LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
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Technical Note	**LIGO-T0900513-v1-0**	Date: 10/19/2009

Electrostatic Drive Redesign Suggestions from LASTI Experience

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At the time of this writing the designs of the ETM and ITM quadruple pendulum electrostatic drives (ESD) are undergoing modifications. This document is a list of suggestions based off the experience with the ITM ESD at LASTI.

1. **Connect all the biases together in the pattern to minimize solder connections.**

   The solder connections are one of the most fragile points on the quad pendulum and should be minimized if possible.

2. **Improve the cable routing to tidy up the cables on the way down from the PUM.**

   The current configuration has the cables traveling out to the sides of the reaction mass (3 and 9 O'clock positions). Since there is no intermediate clamp between the penultimate mass and the end points of the cables, they tend to flare apart on the way down, which risks bumping into earthquake stops, the structure, or falling in the gap between the test and reaction masses. The controls prototype ESD avoided this issue by tacking the cables directly to the barrel with Vacseal. At LASTI we improvised a makeshift guide wire hanging off the bottom of the penultimate mass that holds the cables together until they reach the top of the reaction mass.

   A suggestion to fix this issue is to move the cable connections to the top of the reaction mass. The top of the reaction mass is less accessible to the two bottom control channels, thus only 3 of the 5 cables make it easily to the top. One possible solution is to run the two lower cables up the barrel and tack them down somehow on the barrel near the top. Another is to create an isolated trace in the existing gold barrel coating of the compensation plate. Experience at LAST did show the lack of robustness in the barrel coating. It rubs off extremely easily (the LASTI CP has smudge marks simply from handling), consequently this point should seriously be considered while designing the route of these lower channels. The gold pattern itself is much more robust since it is deposited on something other than glass, perhaps nickel.

   The issue of falling in the gap can be further minimized by shifting the electrical connection of the cable onto the barrel. A previous proposal suggests folding a tab or the gold pattern itself over the bevel onto the barrel. Another suggestion I heard proposed was to attach a connector onto the center of the barrel's top surface, where the cables from above would terminate. Obvious considerations relate to the mechanical robustness of such a connector. For the compensation plate it might be prudent to leave a hole in the mechanically unreliable gold barrel coating where the connector will sit.

3. **Improve the clearance of the cable termination points with respect to the structure.**

   The clearance is tightest right at the 3 and 9 O'clock points. Most of this issue is already solved by item 2 above. However, if the lower channels cannot be routed to the top of the reaction mass shifting the lower connections down below the 3 and 9 O'clock points will improve the clearance. The cables will still need to hug close to the barrel on the way up or they will run into the same clearance issue with the structure.

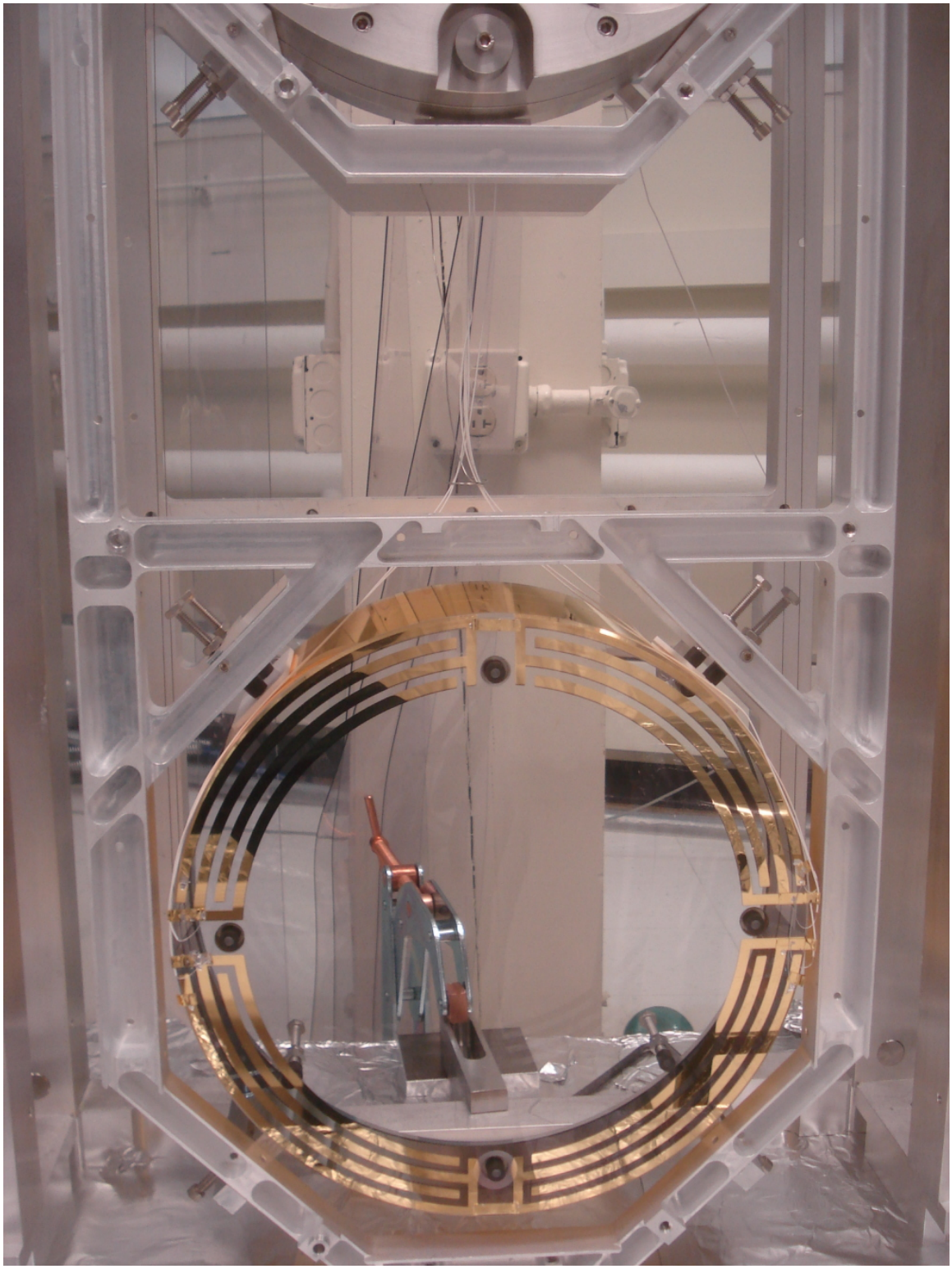

Figure 1: The LASTI ITM CP ESD. The cable terminate at the 3 and 9 O'clock positions. Note the proximity of the structure at those points. Also visible is an improvised guide wire holding the cables together in the gap between the penultimate mass and reaction mass.