



Control of AIGO High Performance Vibration Isolation System in an 80 m Fabry-Perot Cavity

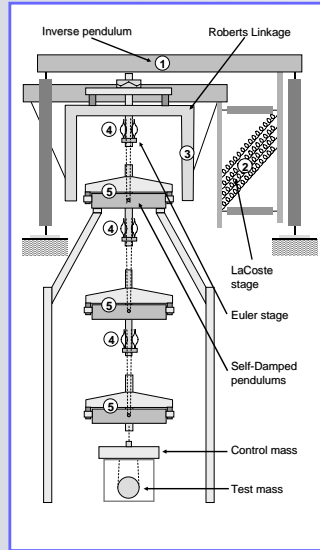


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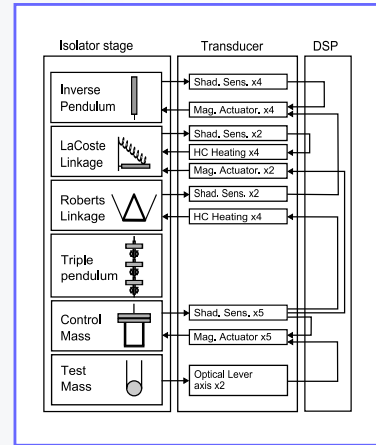
Isolator and control overview

- All stage are passive
- Sensing and actuation at the pre-isolation stages and the control mass
- Inverse Pendulum controlled via magnetic coil actuators
- LaCoste linkage controlled via magnetic actuators and ohmic thermal control of suspension springs.
- Roberts linkage controlled via ohmic thermal control of suspension wires causing thermal expansion.
- Control mass controlled via magnetic actuators. Can be controlled in 5 DoF: X, Y, Z, Pitch and Yaw. Similar to VIRGO Marionetta.
- No direct feedback on test mass
- Optical lever sensing of test mass alignment (Pitch and Yaw)
- Digital control system using: Sheldon Instruments DSP + NI LABVIEW



Control scheme

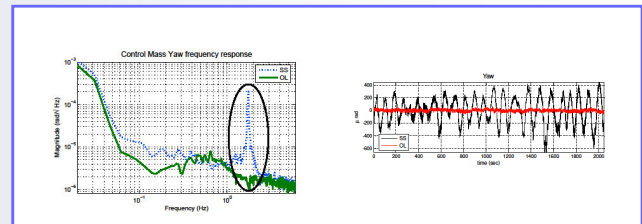
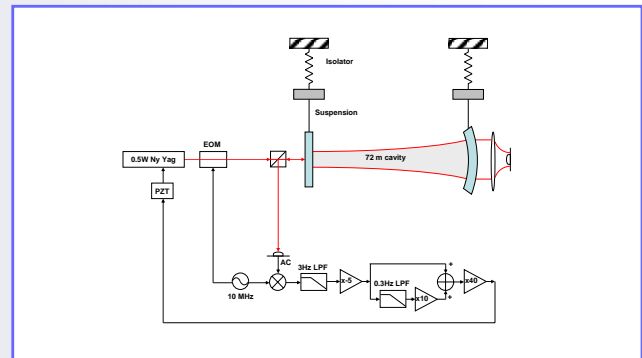
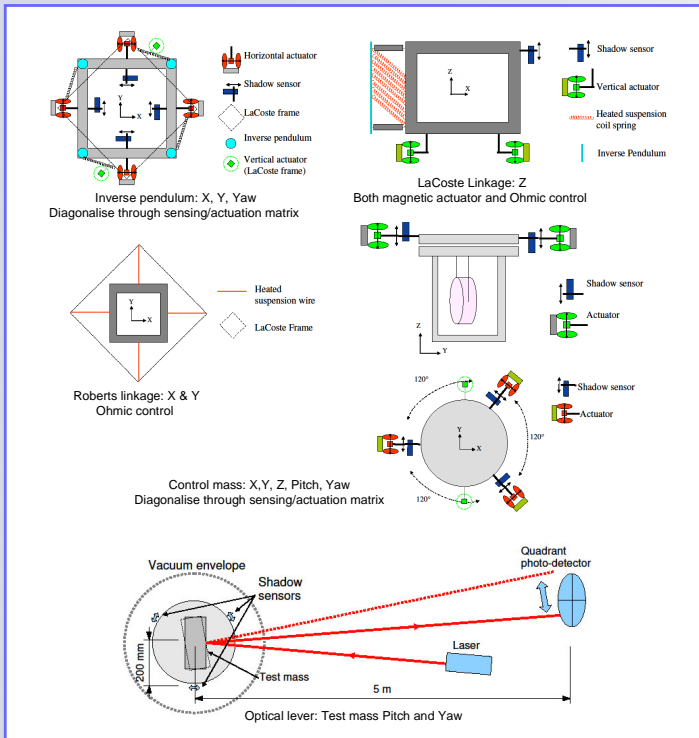
- Positioning & drift control through pre-isolation stages
- Alignment control through control mass, via optical lever readout
- Control mass sensing used to align optical lever when out of dynamic range
- Automatic optical lever feedback transition operated by digital control system.
- Filters avoid injection at suspension normal modes



Results

- Laser locked directly through Pound-Drever-Hall signal of 72 m cavity

Controlled Degrees of Freedom



- Optical lever critical to achieving low angular noise
- Initial run with high damping of inverse pendulum has residual motion performance at nanometre level (~3 nm per test mass). Improved feedback scheme using differential motion of Inverse pendulum and Roberts linkage allows orders of magnitude improvement
- Long term locking at high duty cycle.

