

aLIGO EOM at LLO and LHO Assembly/testing/installation

Volker Quetschke, Gregorio Tellez, Joseph Coleman,

**Center for Gravitational Wave Astronomy
& Department of Physics and Astronomy
The University of Texas at Brownsville**

and the LIGO-UF group

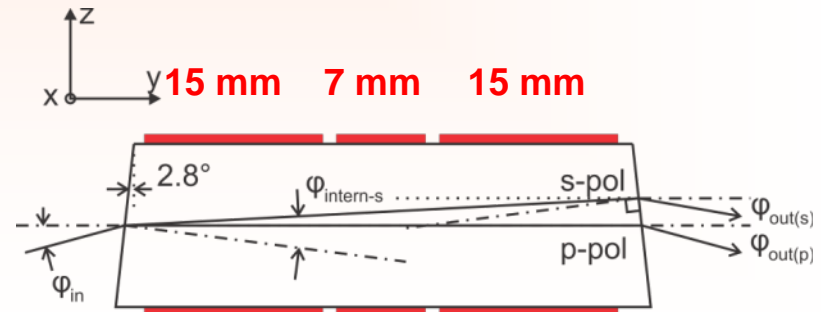
**Department of Physics
University of Florida**

aLIGO modulators follow the design of the eLIGO modulators, but were adjusted to follow aLIGO specifications:

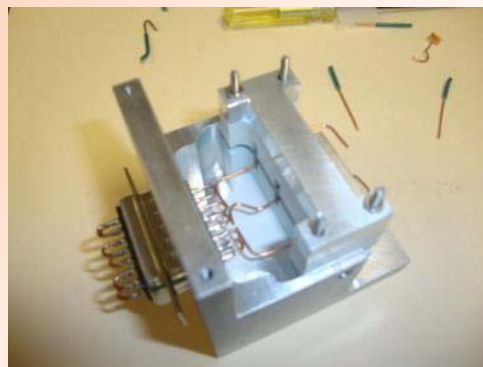
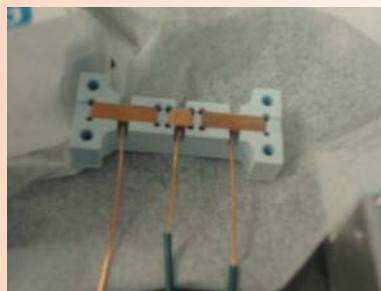
- Three electrode, wedged RTP crystal (rubidium titanyl phosphate - RbTiOPO_4)
 - Wedged avoids cavity effects and reduces amplitude modulation
 - RTP has low absorption, is capable to handle 200W exhibits a small thermal lens
 - Three electrodes on one crystal minimize the number of optical surfaces (and the price)



Polarization	Angle [degrees]
p	5.2
s	4.7

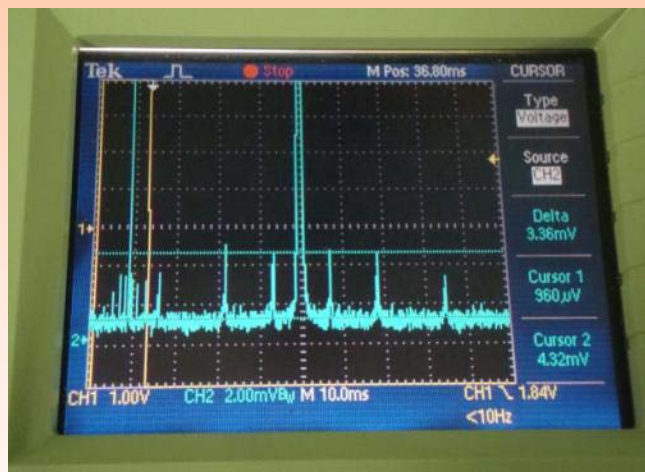


- Assemble modulators in clean environment
- Build and tune three simultaneous pi-network resonant circuits with 50Ω input impedance. (9.1 / 24.1 / 45.5 MHz)



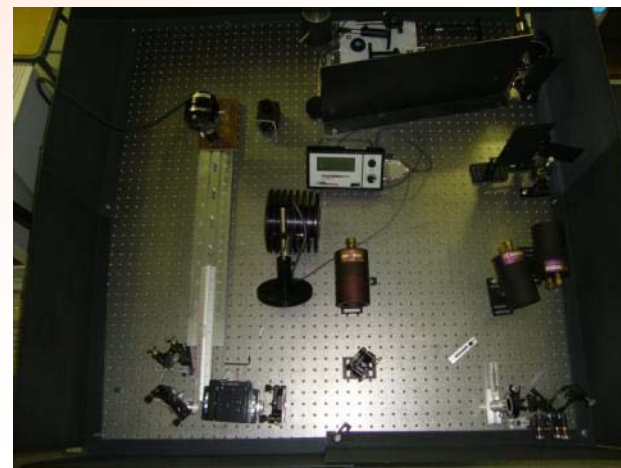
- Finalize tuning at UF
- Measure sidebands
- Test high power compatibility

<i>Frequency [MHz]</i>	<i>EOM-1: Number of turns per coil</i>	<i>EOM-1pi network shunt capacitance</i>	<i>EOM-2: Number of turns per coil</i>	<i>EOM-2 pi network shunt capacitance</i>
<u>9.1</u>	108	820 pF	102	680 pF
<u>24.1</u>	67	270 pF	68	270 pF
<u>45.5</u>	31	210 pF	30	190 pF



<i>Frequency [MHz]</i>	<i>EOM 1</i>	<i>EOM 2</i>
<u>9.1</u>	0.325	0.388
<u>24.1</u>	0.117	0.184
<u>45.5</u>	0.310	0.299

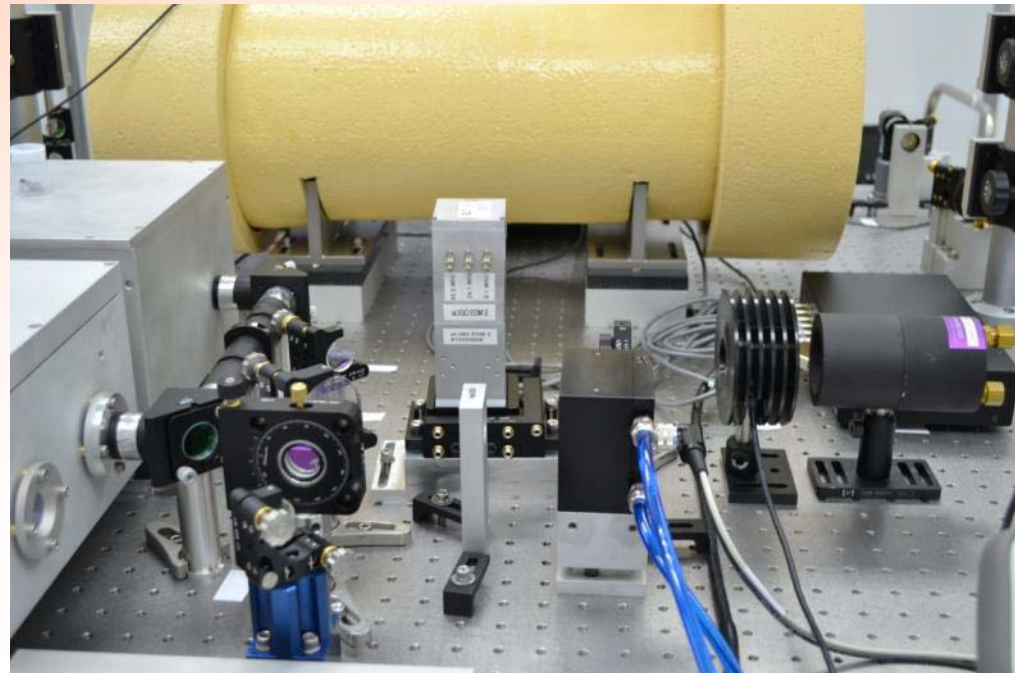
Sidebands measured with three 24 dBm signals simultaneously driving all three electrodes

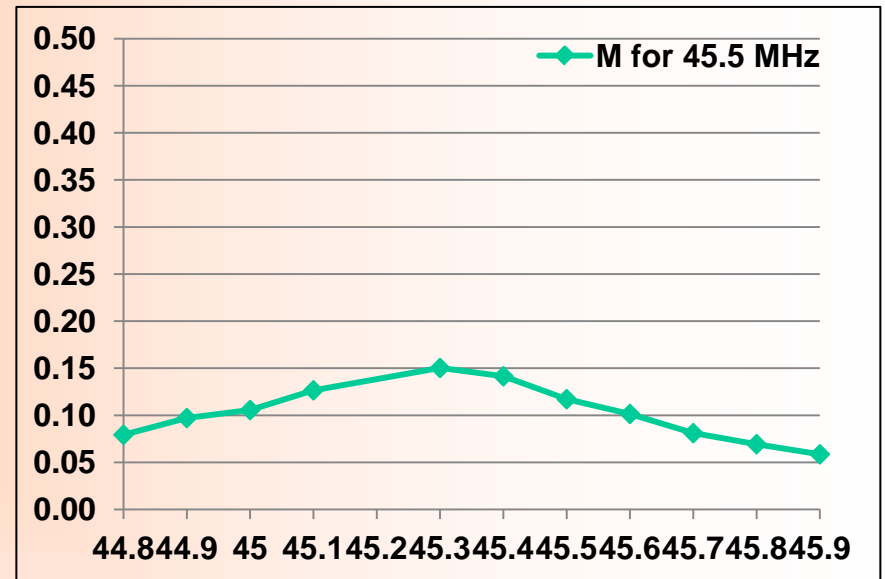
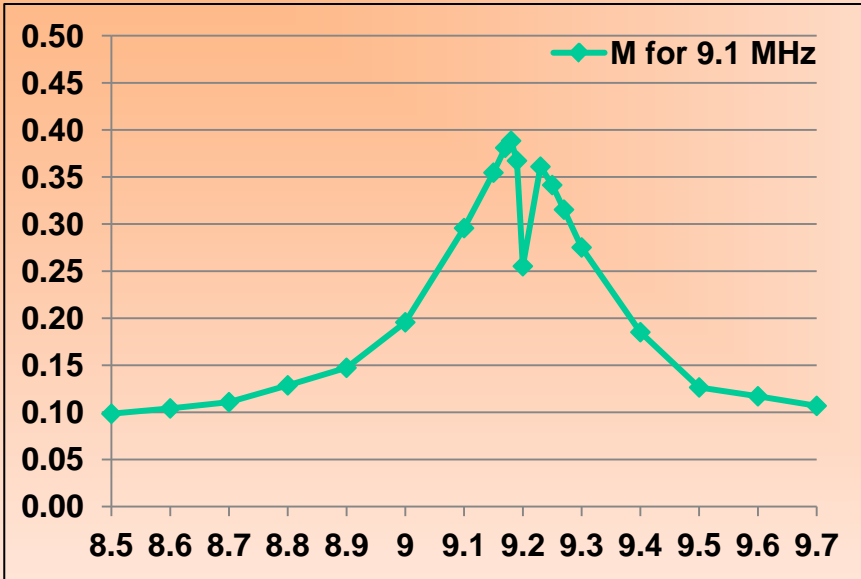


Setup with 150W laser and realistic beam parameters to verify high-power compatibility

- Was installed, but shortly after uninstalled and retuned for H1 frequencies

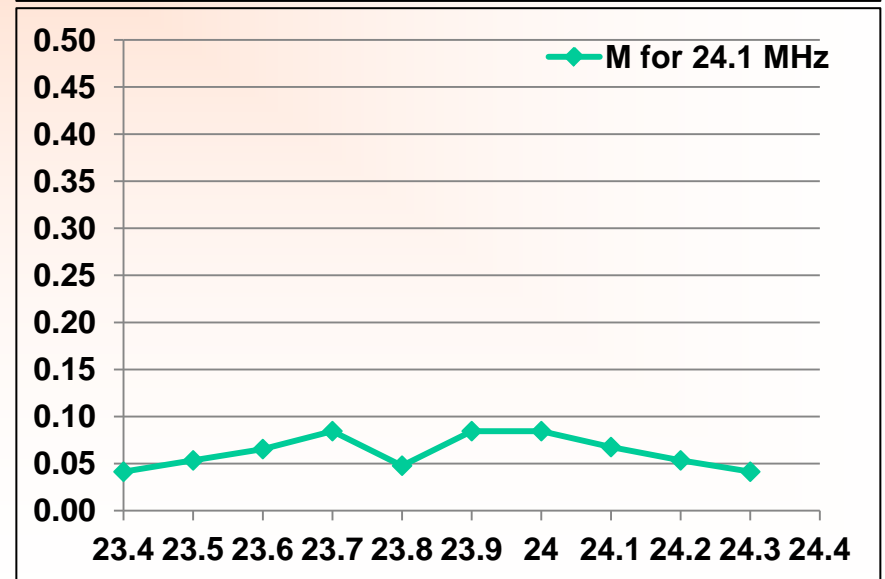
- L1 modulator install





- Some re-tuning was done 04/2012

<https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3027>



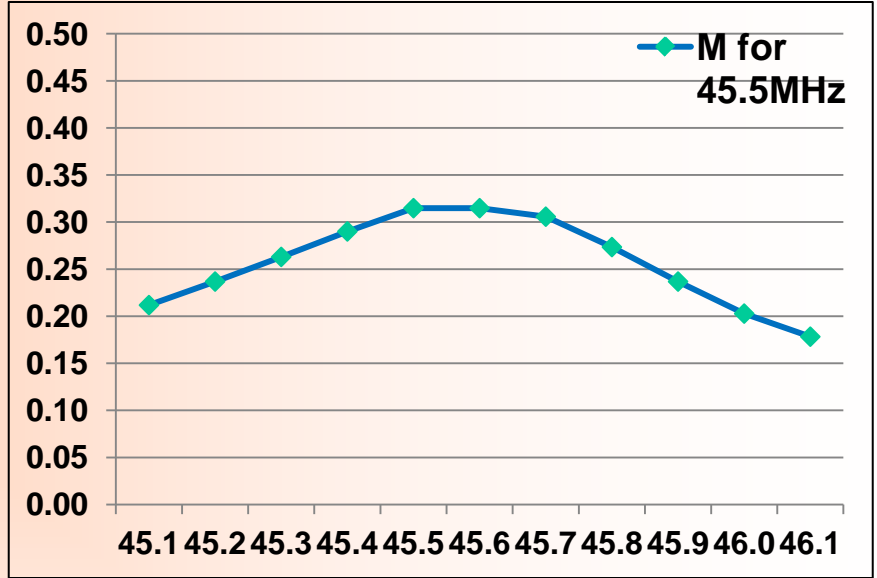
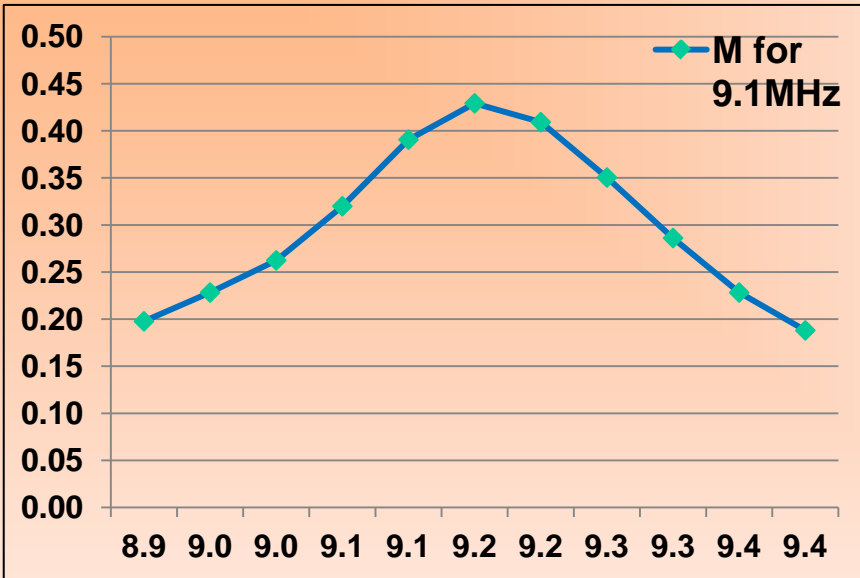
- RFAM measurements with 24dBm drive

Freq.	PM	RFAM	RFAM/PM
45.3	0.15	6.2E-06	0.000041
9.18	0.39	3.9E-05	0.000100
24.0	0.09	1.0E-06	0.000012

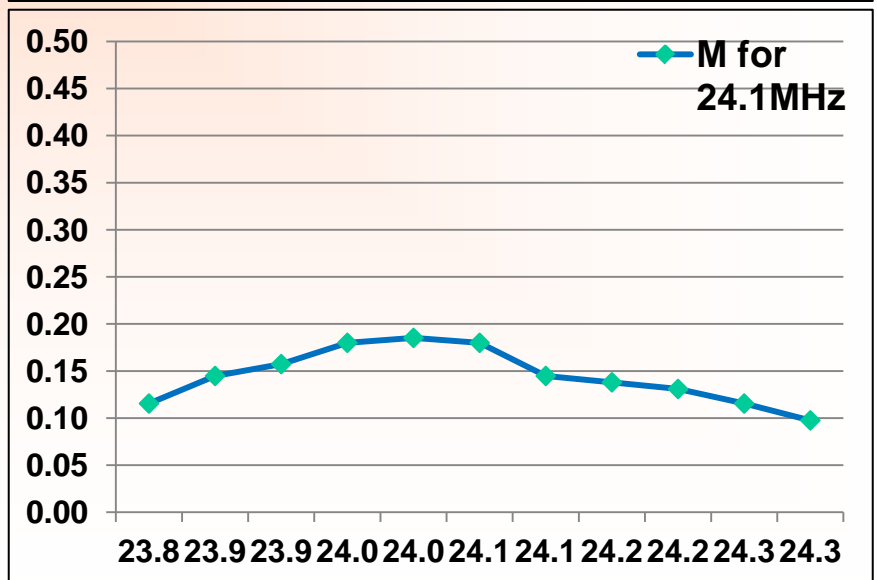
- <https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3034>

Installation at LHO 08/2012

Modulation depth for 24 dBm drive



- <https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=3693>



- All went well

Freq.	PM	RFAM	RFAM/PM
45.5	0.31	5.5E-05	0.000177
9.1	0.39	9.13E-05	0.000234
24.1	0.14	3.17E-05	0.000226

- <https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=3695>

- Re-tuning for LIGO India?

- LLO - Chris explanation:

< <https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=2901> >

- PM vs freq:

< <https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3027> >

- AM at peak:

< <https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3034> >

- LHO - PM vs freq:

< <https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=3693> >

- AM at peak:

< <https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=3695> >