

ADVANCED LIGO OMC: OPERATION AND CHARACTERIZATION

A photograph of the interior of an Advanced LIGO Optomechanical Cleaner (OMC). The room is a large, cylindrical chamber with a highly reflective, metallic interior. The floor is a large, flat, perforated metal plate. In the center, a complex mechanical structure is mounted on a raised platform. This structure consists of a white metal frame with various components, including a central mirror assembly, cables, and other mechanical parts. The lighting is focused on the central structure, creating a dramatic effect against the dark background of the chamber.

ZACH KORTH - LSC-VIRGO MEETING - 9/24/2013

HANNOVER, GERMANY

LIGO-G1301007

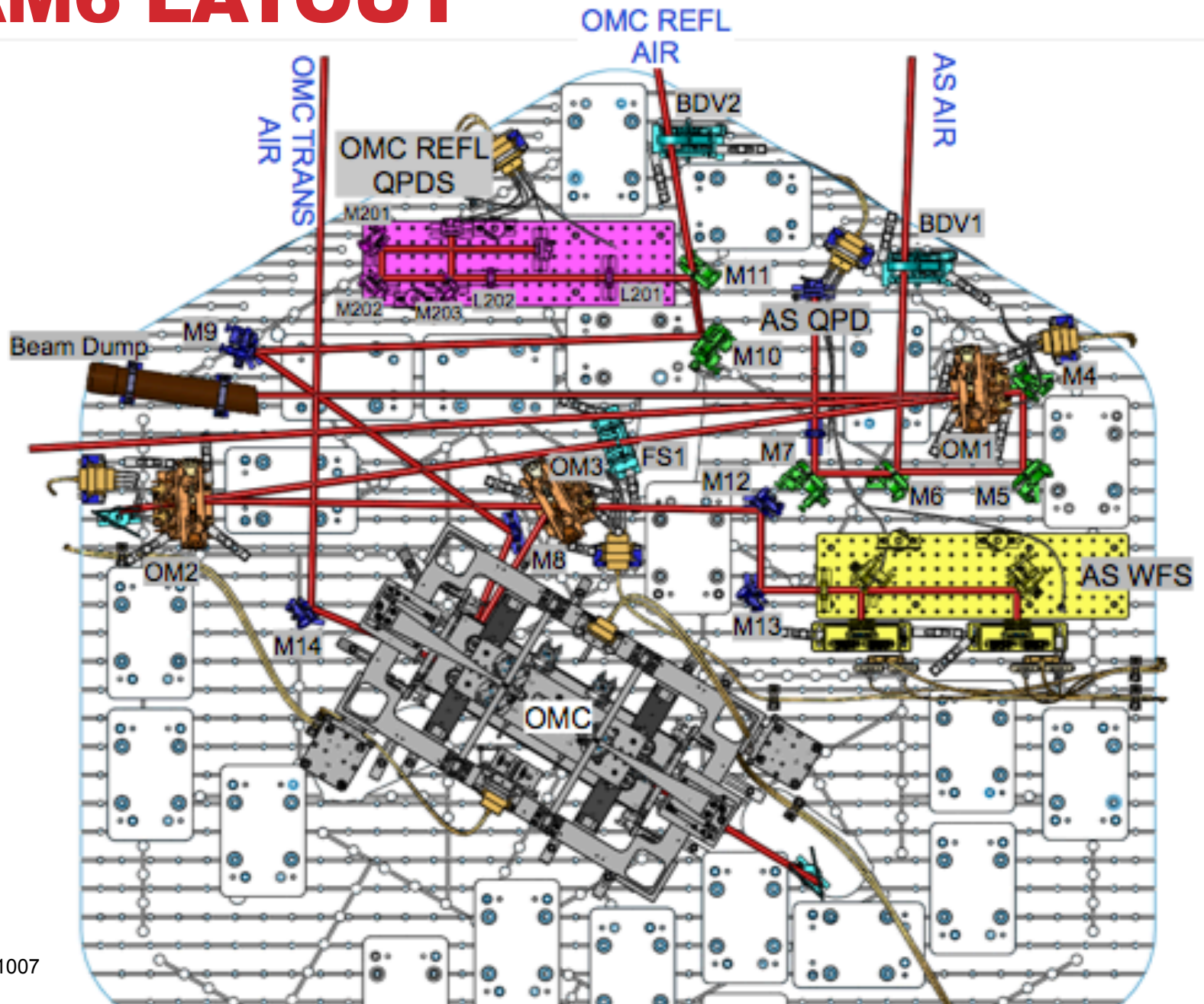
THE OMC TEAM

- **OMC design/fabrication/installation:**
 - CIT: Koji Arai, Jeff Lewis, Rich Abbott, Charles Osthelder, Zach Korth
 - MIT: Peter Fritschel, Sam Barnum, Sam Waldman
- **OMC suspension team:**
 - Jeff Bartlett, Norna Robertson, Jeff Kissel, Stuart Aston, Derek Bridges
- **OMC commissioning team @ LLO:**
 - Valera Frolov, Suresh Doravari, Lisa Barsotti, Zach Korth
 - (...with *much* help from the rest of the commissioners)

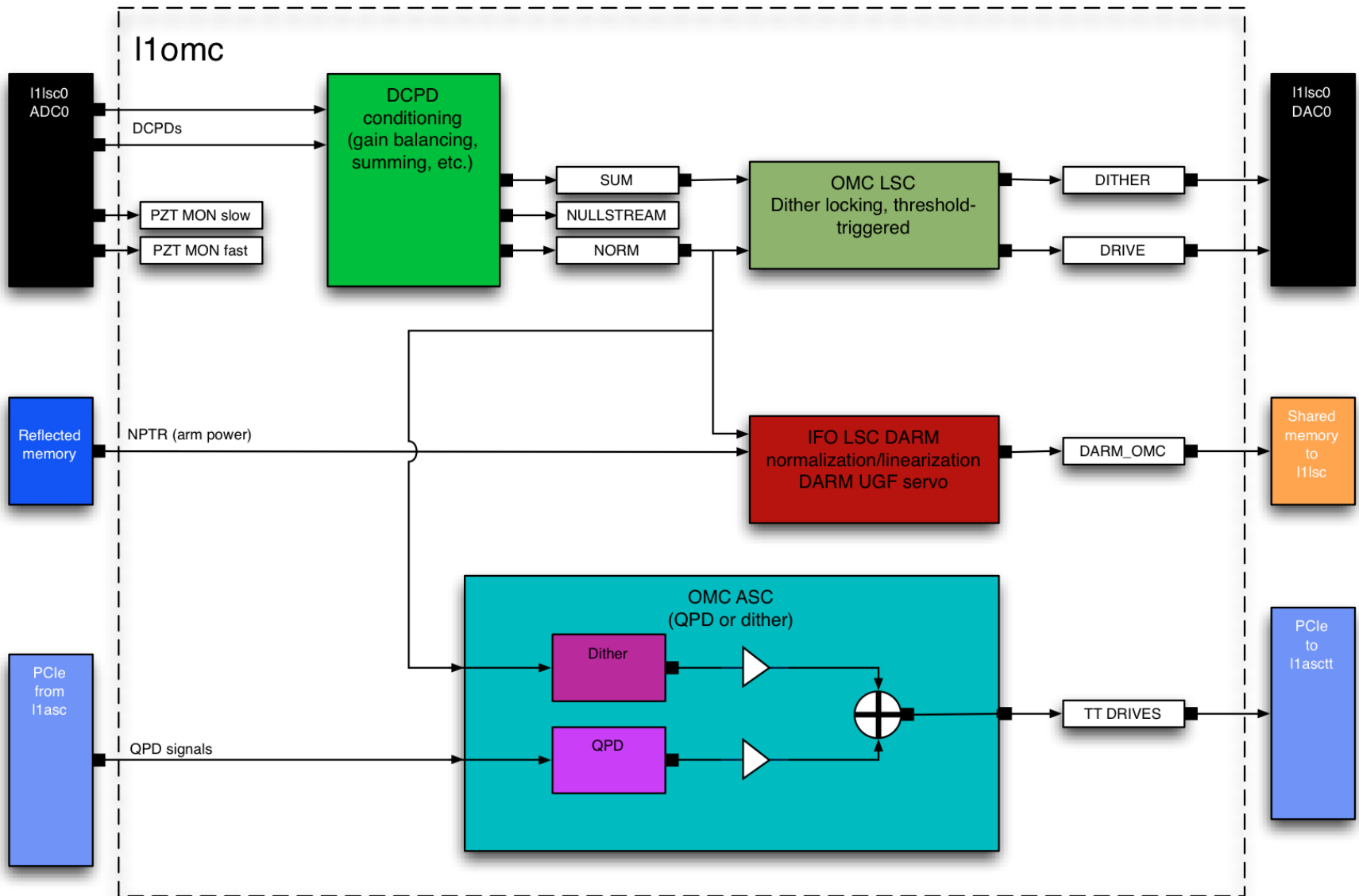
OUTLINE

- **Preparation**
 - HAM6 layout
 - OMC control design
 - Salvage of eLIGO DCPDs
- **First light: in-air operation**
 - Stable length locking, *but*:
 - Mode mismatch?
 - PZT trouble?
- **Low noise: in-vacuum operation**
 - OMC
 - Transmitted intensity noise
 - Length noise
 - Long-term drift
 - Backscatter
 - Simple Michelson
 - PRMI
 - Low-noise DC readout
- **Conclusion**
 - Lessons learned
 - Future work

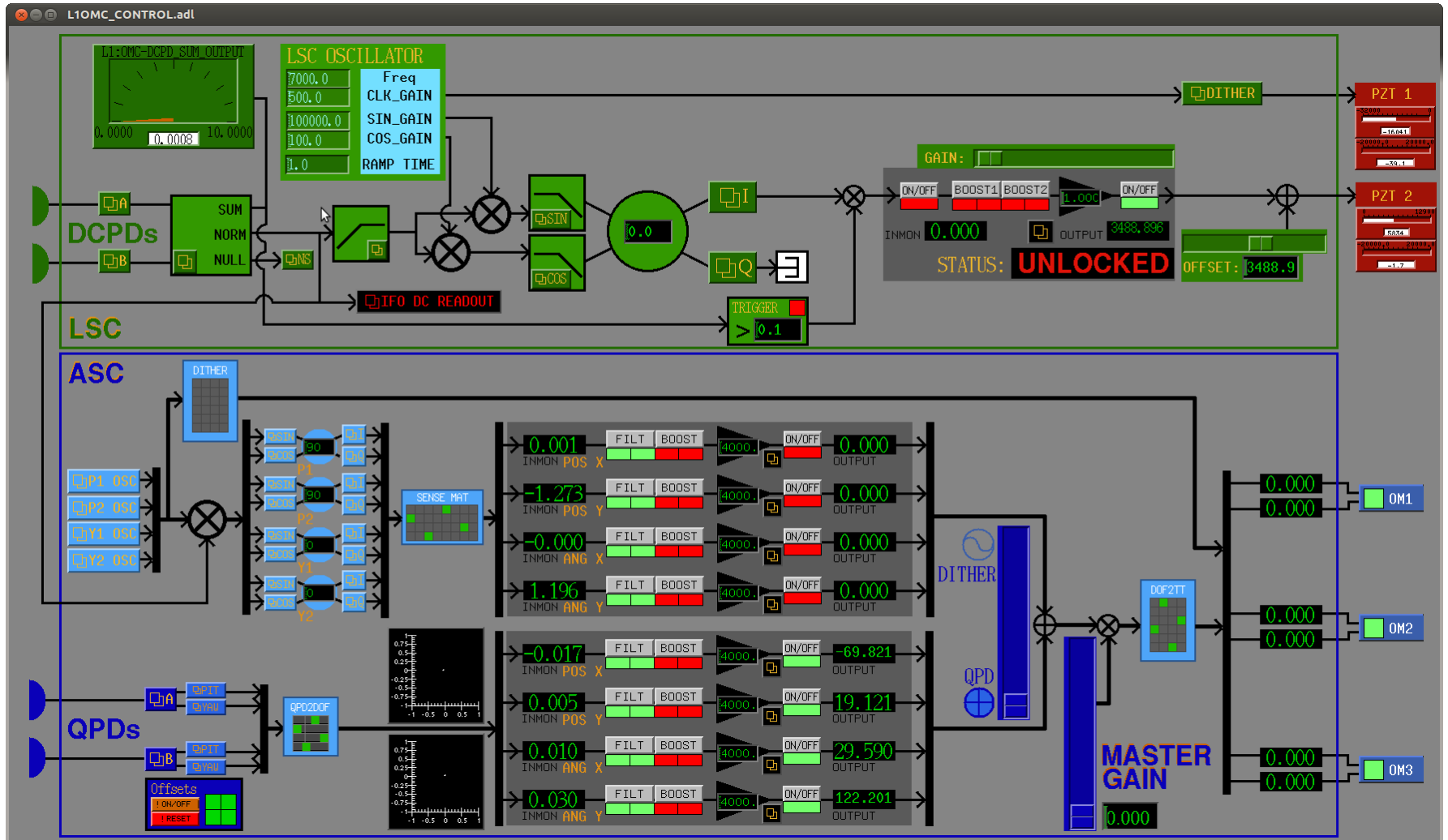
HAM6 LAYOUT



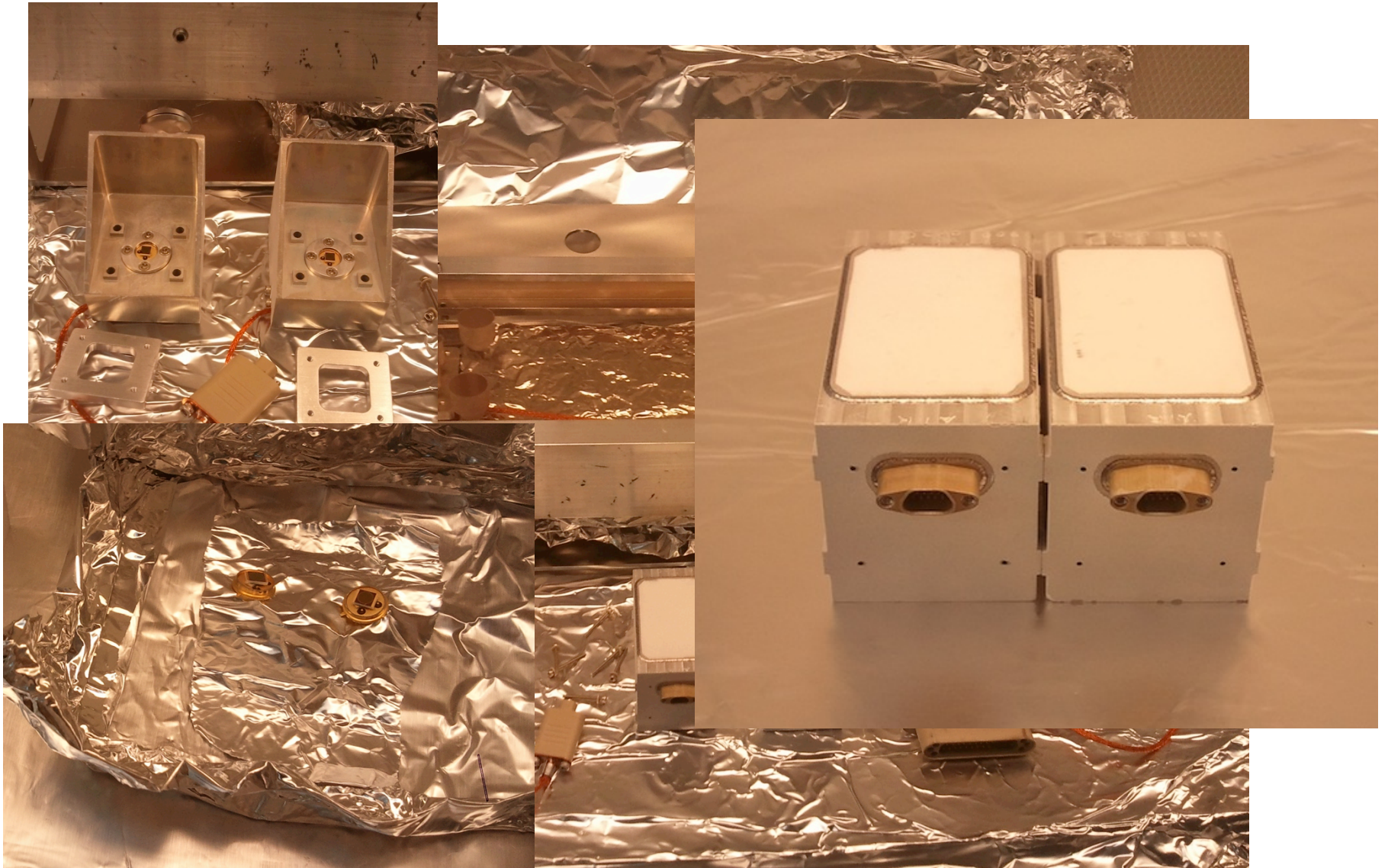
THE OMC CONTROL SCHEME



THE OMC CONTROL SCHEME

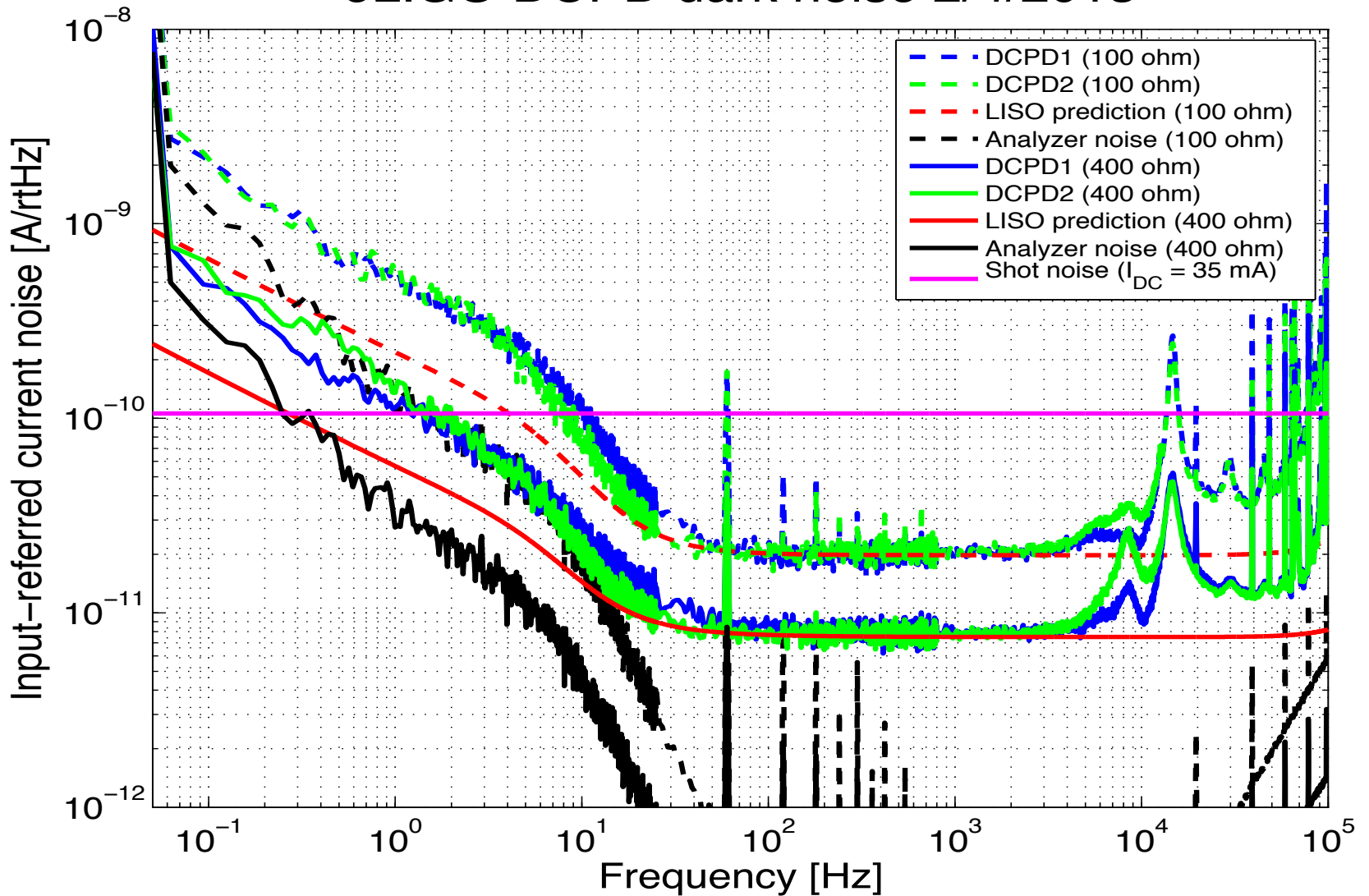


IN WITH THE OLD...



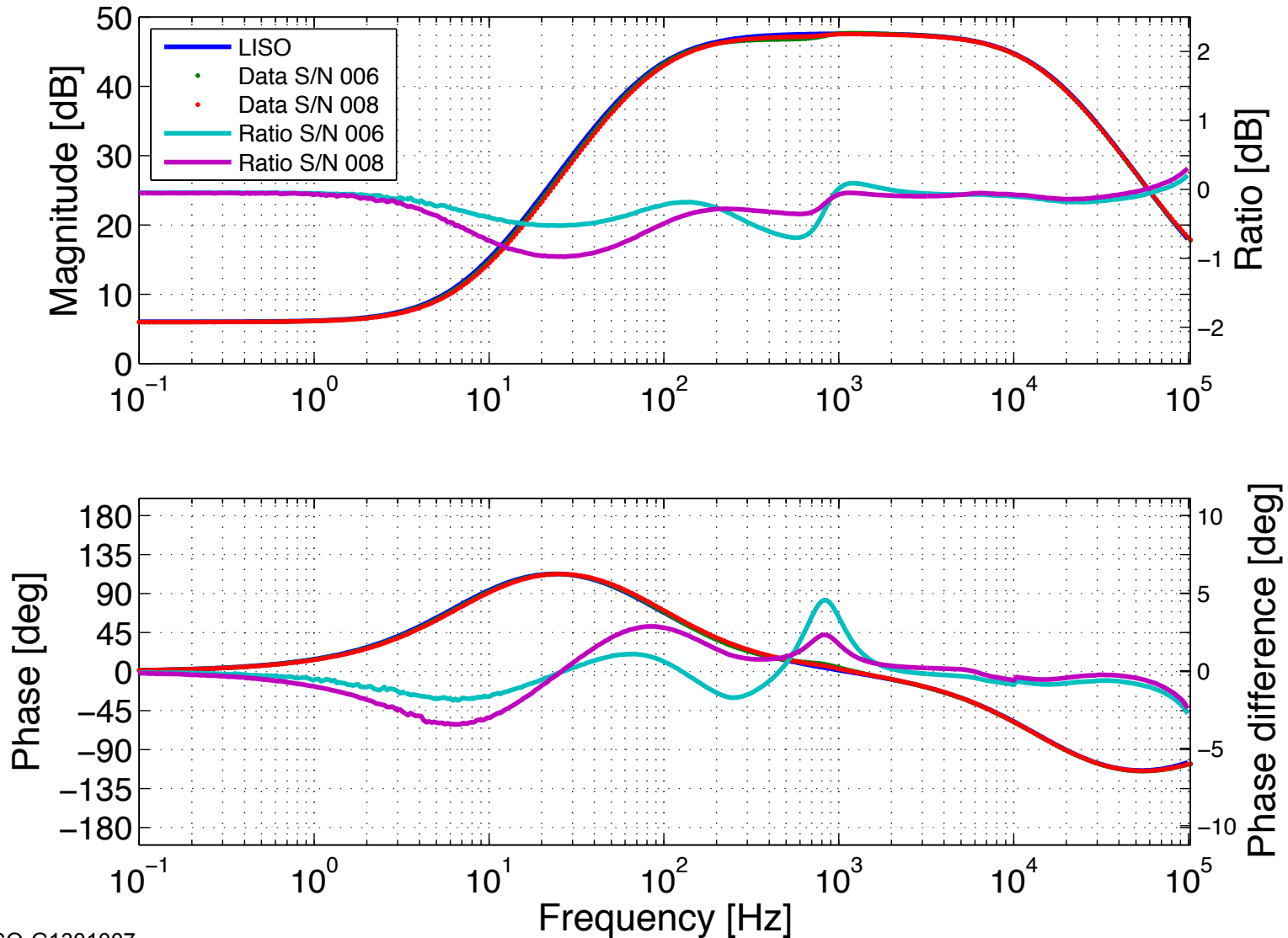
DCPD NOISE:

eLIGO DCPD dark noise 2/4/2013



DCPD RESPONSE:

DCPD in-vac preamp TF vs. LISO 6/6/2013



STABLE IN-AIR LOCKING

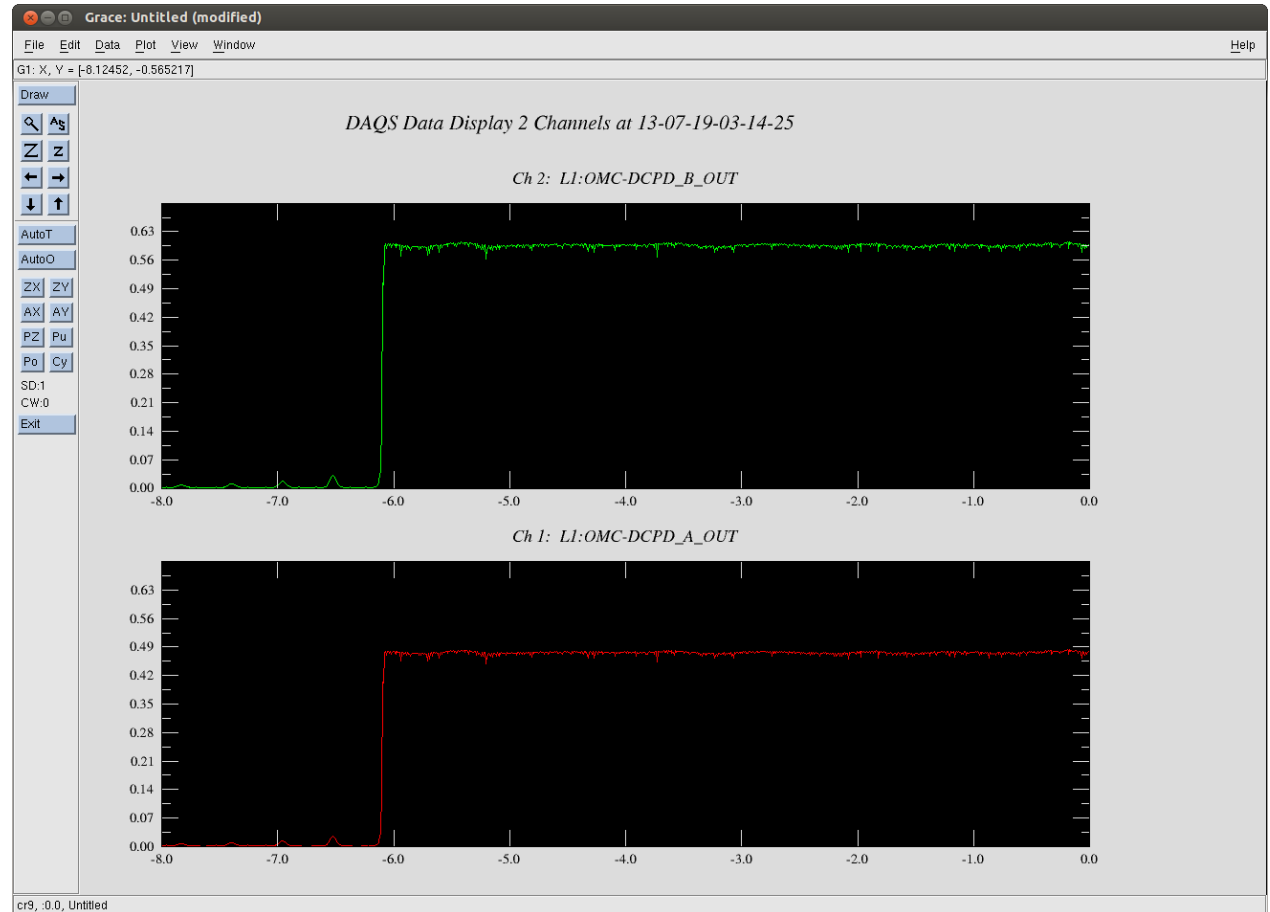
L1 (ISC)

william.korth@LIGO.ORG - 08:20, Thursday 04 July 2013 (7713)

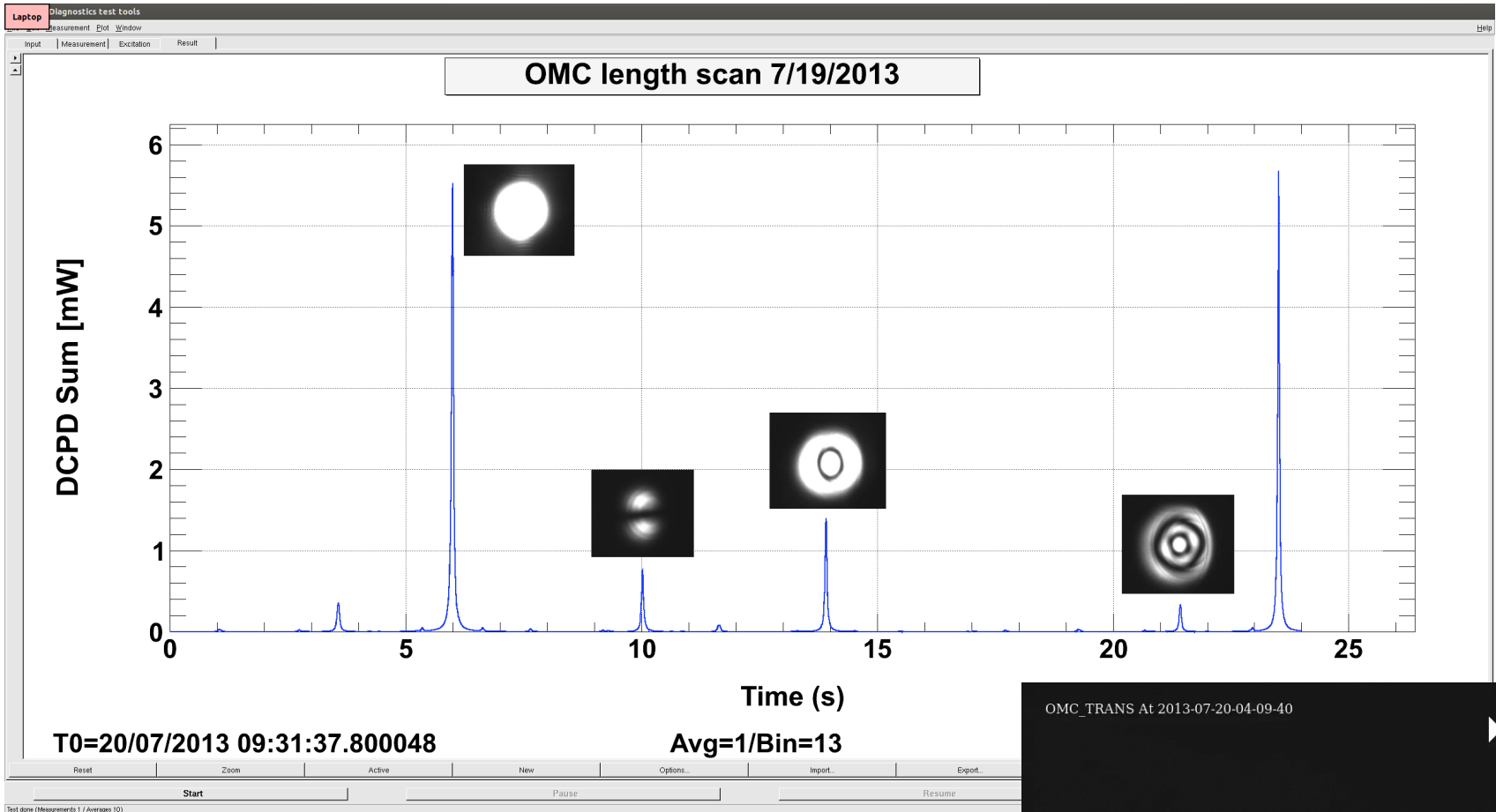
OMC locked on AS beam in air

The OMC has been locked to the AS beam. 🙌

BUT...

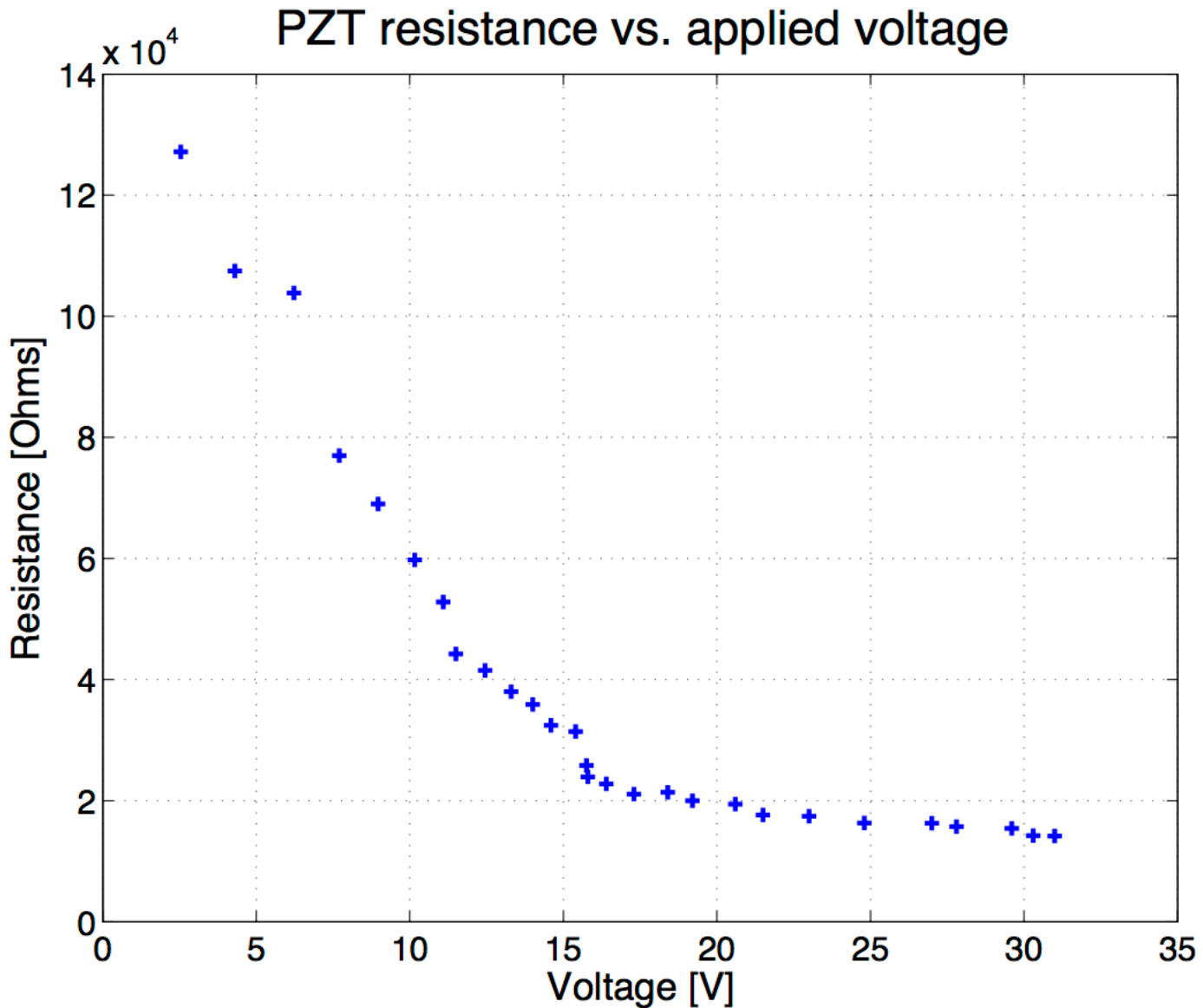


MODE MISMATCH?



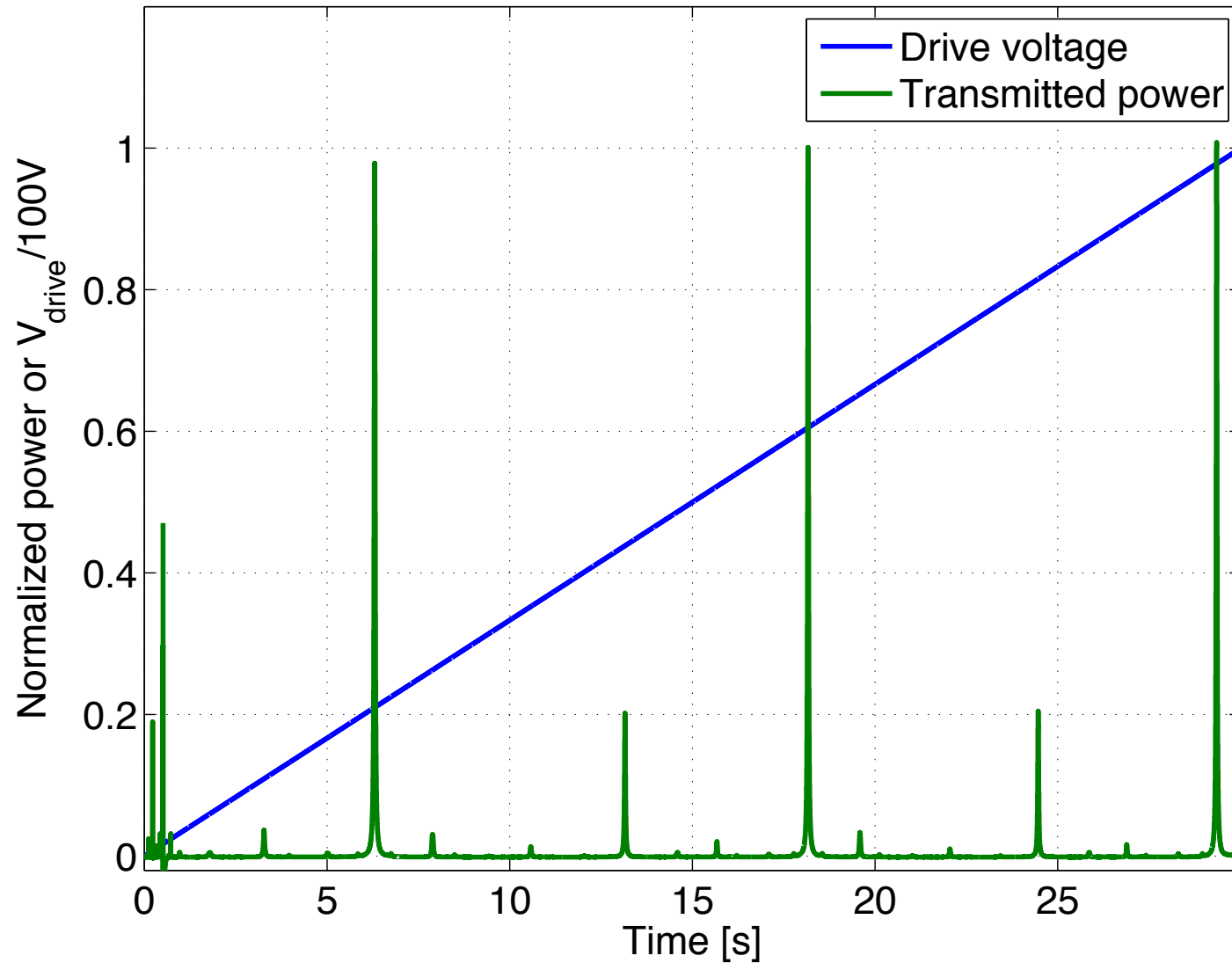
See investigation summary by Chris M. and Lisa B.:
LIGO-G1300909

PZT TROUBLE?



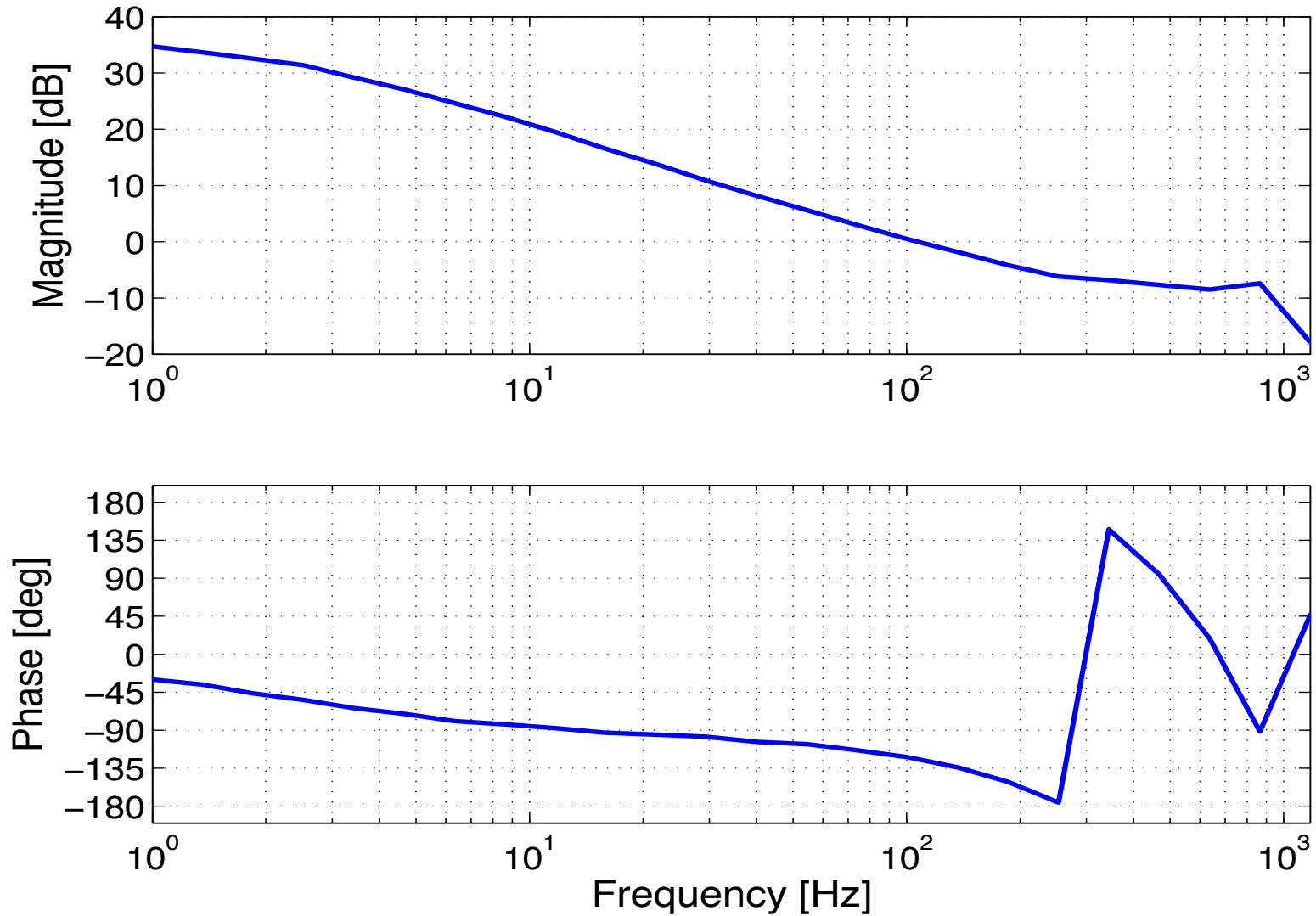
REDUCED RANGE—OK

OMC full-PZT-range sweep

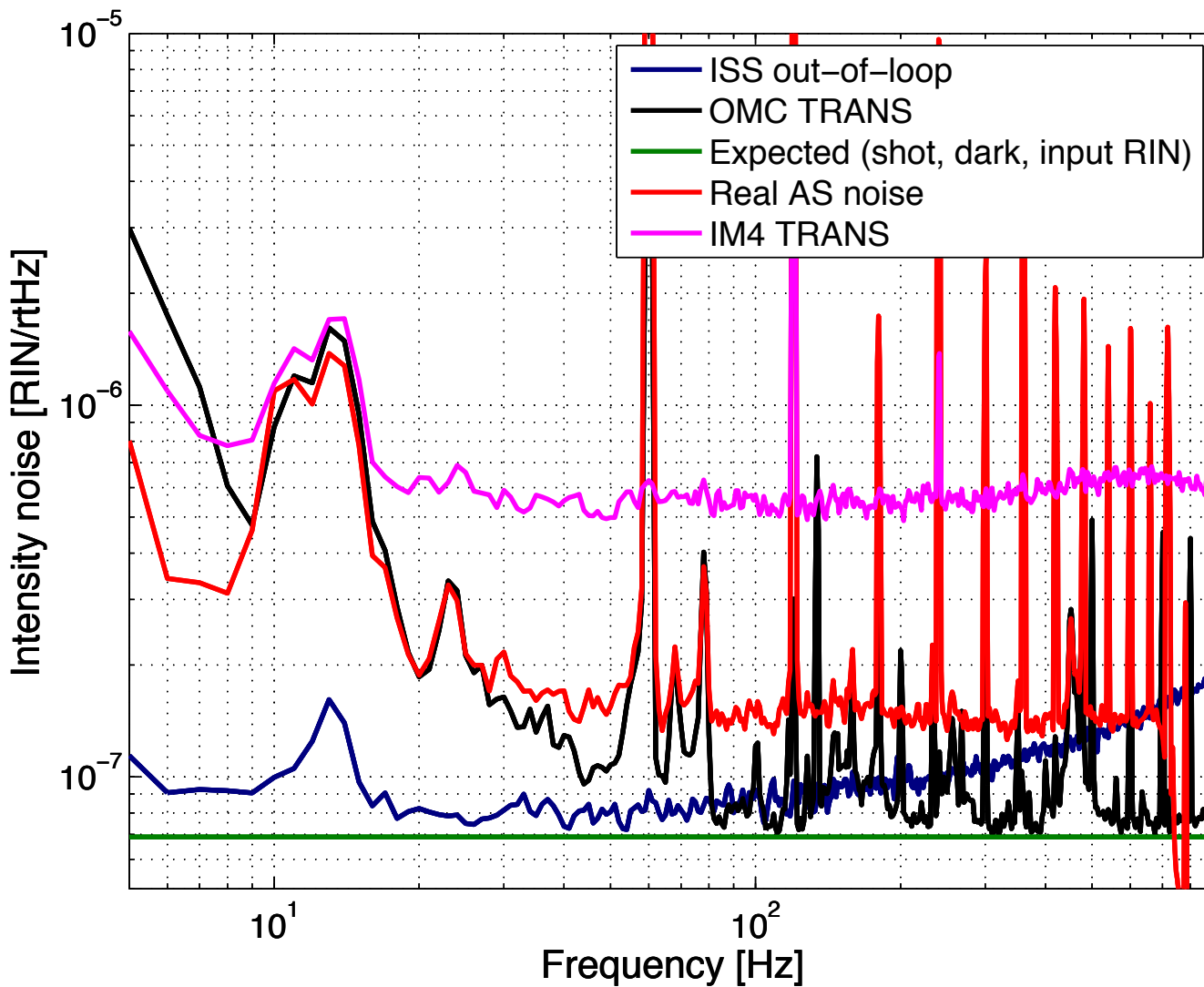


LENGTH CONTROL

L1 OMC length OLTF

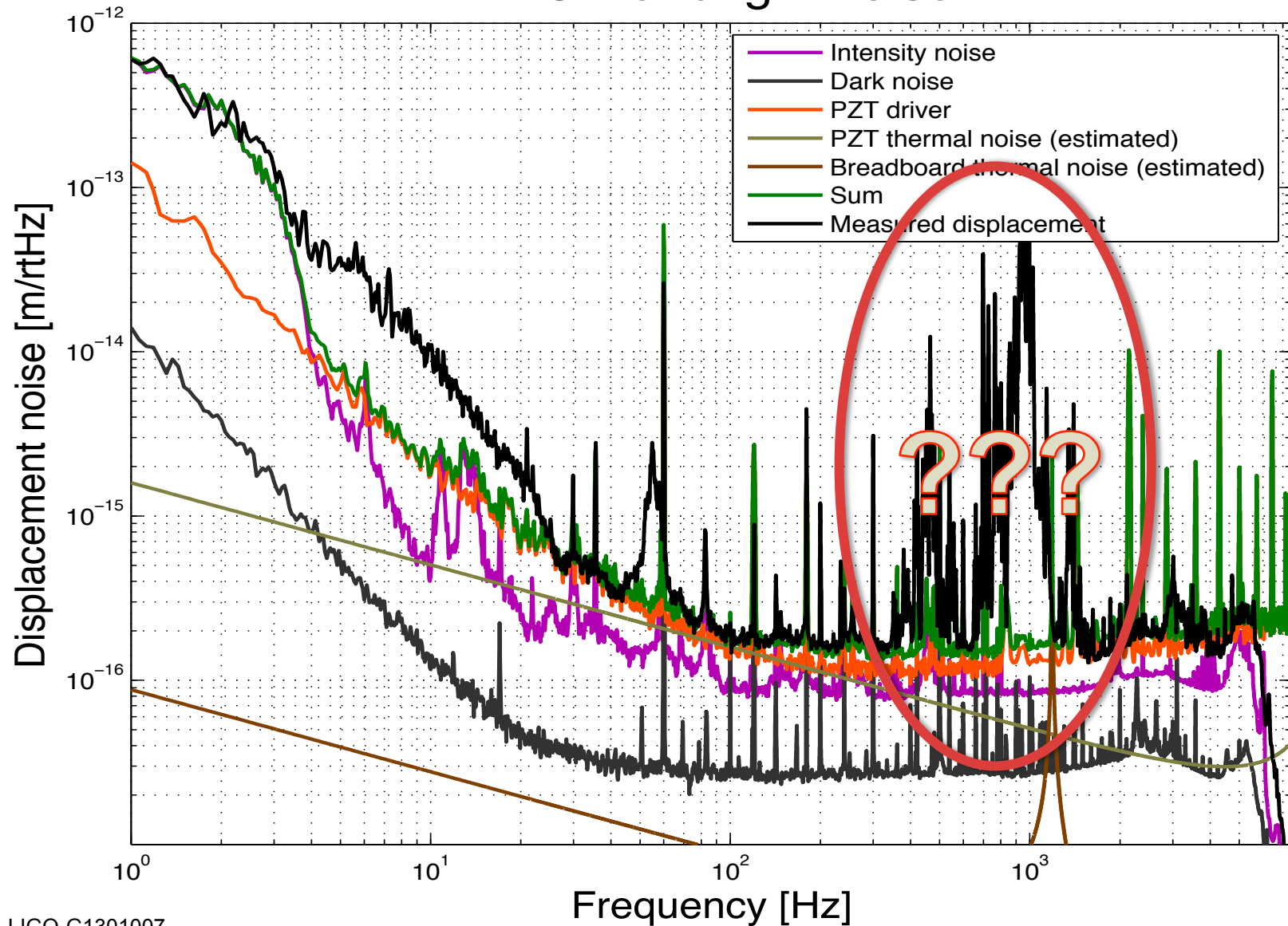


INTENSITY NOISE



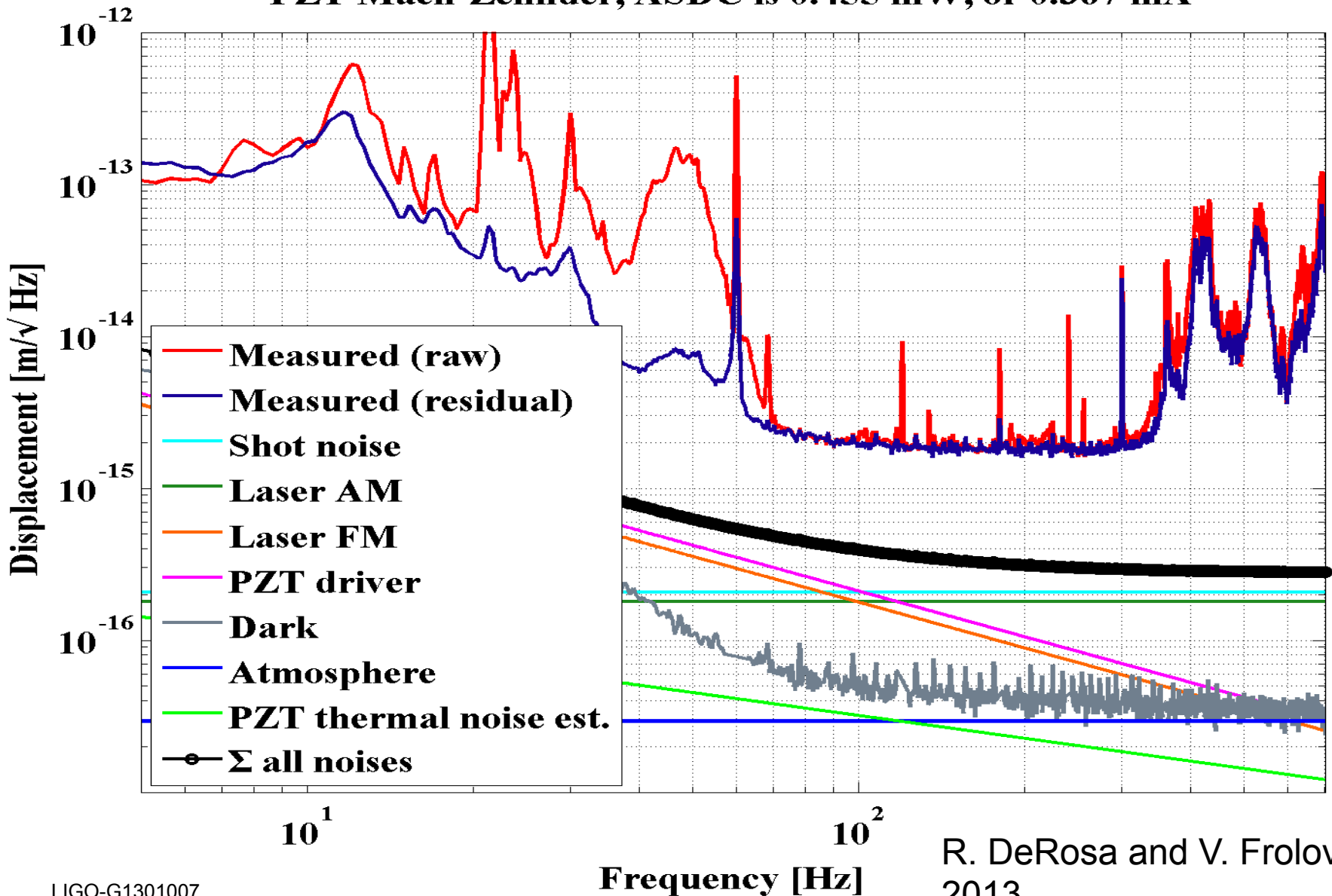
OMC LENGTH NOISE

L1 OMC length noise



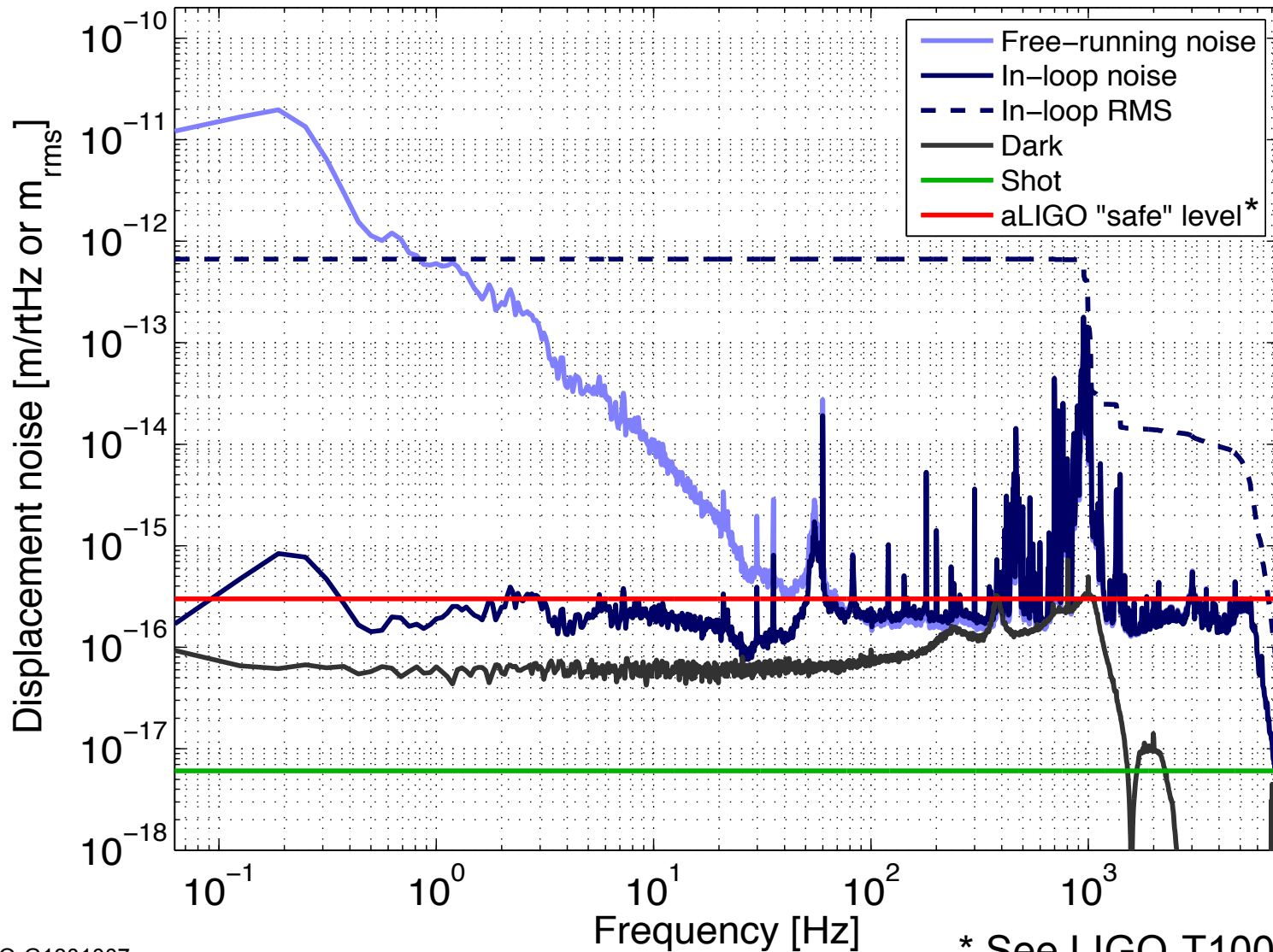
PZT NOISE?

PZT Mach-Zehnder, ASDC is 0.455 mW, or 0.367 mA



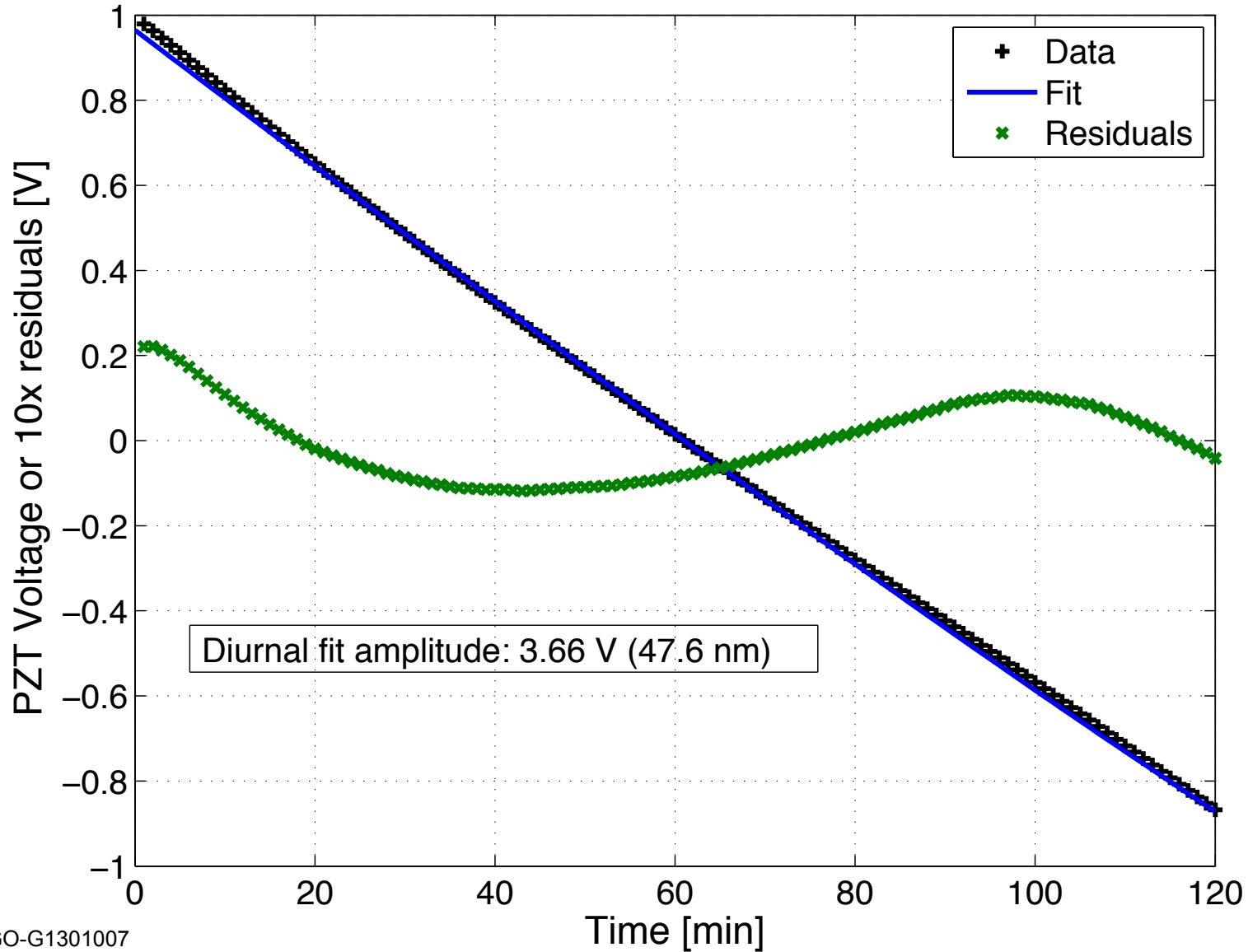
IN-LOOP NOISE

OMC in-loop noise



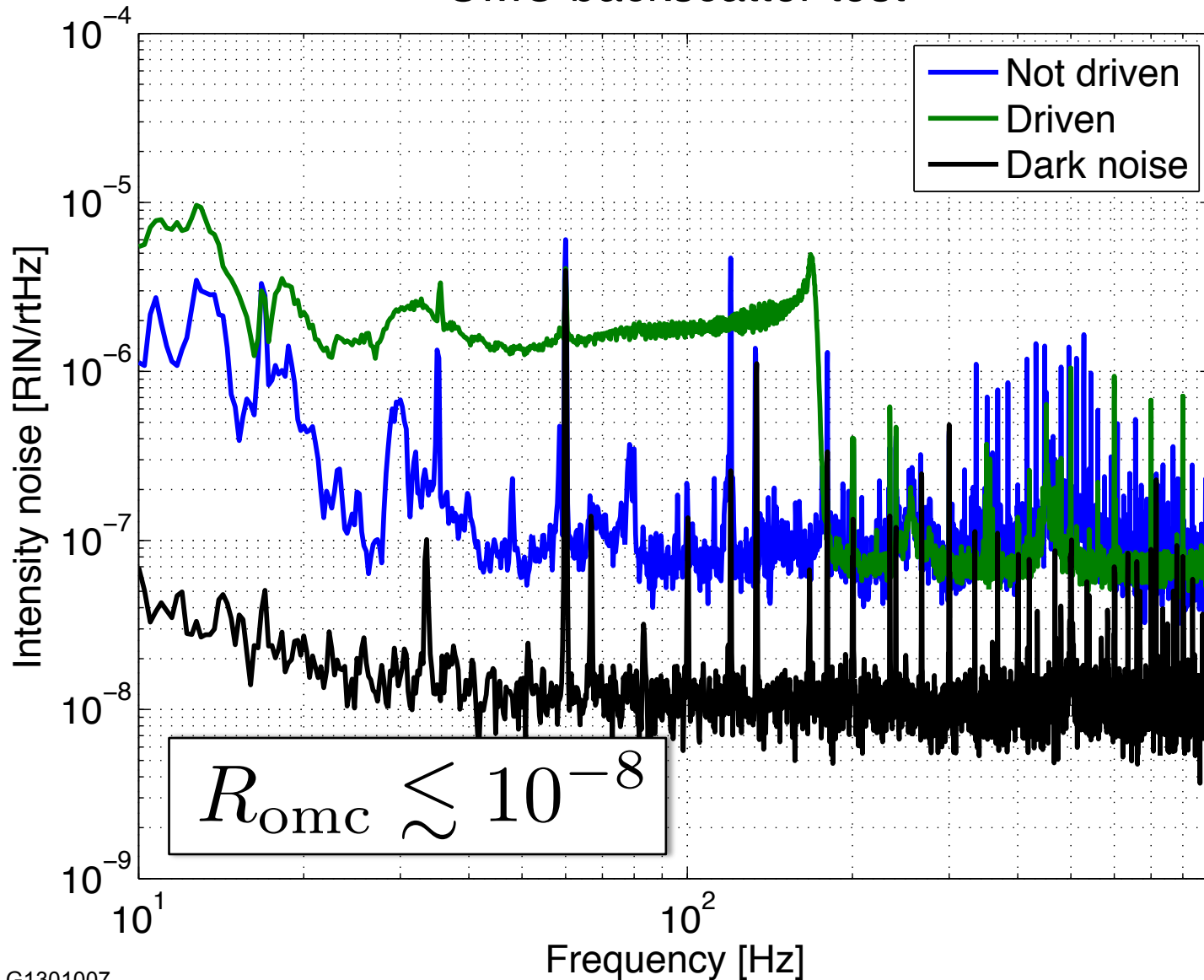
LONG-TERM DRIFT

OMC length "long-term" drift

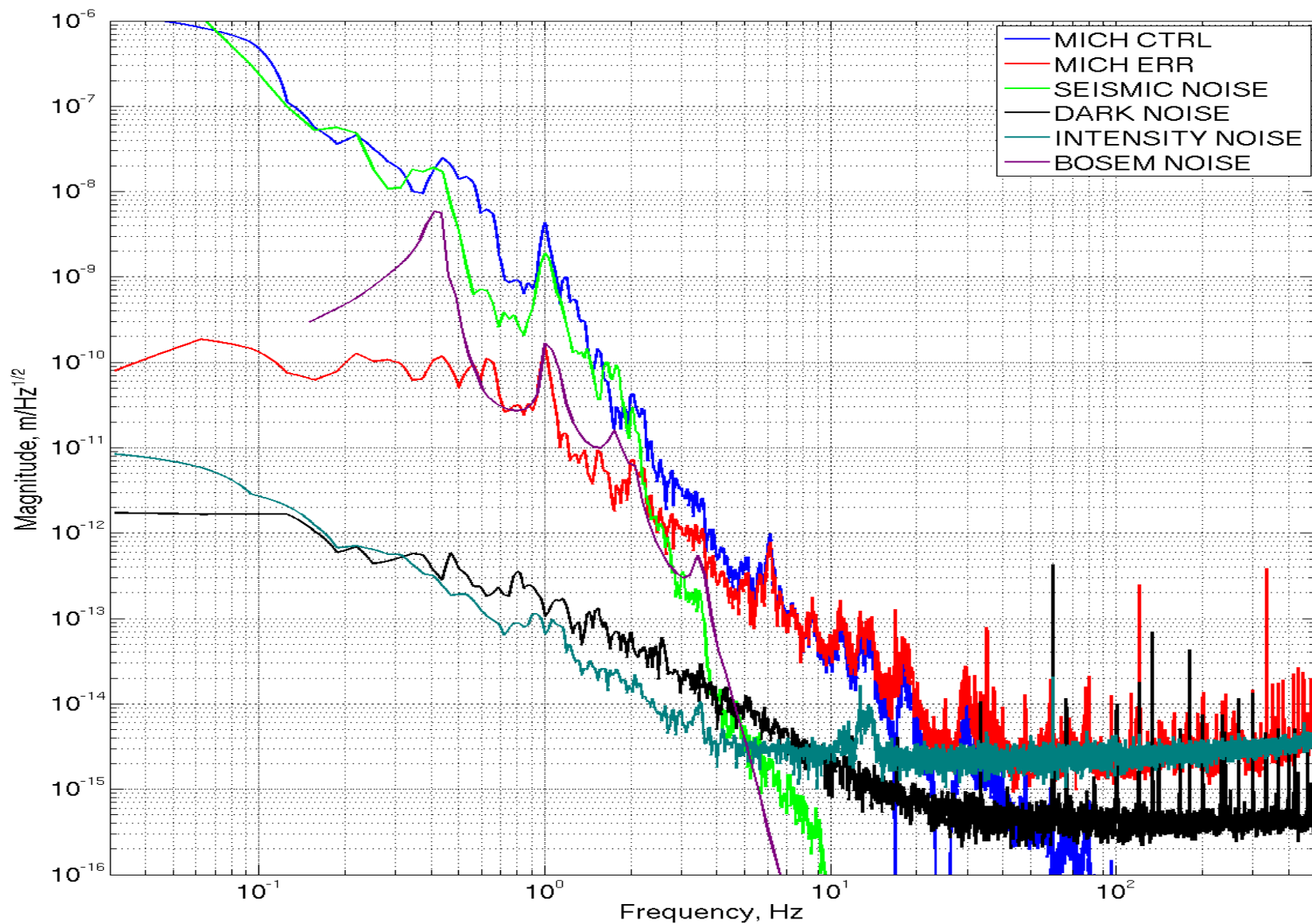


BACKSCATTER

OMC backscatter test

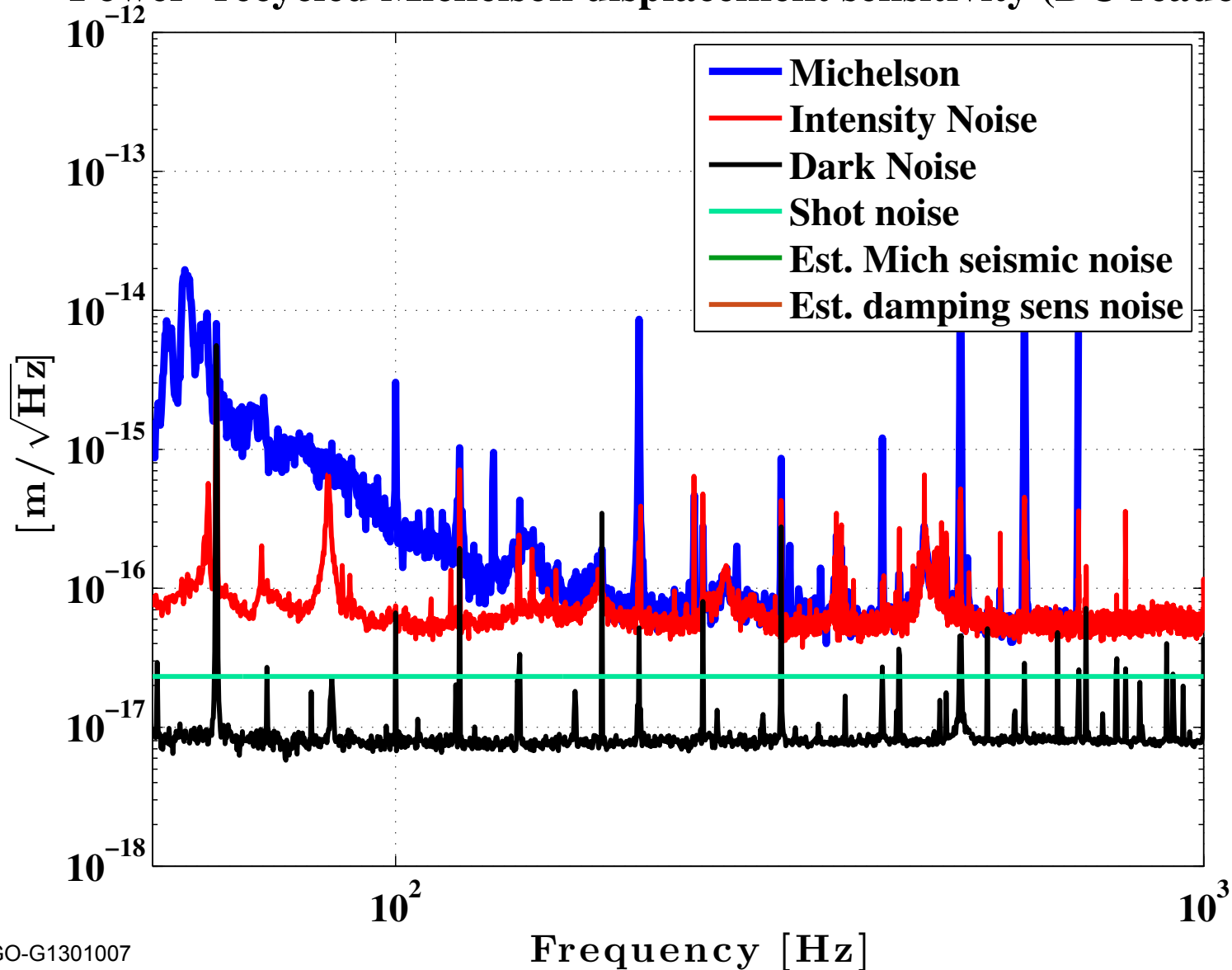


SIMPLE MICHELSON, DC READOUT



LOW-NOISE PRMI, DC READOUT

Power-recycled Michelson displacement sensitivity (DC readout)



CONCLUSIONS / FUTURE WORK

- **OMC operates as expected and performs well, for the most part**
 - **No devastating surprises**, though plenty more work ahead.
- **To do...**
 - Investigate length noise more thoroughly
 - **Angular control**
 - Full integration
 - Automation
 - UGF servo
 - etc.

Thanks for listening!

Danke für Ihre

Aufmerksamkeit!