## 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: $45 \times 15 \times 4 \mathrm{~cm}$ 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 40 m (Copper)
-4-mirror ring cavity

- high finesse ( $\mathrm{F}=210$ )
- short length ( $L m c=48 \mathrm{~cm}$ )
- piezo attached on one mirror
- dither signal ( 12 kHz )
- 2 steering mirrors between IFO and OMC to control tilts
- MMT between the last steering mirror and OMC



## LCGT OMC Requirement

- Local oscillator light is $\sim 1 \mathrm{~mW}$ *, HOM is $\sim 25 \mathrm{~mW}$, and RF SB $(16.875 \mathrm{MHz})$ is $\sim 200 \mathrm{~mW}$
- 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


## Preliminary design


$\sim 30 \mathrm{~cm}$

- Lomc $=85 \mathrm{~cm}$
(roundtrip length /2)
- finesse $=520$
( Rin = Rout $=99.7 \%$ )
- Optical loss $=45 \mathrm{ppm}$
- $f 1$ SB suppression $=10^{\wedge}-4$
- 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 $\sim 25 \mathrm{~mW}$.

