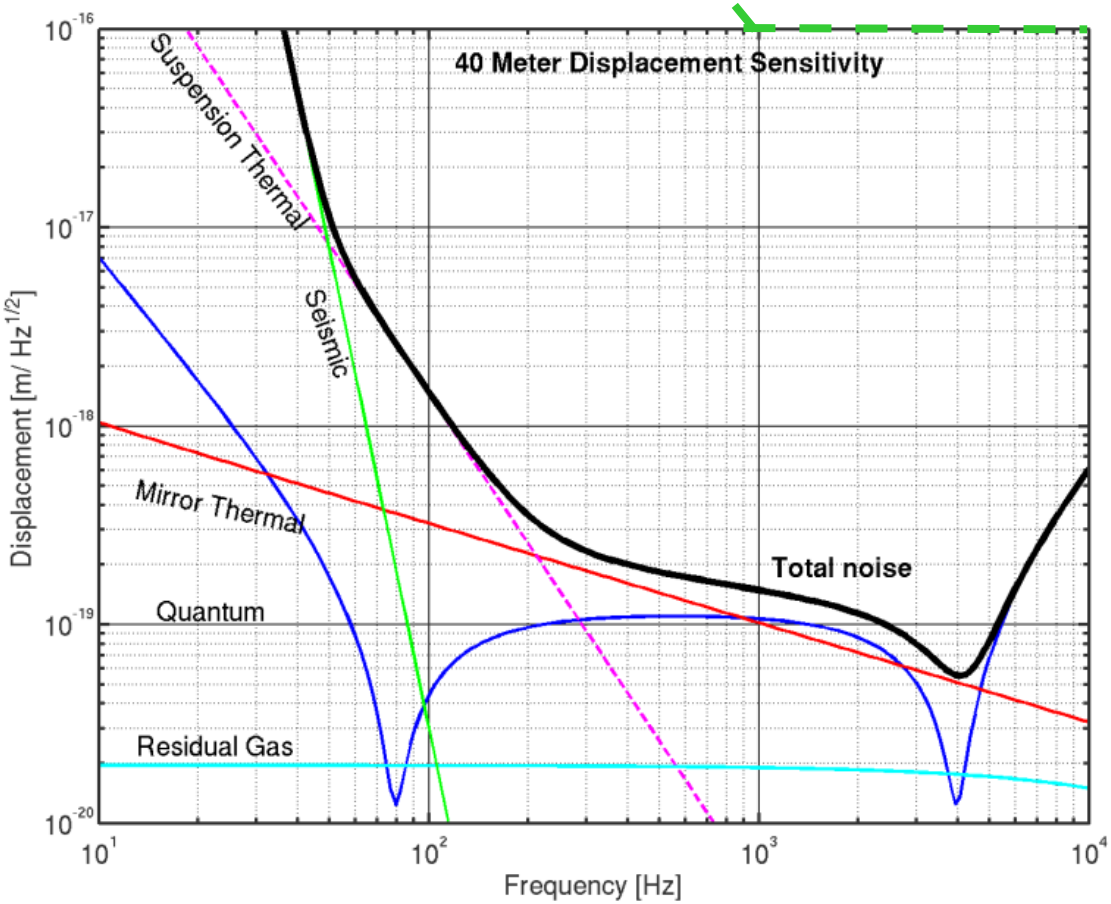
40m TAC Update

October 2006

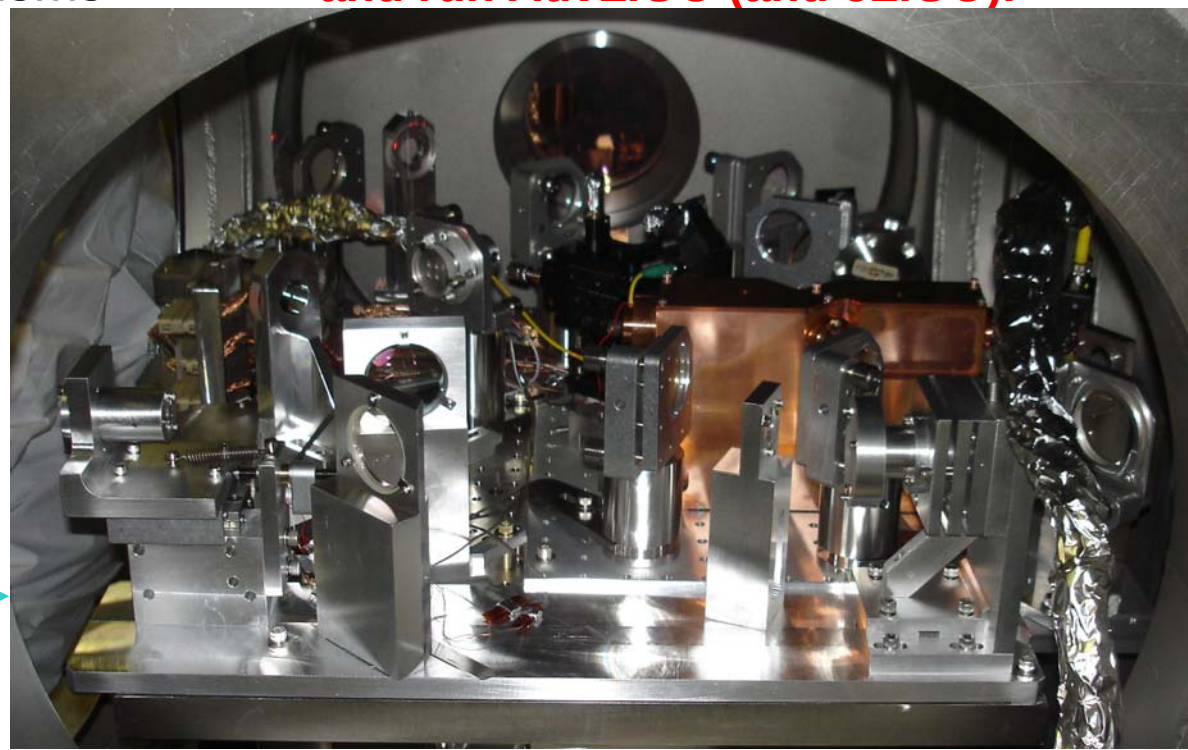


The 40m Team

40 meter prototype

- Objectives:
  - Develop **lock acquisition procedure** of detuned Resonant Sideband Extraction (RSE) interferometer, as close as possible to AdLIGO optical design
- **Test/Characterize LSC scheme**
- **Develop DC readout scheme**
- Characterize noise mechanisms
- Test QND techniques
- Develop/Test ASC scheme
- Extrapolate to AdLIGO via simulation

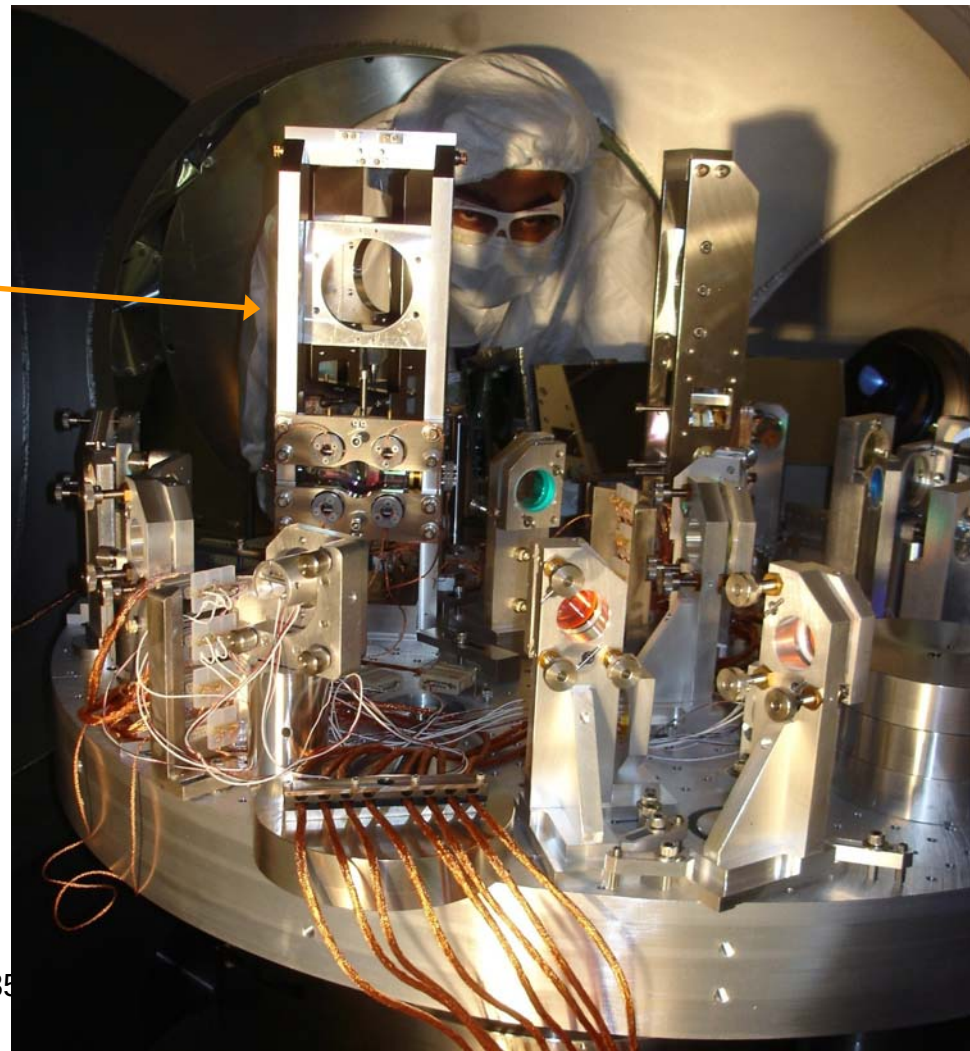
Prototyping will yield crucial information about how to build and run AdvLIGO (and eLIGO).

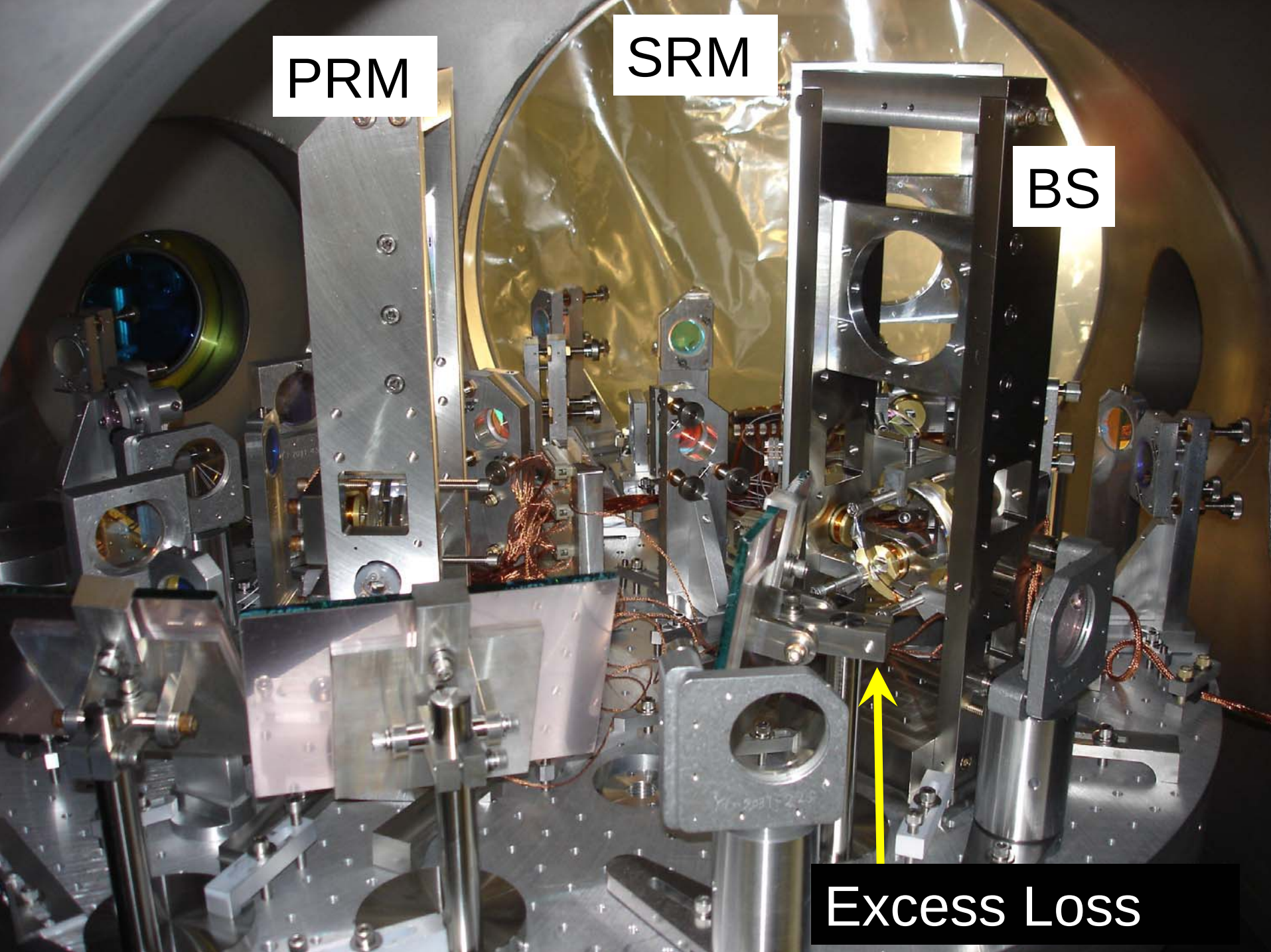


OMC Chamber view from the North side

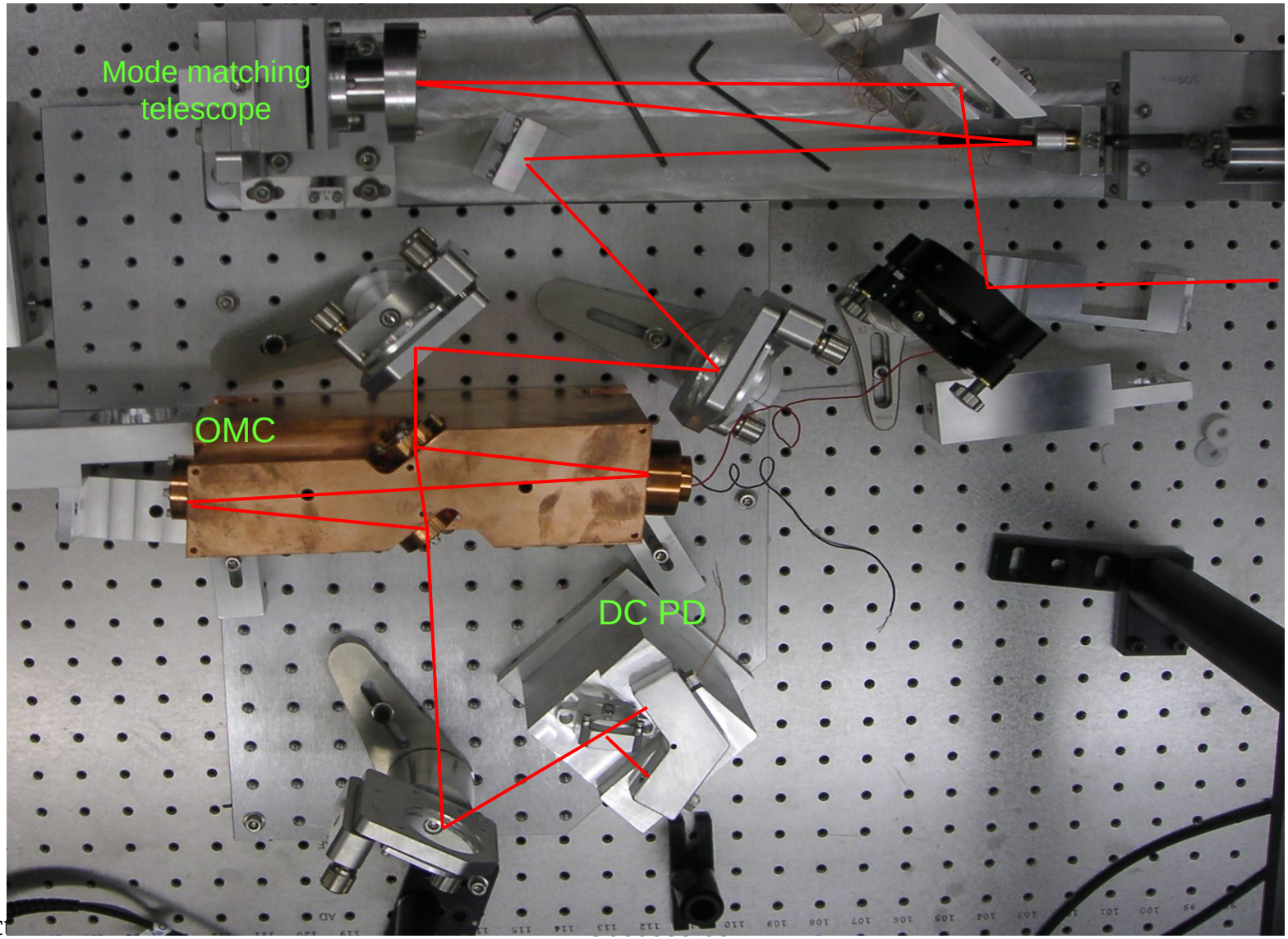
Work since last update (AugLSC)

1) DC Readout hardware installation
2) Mechanical tuning of the OSEMs
3) Mach Zehnder rework
4) Squeezing work
    1) translation stage busted; Go's drawing a new one



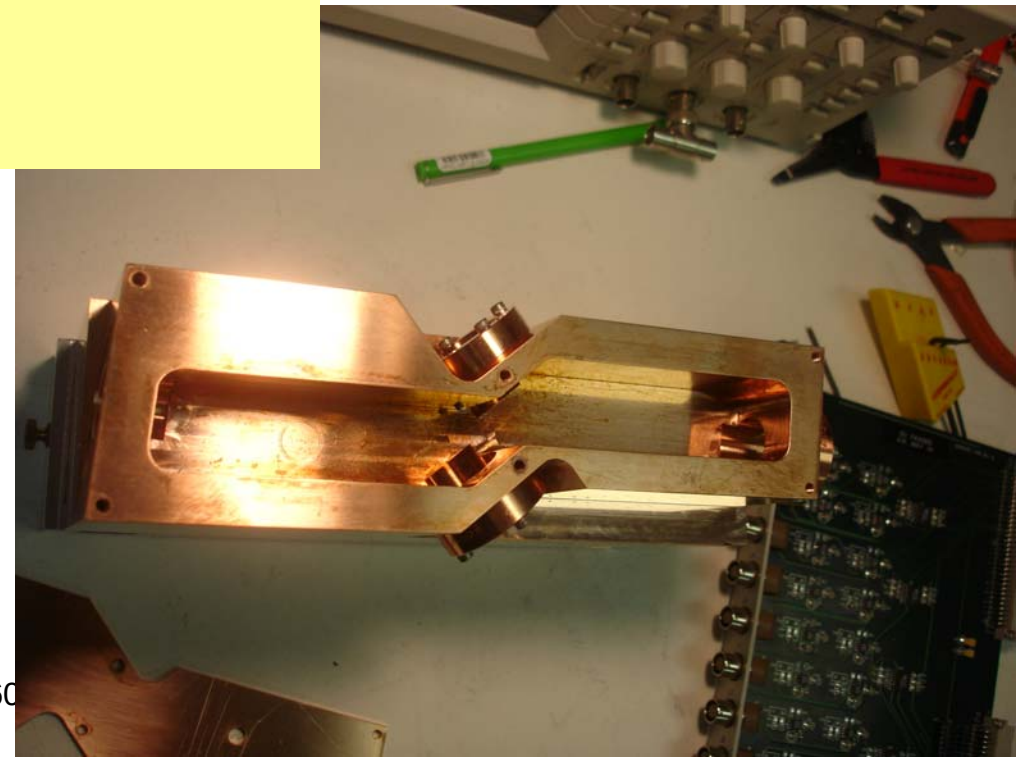

PRM
SRM
BS
Excess Loss

DC readout beamline



DC Readout I

- All in-vac hardware installed (~2 weeks open)
- Tested: OMC Length PZT, DC Photodiodes, OMC length locking (via temporary equip.)
- Initial alignment is good. OMC locked with decent visibility (~75% w/ no tip/tilt).
- Transmitted pickoff beam comes out of vacuum.



DC Readout *Issues*

- Encapsulated PD electronics vacuum nipple is leaky. Leak rate is ~1 liter/year. Better implementation is on the vent list.
- Confirmed that MC1/MC3 spots are off in yaw by ~15 mm, same as was measured a year ago. Re-alignment is on the vent list.
- **Pico Fiasco**: Using the Squeezer translation stage or the OMC's MMT Pico motors causes computers to crash and the MOPA to "wink out". Seems like some kind of immense EMI problem...
- AR Coatings: Several of the CVI mirrors have none.
- Beam Dumps: Mostly neglected in the opto-mechanical layout. Black glass retrofit is on the todo list.
- Various delays due to Piezo Jena. Bottom line: *Let's never ever buy any Piezo Jena stuff again.*

40m Long Term Plans

- From the 40m conceptual design: "The primary goal of the 40 m upgrade is to demonstrate a control scheme for using (RSE)..."
- Also, from the same doc: "The 40m lab is a facility for the development, testing, implementation, and staging of small improvements to the LIGO interferometers"
- The 40m prototype should be used to inform the design and reduce the commissioning time in the Enhanced LIGO.
- Also cannot table the AdvLIGO ISC tasks that are on the 40m plate.

40m Long Term Plans

- http://lhocds.ligo-wa.caltech.edu:8000/40m/Long_Term_Plans_@_the_40m
- **DC Readout** (on a Michelson and then a PRFPMI)
- Develop the new AdvLIGO **LSC** Scheme
- **DC Readout** on the DRSE (w/ new LSC config.)
- Advanced LIGO **ASC** Scheme

DC Readout (Phase A)

- **Lock OMC Length Loop (w/ new controls)**
- Lock OMC Alignment Loops (dithering)
- **Characterize in-vac DC PDs (noise, TF)**
- Simple Michelson displacement noise (DC v. RF)
- PRFPMI displacement noise (DC v. RF)

Along the way, DWFs, Oplev filters, new CM servo

- http://lhocds.ligo-wa.caltech.edu:8000/40m/Long_Term_Plans_@_the_40m

AdvLIGO LSC

- **Re-establish the Full IFO locking**
  - » Mach-Zender has been reworked to stabilize the RFAM problems
  - » New MC servo is in so the frequency noise is better (hopefully)
- Some characterization ? What exactly ?
- **Adopt the new LSC Scheme (after one is chosen)**
  - » requires major in-vac overhaul for cavity lengths, finesses, etc.
- Prototype new style RFPDs (Grote/Sandberg style)
- Complex Modulation (to replace the Mach-Zehnder)

▪http://lhocds.ligo-wa.caltech.edu:8000/40m/Long_Term_Plans_@_the_40m

AdvLIGO *ASC*

- **Goes along with the new LSC Scheme**
  - » New WFS circuits (because we don't have any WFS)
- This is a hard problem.

- `http://lhocds.ligo-wa.caltech.edu:8000/40m/Long_Term_Plans_@_the_40m`

DC Readout (Phase B)

- **Determine a set of measurements to do for this.**
- **Laser noise transfer functions, angular noise, scattering.**

- **Could also take this opportunity to install AdvLIGO CDS Infrastructure; provides some spares for iLIGO.**

- `http://lhocds.ligo-wa.caltech.edu:8000/40m/Long_Term_Plans_@_the_40m`

Last Slide !

- http://lhocds.ligo-wa.caltech.edu:8000/40m/High_Level_Schedule

- Check out the Wiki for a schedule goal ---
- What's missing, what's extraneous?
- Need some new grad students to make it all go; send us your hot shot undergraduates.