LCGT OMC design ver.1

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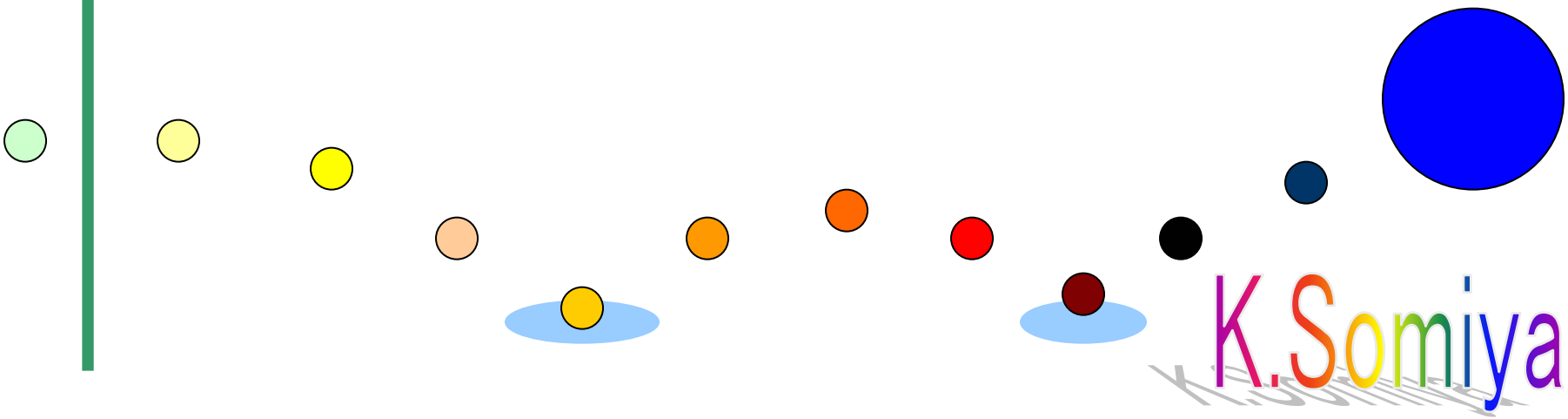
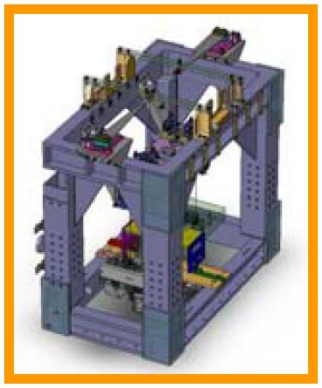


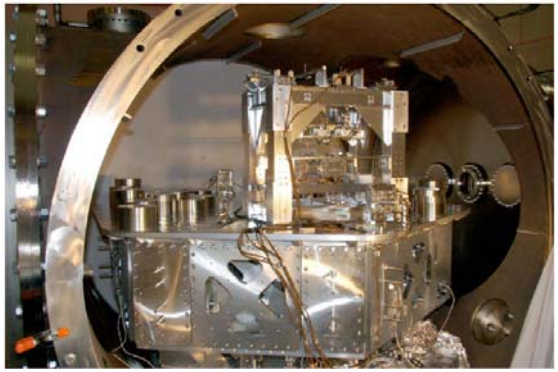
Previous works 1



(1) LIGO-DCC-T060257-03

OMC for eLIGO (aluminum)

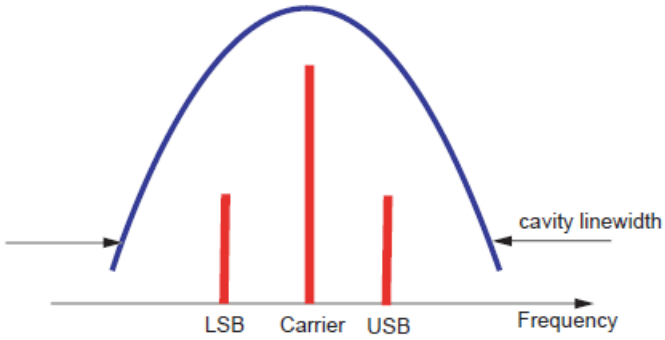
- double pendulum
- top: controlled by OSEMs (7?)
- bottom: 45x15x4cm baseplate
- will be silica in aLIGO



(2) LCGT document Sec. 7.4

OMC for RF readout

- low finesse (F=14)
- very short length (Lmc=3.5cm)
- piezo attached on OMC end
- should be changed for DC readout

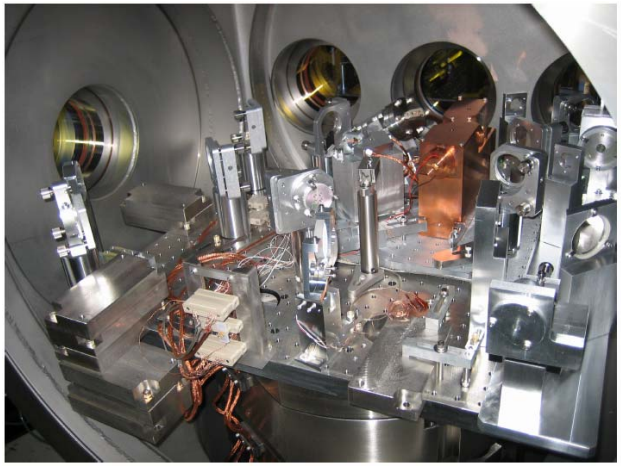


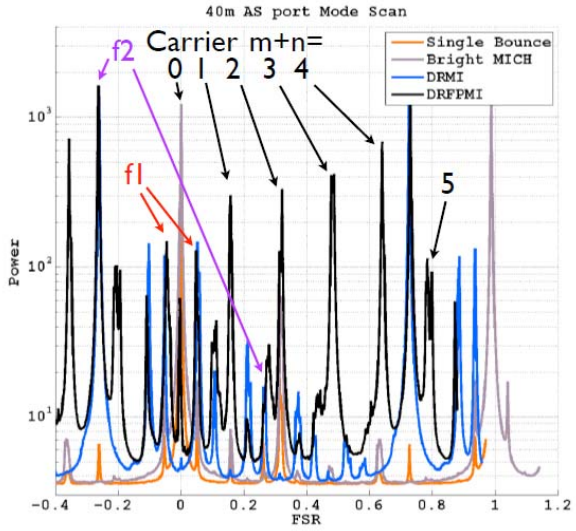
Previous works 2

(3) R.Ward's PhD thesis (LIGO-DCC-P1000018)

OMC in the 40m (Copper)

- 4-mirror ring cavity
- high finesse (F=210)
- short length (Lmc=48cm)
- piezo attached on one mirror
- dither signal (12kHz)
- 2 steering mirrors between IFO and OMC to control tilts
- MMT between the last steering mirror and OMC





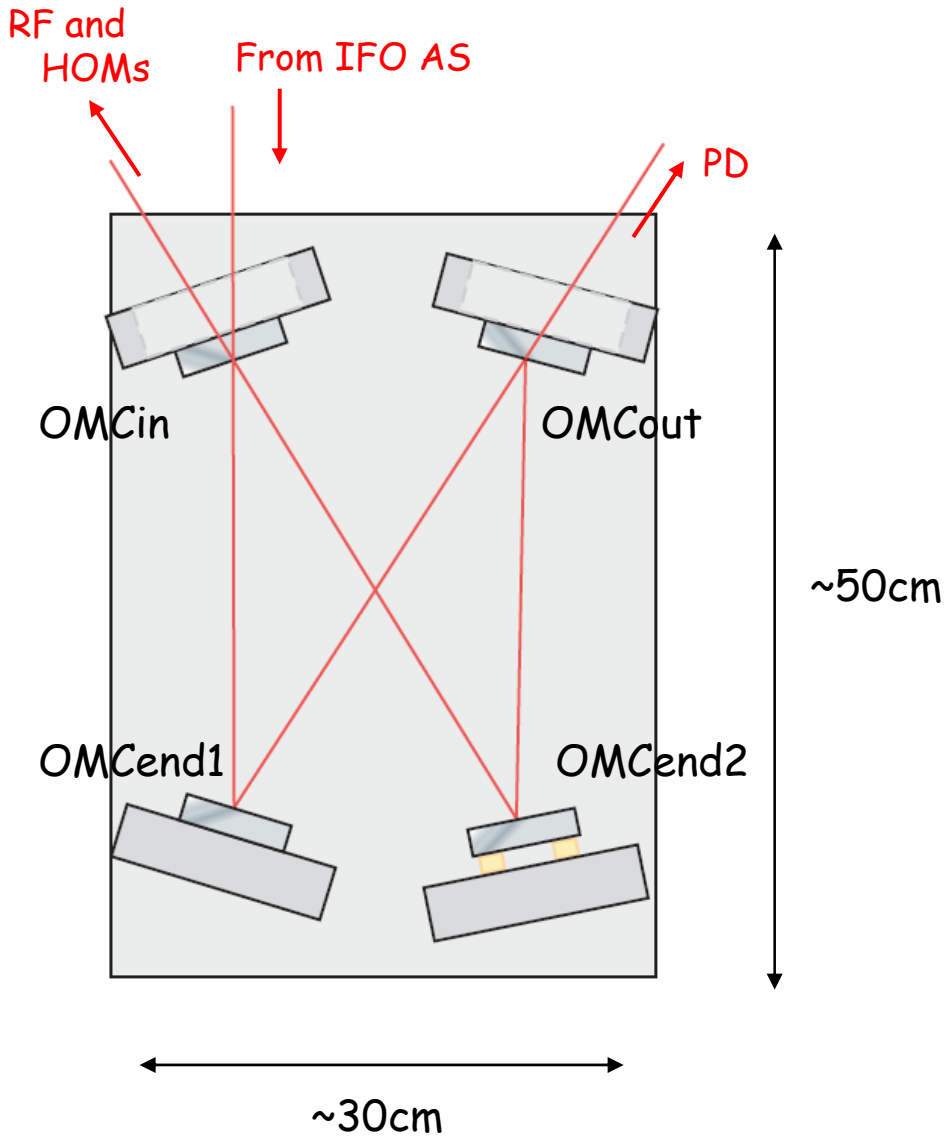
top: 40m DC readout sensing chain
bottom: mode scans of the AS port

LCGT OMC Requirement

- Local oscillator light is ~1mW*, HOM is ~25mW, and RF SB (16.875MHz) is ~200mW
- OMC should suppress RF by 1/10000 and HOM by 1/1000 or less so that shot noise increases no more than 5% (-> 2%)
- The signal optical loss at OMC should be less than 5% (-> 3%)
- PD quantum efficiency should be more than 95%
- OMC displacement noise, TBD

* arm loss = 45+/-4ppm is assumed

Preliminary design

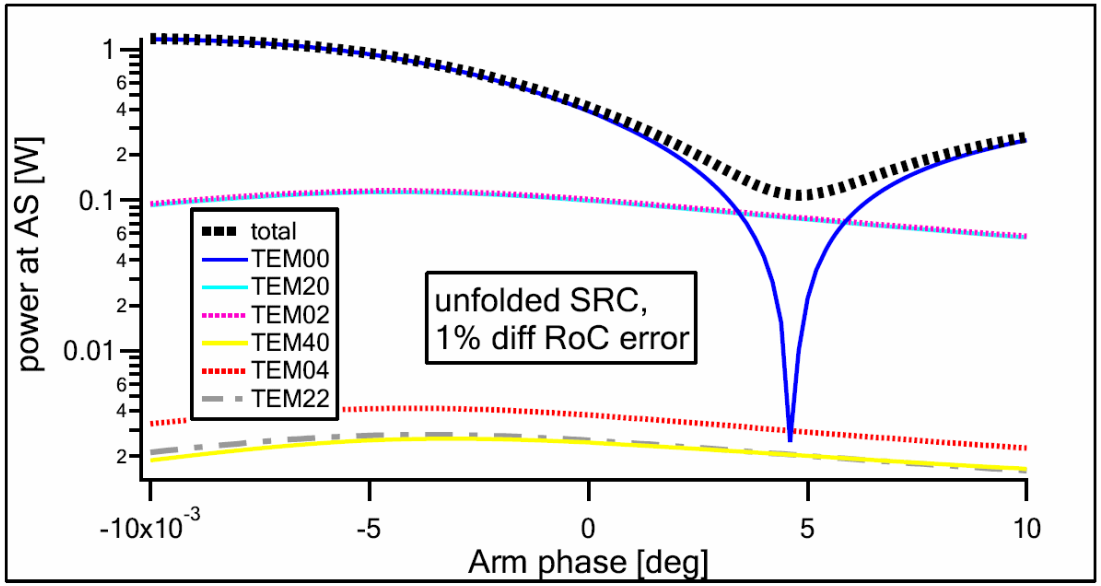


- Lomc = 85cm
  (roundtrip length /2)
- finesse = 520
  (Rin = Rout = 99.4%)
- Optical loss = 45ppm
- f1 SB suppression = 10^-4
- HOM suppression, TBD
- signal loss = 2.3%
- RoC, TBD
- double pendulum

To-do list

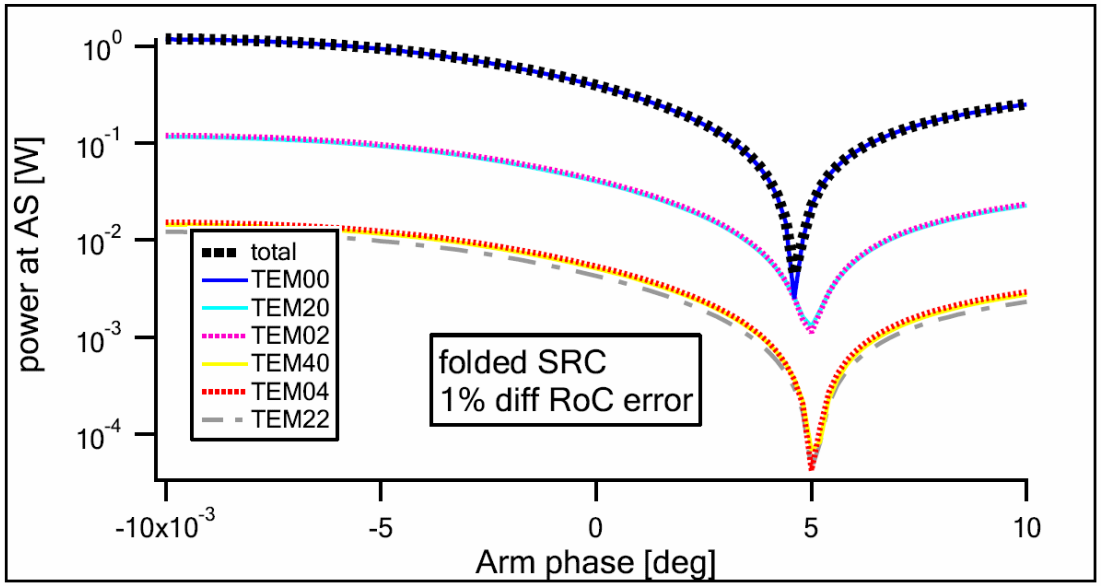
- Astigmatism calculation
  (why is the 4-mirror cavity better?)
- HOM transmittance at OMC
- Displacement noise at OMC
- Re-optimization of the optical parameters
- RoCs and MMTs
- LSC and ASC

HOM calculation



Calculation was done using FINESSE.

0.004 deg offset applied for DC readout



With the SRC folded, the total HOMs at AS is ~25mW.