Thermal actuator update

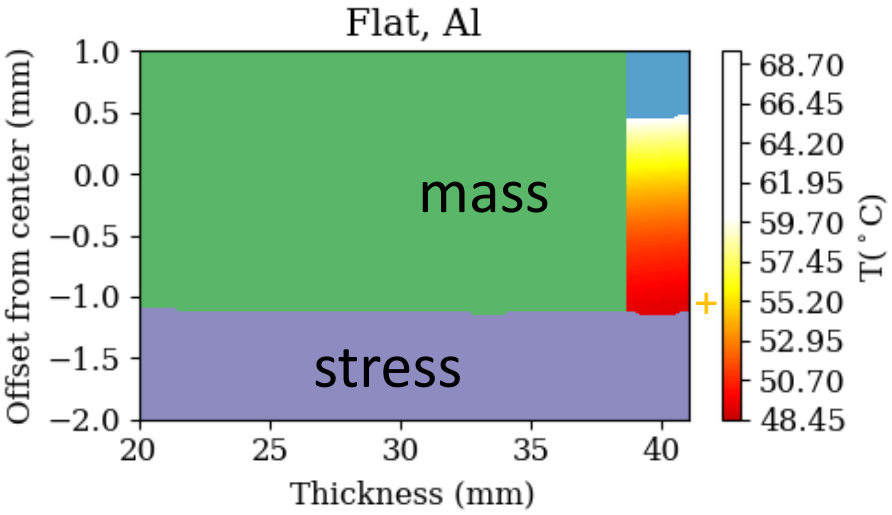
Performance of 1kg CFM mirror

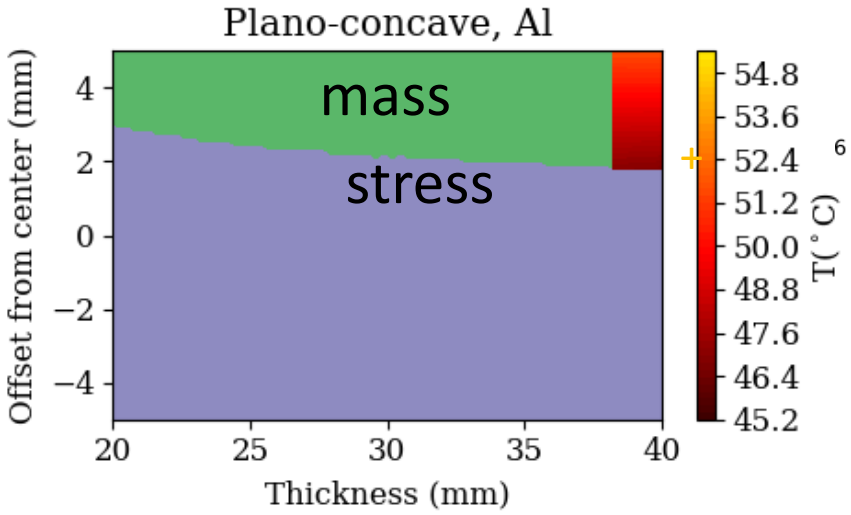
SAMS meeting (2019/04/25)

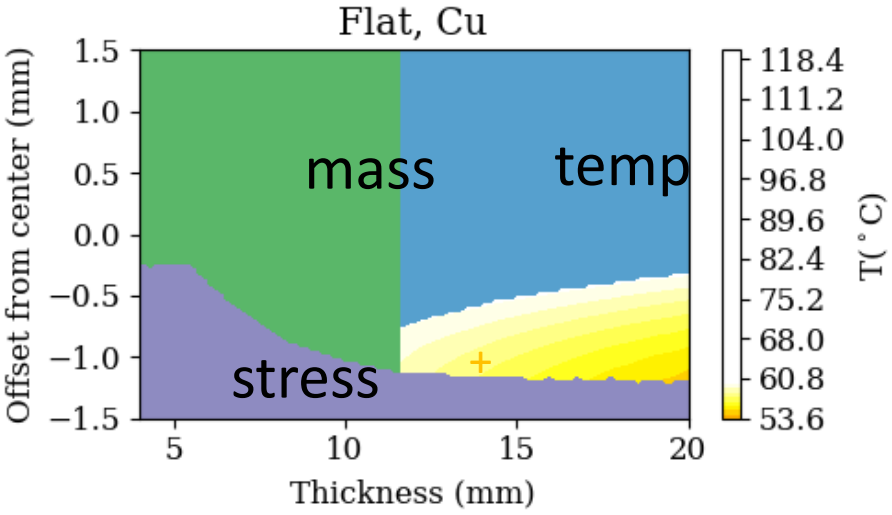
LIGO- E1900126

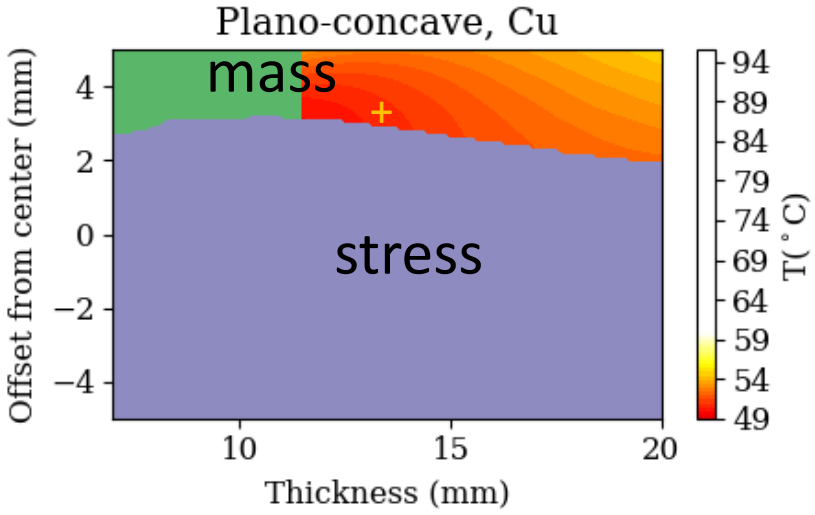
Huy Tuong Cao

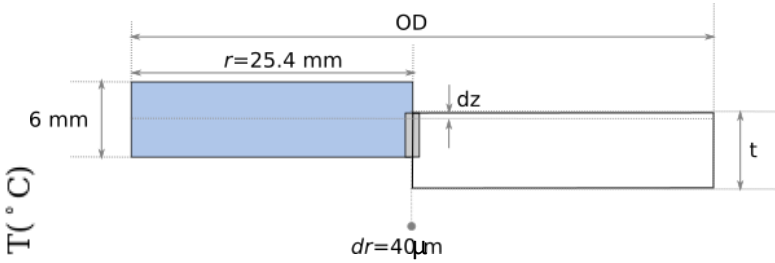
FEA results and applying constraint







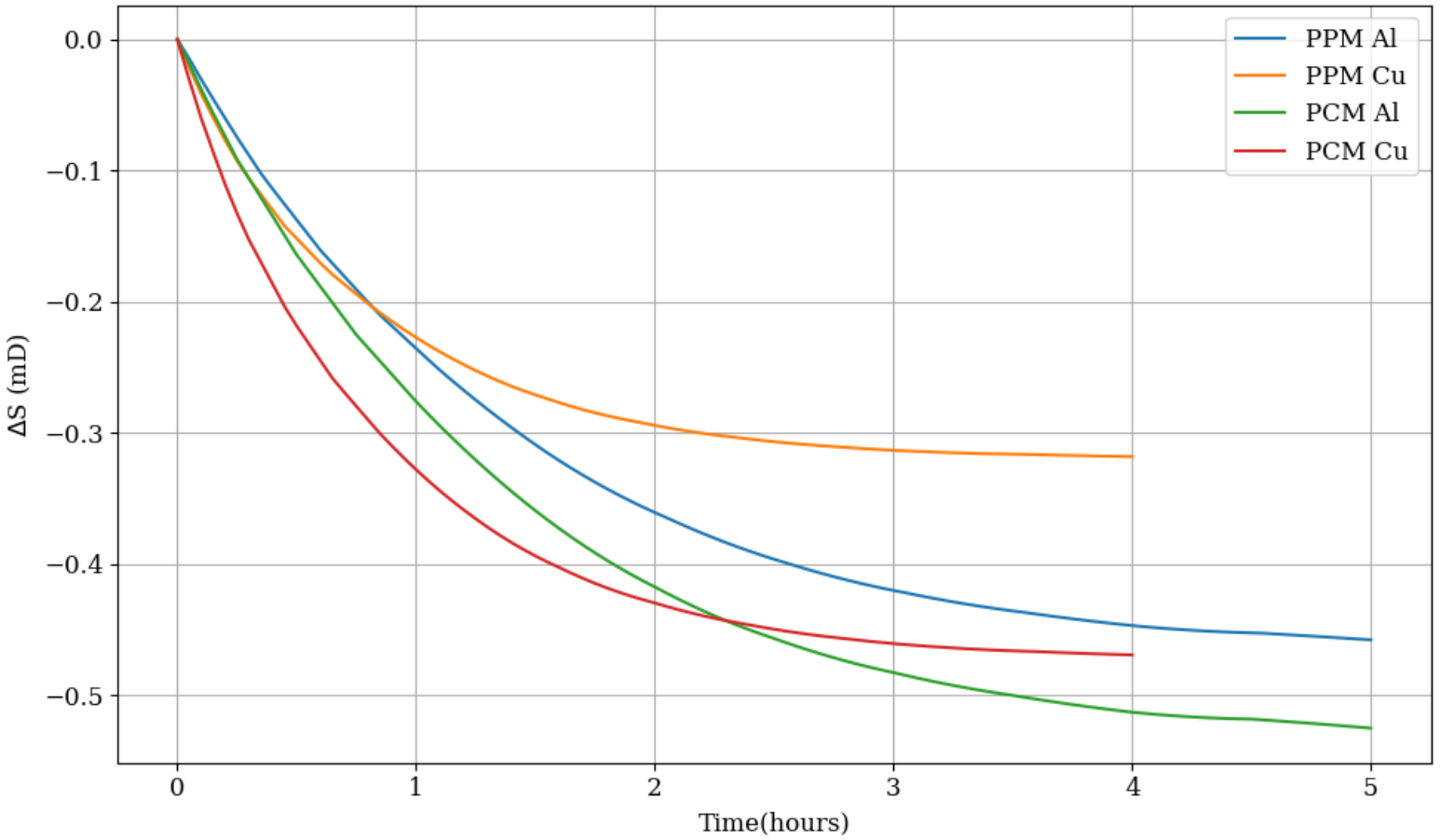




Constraint type	Requirement
Mass	>=1 kg
Temperature	< 60°C
Max tensile stress	$S/P_{T,max}$ > 8.8 mD/MPa

- Assumed OD: 120 mm
- Radial interference: 40 μm

Also checking for thermal time constant



- Time dependent model: compute change in spherical from assembly state to equilibrium at room temperature
- Estimate thermal time constant
- Higher volume to reach required mass in aluminium case → longer thermal time constant

(Assuming there is high emissivity coating on actuating ring – e.g. diamond-like coating (DLC) , emissivity = 0.65 at 300 K)

Benchmarking performance at m =1kg

Material	**Mirror geometry**	**Thickness** (mm)	**Offset** (mm)	**ΔS from 100°C** (mD)	**$T_{150\ mD}$** (°C)	**Mass** (kg)	**$S/P_{T,max}$** (mD/MPa)	**1st excitable mode** (kHz)	**Time constant** (minutes)
Aluminium	Flat	38.8	-1.1	453	50	1.00	8.9	12.7	84
Aluminium	Planoconcave	38.2	1.8	530	47	1.00	8.9	12.8	81
Copper	Flat	11.6	-1.1	320	59	1.00	8.9	5.98	51
Copper	Planoconcave	11.5	3.1	460	49.5	1.00	8.9	5.99	54