



Advanced Seismic Isolation Technology Demonstrator

... as an illustrative example of a design that can
meet AdLIGO-like requirements.

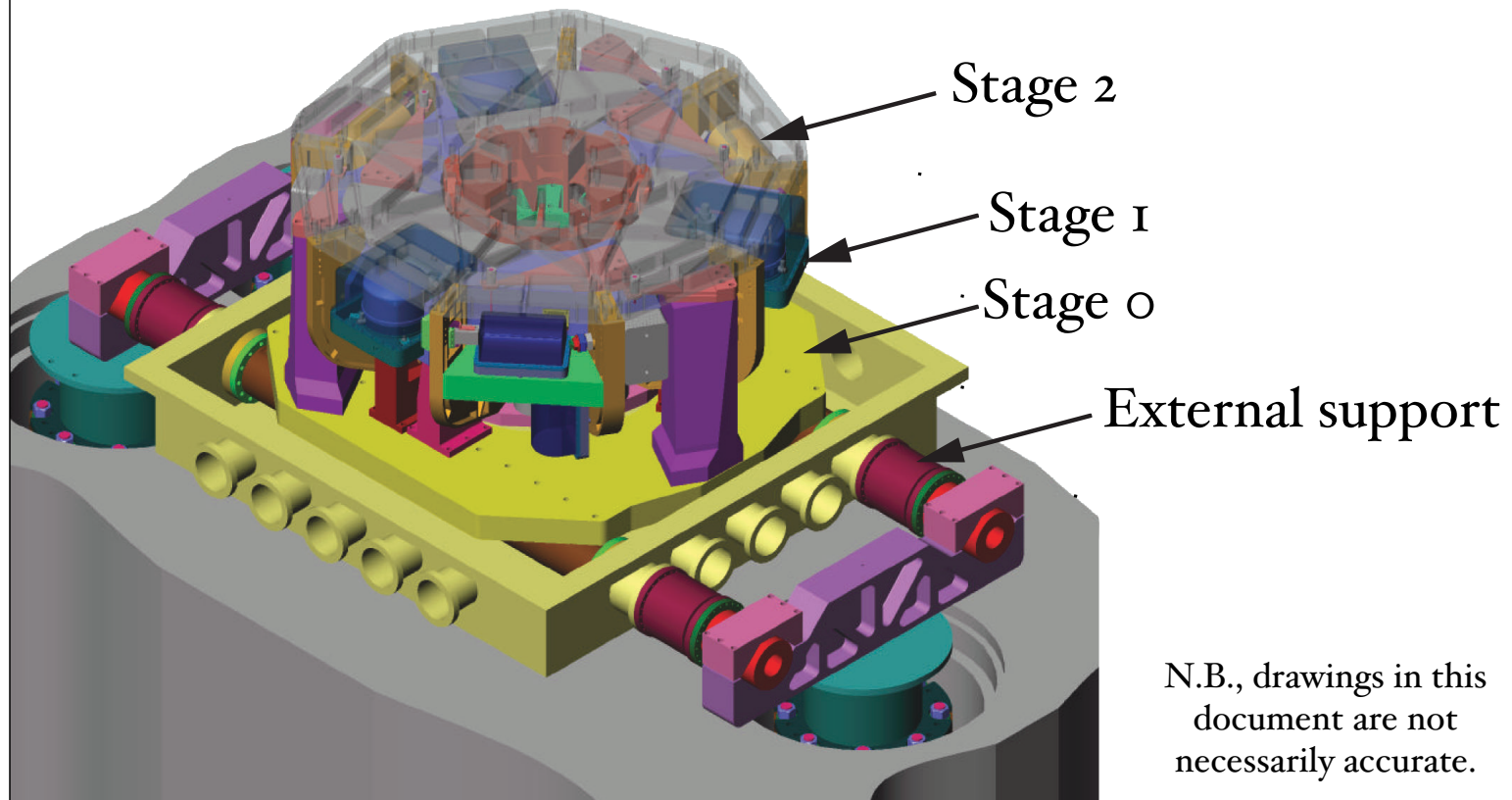
Joe Giaime, LSU & Brian Lantz, Stanford.

Salient features

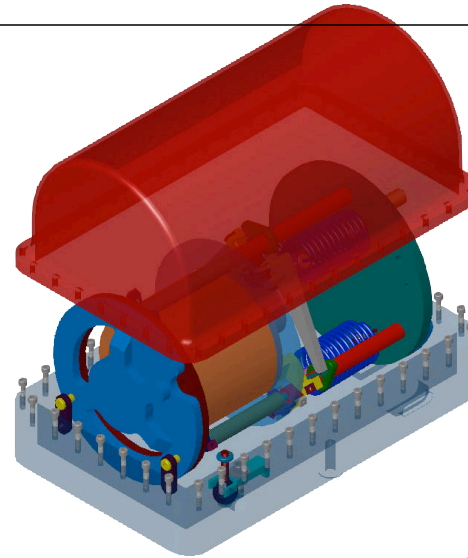
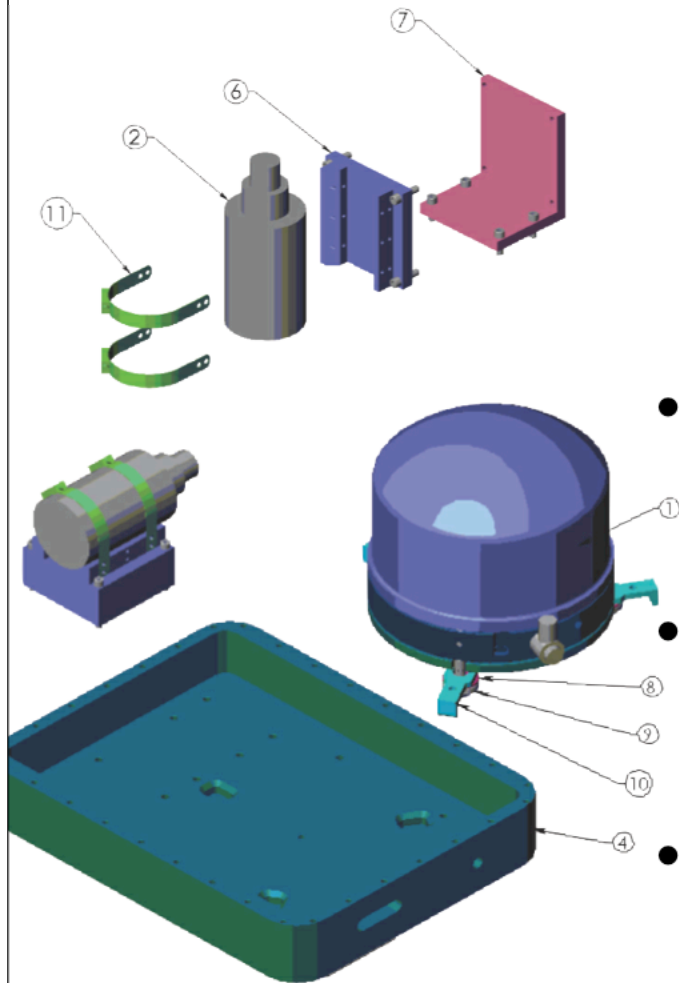
- Self-contained pods that hold seismometers.
- Stiff blade springs and flexures.
- Collocation of sensor-actuator pairs.
- Stiff structure.
- Alignment precision.
- Adjustable mass distribution.
- Flexible optics table for payload.

Technology demonstrator

- Two cascaded suspended stages (1 & 2) supported by stage 0, itself supported by external support on slab.

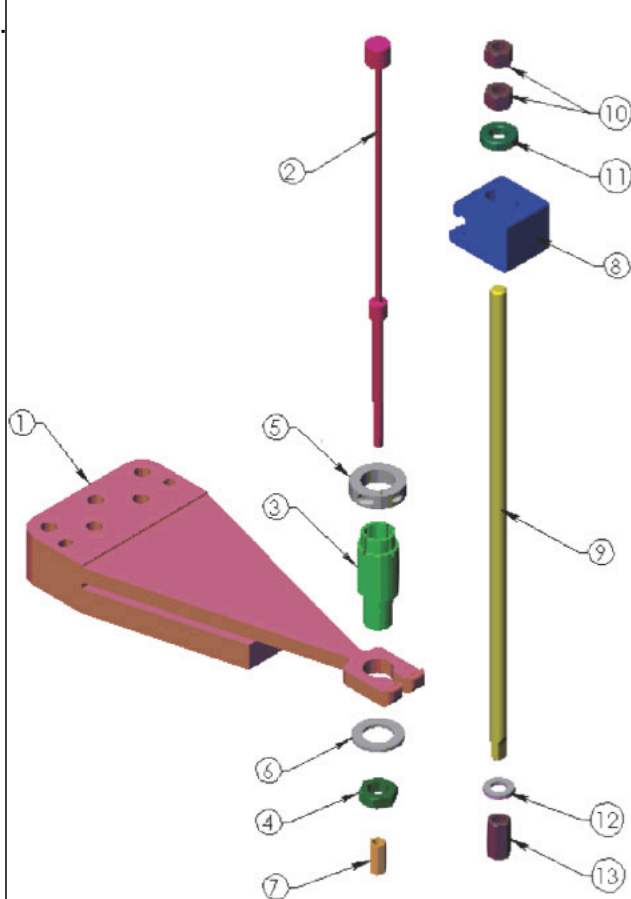


Instrument pods



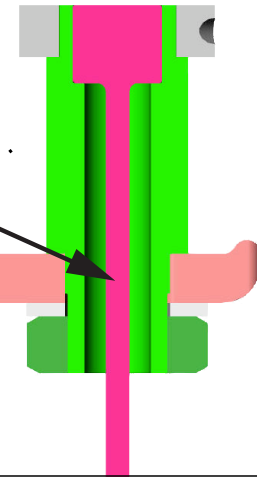
- Delicate seismometers and geophones to be enclosed in trace gas atmosphere.
- Alignment is preserved among components, even when pods are swapped.
- facility for locking/unlocking instruments.

Stiff blade springs and flexures

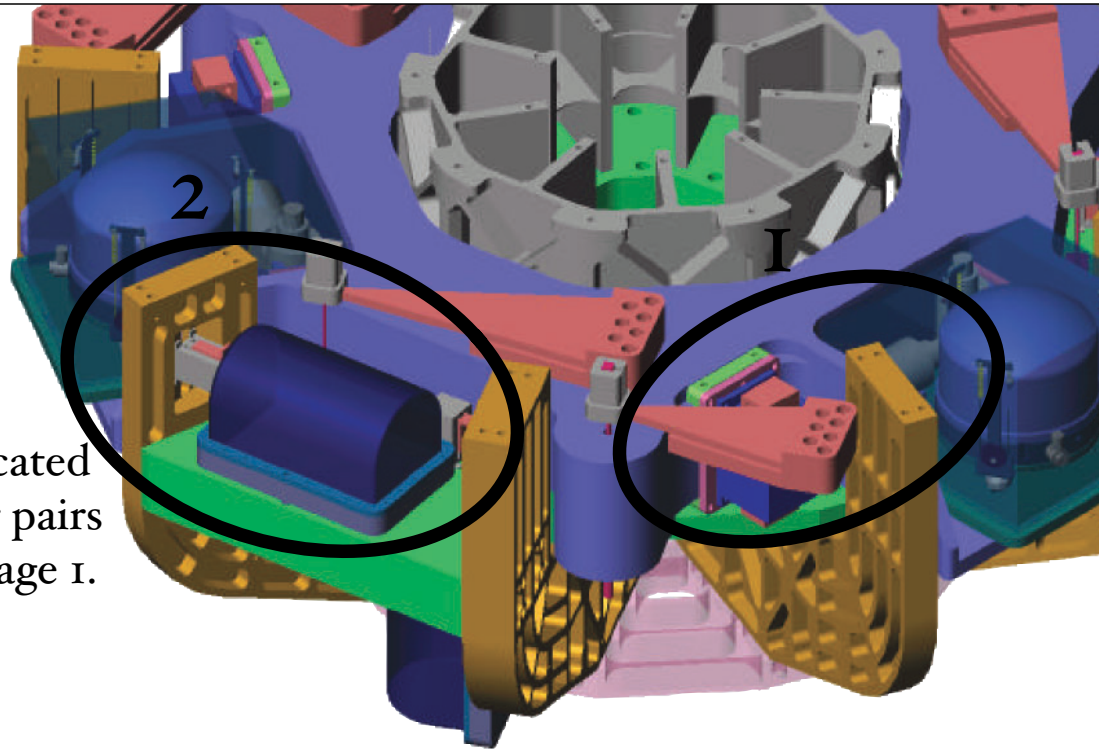


- Pre-shaped triangular blade springs become flat and horizontal at design load. Trim masses account for variations.
- Machined rod flexures allow for horizontal compliance, with known zero-moment position.
- Careful shaping and clamping to avoid stress concentration.
- Special jig for installation.

Zero-moment position:
when stage below swings
horizontally, the torque on
the blade is zero.



Collocation



Horizontal collocated sensor & actuator pairs on Stage 2 and Stage 1.

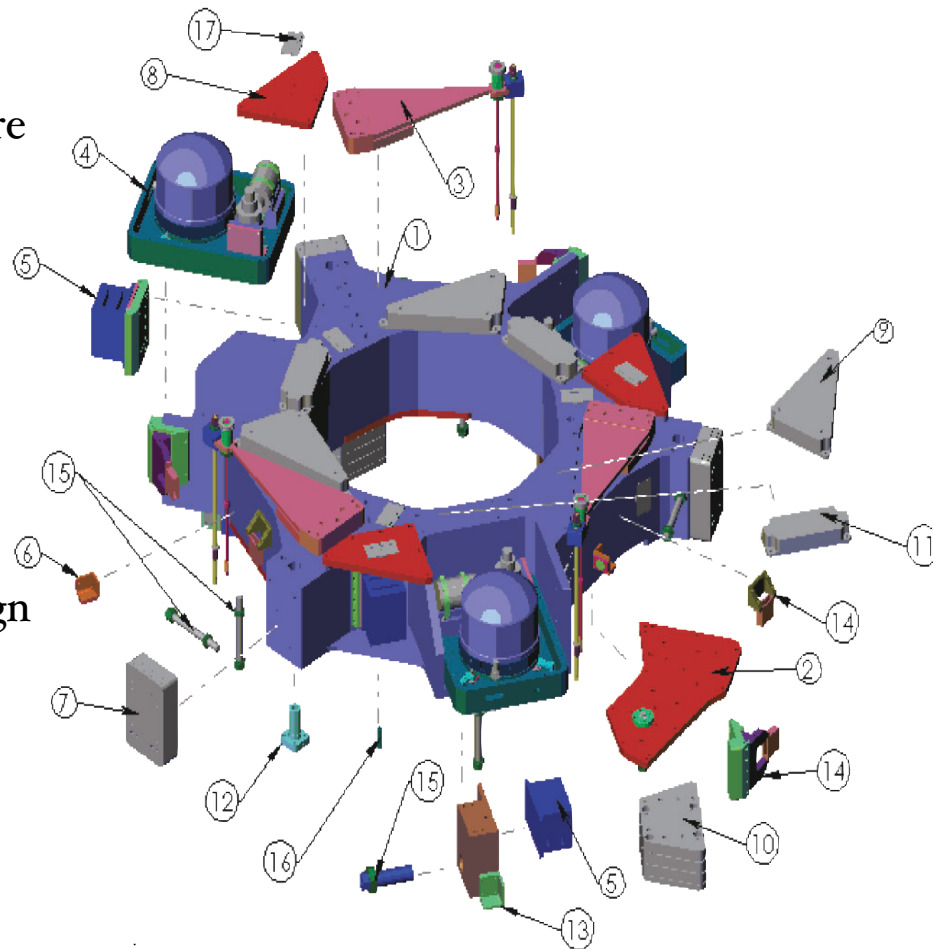
- Each sensor is placed near its associated actuator, to minimize compliance between them.
- They are also oriented so that the sensing axis and force axis are aligned.

Stiff Structure

- Servo-control loops will be closed using the sensors and actuators in all 6 degrees of freedom on each stage.
- The sensed DOFs are not orthogonal, so instability can result if the structural resonances are too low in frequency.
- This requires iteration between FE modeling, structural design, light-weighting, and bolt/weld strategy.
- The Tech Demonstrator meets similar stiffness requirements, albeit with a smaller payload. The scaling up in payload for the LIGO prototypes will require a stiffer (and probably heavier) structure.

Alignment Precision

- The alignment tolerances are satisfied by following the vendor-supplied installation procedure.
- Jigs, special clamps, and gauges are supplied and explained.
- The complexity of the design suggests that jigs & careful assembly is preferable to hand alignment using dynamic measurements.



Adjustable Mass Distribution

Tech Demo unit stage 2
example:

Weights can be bolted to
the Optics table, Keel, or
Vertical Support (less
good), to level the stage,
and move the CG up or
down.

