



Quad Pendulum Noise Prototype Update

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PhD candidate: Mech E

LSC-Virgo Meeting: Amsterdam,
September 2008

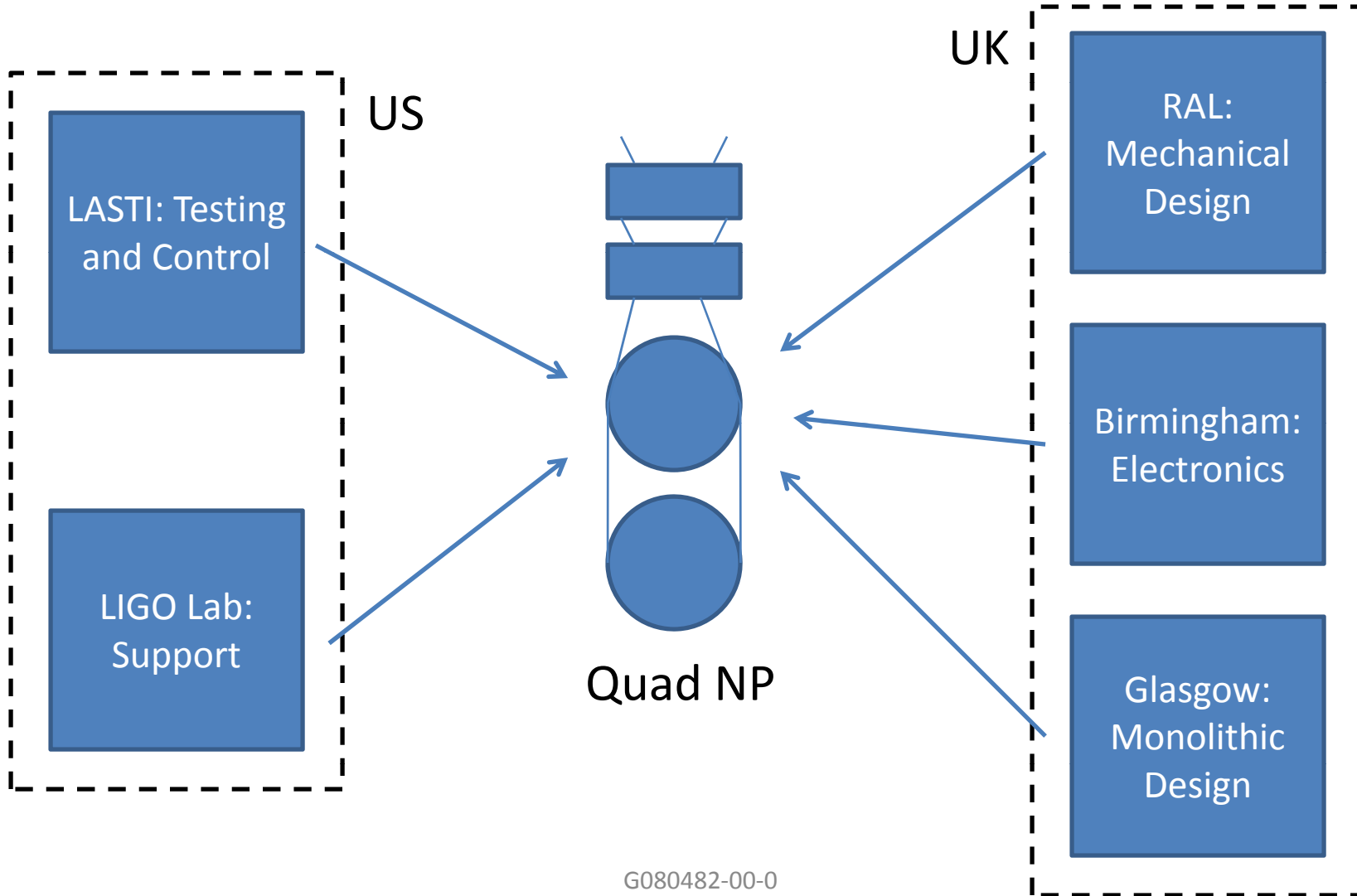


Talk Contents

- Acknowledgements
- Quad NP history at LASTI
- Pitch Hysteresis
- Characterization and Modeling
- Initial control work
- Coming attractions



Contributions to the NP Effort



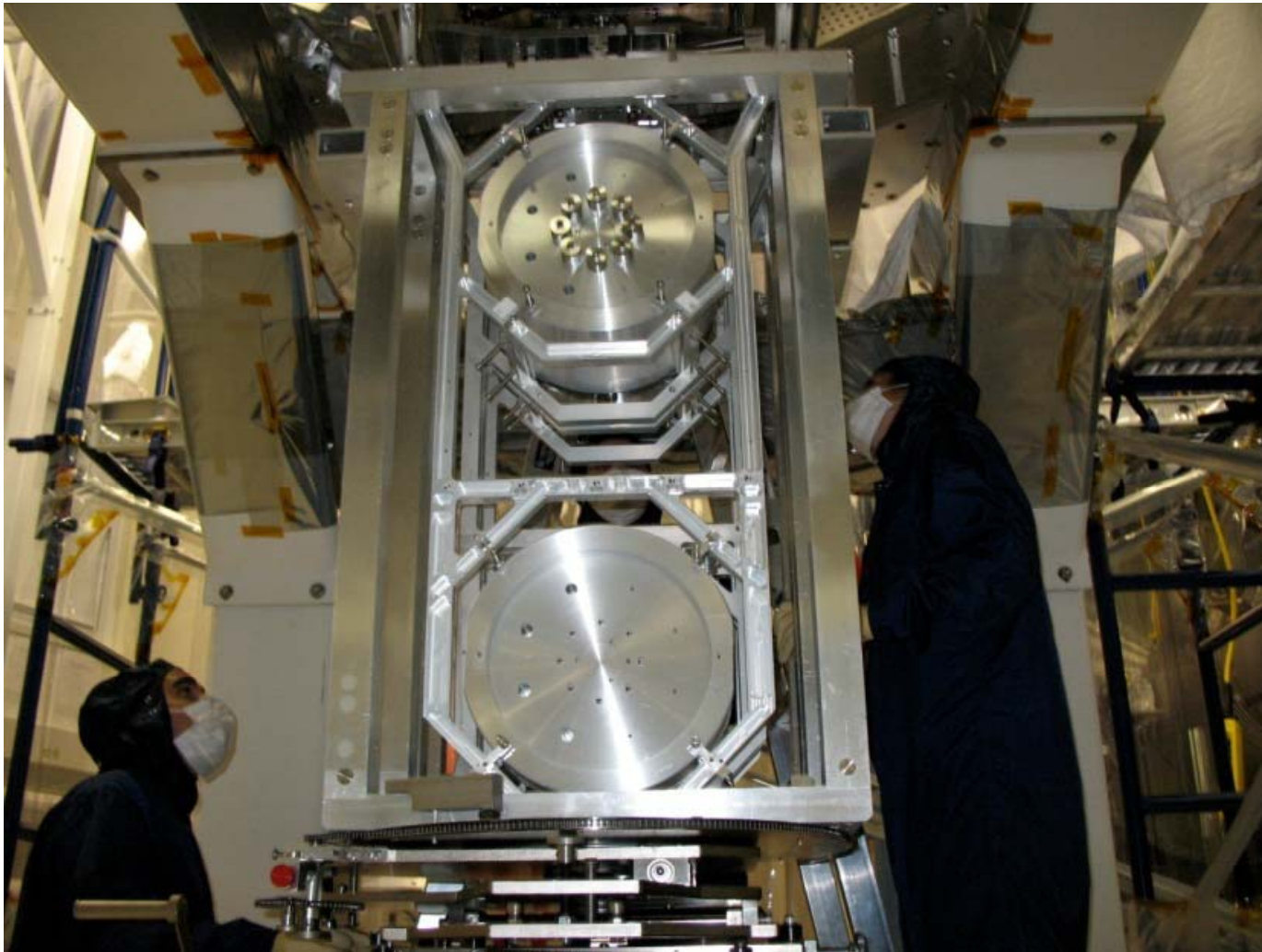
Quad NP History at LASTI

July '07 – parts and people arrive from UK



Pictured: Joe O'Dell - RAL

August 2007 – mounting to ISI



Left: Brett Shapiro – MIT, Right: Sharon Rapoport - MIT

October 2007 – Suspending



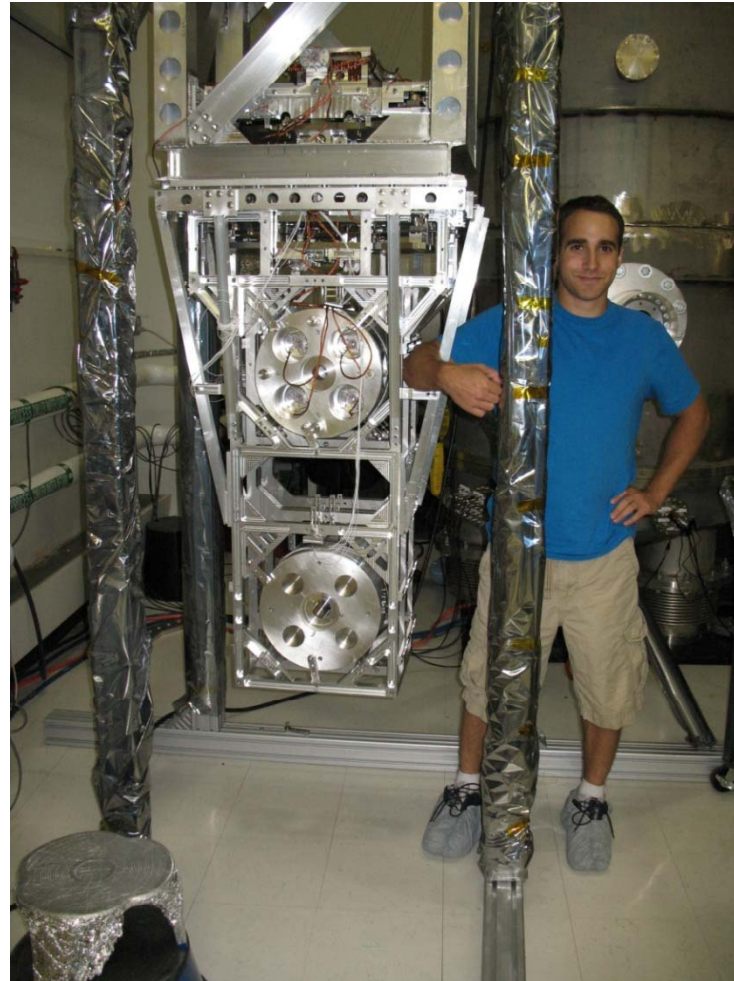
Left: Bunny Suit #1, Mid: Bunny Suit #2, Right: Bunny Suit #3

April 2008 – Quad-ISI BSC installation.



Left: Myron MacInnis - MIT, Mid: Bob Laliberte - MIT

September 2008 – Dismantling the Quad Controls Prototype



Saying goodbye to an old friend.



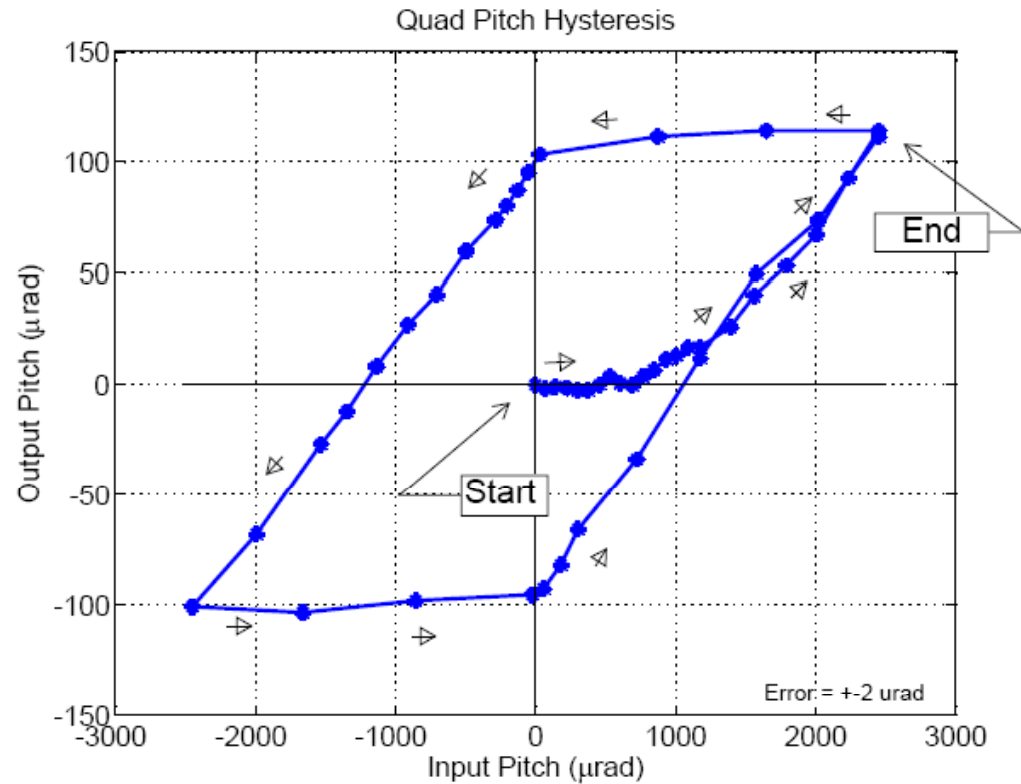
Already Benefits from LASTI Installation

- Knowledge
 - Experience
 - Test of tooling
 - Documentation
- Shaking out kinks and bugs
 - Improved Access to OSEMs
 - Improved Alignment Markings
 - Improved Clamping of Blade Springs
 - Reworking of parts that did not fit
 - Etc...

Pitch Hysteresis

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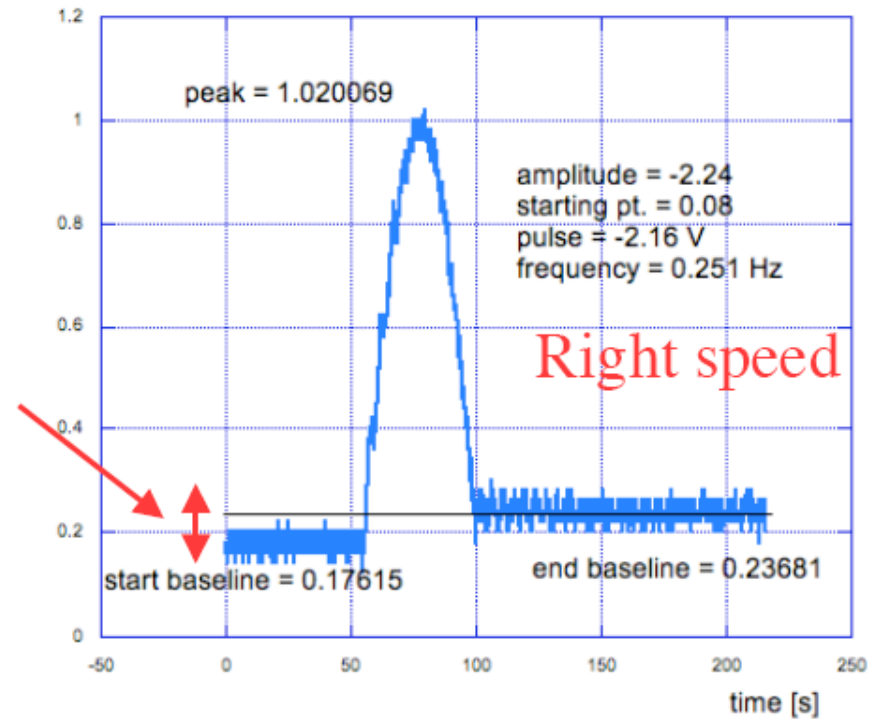
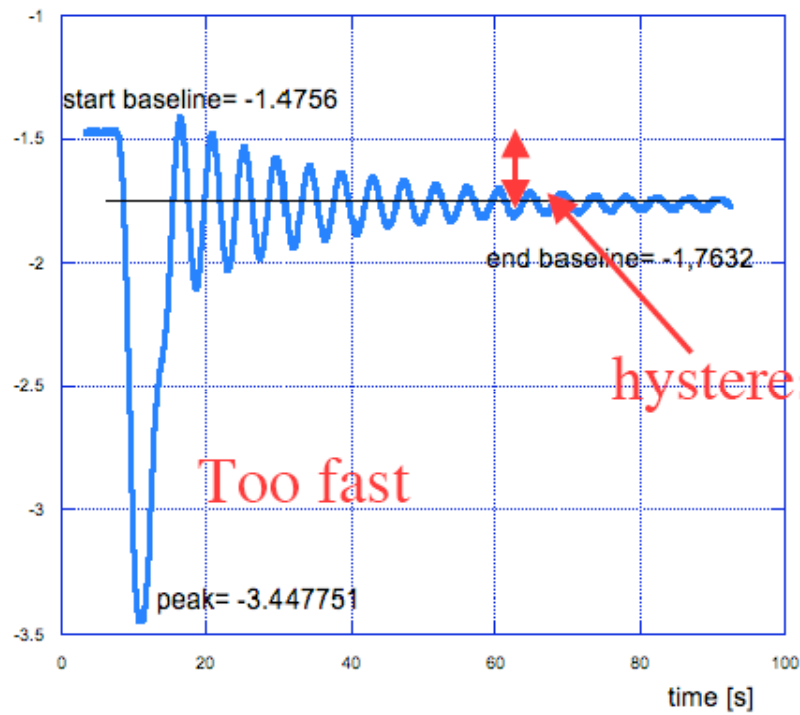
Hysteresis



- Pitch hysteresis of the metal quad reaction mass.



Hysteresis in Geometric Anti-Springs



R. Desalvo et al. G080243

Additional results in R. Desalvo et al. P040002

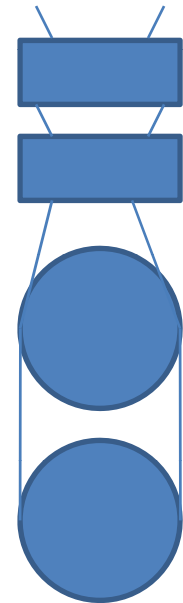
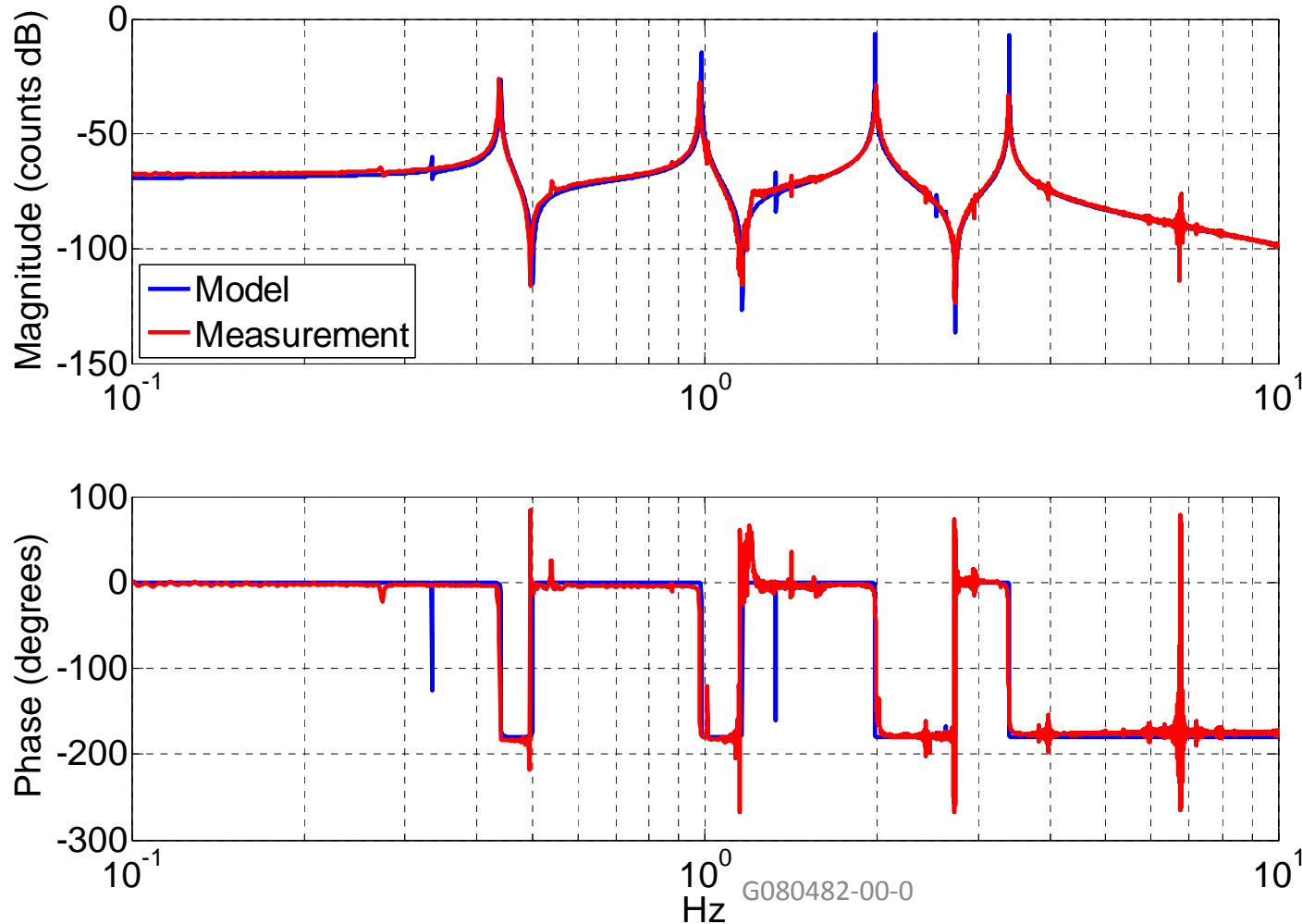
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Characterization and Modeling

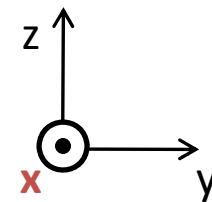


Matlab Model Comparisons

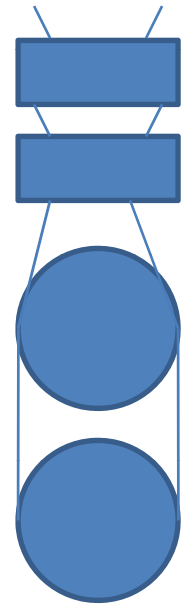
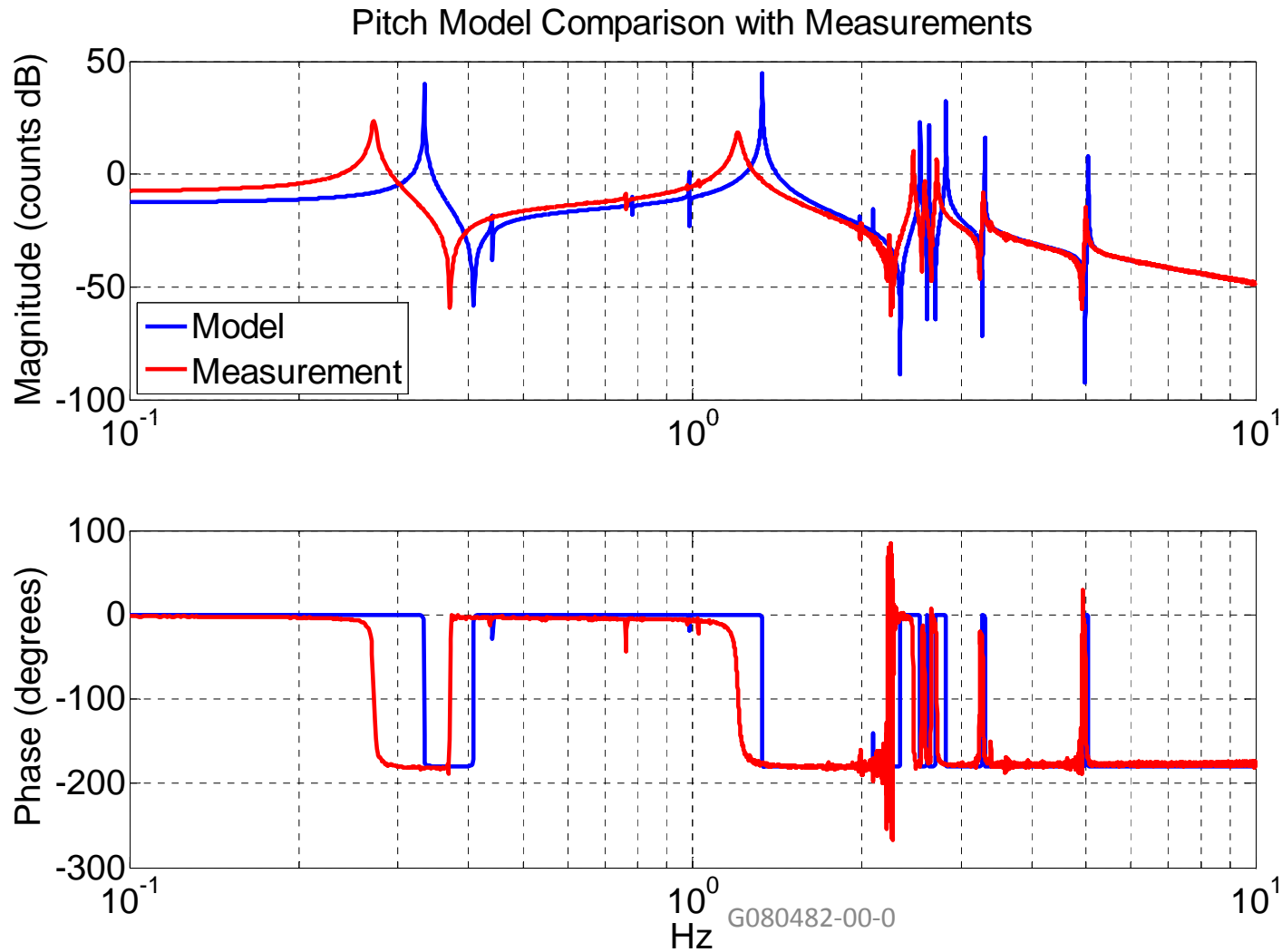
X Top Mass Model Comparison with Measurements



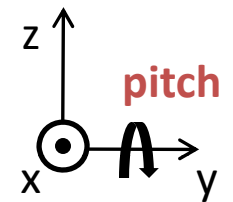
Quad front view



Matlab Model



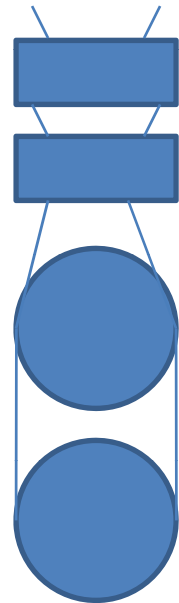
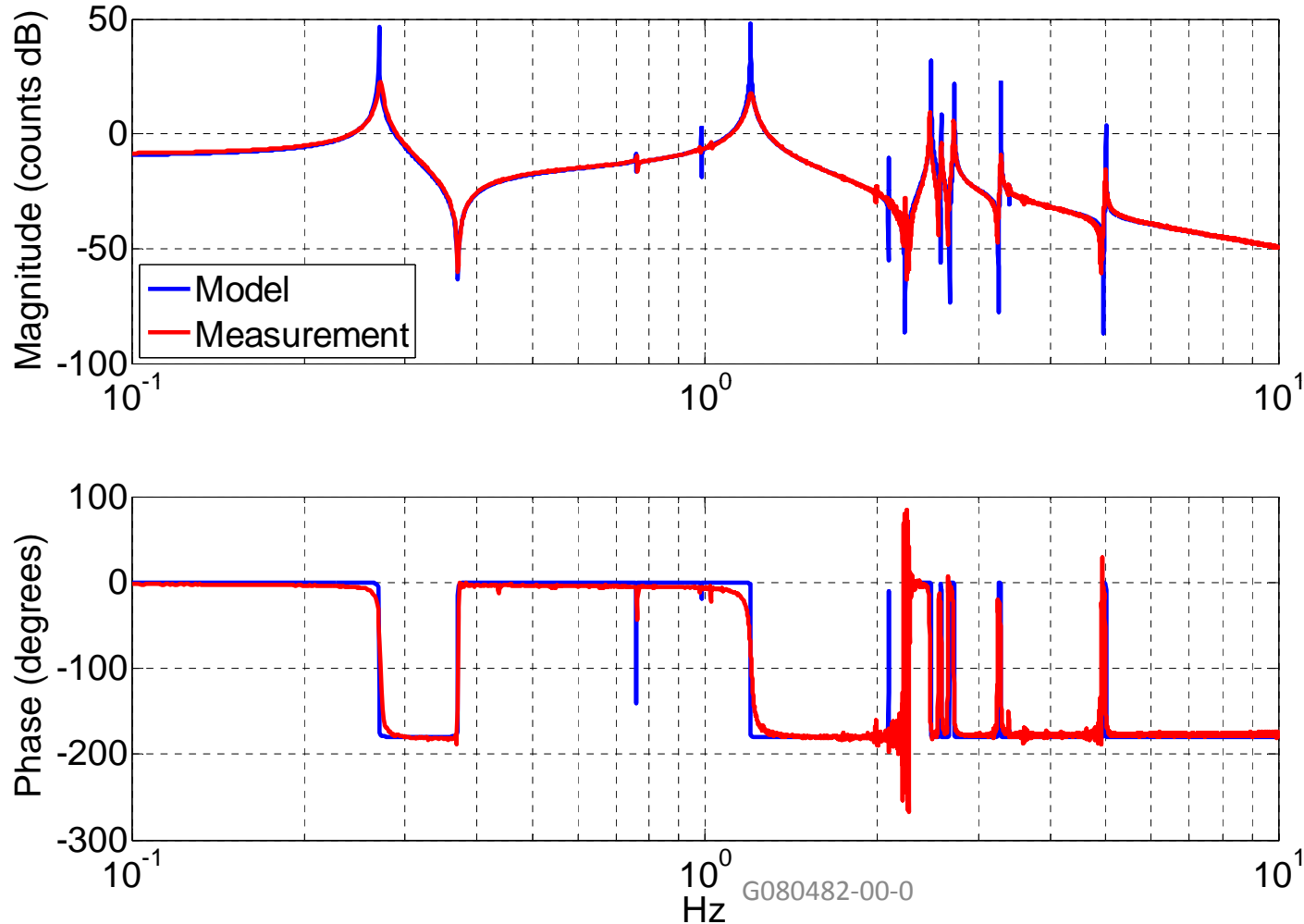
Quad front view



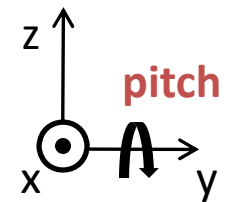


Matlab Model

Pitch Model Fit Comparison with Measurements

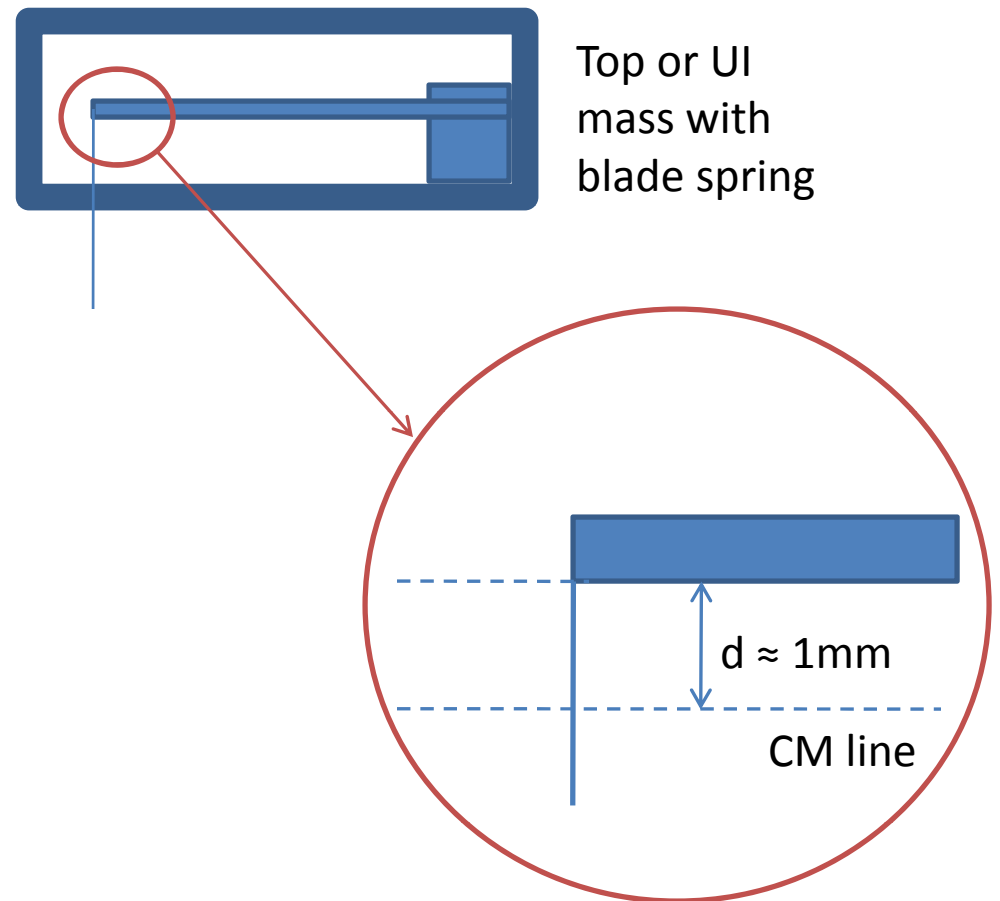


Quad front view



Sources of Model Error

Primary source of error comes from the location of the wire connections relative to the centers of mass.





Errors in Model

Stages	Centers of mass (mm)	dn, d1 (mm)	ly (%)	lx (%)	lxy (%)
Top	-0.215	-0.75	10.4	-0.068	-23.6
UI	-0.083	-0.48	8.5	0.333	-14.82
PEN	1.06	NA	0.9	0.611	NA
Test	1.20	NA	0.86	0.609	NA

Spring tip heights

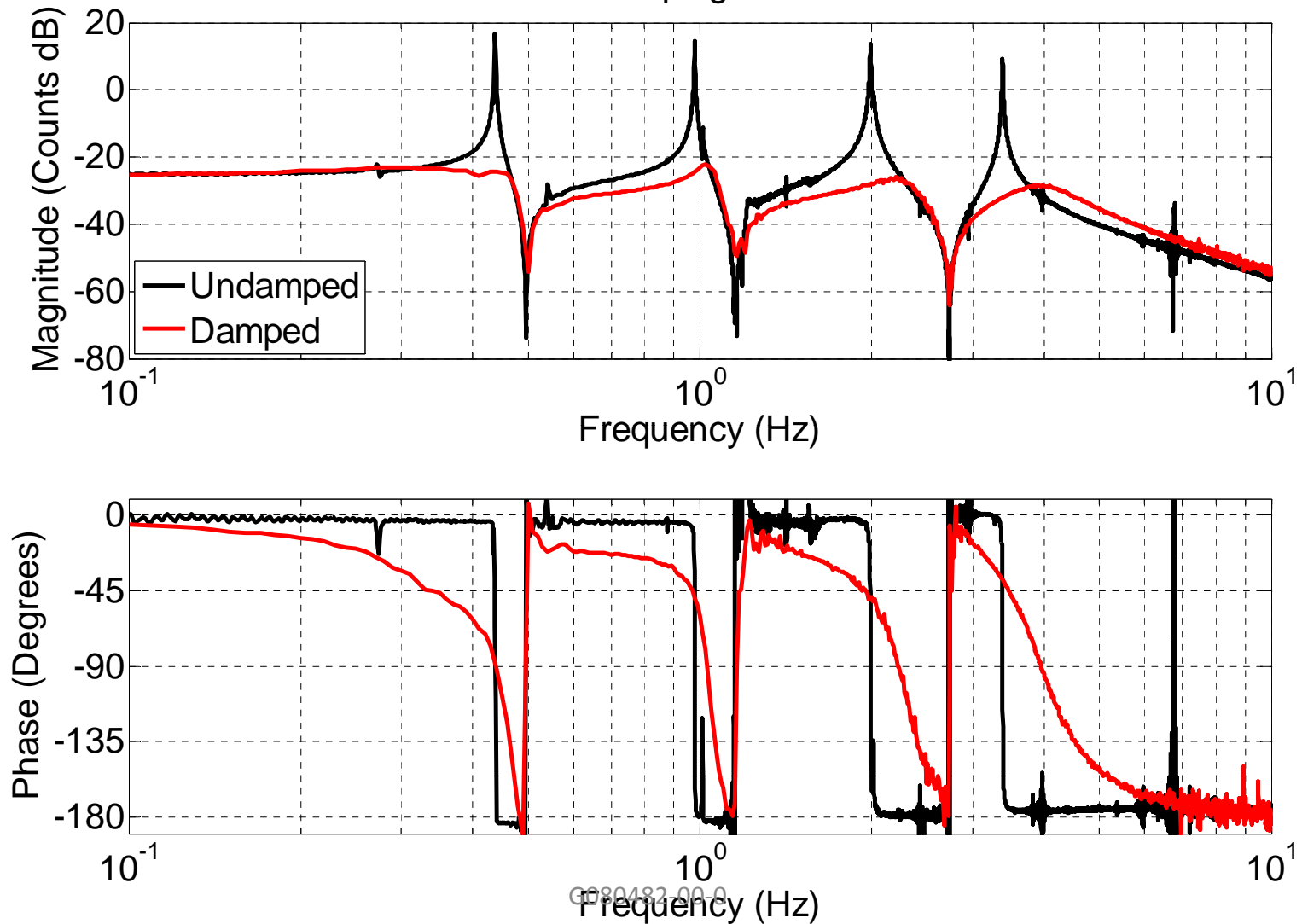
Inertias

Local Damping Control



X Local Damping

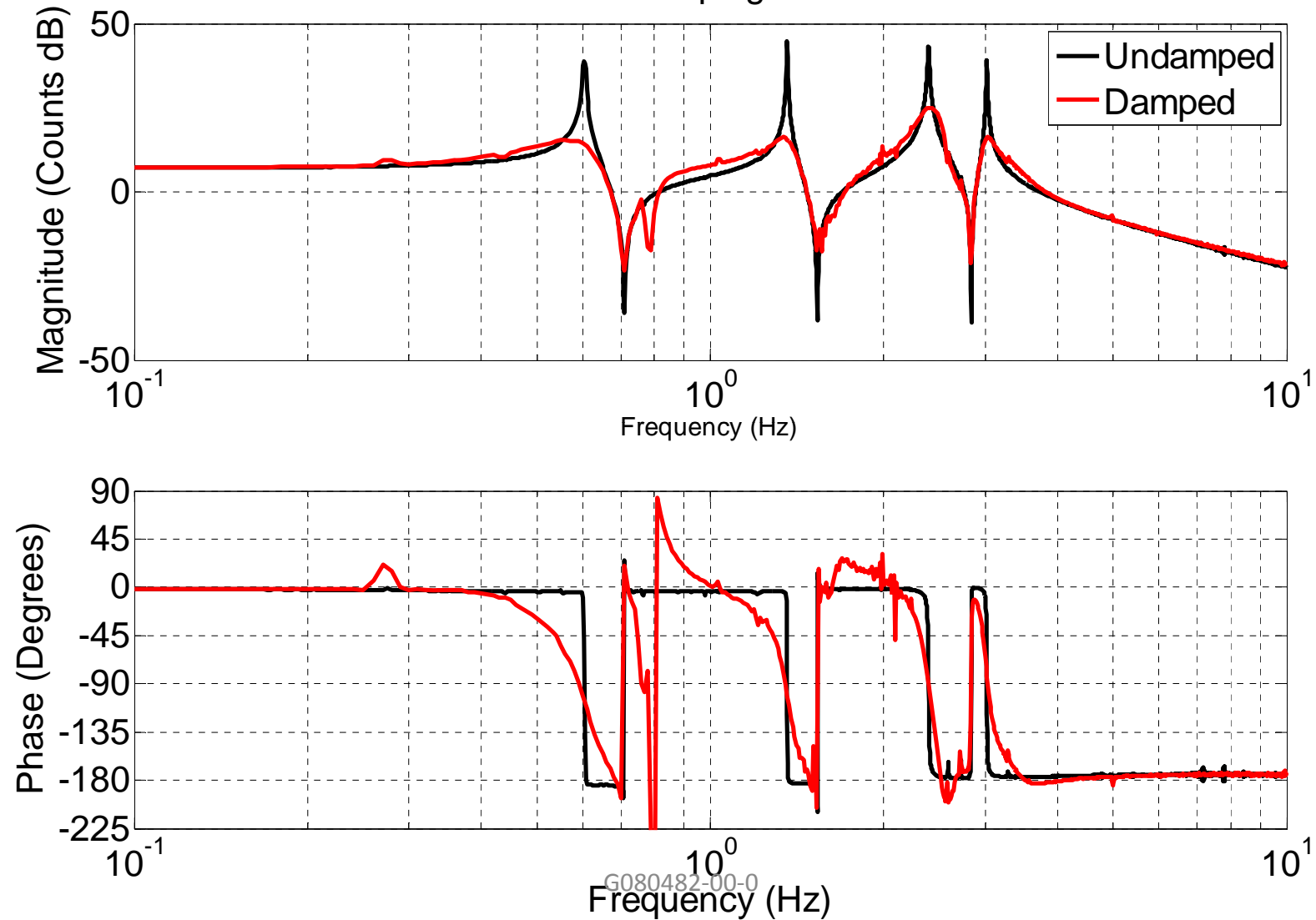
X Local Damping Performance





Yaw Modal Damping

Yaw Modal Damping Performance





Still to Come on the Quad

- Monolithic Glass Installation
- Eddy current damping
- Cavity test
- Heat loading (ring heater, TCS)
- More local damping work
- 1st article assemblies
 - January: Class B practice assembly
 - March: 1st Class A 'real' AdvLIGO assembly



The End