

Oct 21

Overview Suspension and Seismic isolation

60 participants

Matt Evans' presentation

Starting point is the LIGO ISI.

A# suspensions under design. Going from QUAD to BHQS (BHeavyQuadSus). Damp from the top two stages. Built-in high-f dampers.

CE design is the subsequent step. Larger masses will be suspended. Cage as reaction chain.

CEQS with suspended cage. Pay attention to blade flexing.

Discussion about 2 vs 4 wires –

Cage – where it is attached?

- Still a concept, a lot of details missed
- Top piece is attached to the ISI platform

Electrostatic drive wouldn't be on the face – so they will be built in the reaction mass

- Brian Lantz [he] to Everyone (Oct 21, 2024, 11:32 AM)
AEI prototype has run masses and ESDs in this way
- Wires probably steel
- ISI design for CE very similar to LIGO
 - Open point
- Question for Paolo: why are you not happy with the marionette design – I am happy with it, just wondering why LIGO is not using single wires
 - Long to pitch cross coupling were mitigate by changing the CM of the marionette with respect to the wires
- Paola – Thermal noise in RM wires can matter

DHS: Are electrostatic drives pretty sure not to bring in noise or coupling? and: is it feasible to just use photon pressure? A suspension could presumably be designed to work well with both.

- Observing mode without ESD, but we don't know if that is true
- Photon actuator, in lock – maybe
- Denis Martynov (Oct 21, 2024, 11:47 AM)

- Probably a bit of a crazy idea to remove ESD: glue Al mushrooms on the mass and actuate on the test masses with induced eddy currents during the lock acquisition.

Odylio Aguiar to Everyone (Oct 21, 2024, 11:35 AM)

Not for A#, of course, but I think it would be a good idea to design the CE suspension system with room for the addition of the cryogenic hardware in the future (for the 2nd phase of CE)

Matthew J Evans (Oct 21, 2024, 11:43 AM)

Yes... we are hoping to ensure that the CE facility is compatible with cryogenic operation.

Luciano di Fiore' presentation

ET_LF baseline in reference design – 17m super-attenuator (starting from Virgo's 9m)

Work on going to reduce the length with new concepts:

- Increase ratio of total Mass / payload mass
- Mass distribution along the chain – paper that describe the mathematical optimum
- Simulation model: Octopus
- Improving pre-isolator
 - Nested inverted pendulum
 - Bertocco et al, CQG
 - Prototype in 1:2 scale, assembling starts early 2025

Brian Lantz [he] to Everyone (Oct 21, 2024, 12:04 PM)

Matt, Jan, Luciano - Apologies, but I must leave at the 1 hour mark. Nice presentation, and we completely agree about the mass & length distributions. We have found 2 things which frustrate this for the A# design: first, the bounce/ roll modes of the final stages are limited for us by the compliance of the final glass fibers - so we are increasing the mass of the penultimate stage to move the bounce roll mode, even though it gives worse horizontal performance. Second - the optical power in the arms is a significant source of additional angular stiffness - and it is not clear how to optimize this with respect to local damping from the upper stages and the noise from the angular controls of the interferometer.

Paolo's presentation

Tilt to longitudinal coupling

- Jan: damping strategy? Paolo: Virgo's experience doesn't see drawbacks with single wires – there are cross-couplings, but not limiting

- Nathan Holland to Everyone (Oct 21, 2024, 12:20 PM)
 - Do you want to describe how Virgo solved the tilt to translation cross coupling with CoM placement?
- Virgo's strategy: soft, heavy and control only where needed
- Matt: LIGO equivalent "separation" in Virgo is filter 7
 - For Luciano: ET for HF less challenge, it seems more urgent – what is the strategy there?
 - Less attention to that so far – but we will ramp that effort
- Paolo: one of the point is that we need a new blade system for larger mass

Den: which are the stages that can be actively controlled?

- The stage we control now will be inside the cryostat
- So we need to add damping at the stage before the cryostat
- Which are the sensors we need?

Glasgow update – Karl Toland

Updated ANSYS modeling of fibers, including imperfections

Prototype lower stage suspension – 2.7m tall vacuum tank 100-400kg