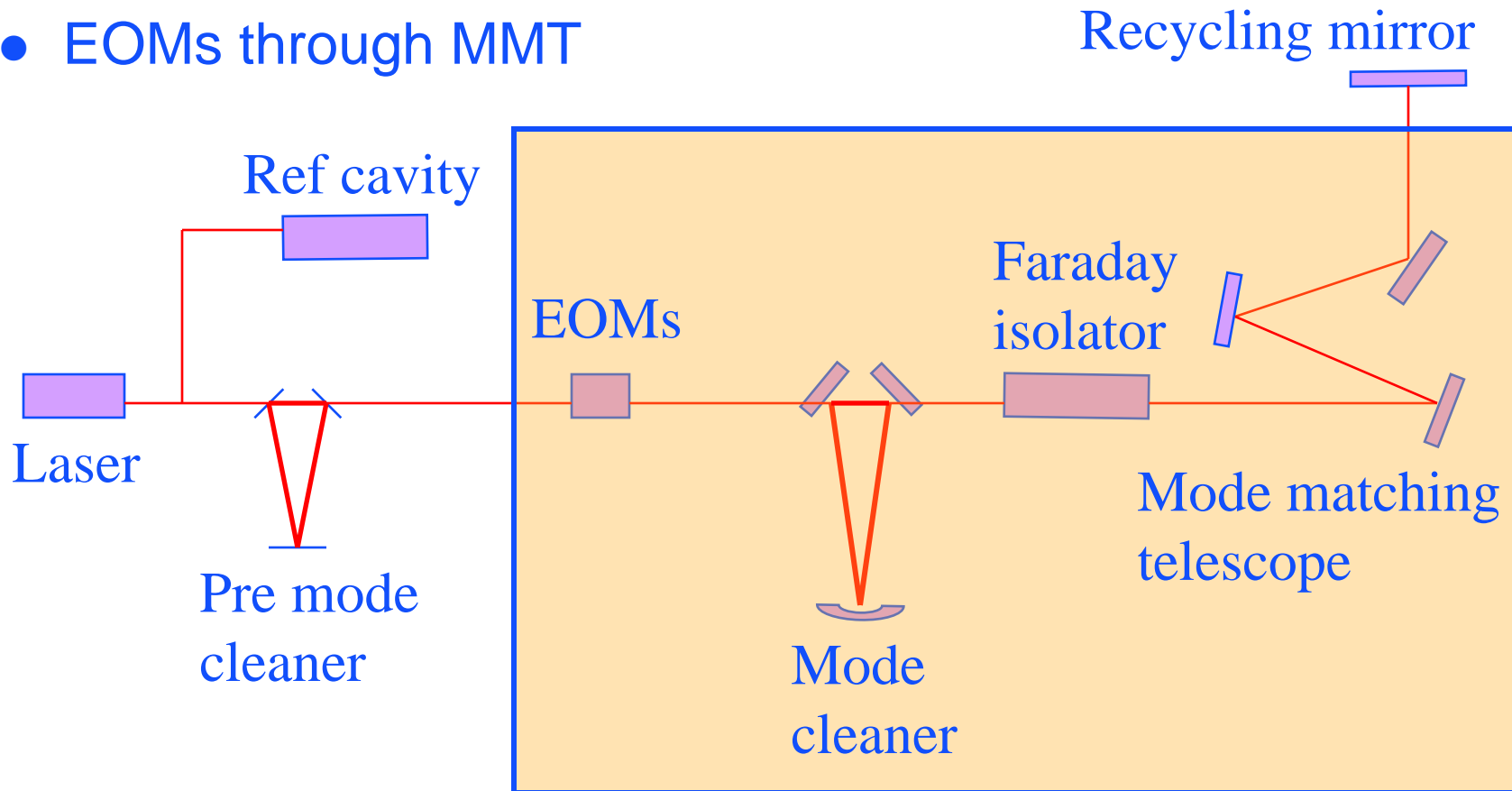

eLIGO Input Optics Characterization and Performance

Kate Dooley
University of Florida

Input Optics

- EOMs through MMT



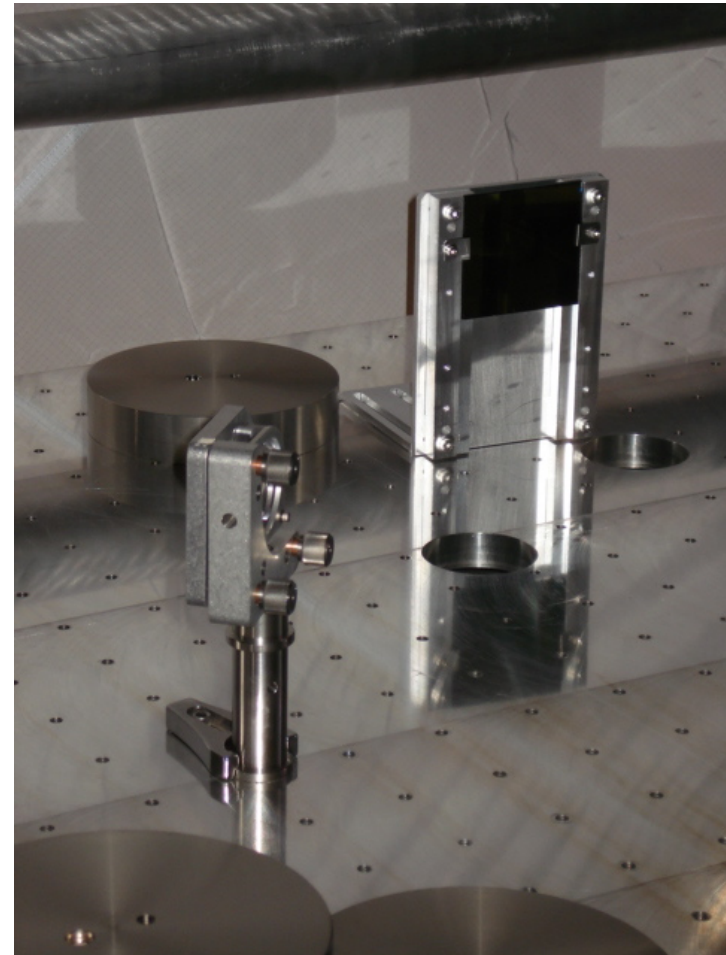
IO Upgrade

Why?

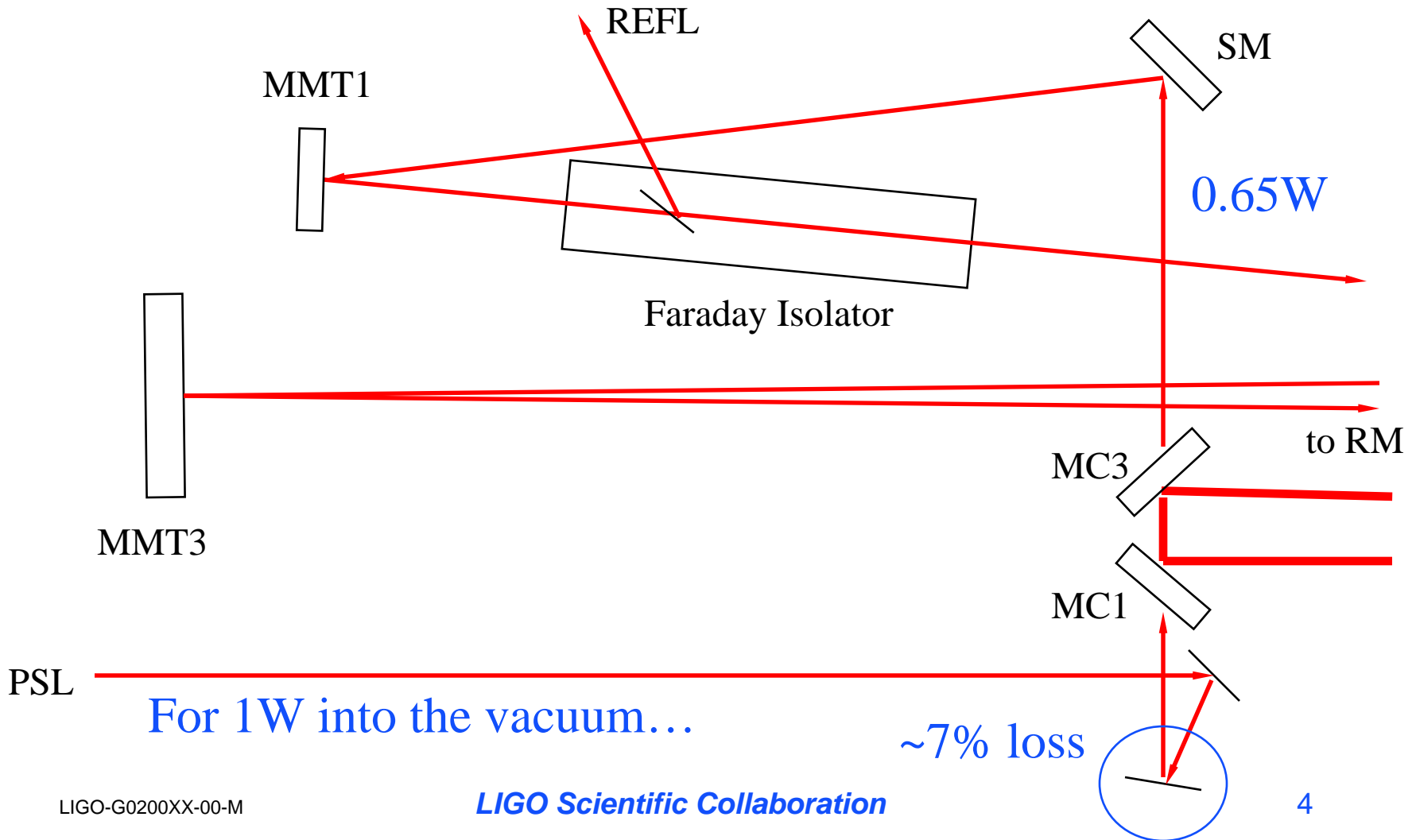
- 3x increase in laser power
- Commission advLIGO designs
- Fix problems found during iLIGO

Tasks:

- New Faraday Isolator
- Clean mode cleaner
- Adjust mode matching telescope
- New electro-optic modulators



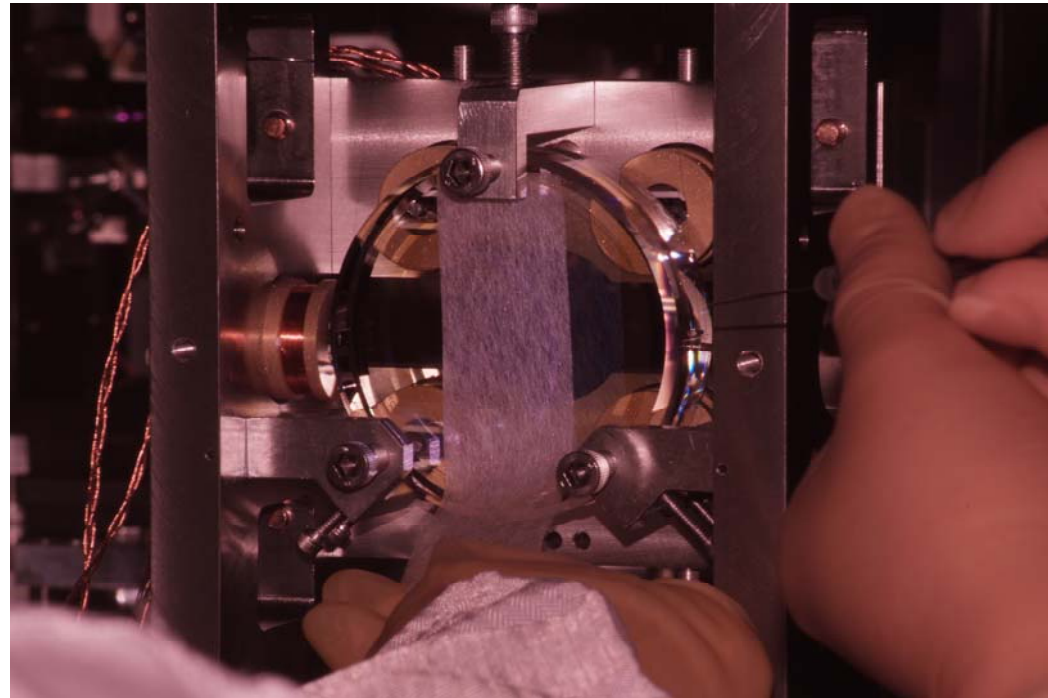
New Layout



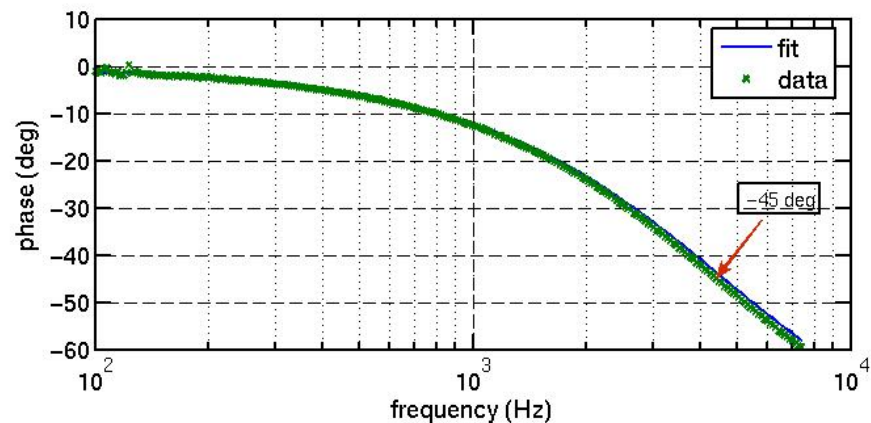
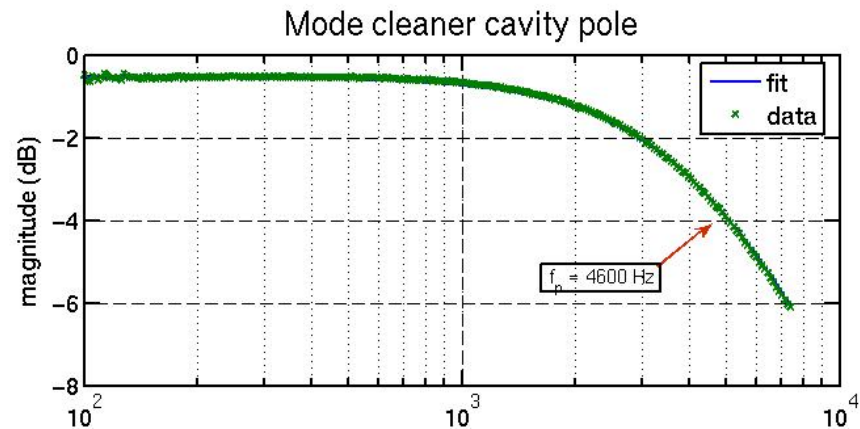
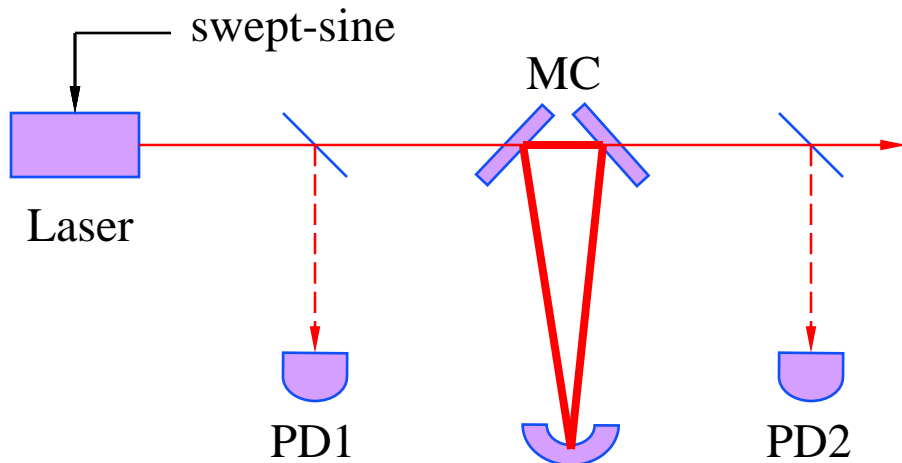
Mode Cleaner Absorption

Absorption (ppm)

	Before Cleaning	After Cleaning
LHO	20	19
	78	25
	41	51
LLO	61	7
	18	6.5
	42	11



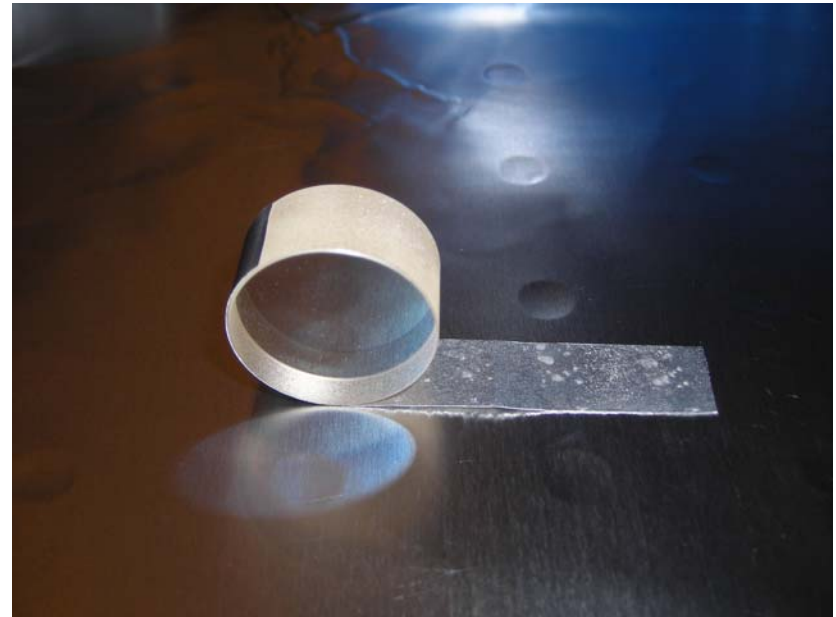
Mode Cleaner Cavity Pole



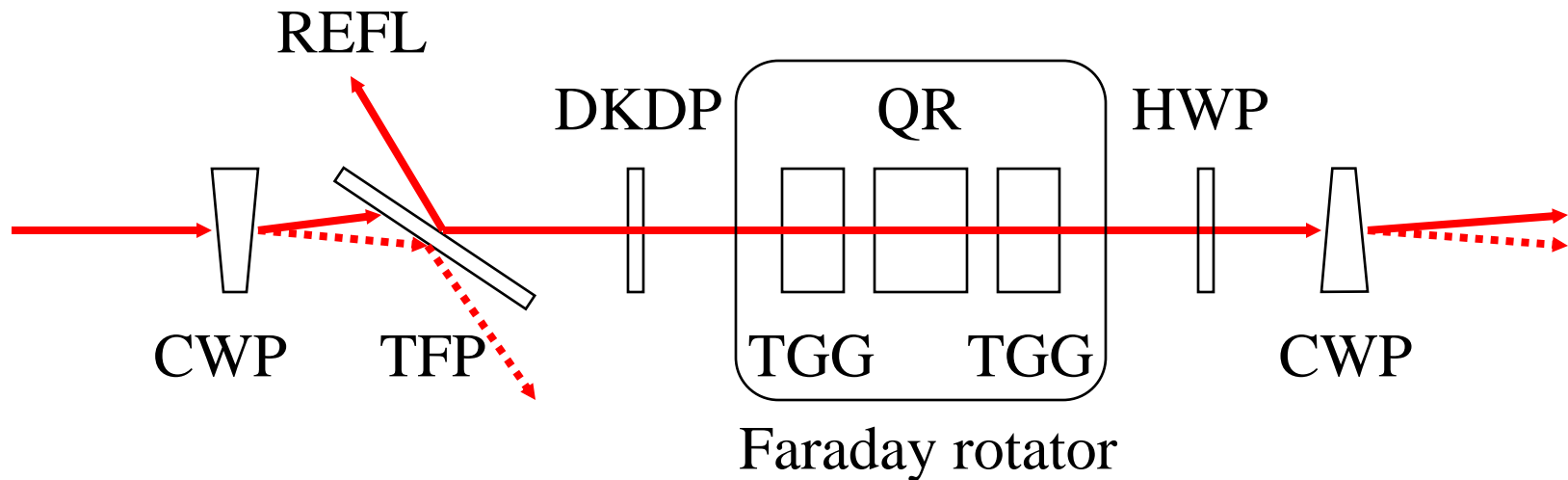
	Before Cleaning	After Cleaning
LLO	4569 Hz	4500 Hz
LHO	4596 Hz	4504 Hz

Faraday Isolator

- Higher isolation ratio
 - » Multiple high extinction ratio polarizers
 - » Multiple TGGs, Quartz rotator
- Higher transmission
 - » High transmission polarizers
 - » Low absorption TGG
- Lower thermal drift
 - » Increased thermal contact with crystals
- Less thermal lensing
 - » Negative lens DKDP

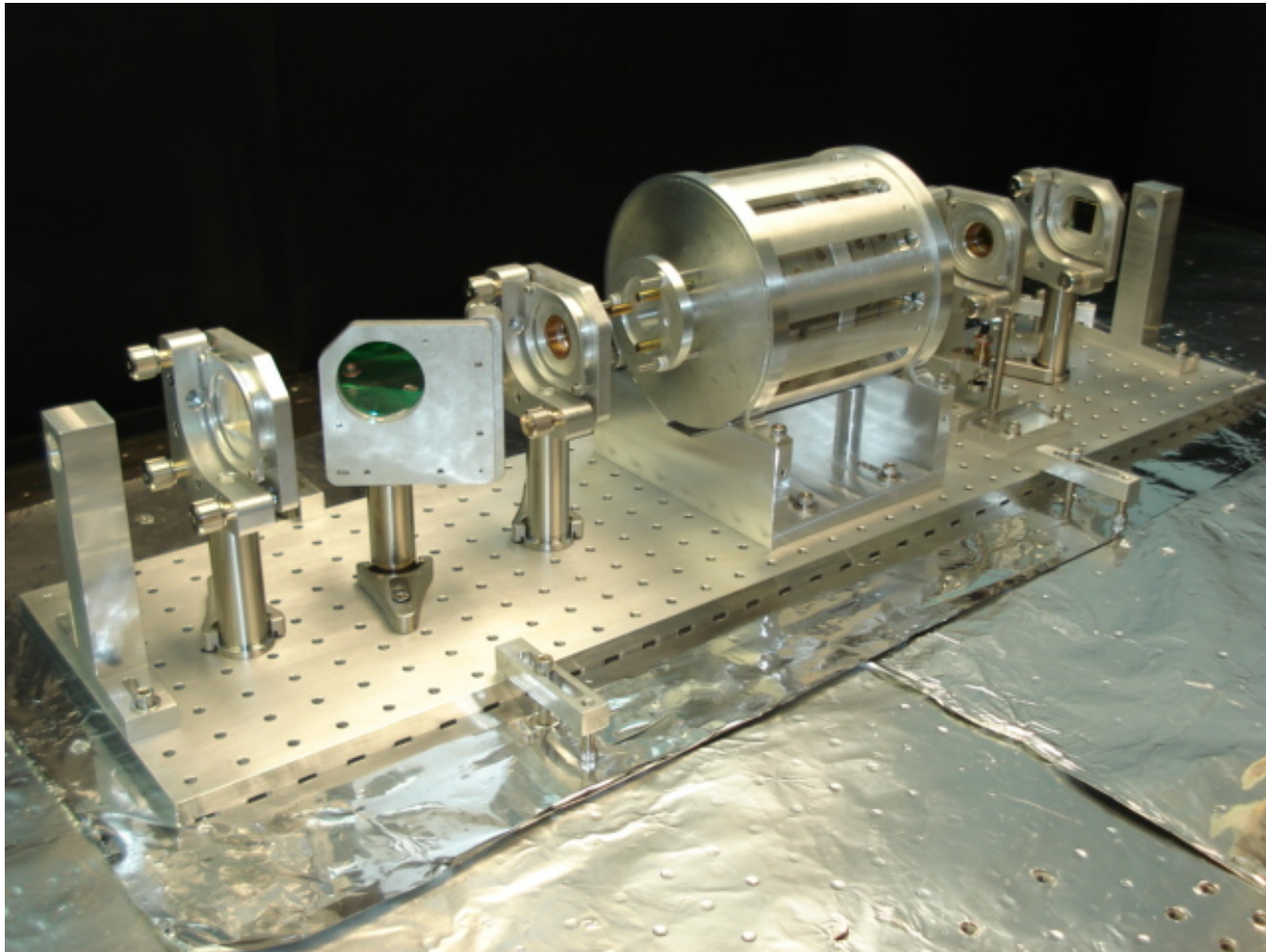


Faraday Isolator Design

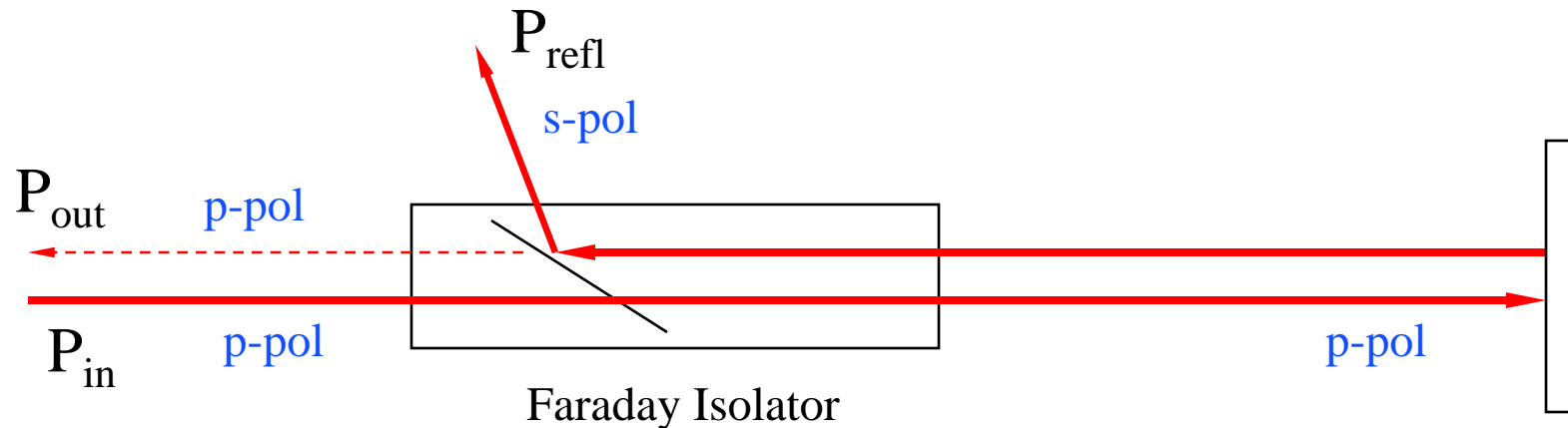


$$\begin{aligned}
 \text{p-pol} &\Rightarrow +22.5 - 67.5 + 22.5 + 22.5 \Rightarrow \text{p-pol} \\
 \text{s-pol} &\Leftarrow +22.5 + 67.5 + 22.5 - 22.5 \Leftarrow \text{p-pol}
 \end{aligned}$$

Advanced Faraday Isolator



Isolation Ratio

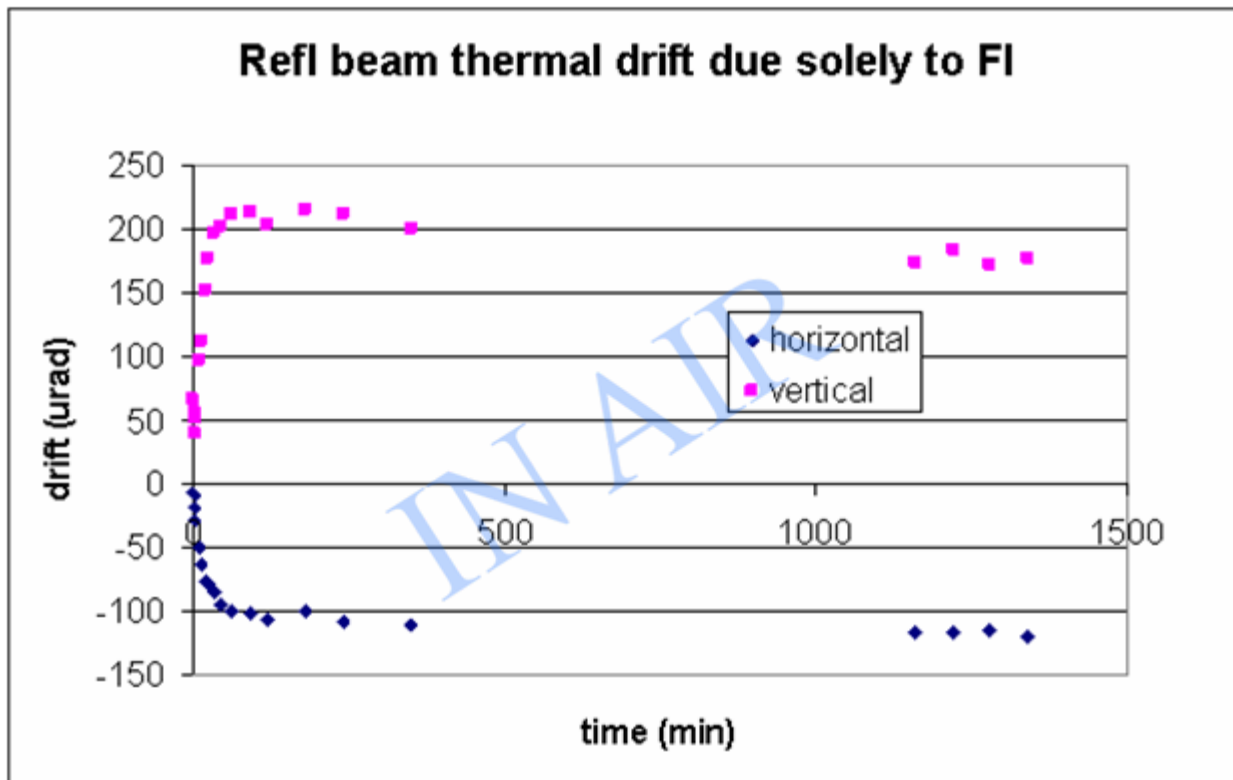


$$IR \equiv 10 \log \left(\frac{P_{in}}{P_{out}} \right)$$

	iLIGO	eLIGO
In air	26 dB	35 dB
In vacuum	14 dB	29 dB

LLO data

Thermal Drift

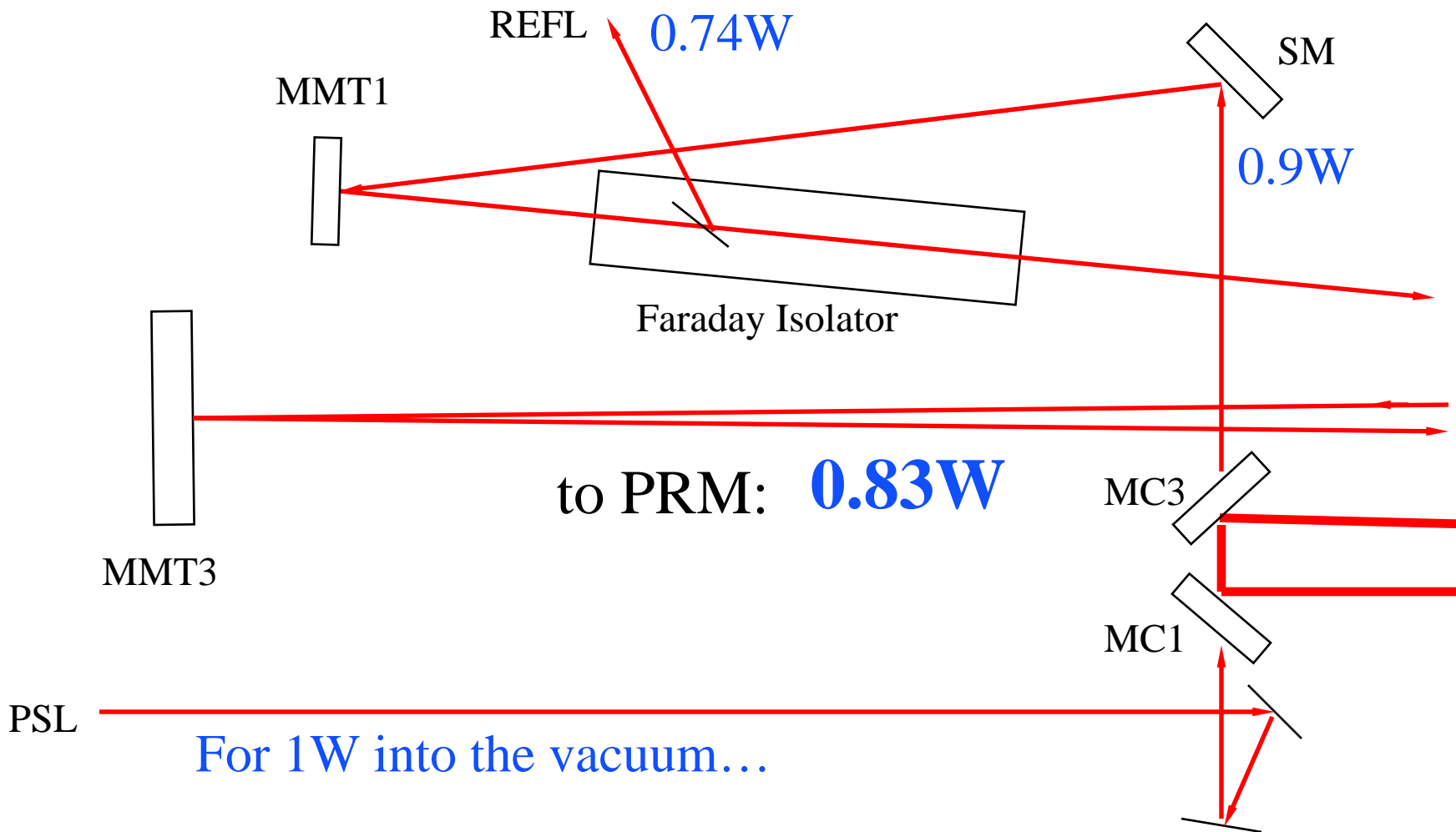


Upper limit of 3%
beam diameter
movement on WFS

iLIGO	~100 urad/W
eLIGO	~10 urad/W

LLO data

Power Budget



Summary

	iLIGO	eLIGO
FI Isolation Ratio	14 dB	29 dB
FI Transmission	89%	92%
FI Thermal Drift	BIG	small
FI Aperture	12 mm	20 mm
FI Thermal Lens	10 m	-70 m
Mode Cleaner Absorption (avg)	43 ppm	20 ppm
Mode Cleaner Finesse	1333	1360
IO Efficiency	65%	83%

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- Josh Smith
- David Tanner
- Luke Williams





Extras

Old Faraday Isolator



Old Faraday Isolator

