

Suggestions for modifications to future suspension designs

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1. Align the principal axes of rotation with the IFO coordinate system (no off-diagonal elements in the inertia matrix).
2. Align the Horizontal Actuation Plane with the Lower Zero Moment Plane, especially on the top stage.
3. Placement of sensors and actuators on lower stage masses to control degrees of freedom / resonant modes not visible at the top stage. Be mindful that the sensor and actuator noise of these control loops do not spoil the performance in the detection band of interest.
4. Utilization of better sensors throughout the pendulum, and especially at the top stage.
5. Orient the UIM and PUM OSEMs to better align with the degrees of freedom we want to control (pitch and yaw). That is use a cross pattern: one on top, one on bottom, one on left, one on right.
6. Add a fourth OSEM to the face of the top mass in a configuration similar to the previous point. In aLIGO there are only 3, which makes length to angle decoupling more challenging since there is no 'pringle mode' to drive and zero out.
7. Consider reducing the complexity and/or weight of the reaction chain (i.e. it does not need to be a copy-and-paste of the main chain).
8. Do not consider the design of the cage last. Its design is important both for the performance of the BSC-ISI, as well as ease of assembly.
9. In order to keep all resonant frequencies low and/or clustered together, the distribution of mass between the stages should be optimized. More mass at top, less at bottom. See LIGO-T1300786.
10. Maybe we want to replace the ESD with a 'photon calibrator' like device.