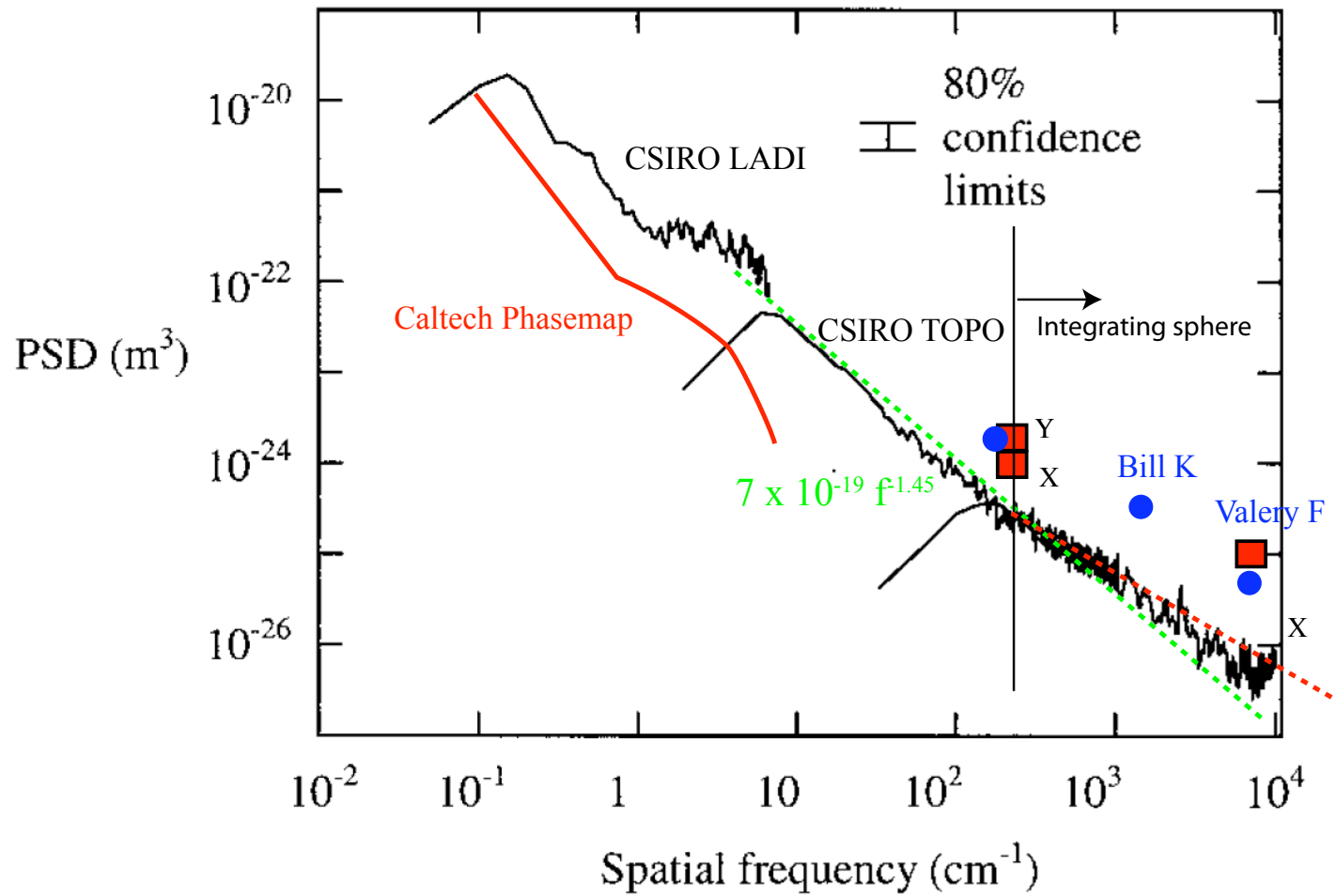


# LIGO I COC

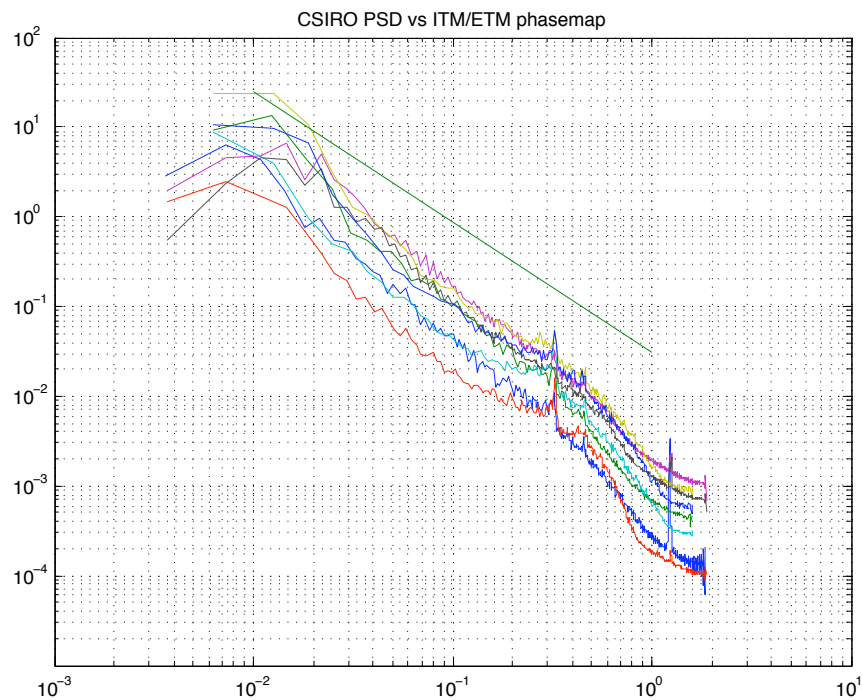
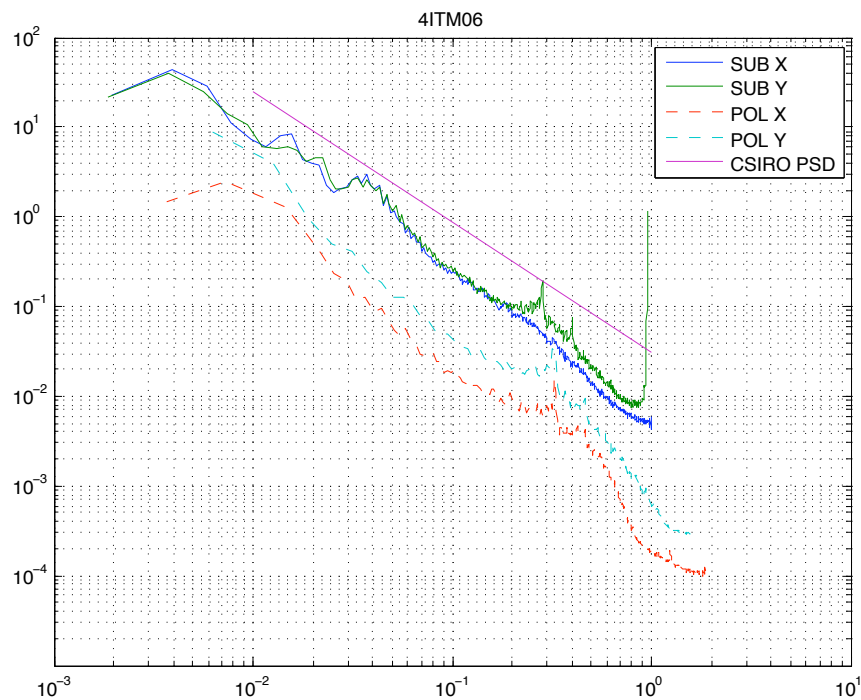
## consistently inconsistent

- CSIRO substrate surface measurement
  - »  $f < 10\text{cm}^{-1}$  : LADI (large-aperture digital (phase shifting Fizeau) interferometer
  - »  $f > 10\text{cm}^{-1}$  : TOPO (three-dimensional noncontact optical profiler) ~ Rei W
  - » CSIROPSD =  $7 \times 10^{-19} f^{-1.45}$
  - » LADI + spectroscopic ellipsometer are used to characterize LIGO I BS
- Caltech OTF phasemap measurement
  - » Used in FFT to predict reasonable power recycling gain
  - » Cannot be off by 2, possibly over estimation, but not underestimation
  - »  $\text{PSD}(f < 10\text{cm}^{-1}) \sim 0.1 \times \text{CSIROPSD}$
- Larger angle scattering
  - » Bill(H1 ITM), Valery(L1 ITM) :  $\text{PSD}(f > 100\text{cm}^{-1}) \sim 10 \times \text{CSIROPSD}$
  - » LiYuan(OTF integrating sphere  $> 1.5^\circ$ )  $\sim 5 \times \text{CSIROPSD}$

# Three groups of data set



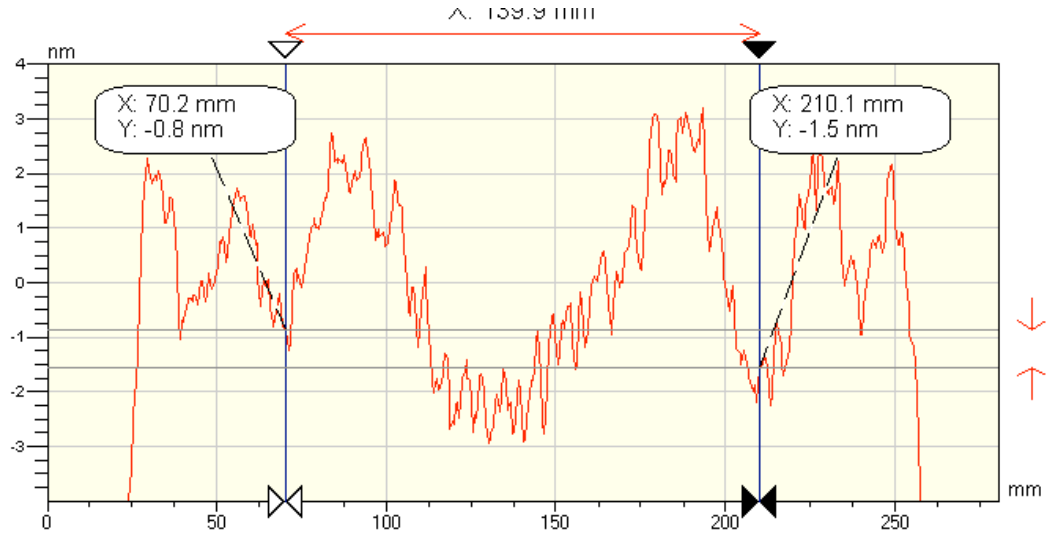
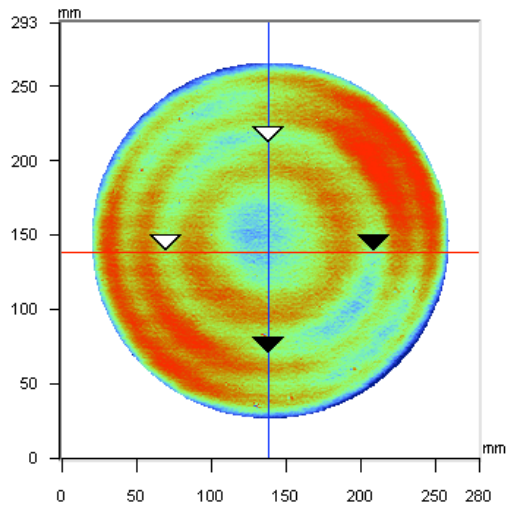
# CSIRO vs Phasemap PSD



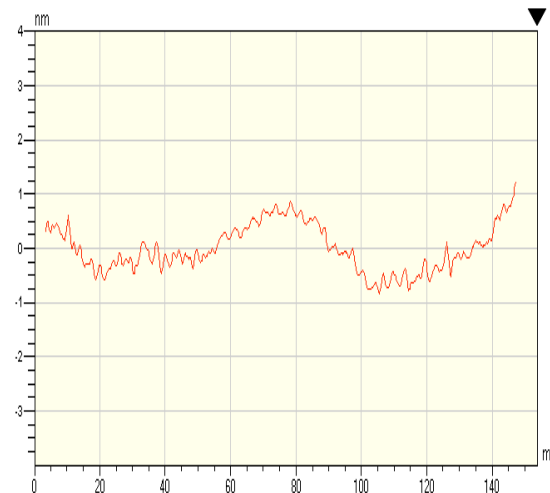
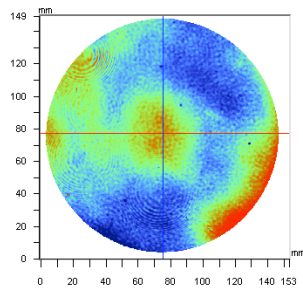
# CSIRO(LADI) vs CIT(WYKO)

4ITM06 : substrate vs coated

CSIRO



CIT



**LIGO**

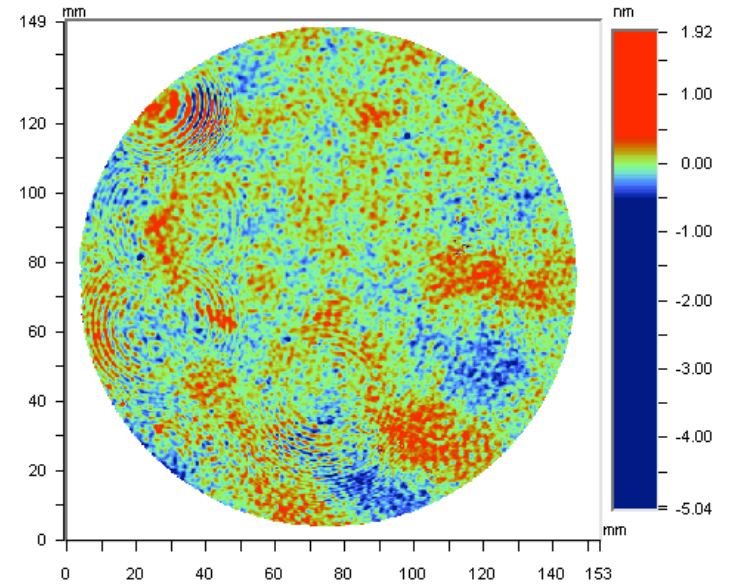
# Orange peel

- psd shows bumps at  $\sim 0.3$  cm -

Caltech  
phasemap

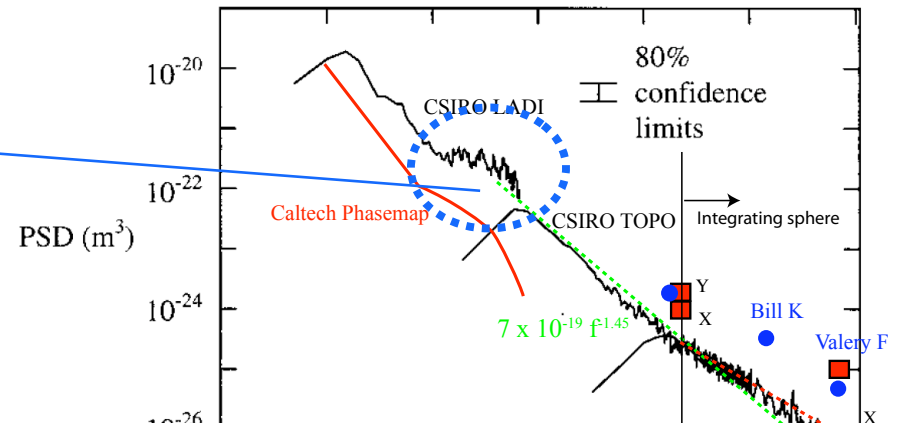
loss  $\sim 2.4$  ppm  
new FFT grid size  
 $= 0.14 \sim 0.28$ cm

loss  $\sim 1.3$  ppm x 2  
old FFT :  
loss(35cm/256) -  
loss(35cm/128)



CSIRO  
PSD

$\sim 10$ ppm

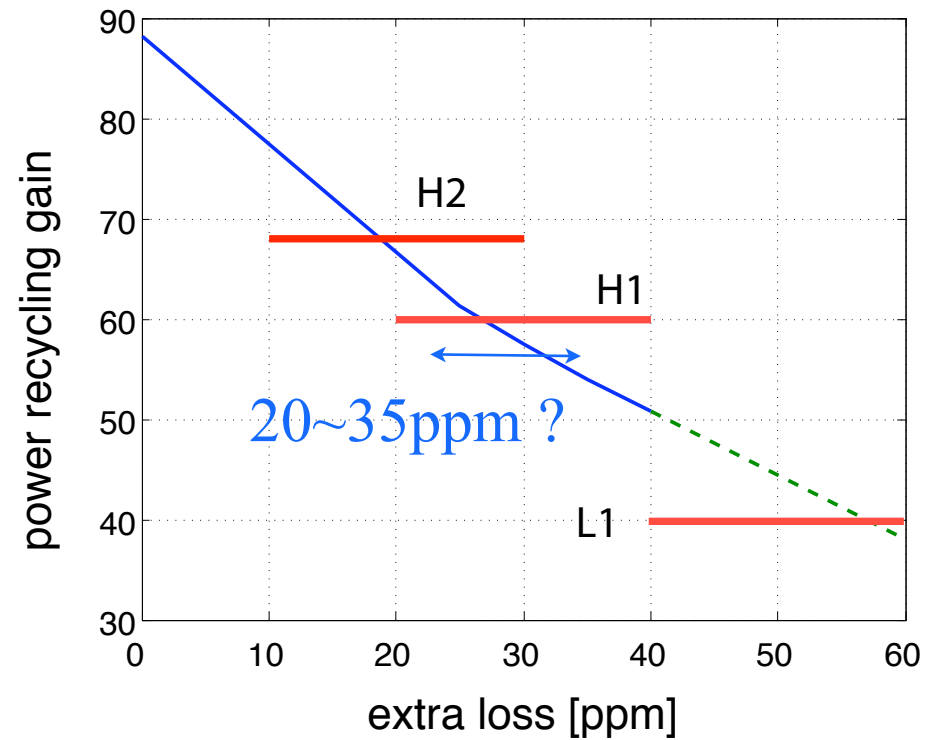
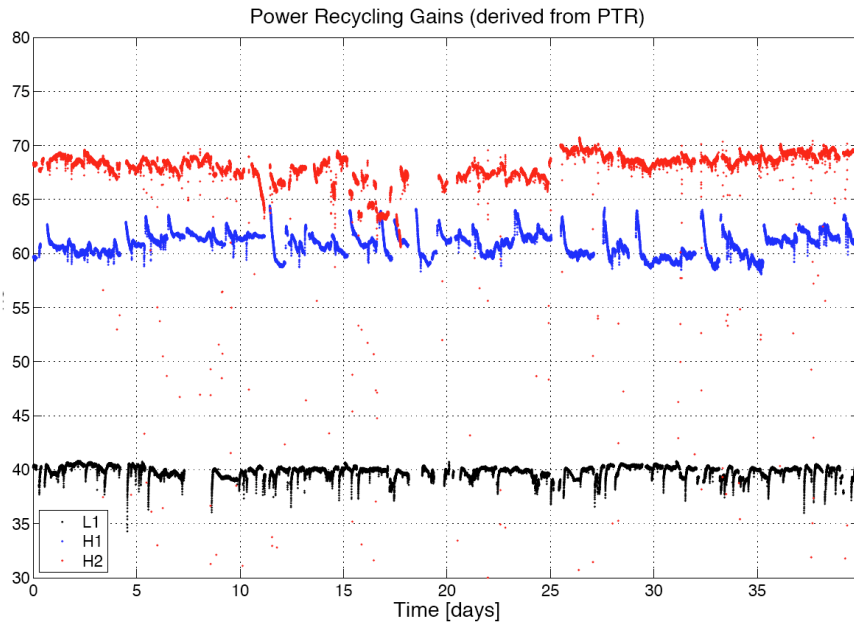


G060572

New FFT for advLIGO -

# Loss vs Recycling gain

Recycling gain as a function of extra loss per mirror

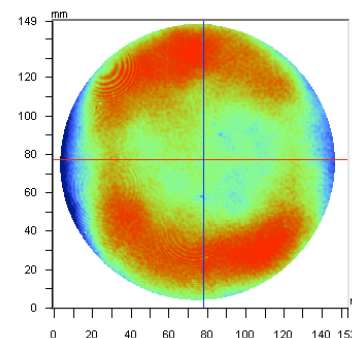


## FFT loss

phasemap x 2 is unacceptable

ITM map	ETM map	loss ppm
-	-	2
4ITM05	ETM01	46
-	ETM01	41
4ITM05	-	10
ETM01	-	9
-	4ITM05	15
1.5 x 4ITM05	1.5 x ETM01	98 ( $\Delta=26 \times 2$ )
2 x 4ITM05	2 x ETM01	172 ( $\Delta=63 \times 2$ )
4ITM06	ETM02	30
1.5 x 4ITM06	1.5 x ETM02	63 ( $\Delta=16 \times 2$ )
2 x 4ITM06	2 x ETM02	111 ( $\Delta=40 \times 2$ )

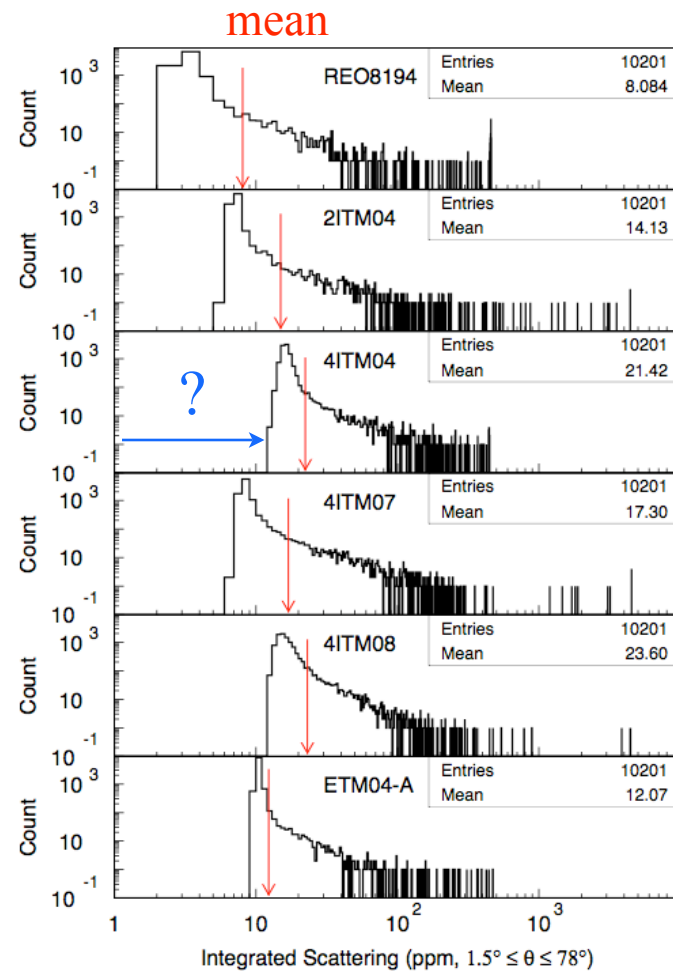
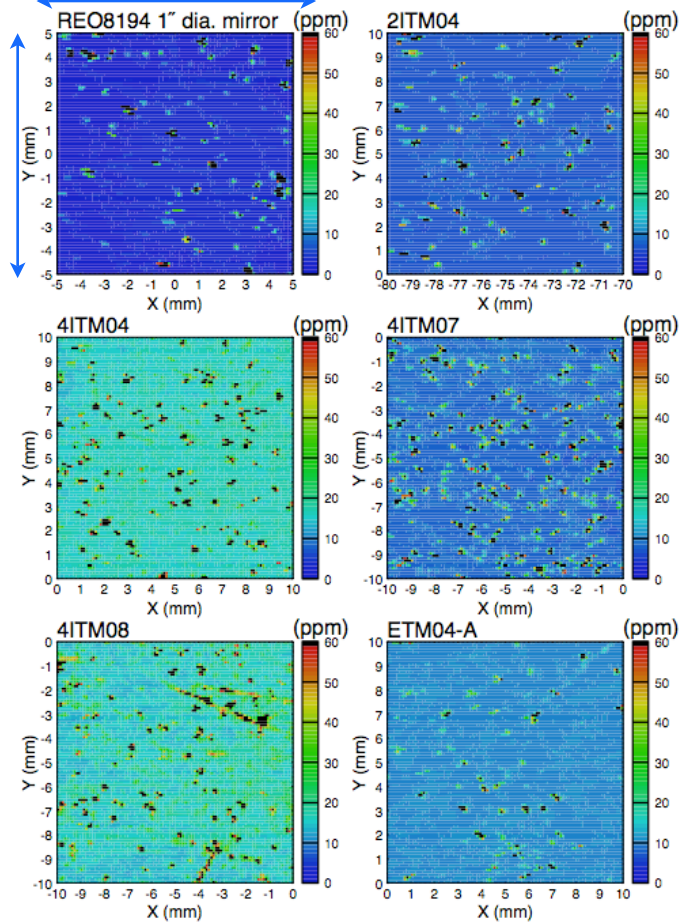
ETM01 H1 X



# Integrating sphere data Liyuan

0.2mm beam size

1cm x 1cm 0.1mm step

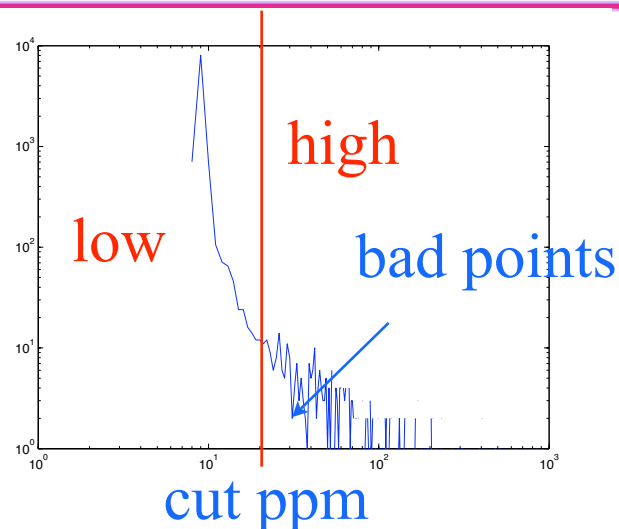




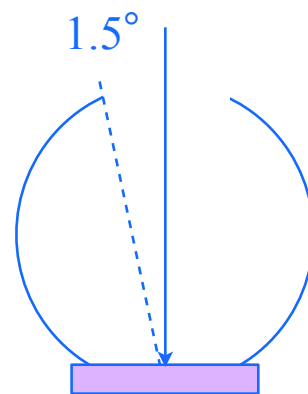
## Point scattering loss ~ 10ppm

### ● 2ITM04

- » total of 10201 data
- » mean(all)=16, std(all)=109
- » bad points 362 with loss > 20ppm
- » mean(bad)=193, std(bad)=556
- » mean(con)=193 \* 362/10201 = 7 ppm



	cut ppm	bad points	mean (all)	mean (bad)	mean (high)	mean (low)
2ITM04	20	362	16	193	7	9
4ITM04	30	613	23	95	5.7	17.3
4ITM07	20	882	18	105	9.1	8.9
4ITM08	30	936	25	91	8.3	16.7
ETM04A	15	356	12	53	2	10



high  
point scattering : uniform  
< 10 ppm

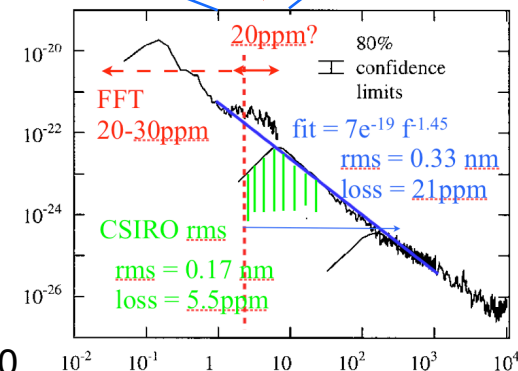
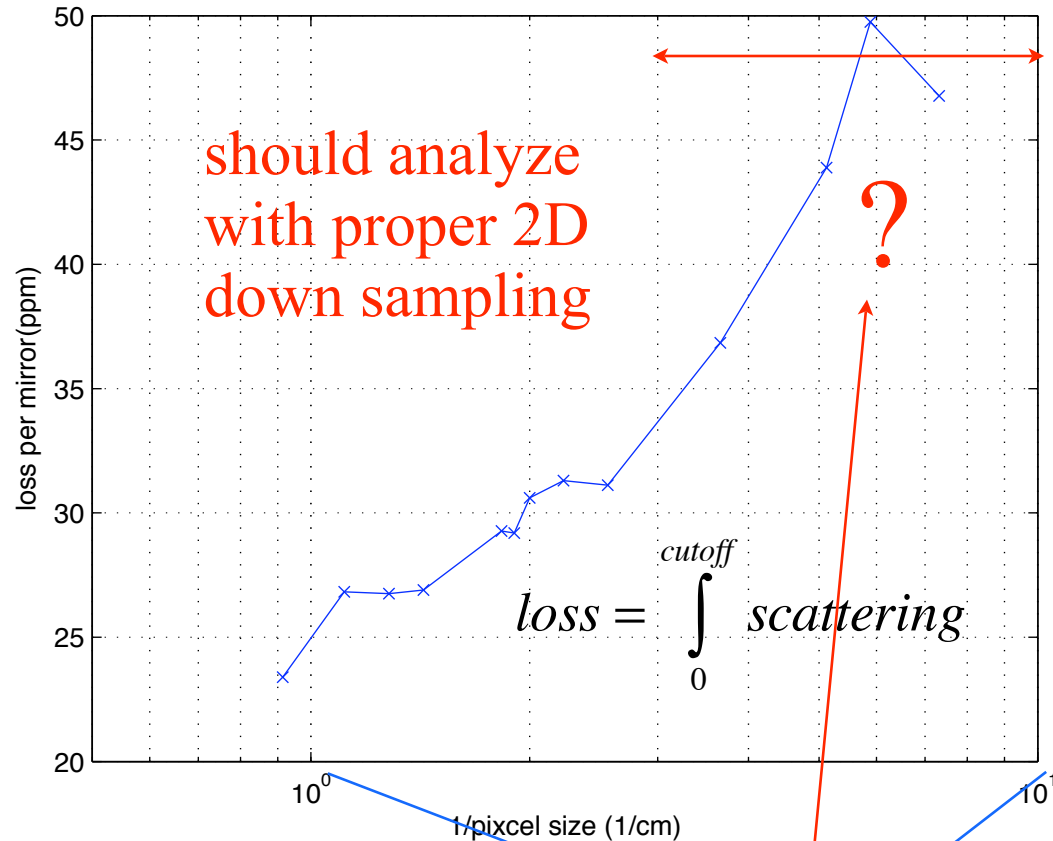
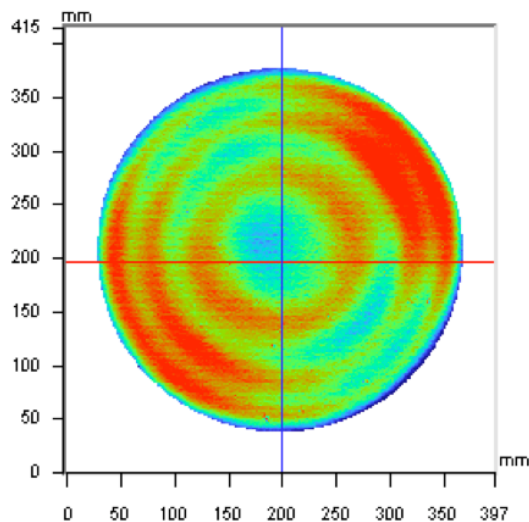
low  
CSIROPSD x 5  
=> loss ( > 1.5° ) = 15 ppm

# LIGO

## loss per size or

Loss calculated using a bin size :  
assume no loss with spatial  
frequency longer than 1/bin size

$\text{loss}(1/\text{bin}_2) - \text{loss}(1/\text{bin}_1)$   
= loss coming spatial freq between  
 $1/\text{bin}_2 - 1/\text{bin}_1$



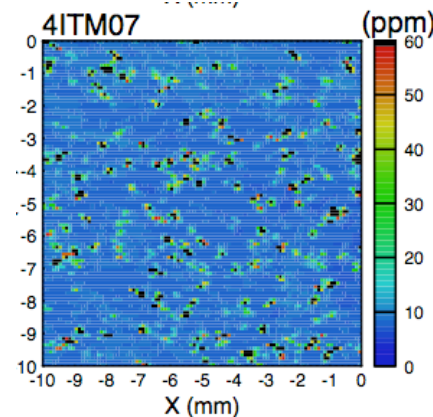
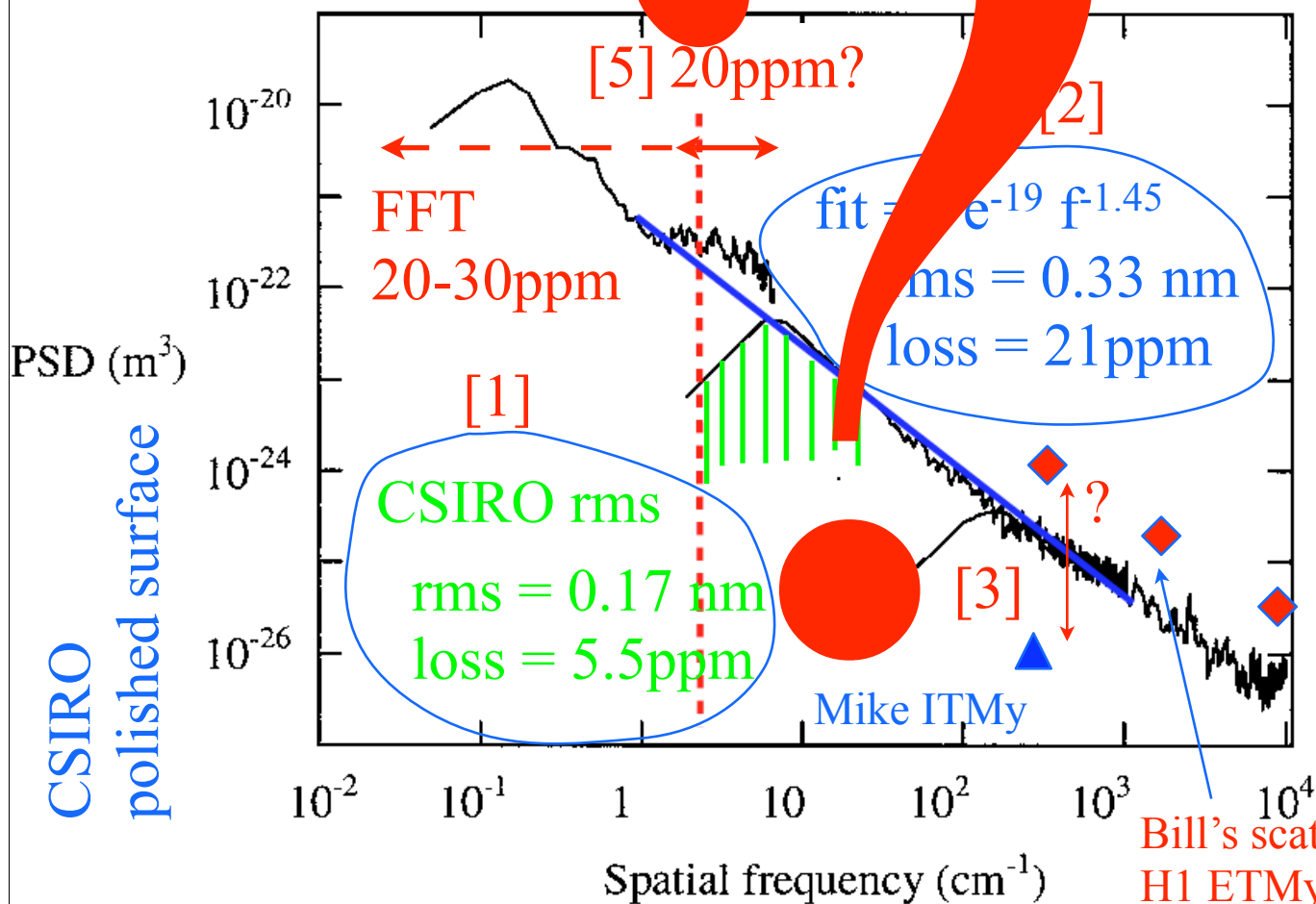
COC meeting @ CIT on August 1, 200

# LIGO

$$loss = C \left( \frac{4\pi\sigma_{1D}}{\lambda} \right)^2$$

## Summary

( $C_{1D \rightarrow 2D} = 1.2$ )



Liyuan's integrating sphere

Bill's scatterometer  
H1 ETMy