

# A new experimental set-up for scattering studies

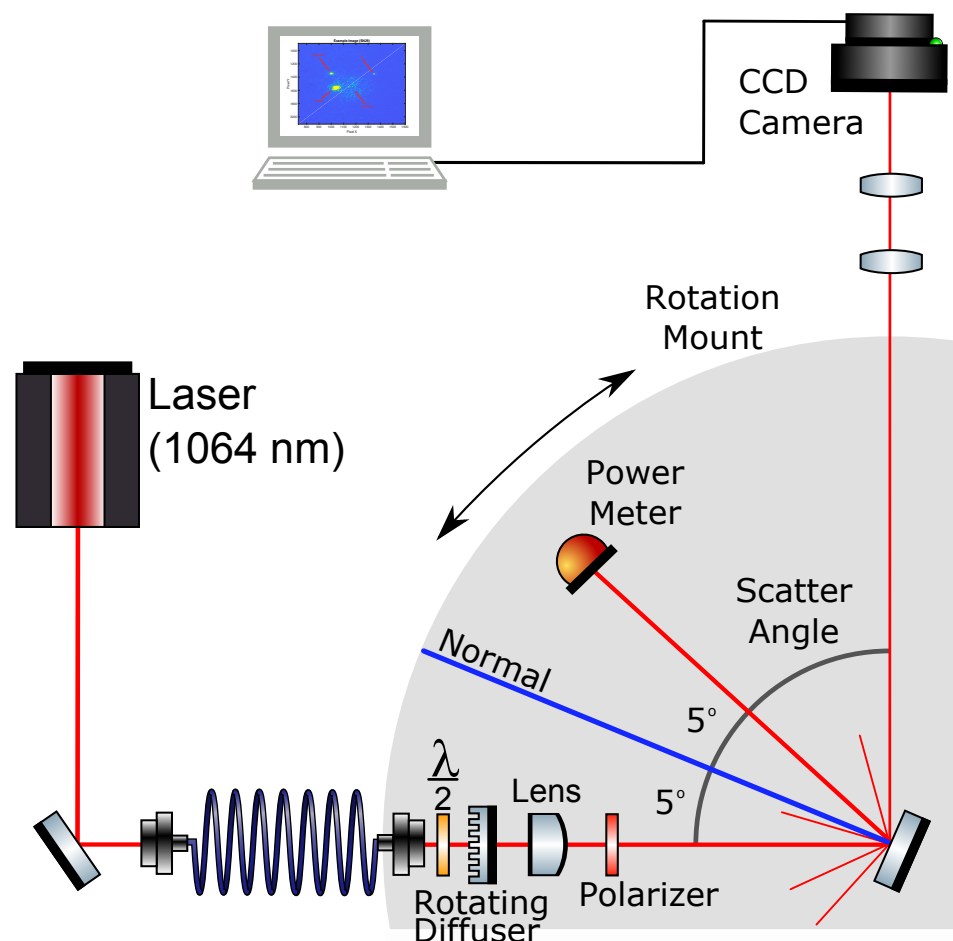
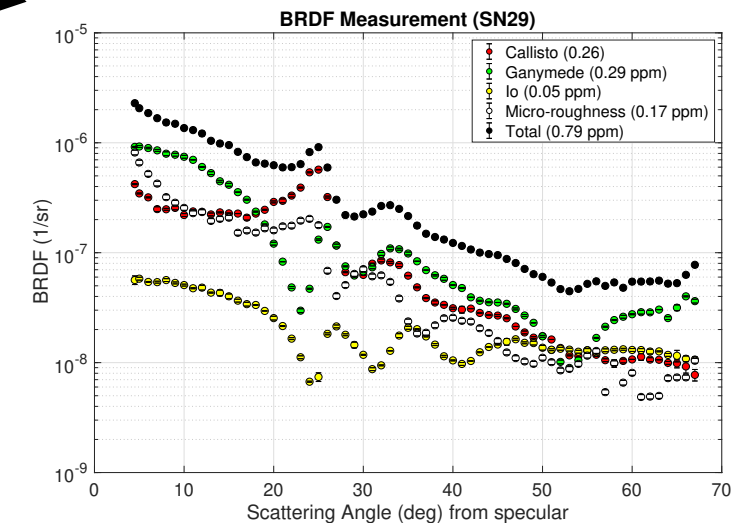
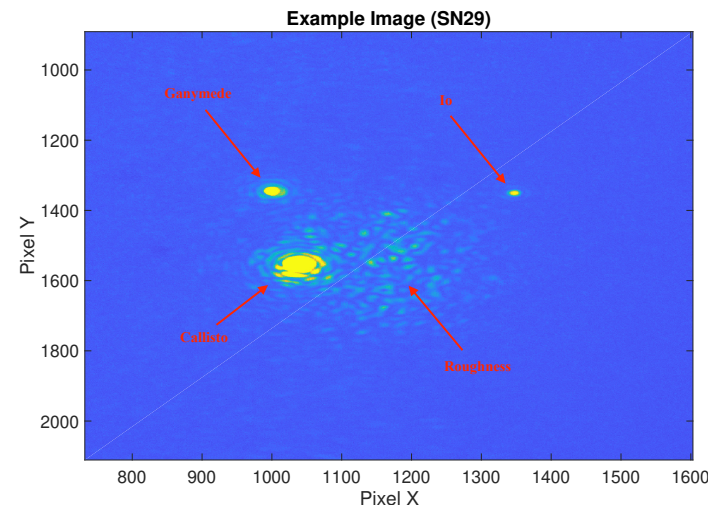
Antonios Kontos, Bobby King (Bard College)



## SUMMARY

- Scattering metrology is useful in determining the suitability of a mirror design for use in GW detectors.
- The BRDF is a measurement of the scattered power per solid angle, as a function of angle.
- Combined with a camera, it is possible to get information about a) surface roughness, b) coating defects, and c) total integrated scattering.
- We present a set-up to do such studies, with emphasis in defect detection and characterization.

FIRST MEASUREMENTS  
PERFORMED ON LIGO  
FILTER CAVITY OPTICS  
(T2100017)



1064 nm  
Light

Rotating  
Diffuser

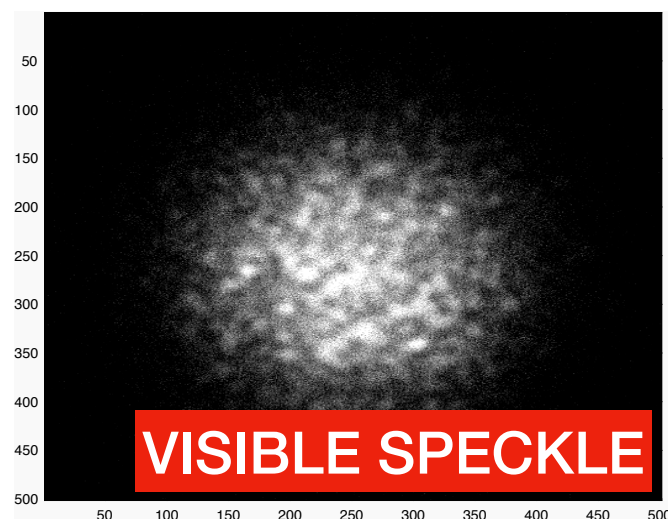
Camera

## THE SPECKLE CHALLENGE

- Due to the spatial and temporal coherence of a laser, scattering and scattering images are affected by speckle.
- Makes scattering modeling and identification of defects hard/impossible.
- We improved our set-up by reducing spatial coherence of our beam. (Next slide)

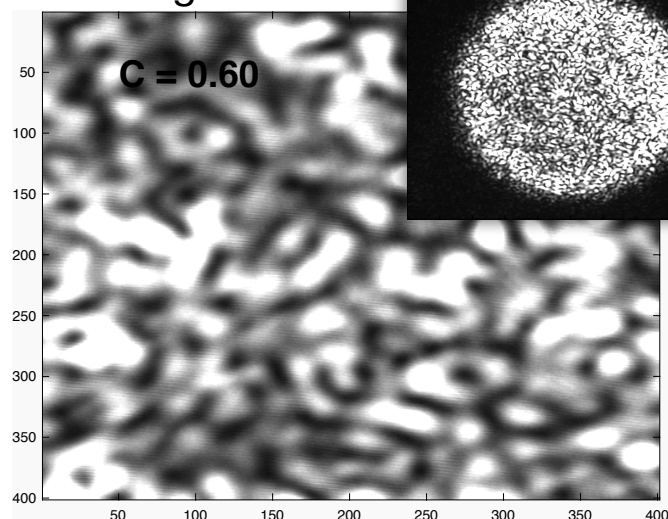
# ROTATING DIFFUSER TO THE RESCUE

GAUSSIAN BEAM ON  
ROUGH SURFACE



Let's improve

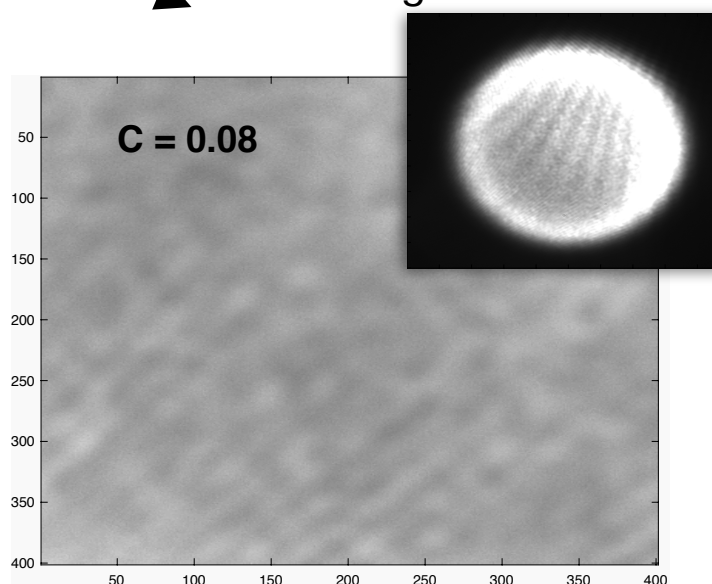
Beam through  
Flat Top Diffuser  
on rough surface



No, let's actually improve

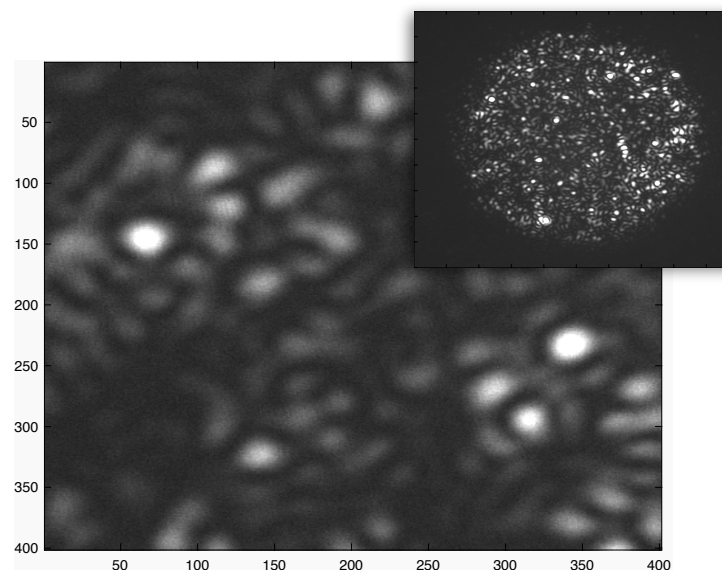
Apply to bad mirror  
(With lots of defects)

Beam through  
ROTATING  
Flat Top Diffuser  
on rough surface

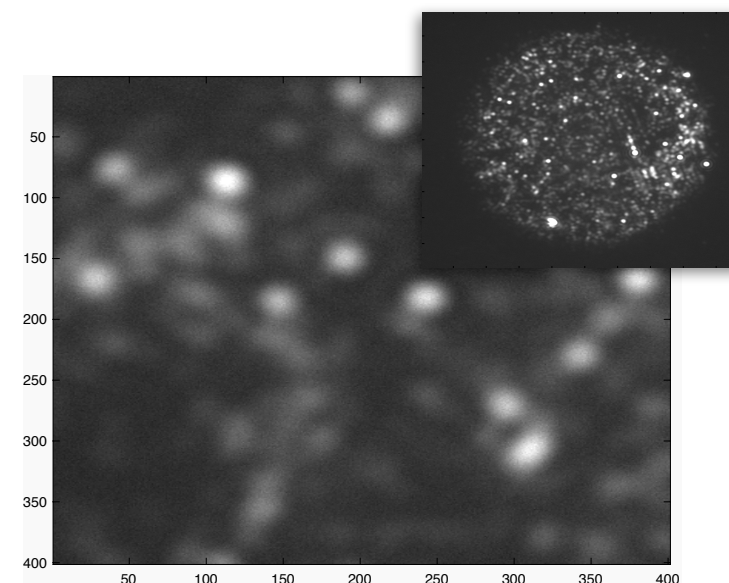


CONTRAST 'C' IS A MEASURE OF SPECKLE  
(C=0 means no speckle)

$$C = \sigma_I / \langle I \rangle$$



Guess which one is with  
a rotating diffuser.



## NEAR FUTURE PLANS

- Compare BRDF measurements with diffuse and non-diffuse beam.
- Use advantage to detect defects.
- Model defect scattering as a function of size and depth in coating.
- Study scattering as a function of annealing treatment for GeO<sub>2</sub> coatings.