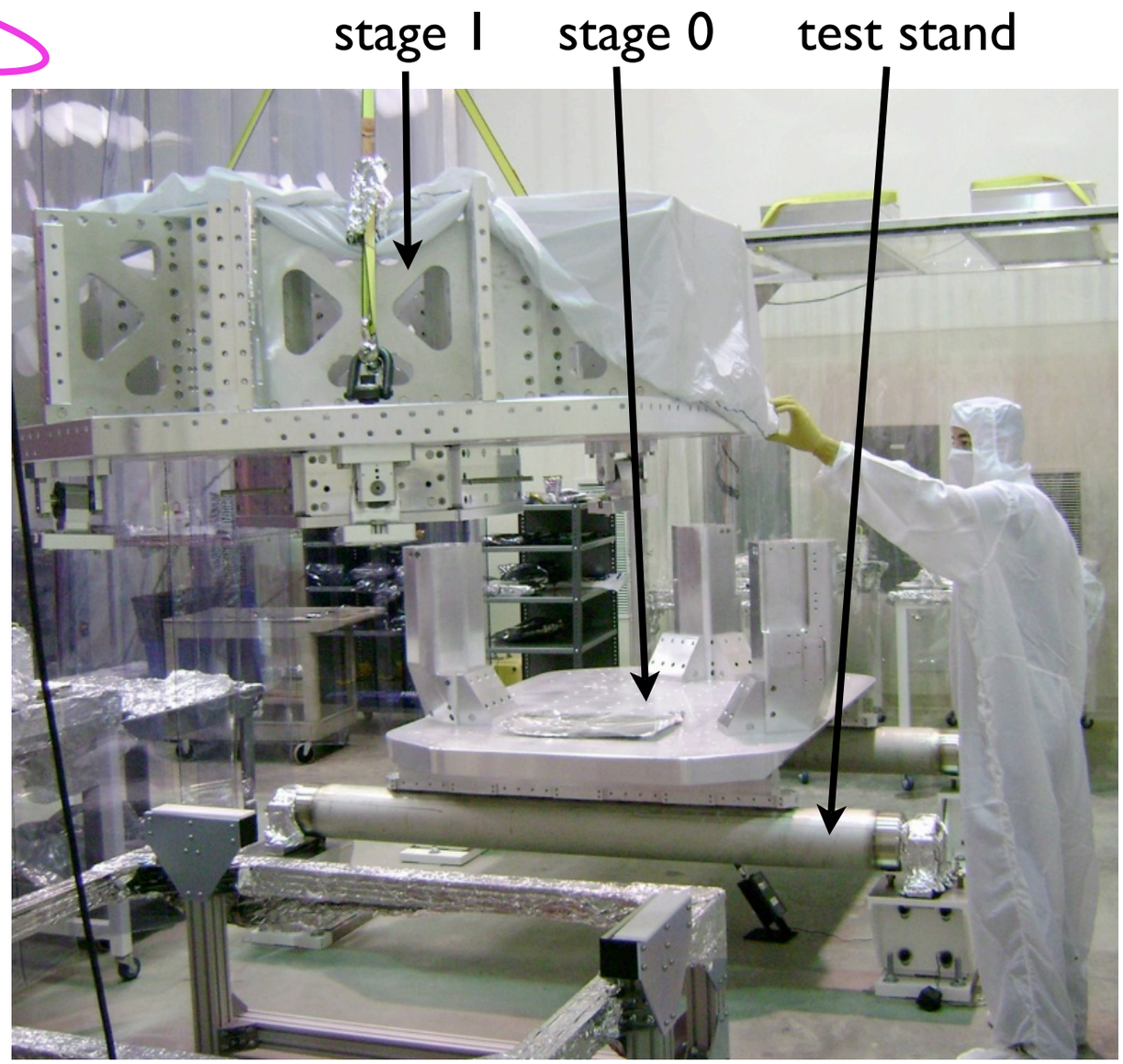
- most parts are aluminum plates and bolts small parts get cleaning by standard LIGO cleaning.
- Big plates and support tubes are chemically cleaned and air-baked in oven at LLO.
- GS13s are put in clean pods
- actuators are cleaned, assembled, then cleaned and baked.
- Displacement sensors are low-temp baked.

Assembly

2 'boxwork' sub-assemblies on stage 1 floor

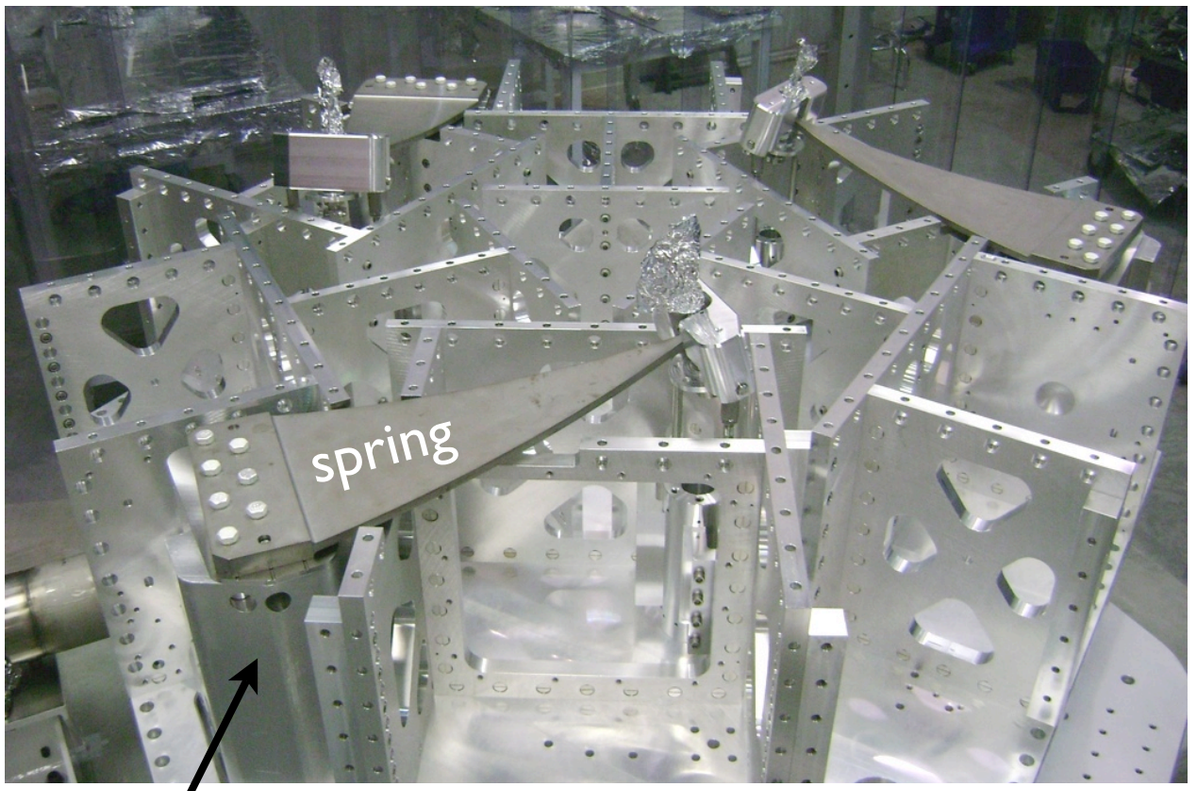


examples of barrel nut locations



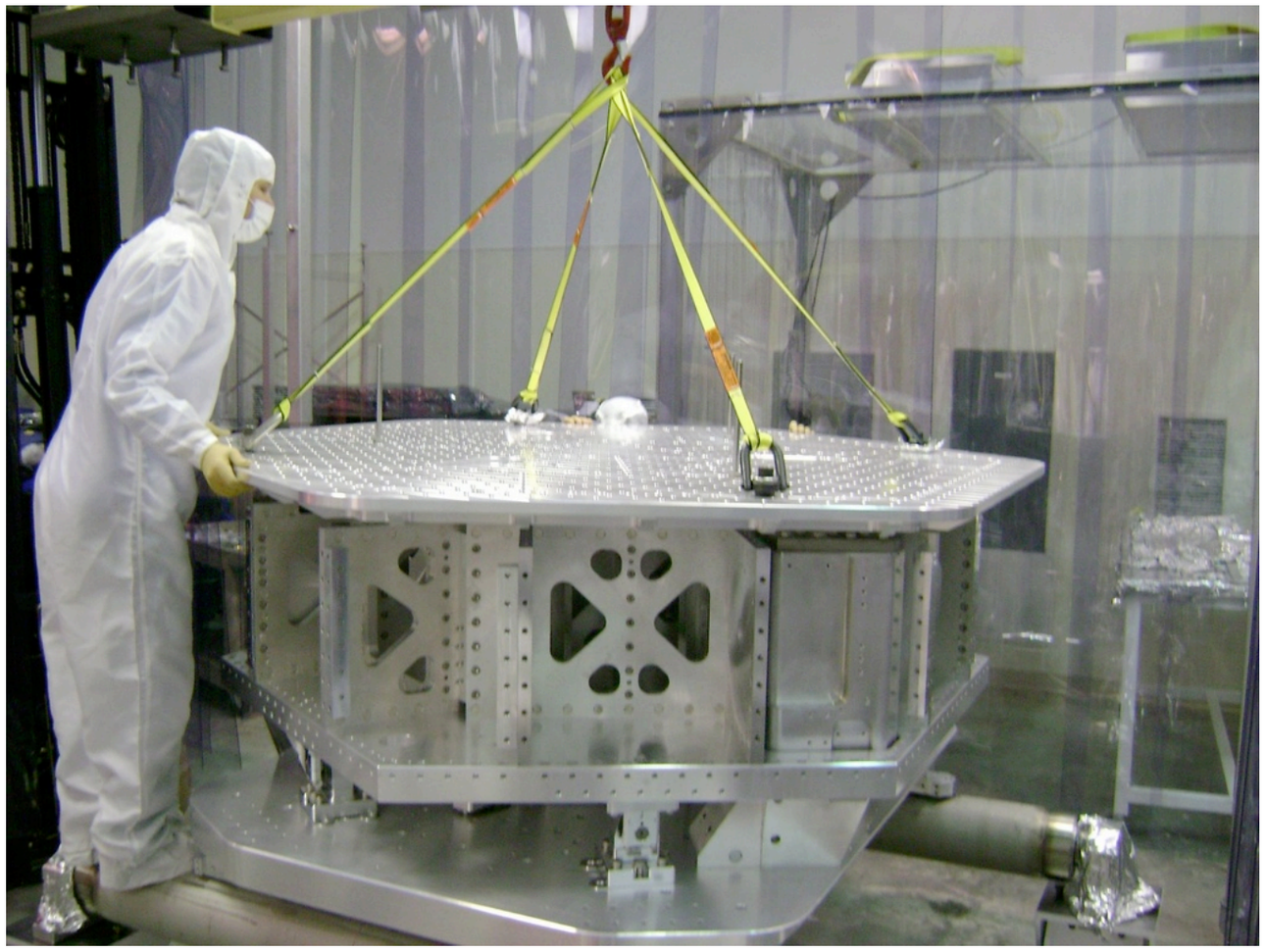
Assembly

Tighten the springs (cover in design, now)



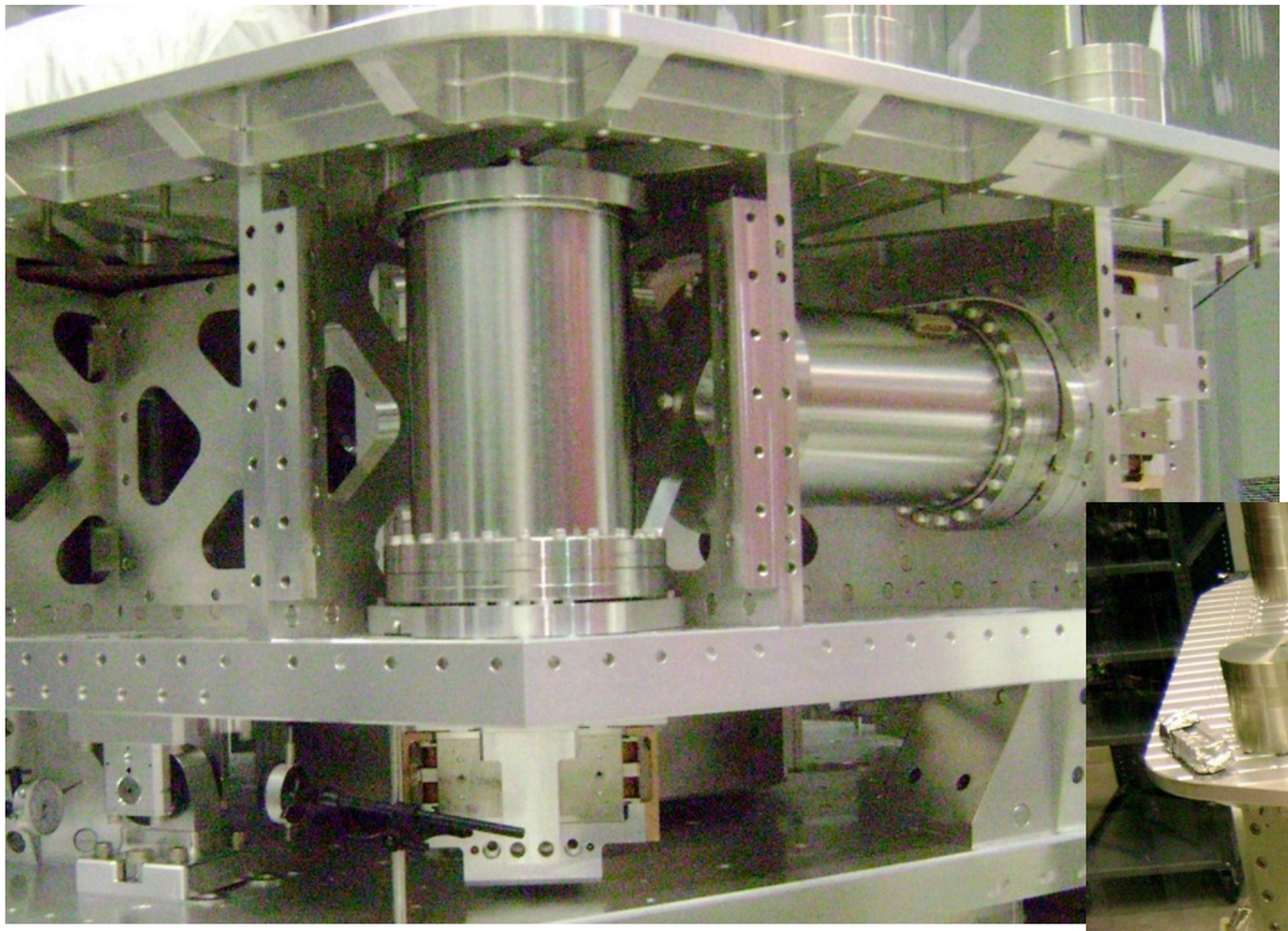
stage 0 spring post

put on the table top

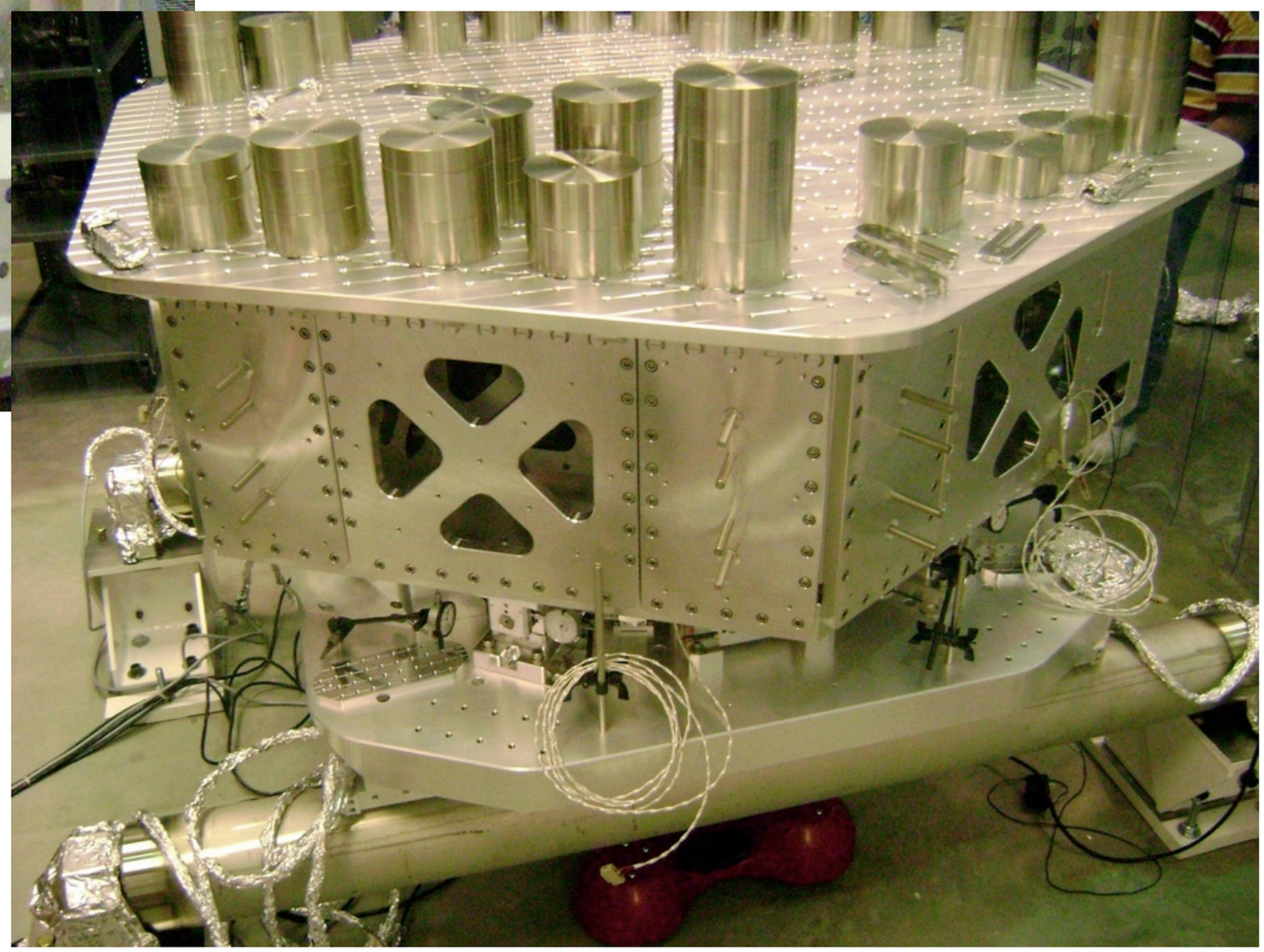


Assembly

Install the sensors



install closeout plates, balance the table



Tests

- We need a list of tests

Tests of the Pieces

- We have unit tests for the GS13 and the displacement sensors
- We need a unit test for the actuators.
- There are a series of tests for the electronics boxes.
- We have a 'pod emulator' which goes into the cable from the GS13, L-4C, or STS-2 and tests the instrument on one side, and the electronics power & readout on the other.
- We need some unit tests for the software.

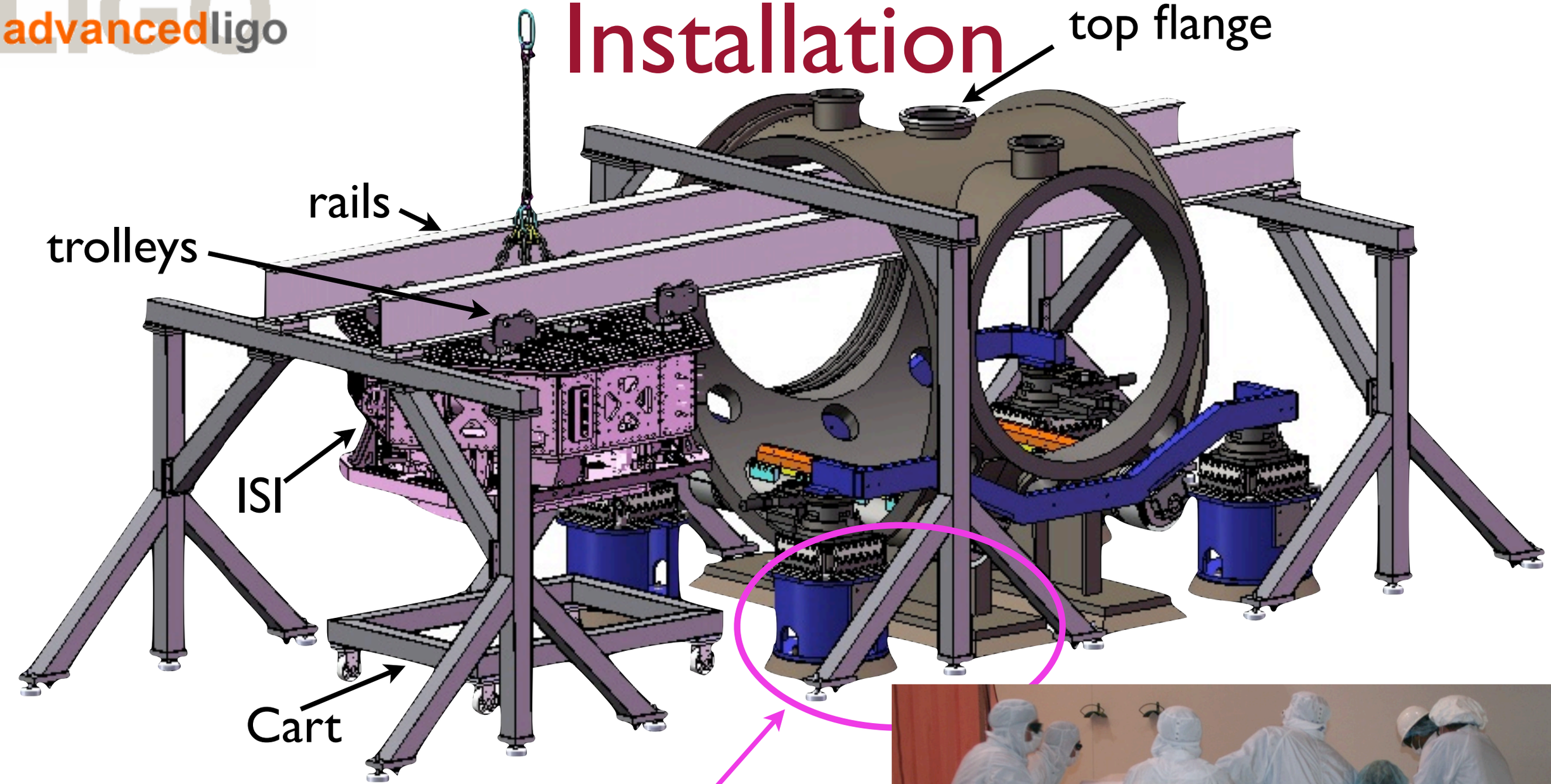
Tests of the System

- We have a series of tests for the system, still must be written up as a procedure.
  - Load, balance, memorize 'hang' location
  - Be sure table moves freely
  - Check non-linearities, X-couplings small
  - natural freq's and bending mode freq's OK
  - maybe run some damping and isolation?

pod emulators

When the tests are done, the system goes into storage

Installation



2 major issues:

1) For 2 close HAMS (e.g. 2 and 3), there is an interference with the fixture.

2) Hard to move on the tile floor.

Issues:

Issue	Proposed Resolution	FDR?
update all drawings with HAM6 redlines	will confirm this is complete	yes
poor dressing of cables	Added to list of design changes	yes
stainless-on-stainless bolt galling	Silver plate relevant bolts	yes
Suggested design changes to improve ease of assembly	Design changes will be made in design documents	yes
Helicoils in barrel nuts at LHO	Test to determine if use of helicoils in barrel nuts in LLO makes an appreciable difference in system performance	yes
Hard to reach all 4 lockers	look at alternate approaches for access - wrench on stick, new access ports in HAM door.	yes
Spring pull down	Design temporary cover to protect operator	yes
Testing: make list of tests	Will be made	no
Testing: unit test for actuator	Test fixture will be built (CDS)	no
Testing: create procedure for system test	To be written based on tests used so far	no
Storage: spring corrosion	Nickel plate the springs	yes
Storage: storage space	Facilities Modification Plan in development	?
Storage: instrumentation on the system	Will depend on availability of GS-13 pods at assembly time and ability of pods to survive shipping	no

Issues:

Issue	Proposed Resolution	FDR?
Storage: crate design	Perform required engineering and prototyping	no
Storage: removal procedure	Procedure remains to be written	no
Installation	change cart wheels to avoid deforming LHO tile floor,	yes
	revised outrigger design to allow use on close-by HAMs	yes
Electronics	Move to new 8800 cap sensor readout	yes
	add second power switch to interface chassis design	yes
Improve GS13 reliability & locking (likely greatest hardware risk)	Talk to manufacturer/ develop lock-free sensors	yes/ unlikely
Improve GS13 stability	Study o-ring connection for far end of GS13	yes
Actuator: wire connectors	Complete minor redesign to improve connections	yes
Actuator: replacement potting compound	New material is being tested by LIGO Lab	yes
Actuator: unit test	Design and build a test fixture	no

Issues:

Issue	Proposed Resolution	FDR?
Commissioning: Additional staff for control design	TBD	no
Improve reliability of computing infrastructure	TBD	no
Train operators to use system	ongoing	no
Implement automated health monitors	TBD	no
Get procurement help for the build	TBD	yes
Resolve computing multiplicity issues	Addressed in CDS review	

Spring compression

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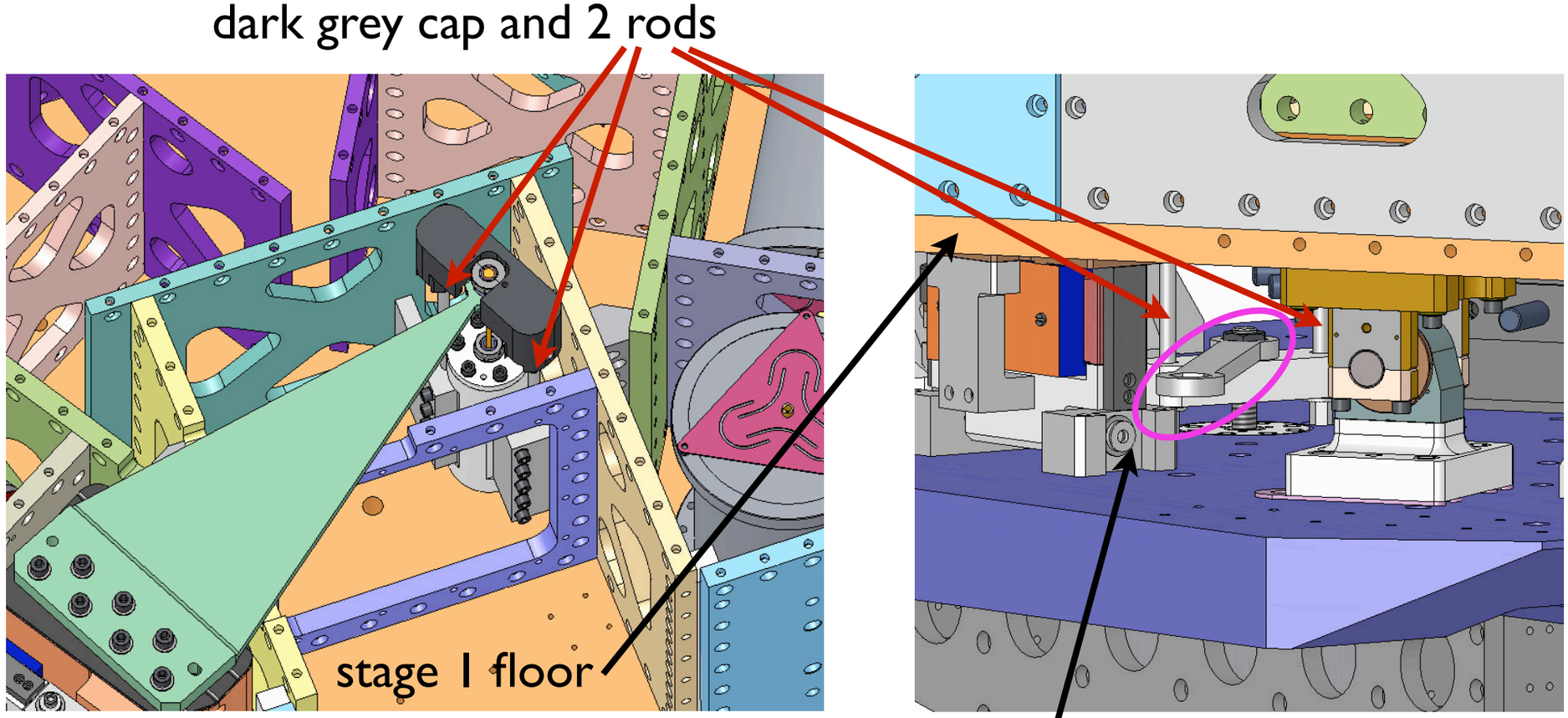
Spring Compression Detail



Access with Optics Table removed

Wrench access from under Stage 1