Comparison of ITMs to replace H1 ITMX

H. Yamamoto

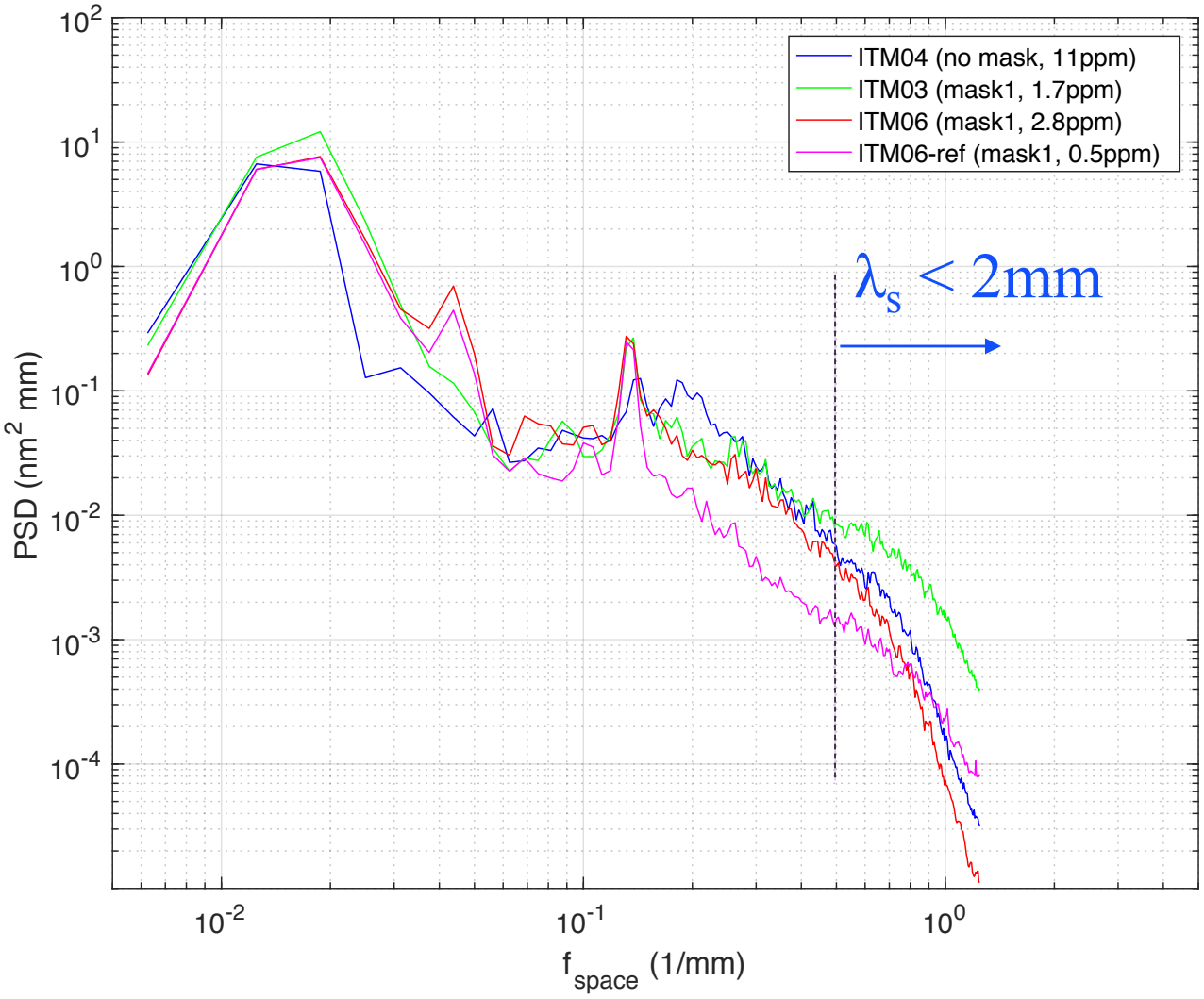
- (known) Large angle scattering losses
- RoC and thermal effects
- IFO performance
- Is ITM06 good? Not bad, but may not be the best

(known) Large angle scattering loss

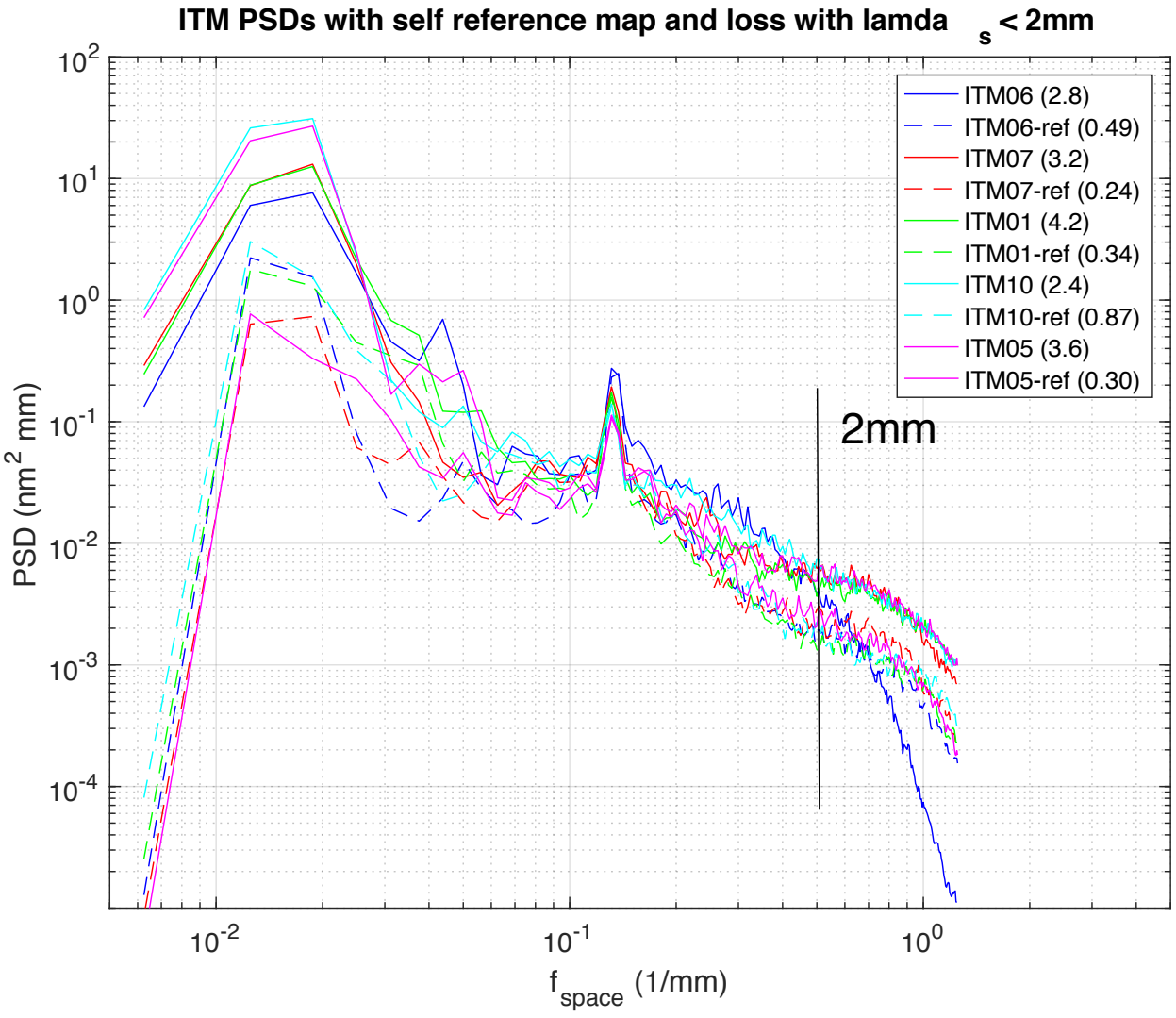
	ITM	04	08	03	11	06	07	01	10	05
		no m L1X	no m L1Y	msk1 H1X	msk1 H1Y	msk1	msk2		msk2	
coated	TIS λ_s<0.06mm	11	13	5.6	12	6.9	5.6	6.5	13	7.7
coated	PSD λ_s<2mm	11	11	1.7	1.6	2.8 0.49	3.2 0.24	4.2 0.34	2.4 0.87	3.6 0.30
uncoated	$(4\pi\sigma/\lambda)^2$ λ_s<1mm	2.6	2.7	0.74	3.3	0.94	1.1	1.7	3.1	1.3
uncoated	$(4\pi\sigma/\lambda)^2$ λ_s<0.08mm	6.1	4.5	1.1	3.1	1.4	1.4	1.7	3.1	2.4

(*) Reds are loss estimated by maps using self-reference maps

Comparison of PSDs



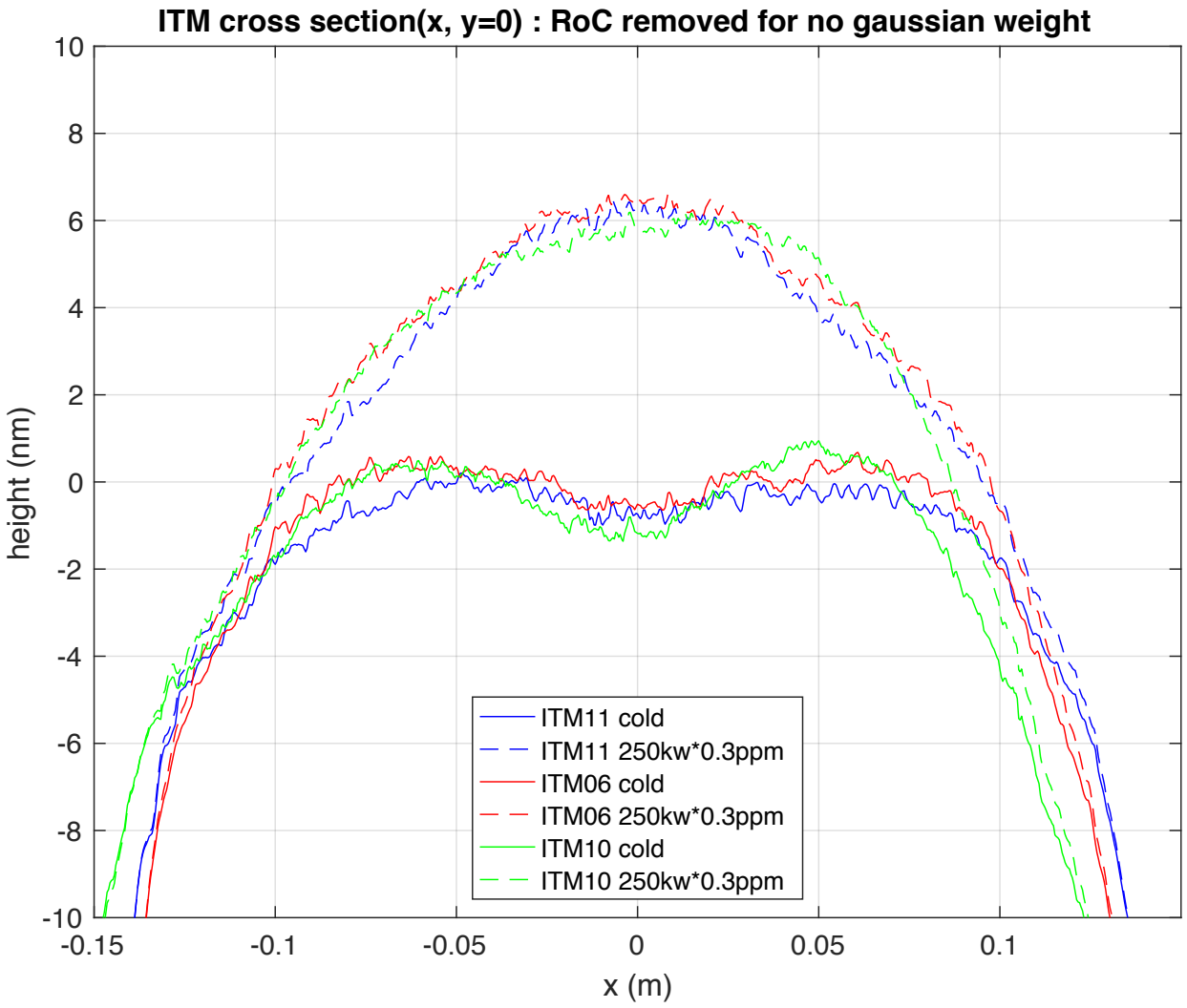
PSDs with self-reference



RoC

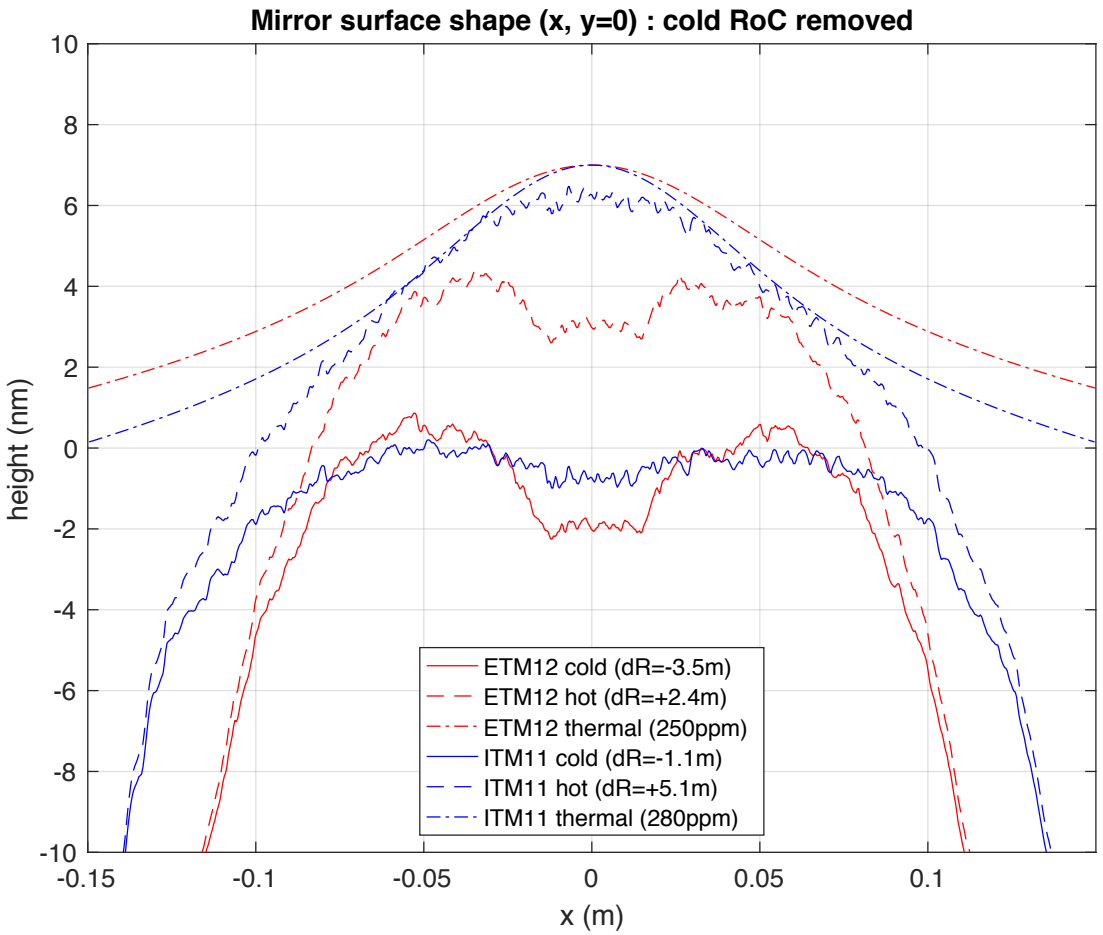
ITM	04	08	03	11	06	07	01	10	05
	no m L1X	no m L1Y	msk1 H1X	msk1 H1Y	msk1	msk2		msk2	
absorption (ppm)	0.20	0.14	0.21	0.28	0.2 0.3				
RoC0	1937.9	1940.7	1939.3	1939.2	1934.34	1940.3	1939.32	1939.2	1939.7
RoC w gauss	-1.1m	-1.3m	-1.2m	-1.1m	-0.9m	-1.3m	-1.2m	-2.2m	-2.1m
RoC w thermal 250kw	3.3m	1.8m	3.4m	5.1m	3.5m 5.7m	3.1m 5.3m	3.2m 5.4m	2.2m 4.5m	2.4m 4.6m

Cross section : ITM

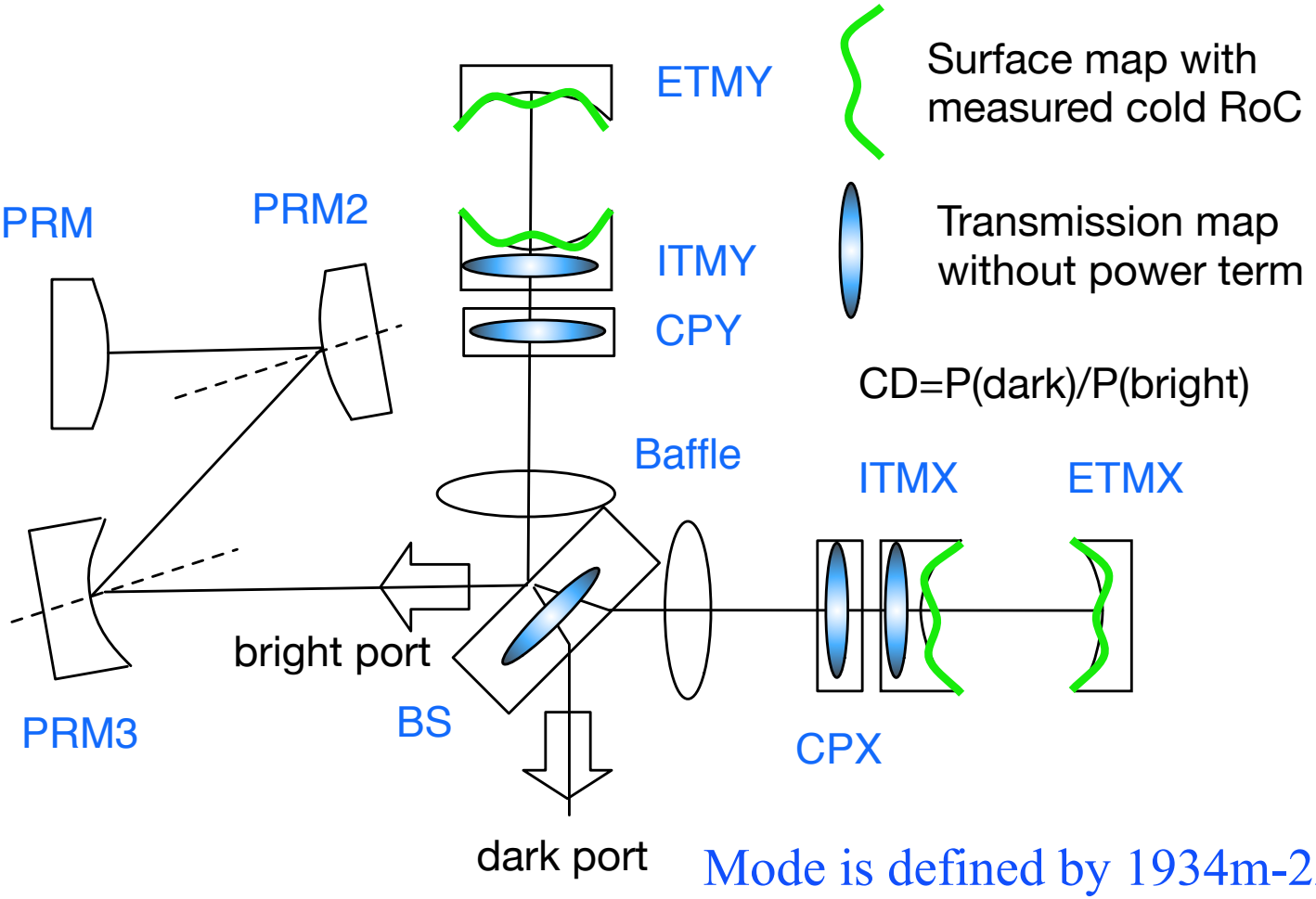


Cross section : ITM & ETM

	ITM 03	ITM 11	ETM 08	ETM 12
abs (ppm)	0.21	0.28	0.16	0.25
RoC gauss	-1.1 m	-1.1 m	-3.4 m	-3.5 m
Thermal 250kw	+3.6 m	+5.1 m	+0.3 m	+2.4 m



IFO performance

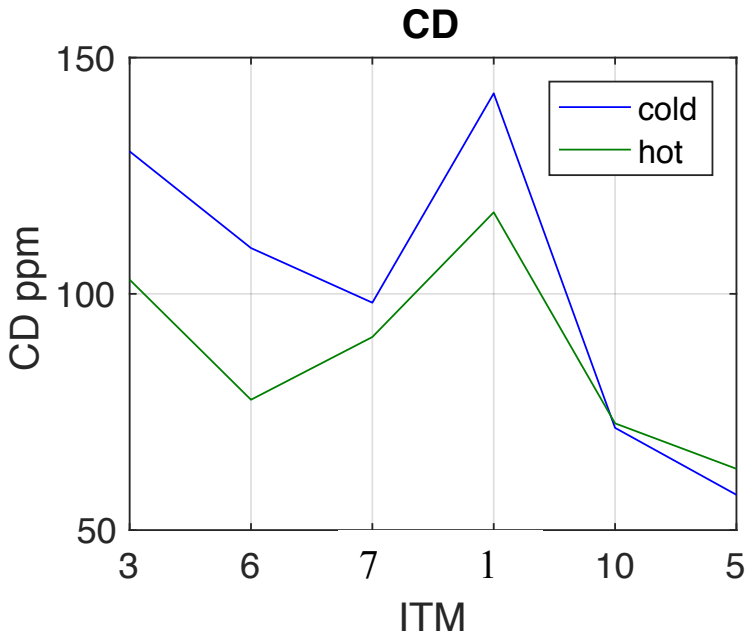


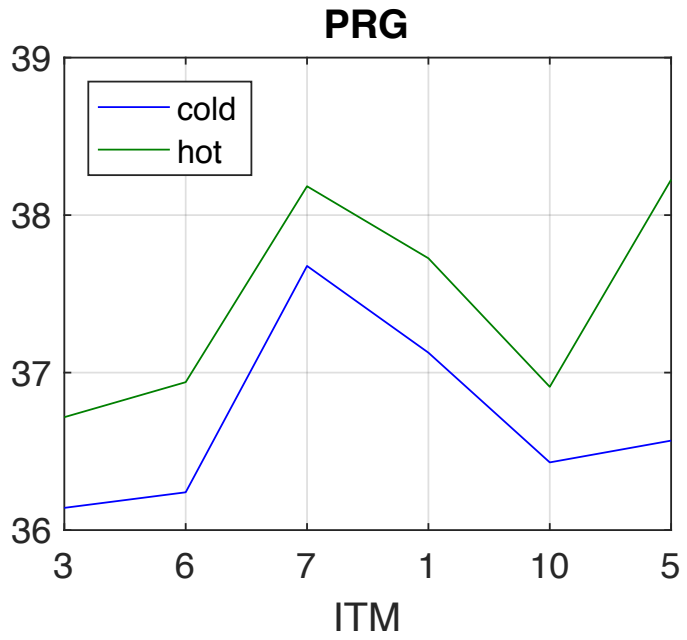
Cold H1 with ITM03

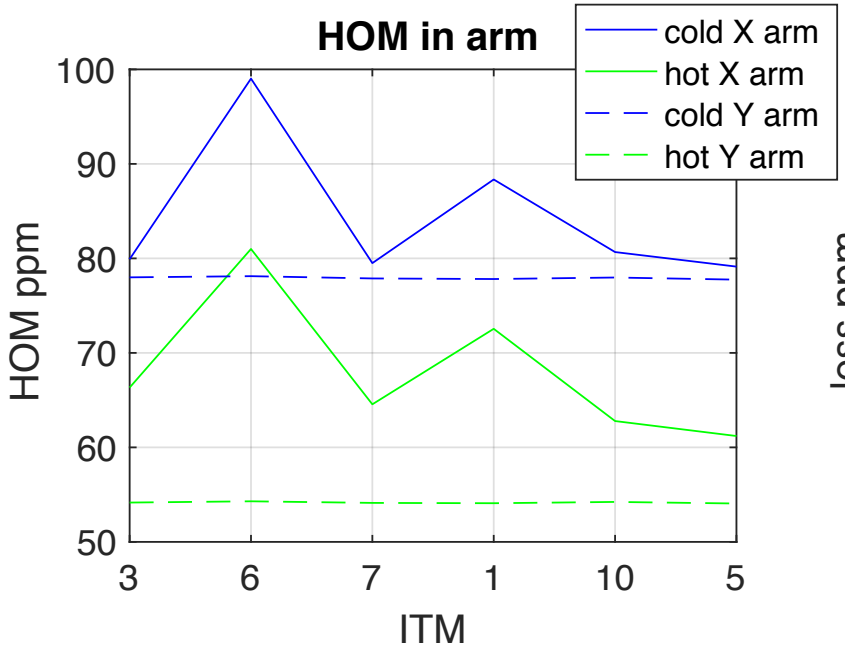
	CD ppm
All imperfections	130
no trans maps in BS,CP,ITM	31
& no ETM map	20
& no ITM map	16

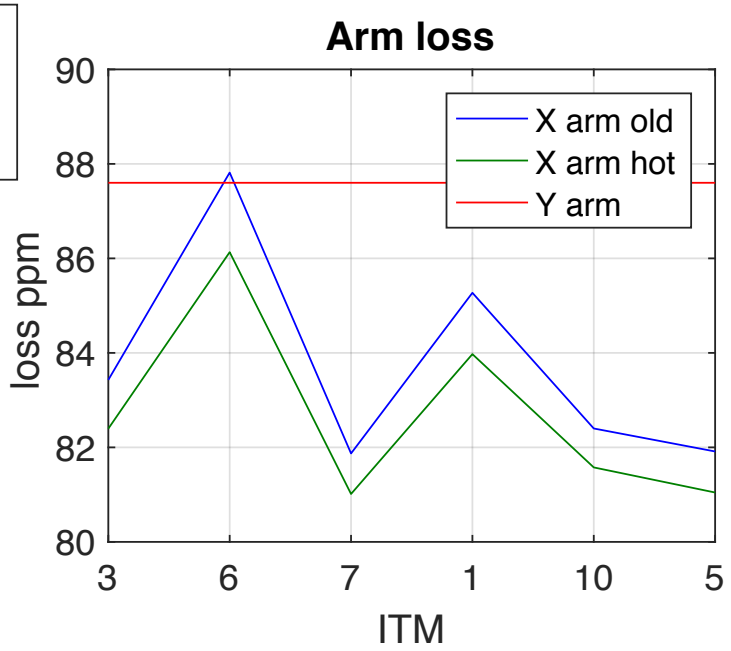
Mode is defined by 1934m-2245m arm
HOM : other than LG(0,0),LG(1,0)

IFO performance vs ITM







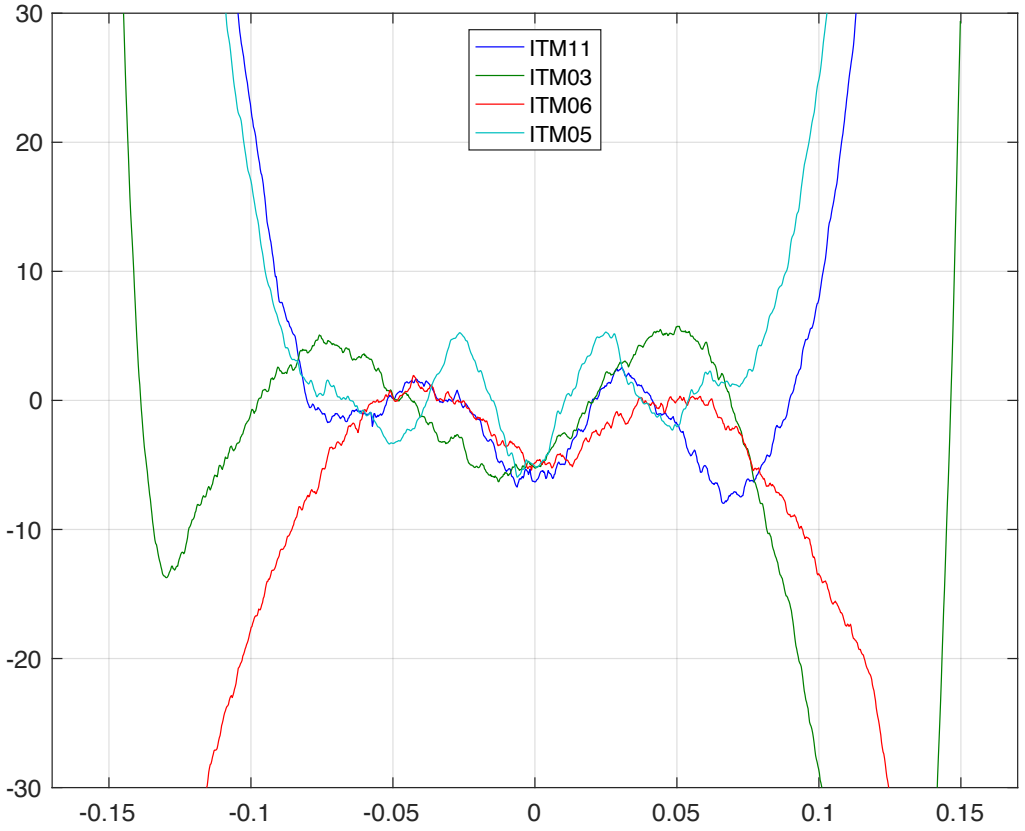


ITM06 RoC (1934.3m)

RoC(ITMX) ITM06	1934.3	1934.3	1939.2
RoC(ITMY) ITM11	1939.2	1934.3	1939.2
PRG	36.2	36.0	36.7
CD (ppm)	110	137	120
HOM in x arm (ppm)	99	99	90

ITM SPTWE : ITM06 vs 05 substrate nonuniformity

Optical path length in ITM
power term in A=160mm subtracted

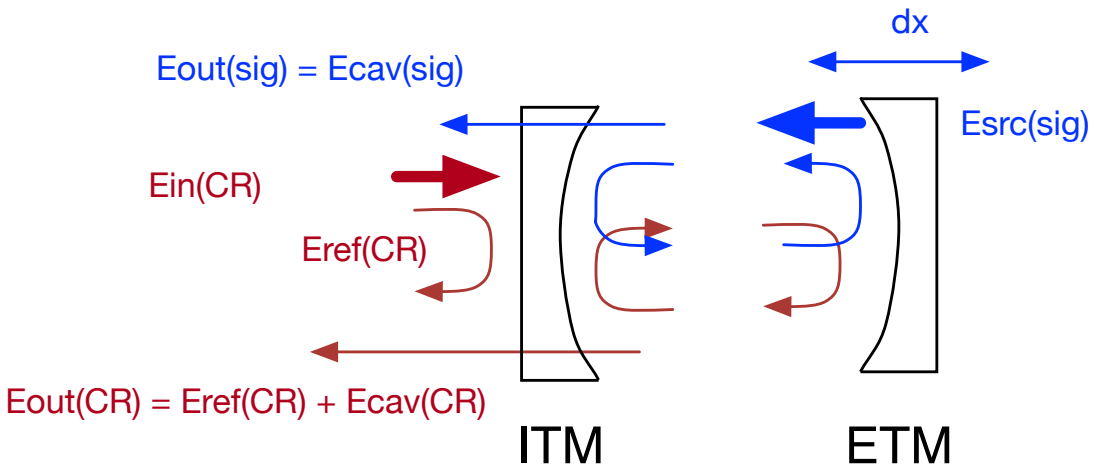


CD : RoC = 1939.7m

ITMX	ITM06	ITM05
All maps	110	57
- ITMX map	88	138
No ITMX map	105	89
No maps	63	46

ITM Transmittance

ITM	03	11	06	07	01	10	05
T (%)	1.39	1.42	1.48	1.502	1.503	1.383	1.382
dT/T(11) (%)	-2.1	0	4.2	5.8	5.8	-2.6	-2.7



$$Eout(CR) = \frac{Ein(CR)}{1+\frac{2L}{T(ITM)}} \approx (1-\frac{2L}{T(ITM)})Ein(CR)$$

$$CD = \left(\frac{Eout(CR:xarm) - Eout(CR:yarm)}{Eout(CR:xarm) + Eout(CR:yarm)}\right)^2$$

$$\approx (\frac{L}{T})^2(\frac{dT}{T}+\frac{dL}{L})^2 \sim 50\,ppm \times O(0.01)$$

$$Eout(Sig) = i\frac{8\pi}{\lambda}\frac{dx}{T(ITM)}Ein(CR)$$

L : total loss in the arm, including T(ETM)

L=(Lx+Ly)/2,T=(Tx+Ty)/2,dL=Lx-Ly,dT=Tx-Ty

$$\frac{dSig}{Sig} = \frac{Eout(Sig:xarm) - Eout(Sig:yarm)}{Eout(Sig:xarm) + Eout(Sig:yarm)} \approx \frac{dT}{T}$$