



# Scatter Loss in Quantum-Noise Filter Cavities

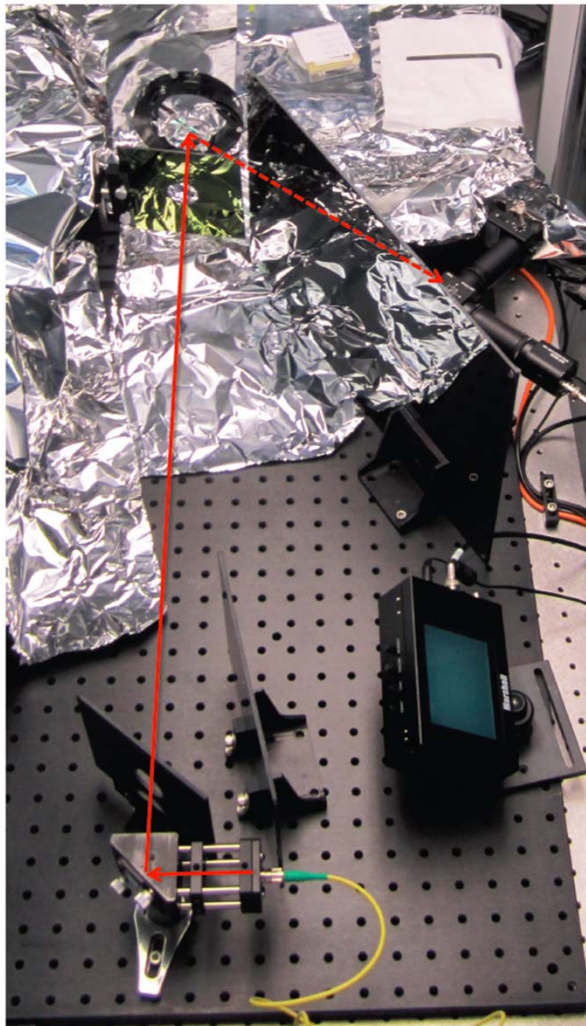
Scatter Measurements  
&  
Scatter-Loss Simulations

Jan Harms for

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Gustafson, Bill Kells, Fabian Magana-Sandoval, Josh Smith,  
Hiro Yamamoto, Liyuan Zhang

# BSDF Experiment I

Valera Frolov (LLO)



| Optic        | *BRDF=dP/P/dΩ/cos(ϑ) (10 <sup>-6</sup> /sr) | Comment   |
|--------------|---|---|
| 2" ATF #1004 | 0.5-1                                       | ISC optic from Lisa. Drag wiped - no other cleaning was done. |
| 2" ATF #897  | 1-1.5                                       | ISC optic from Lisa. Went through cleaning.                   |
| 2" REO       | 3-5   | iLIGO HAM4 AS top periscope mirror                            |
| 2" REO       | 1-2   | Same optic as above after drag wipe                           |

## Previous setup

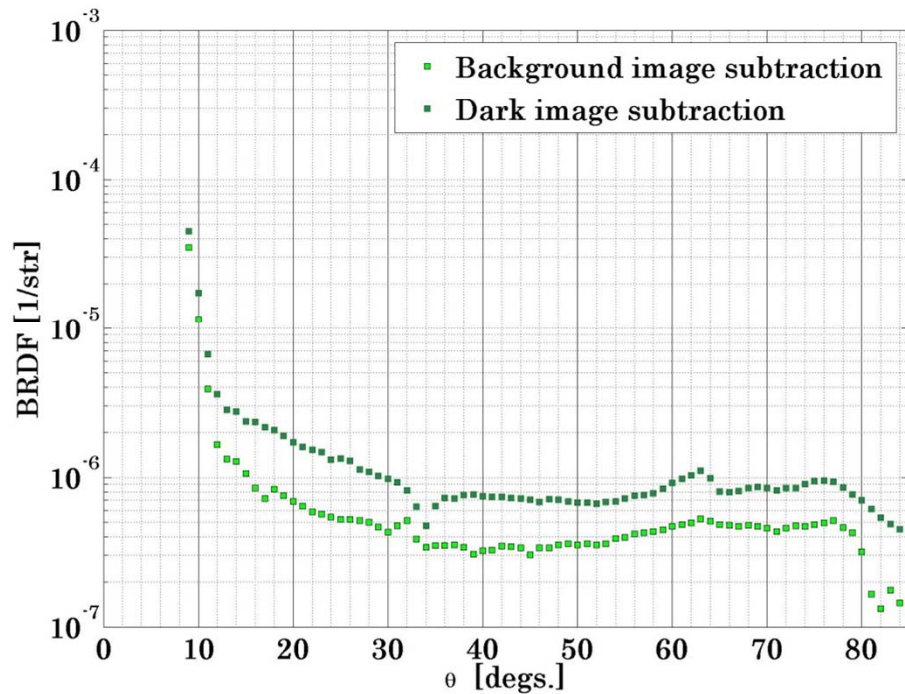
$$\text{BSDF}(45^\circ) \sim 6 \times 10^{-7} \text{ 1/sr}$$

Gooch & Housego HR optic

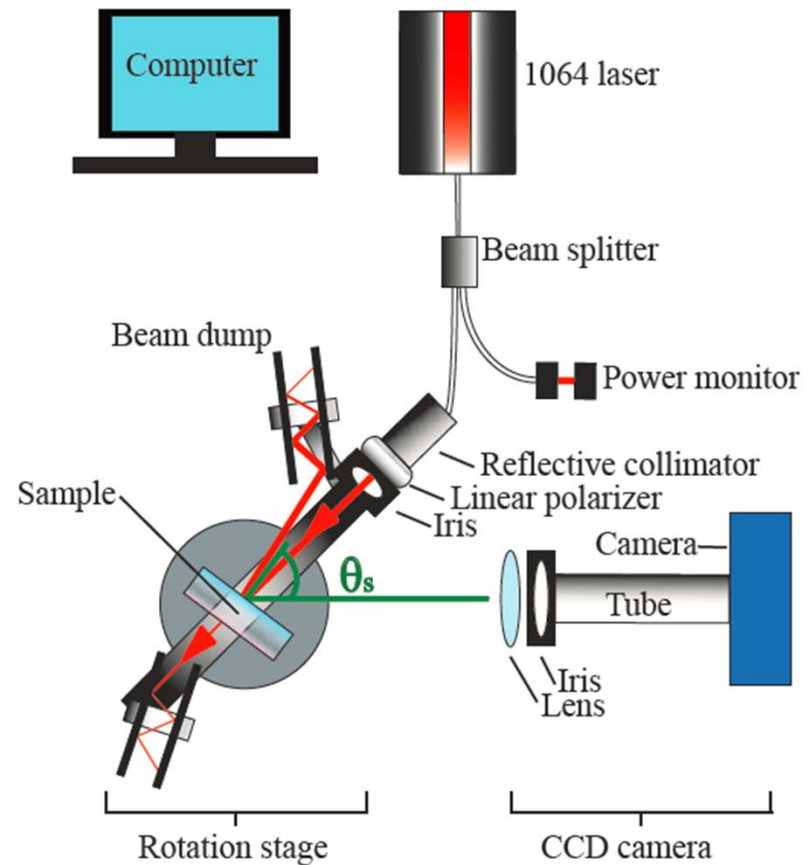
# BSDF Experiment II

Gooch & Housego HR optic

Fabian Magana-Sandoval,  
Josh Smith (Fullerton)



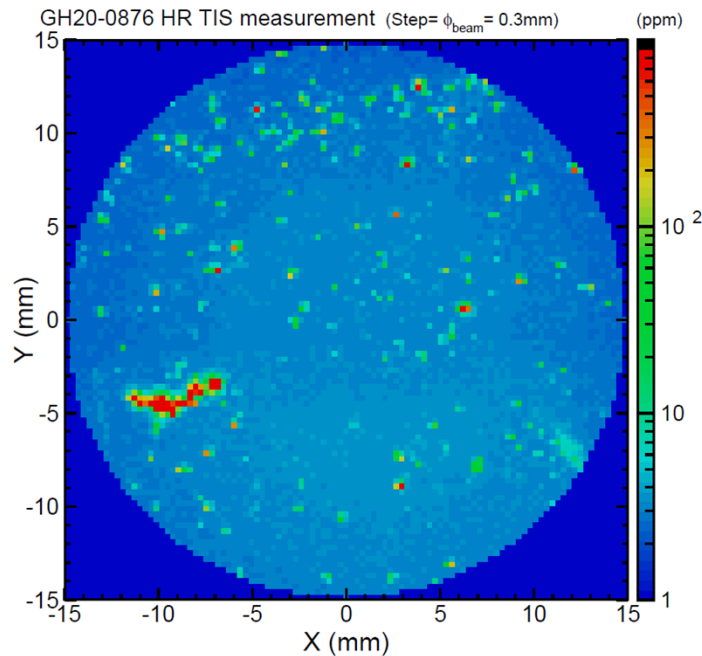
TIS ~ 4ppm  
(using conservative calibration)



# Integrating Sphere

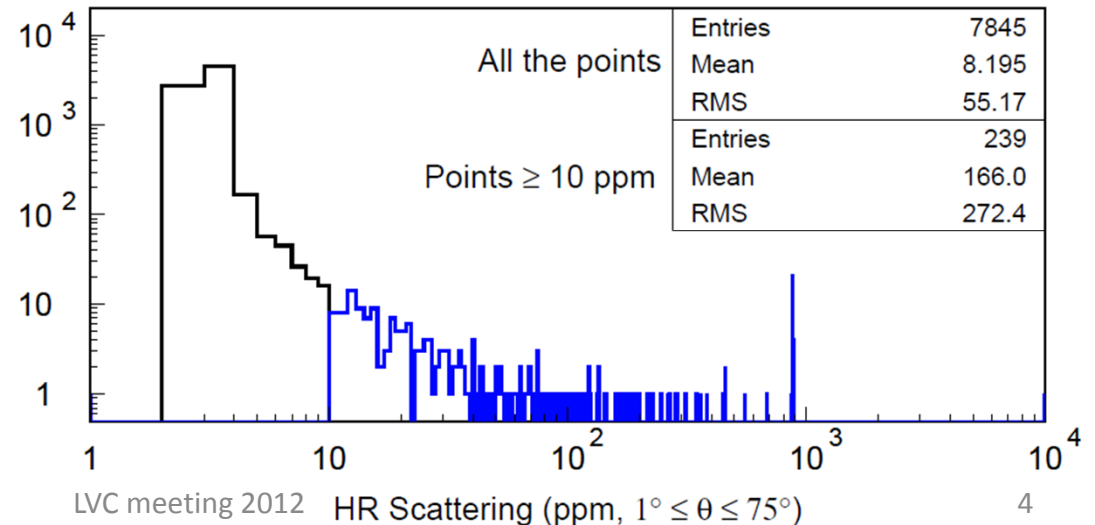
Liyuan Zhang (Caltech)

Central 1cm x 1cm square:  
TIS = 3.8ppm (uniform irradiance)

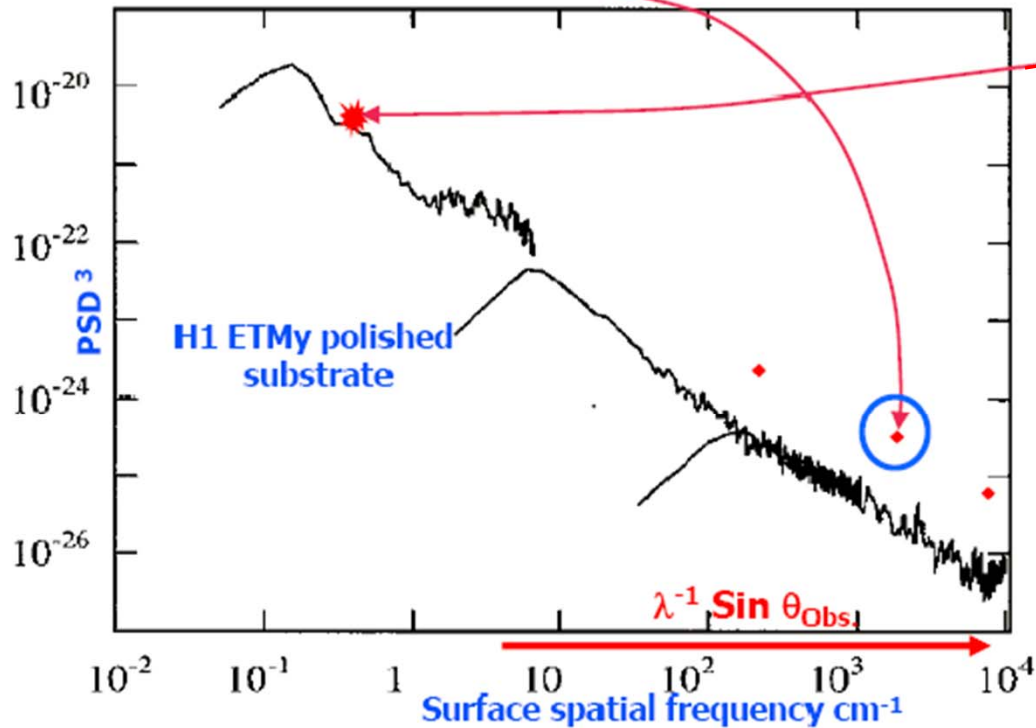
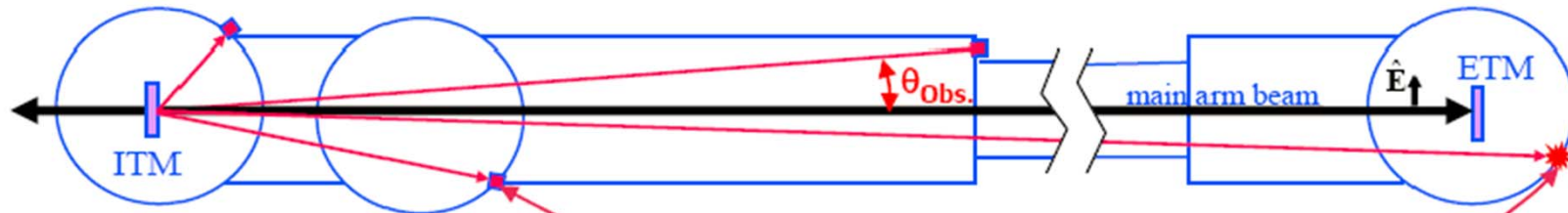


Central 2cm x 2cm square:  
TIS = 9.5ppm (uniform irradiance)  
(includes part of large defect)

Gooch & Housego HR optic



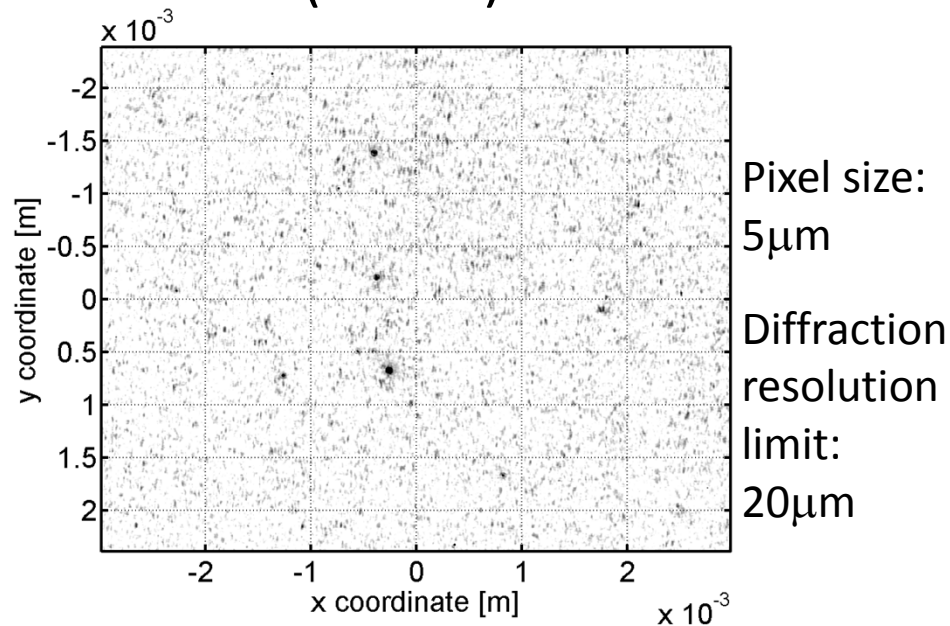
# Observed Discrepancies



Bill Kells:  
T0900128

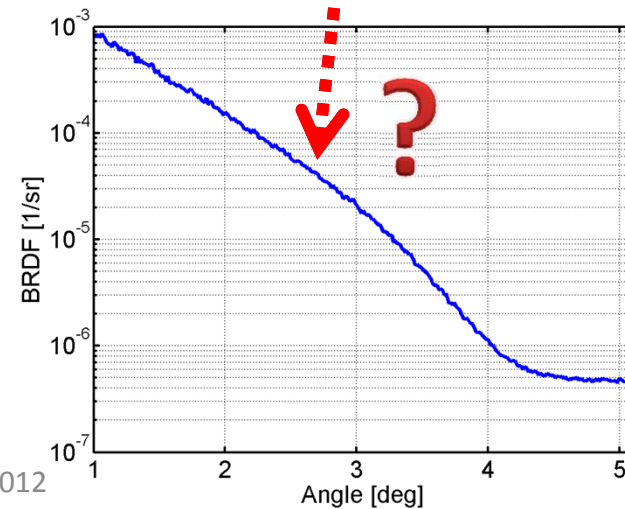
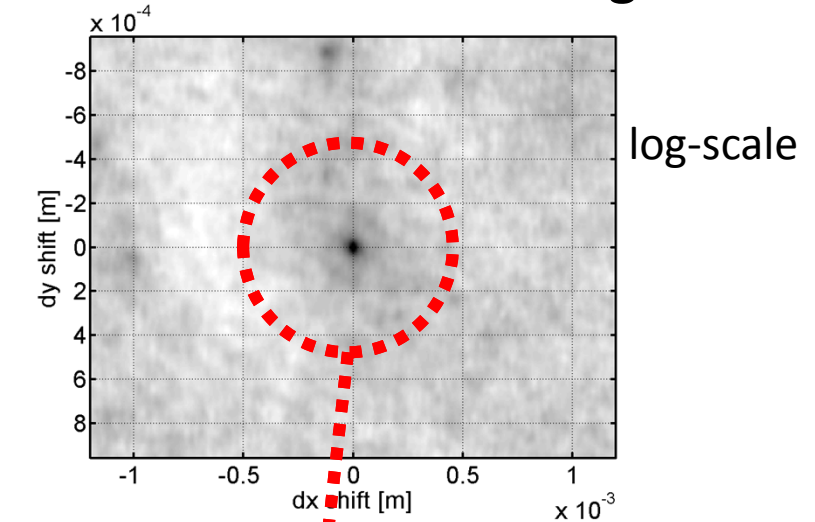
# Point-Defect Scattering

Scatter image from 45deg  
(Valera)



Is our understanding of point-defect scattering good enough?

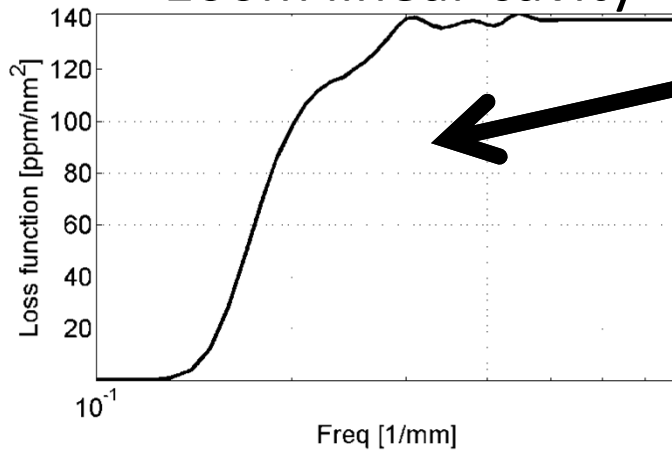
Autocorrelation of image



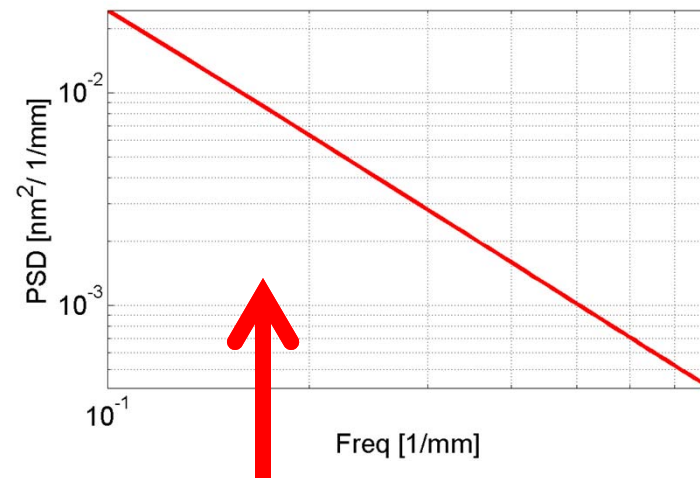
# SIS Simulation

(Hiro Yamamoto)

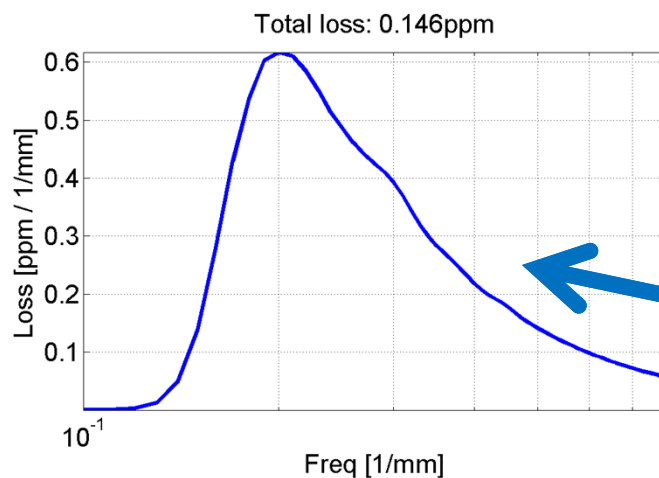
100m linear cavity



Which scatter angles lead to round-trip loss?



Surface-roughness PSD is proportional to loss.



Loss as function of scattering angle.



# Next Steps

Combine as much as possible from the following list using the same set of high-quality optics:

1. Cavity round-trip loss measurements
2. TIS and BRDF measurements
3. Surface-roughness measurements