Future Directions in Mid-Infrared Lasers for the CLARREO IR Payload

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CLARREO SDT, April, 2013

NASA-LaRC

[1]Harvard University, School of Engineering and Applied Sciences
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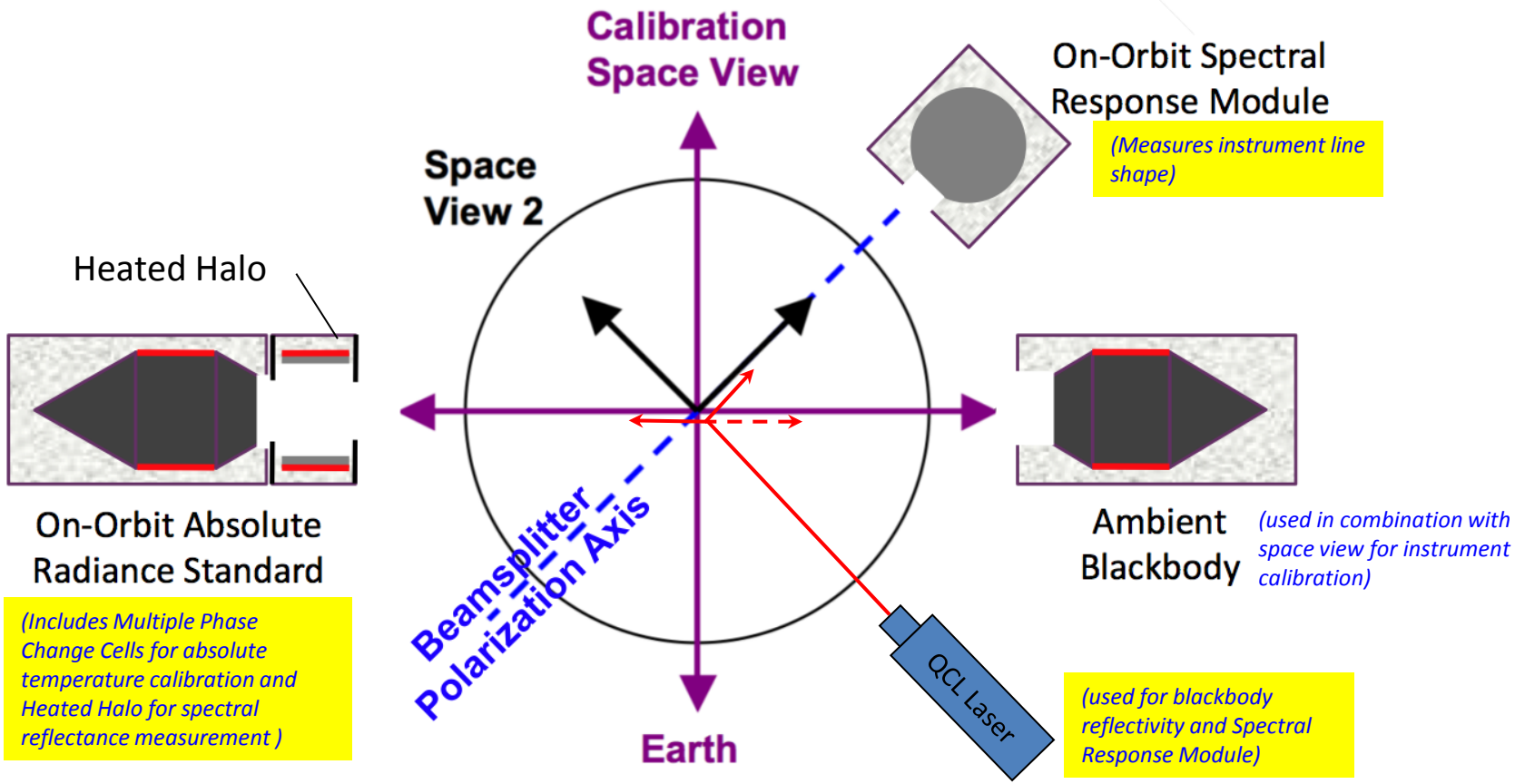
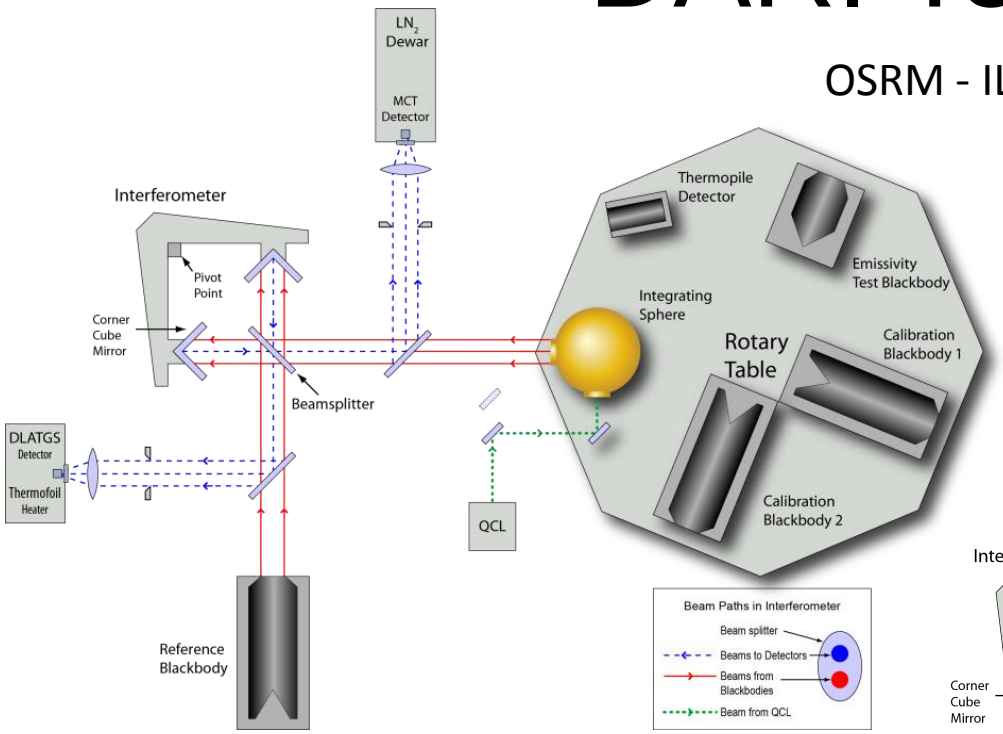
On-orbit Test/Validation (OT/V) Modules



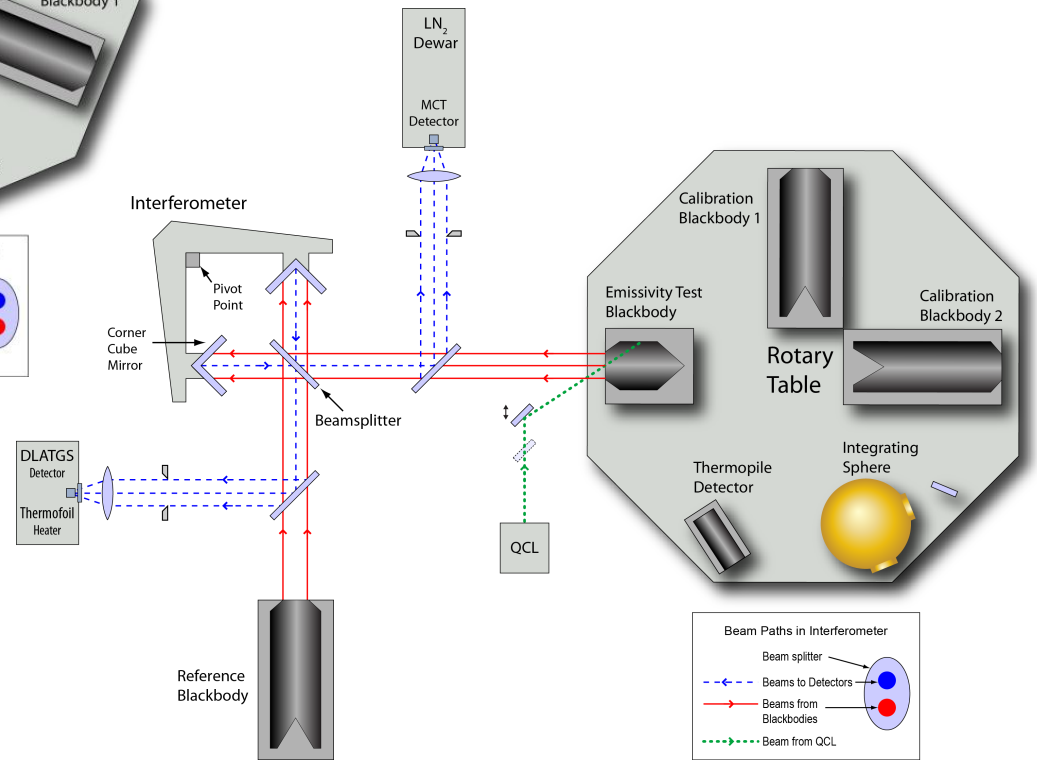
Viewing configuration providing immunity to polarization effects.

DARI Testbed

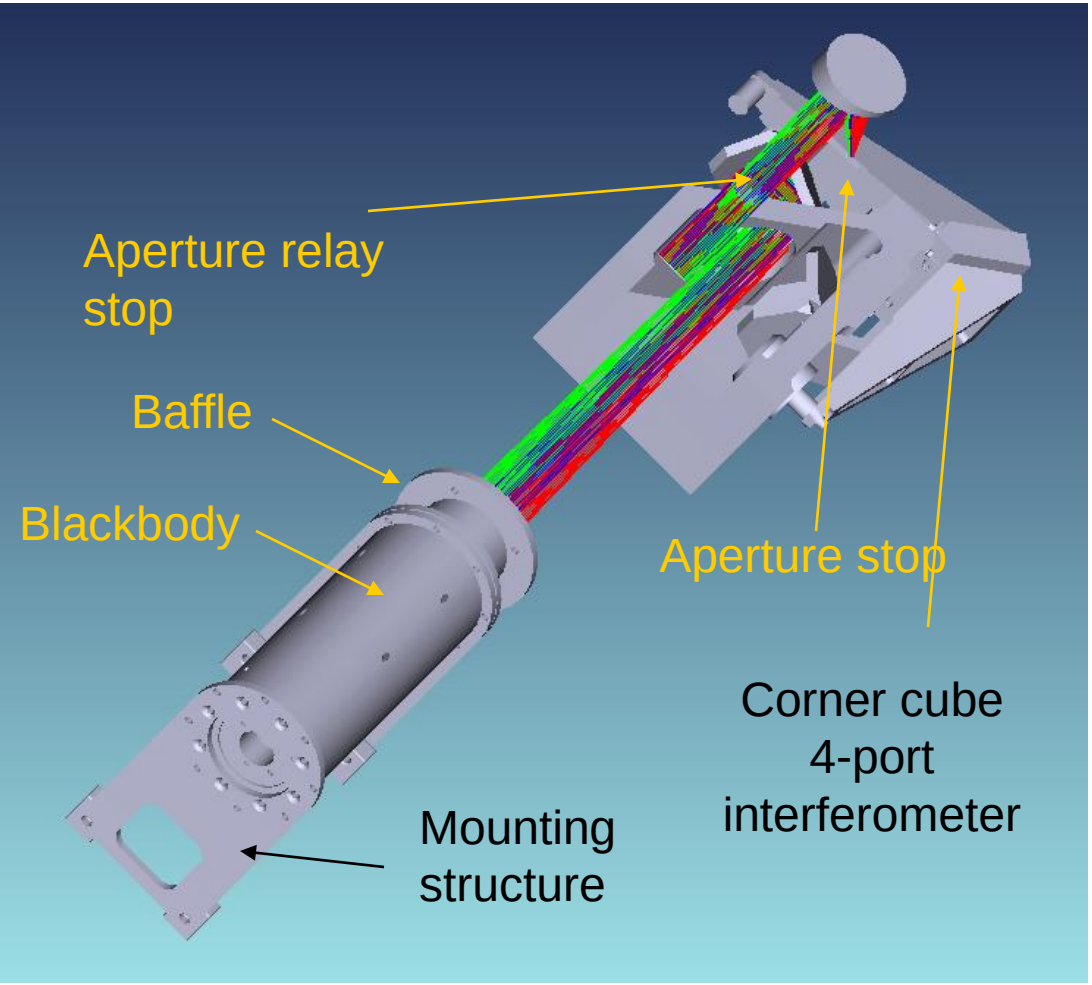
OSRM - ILS

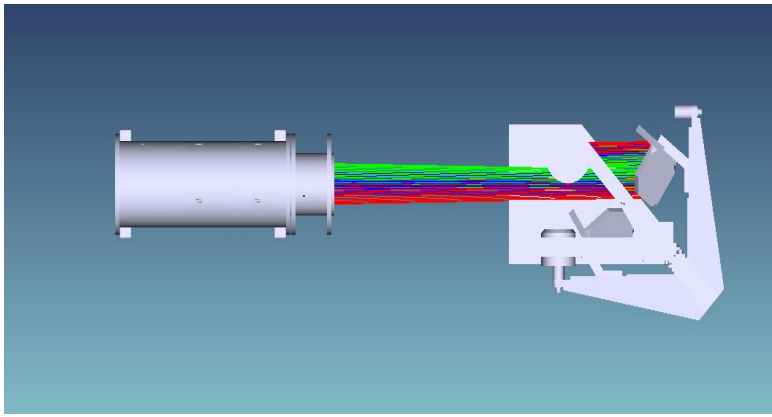


OCEM – emissivity

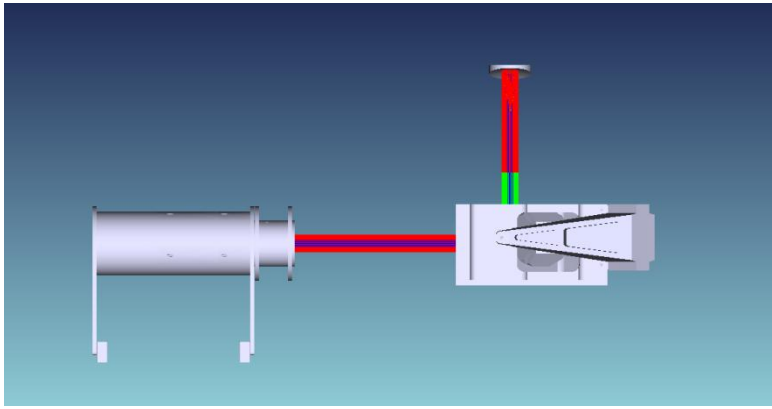


MCT Optical Train for Testbed



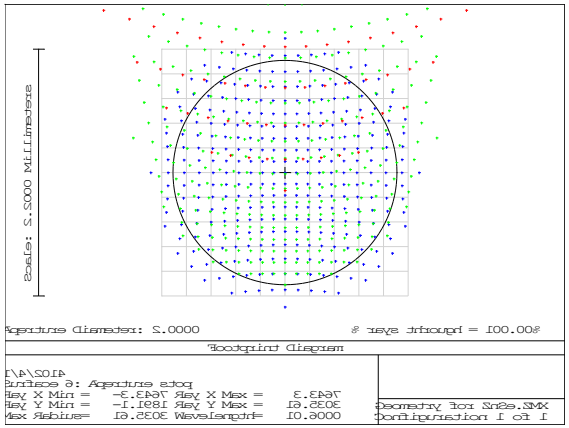


Top View

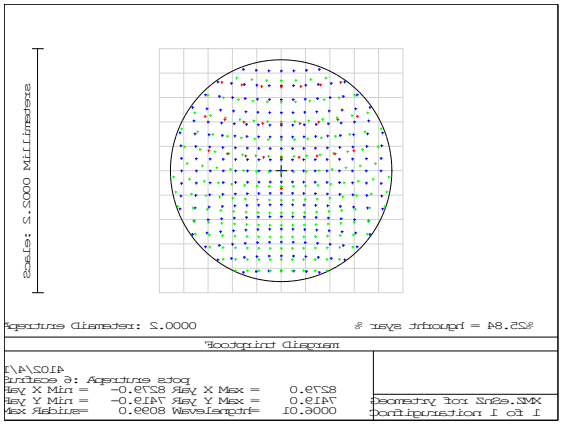


Side View

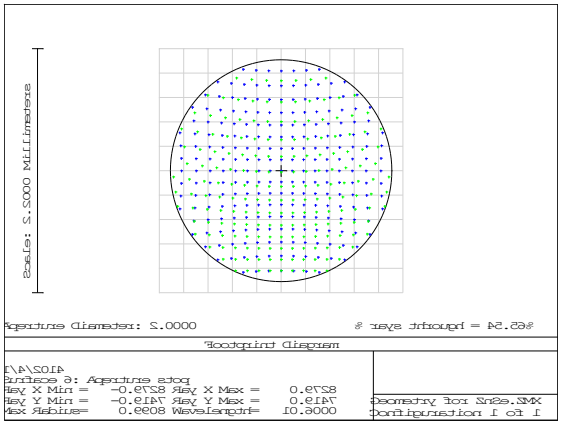
Field of View defined by vignetting



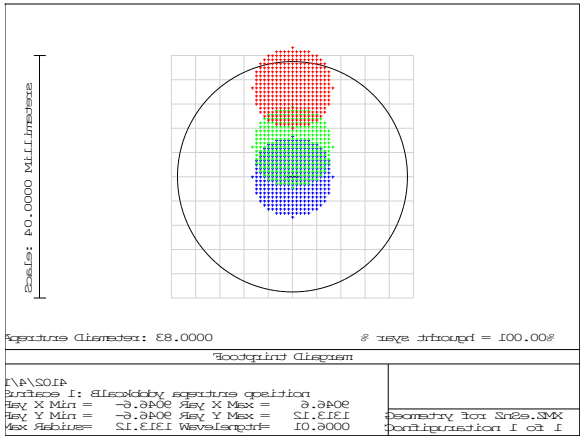
All rays

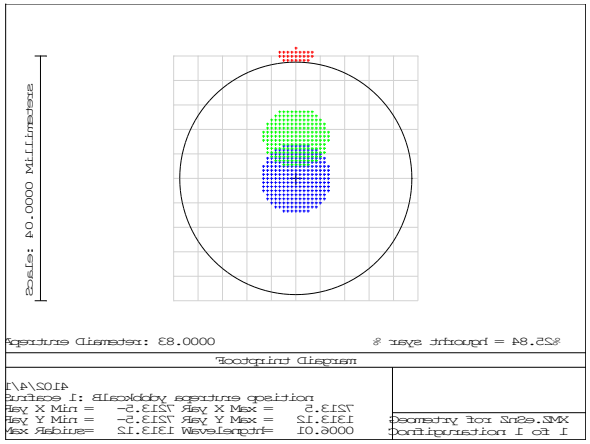


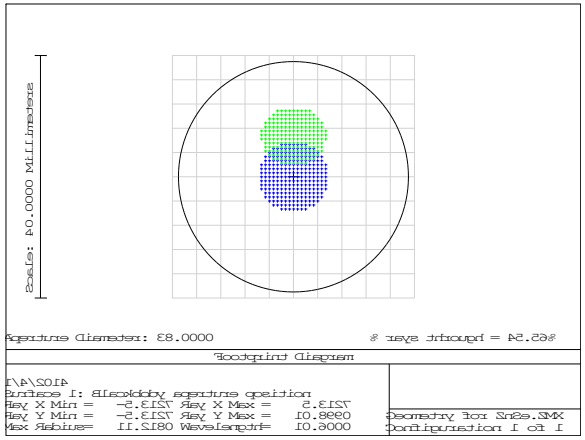
Vignetting due to aperture stop



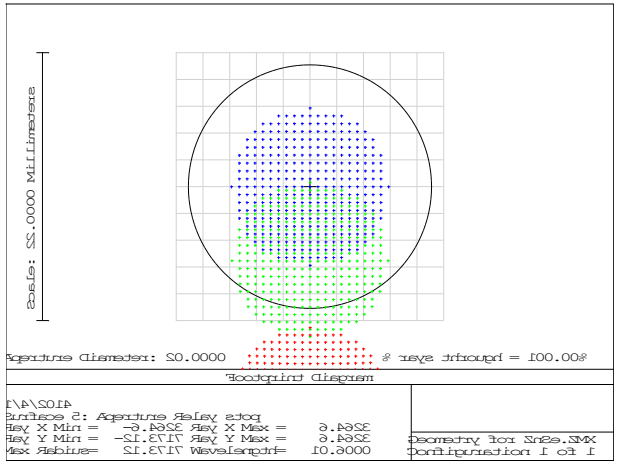
Vignetting due to aperture relay stop



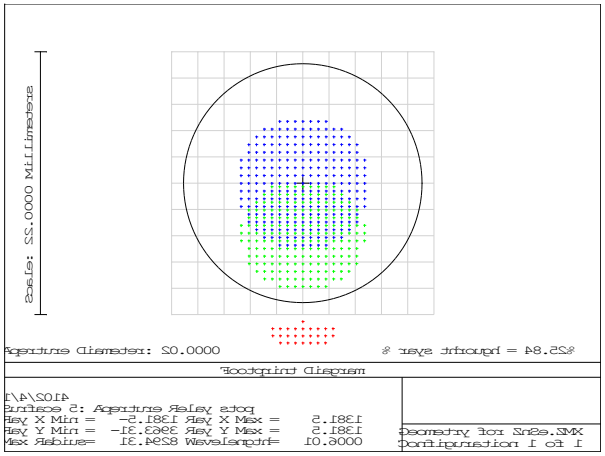




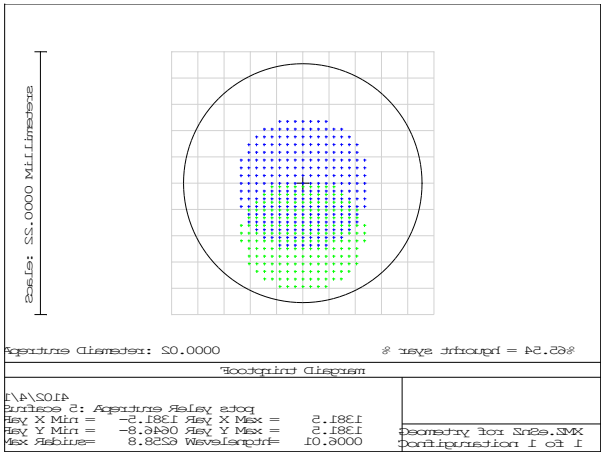
Aperture relay stop, corner cube



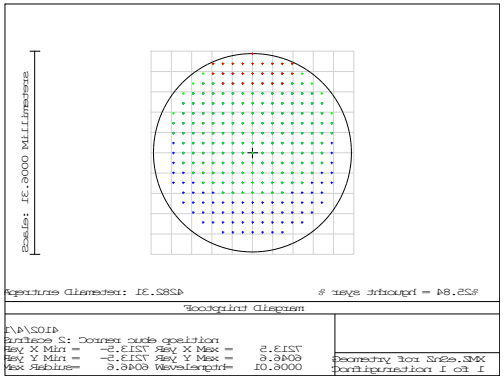
All rays

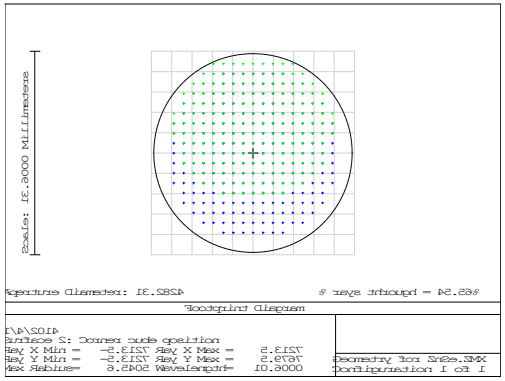


Vignetting due to aperture stop

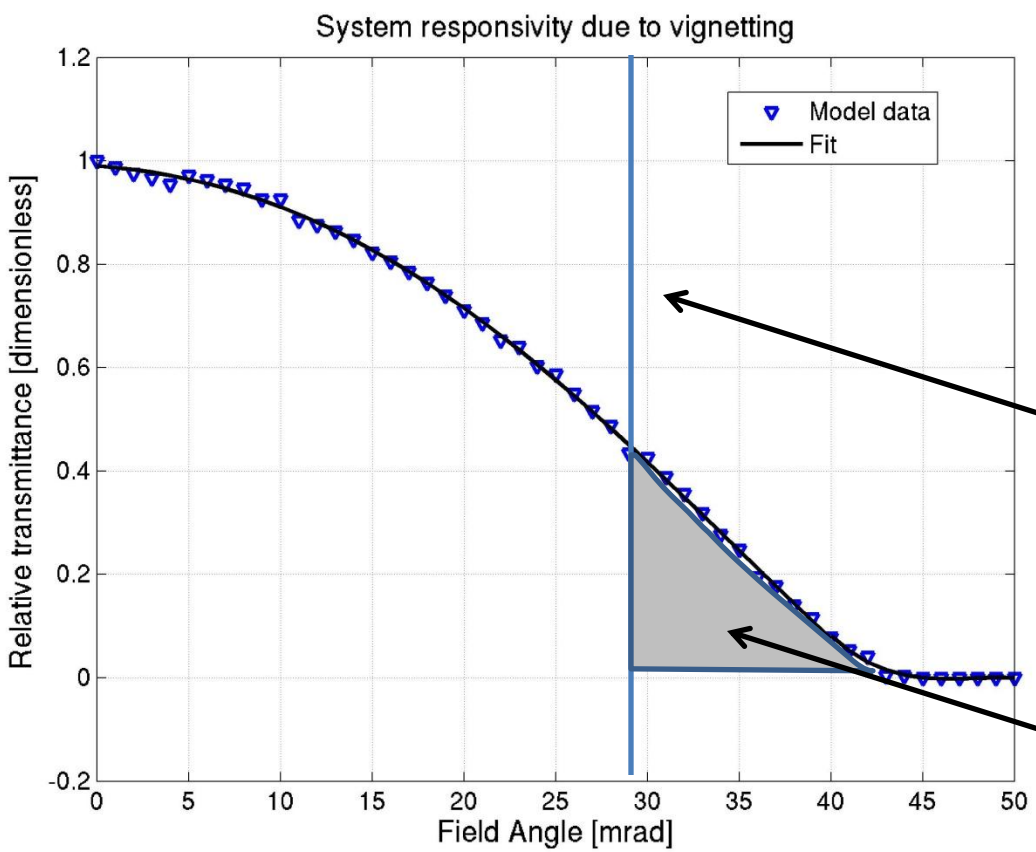


Vignetting due to aperture relay stop





Definition of optical FOV by system

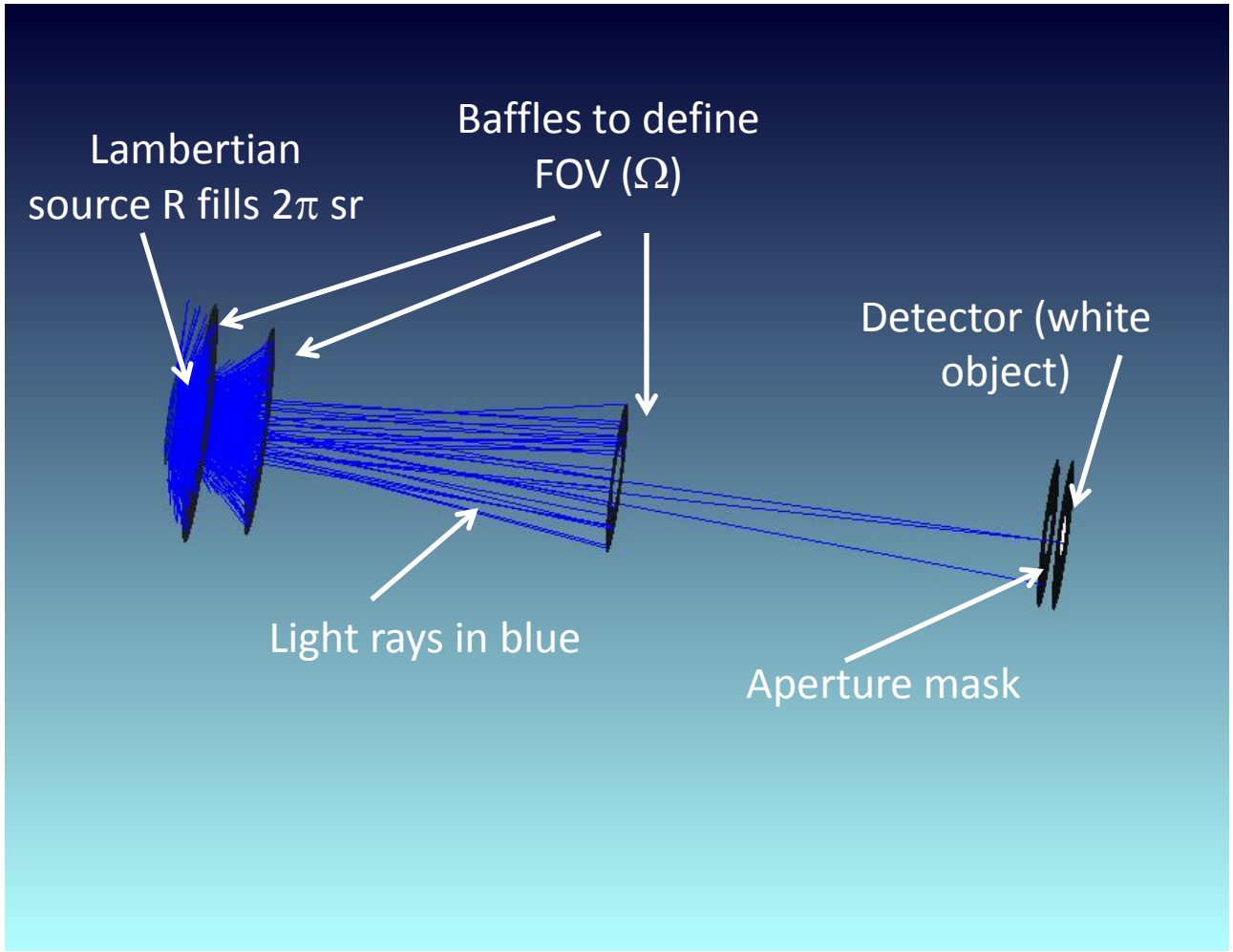


$$P_{meas} = A\int_{\Omega} R\cos(\theta)\, d\Omega$$

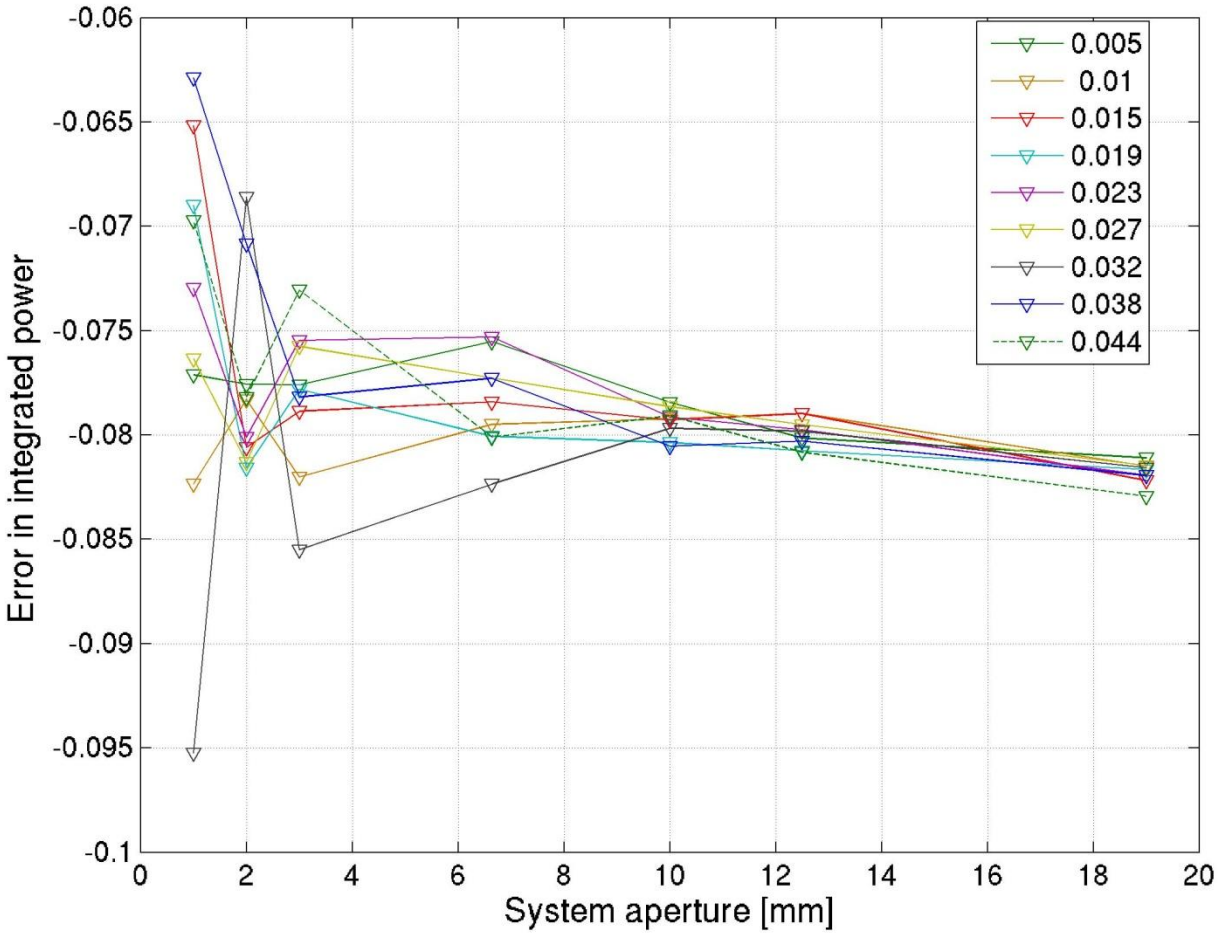
Equivalent FOV (half-angle of Ω) for top-hat responsivity viewing Lambertian source is ≈28 mrad

Extended field responsivity

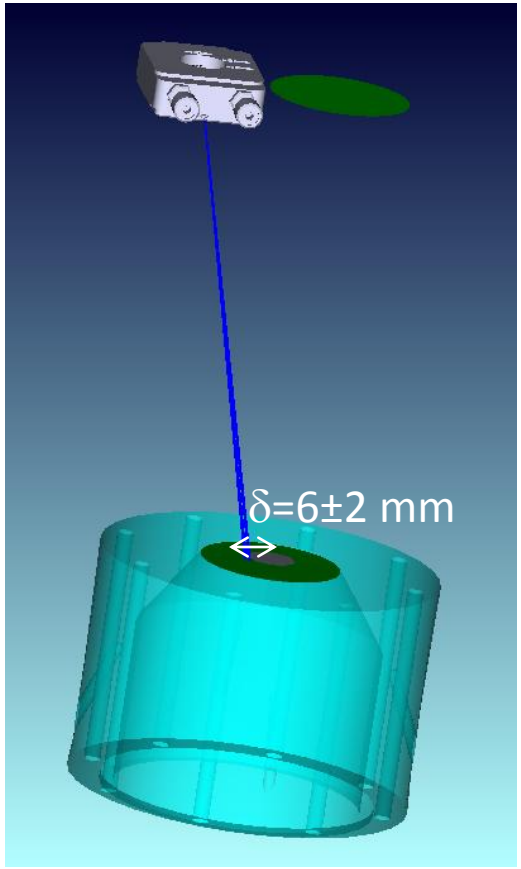
Calibration of Zemax radiometry



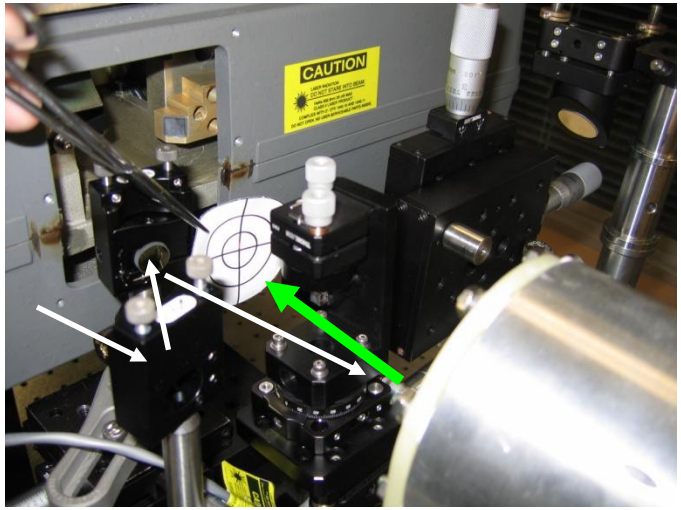
Lost energy for uniform source

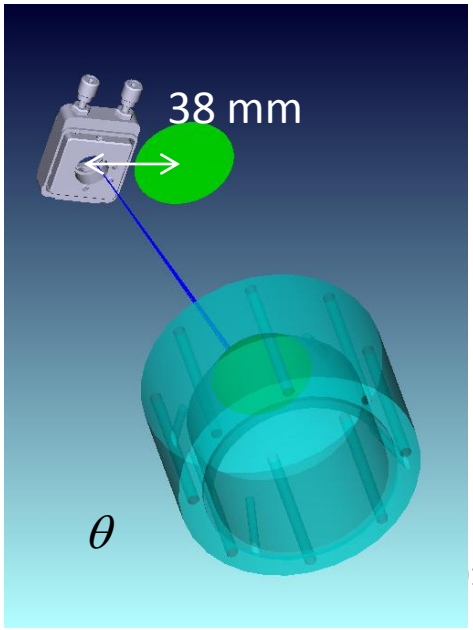


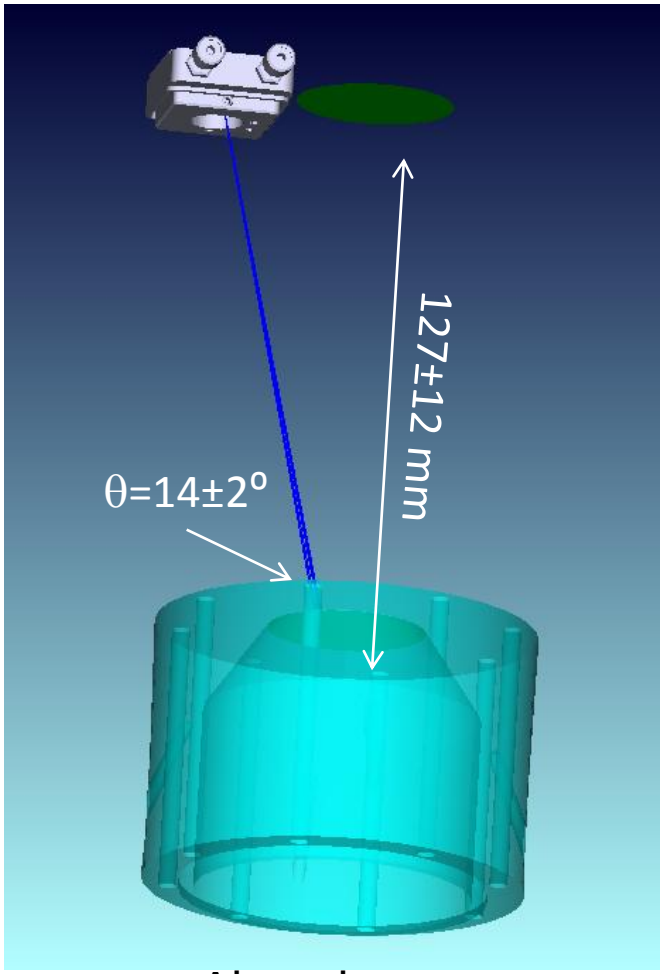
Measurement Geometry



Cross-beam

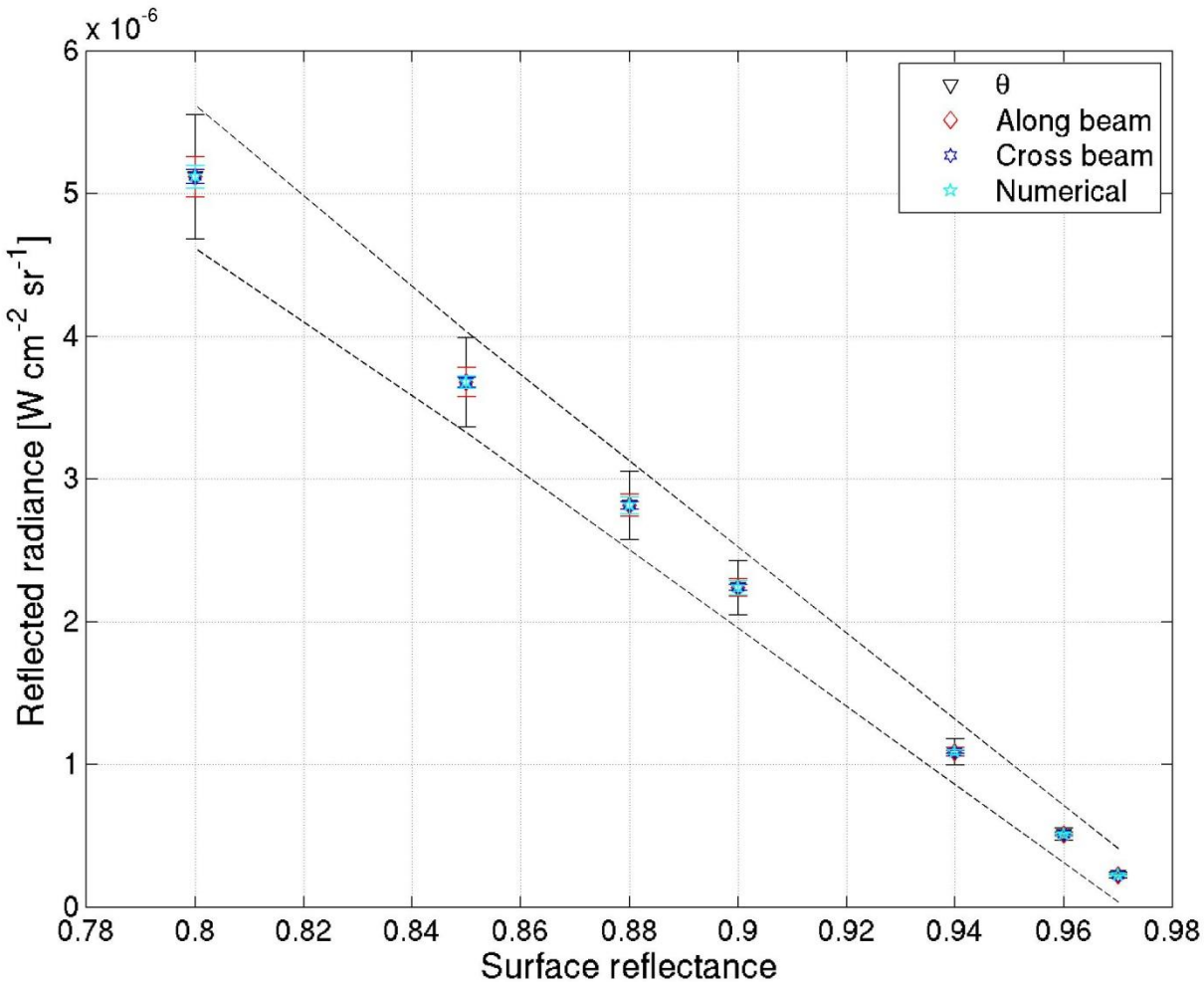




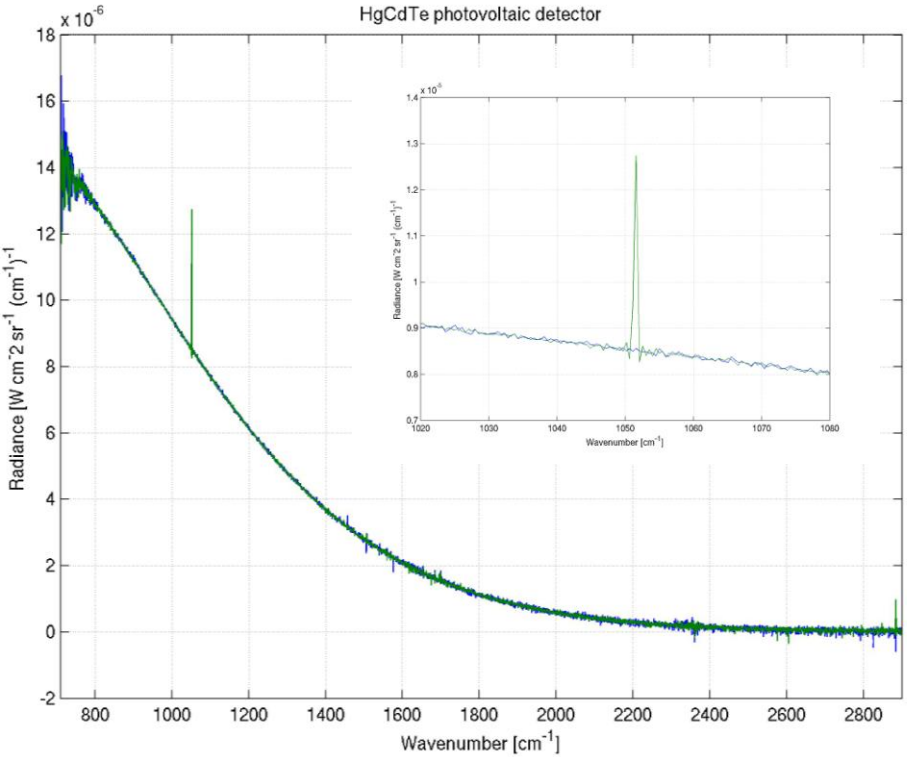


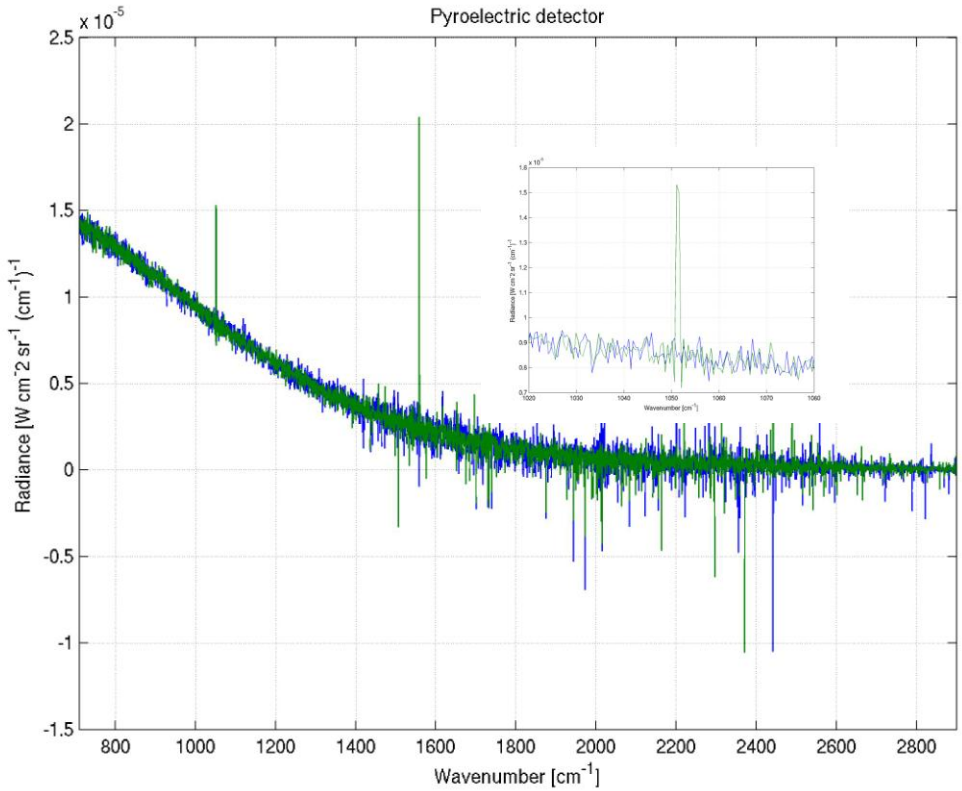
Along-beam

Measured radiance and uncertainties



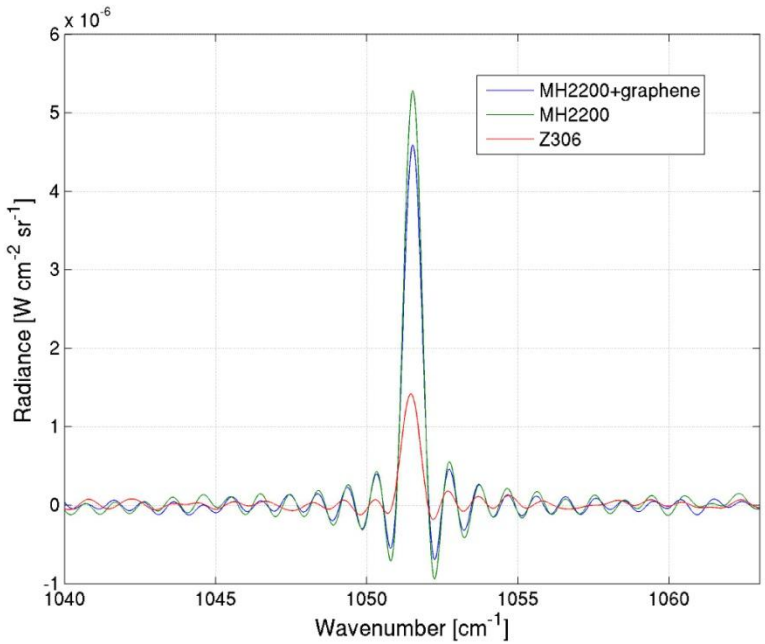
Calibrated unapodized reflectance spectra

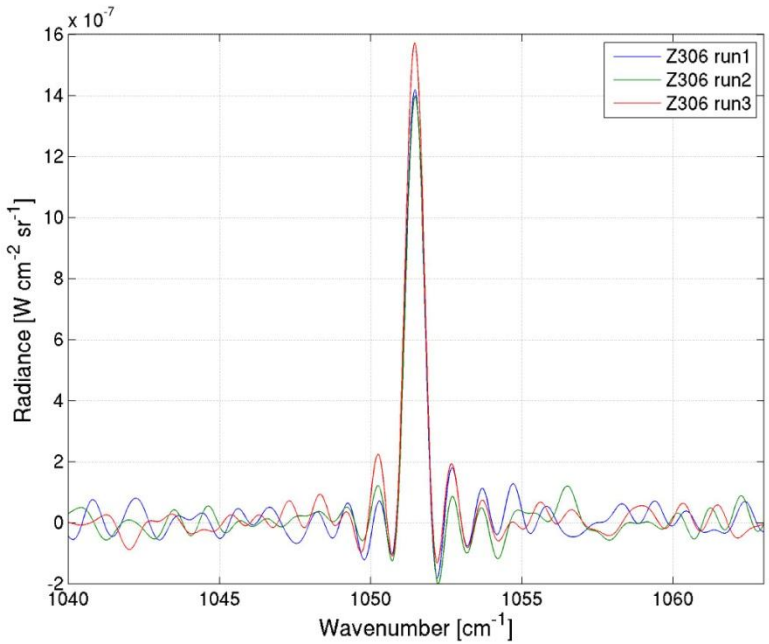




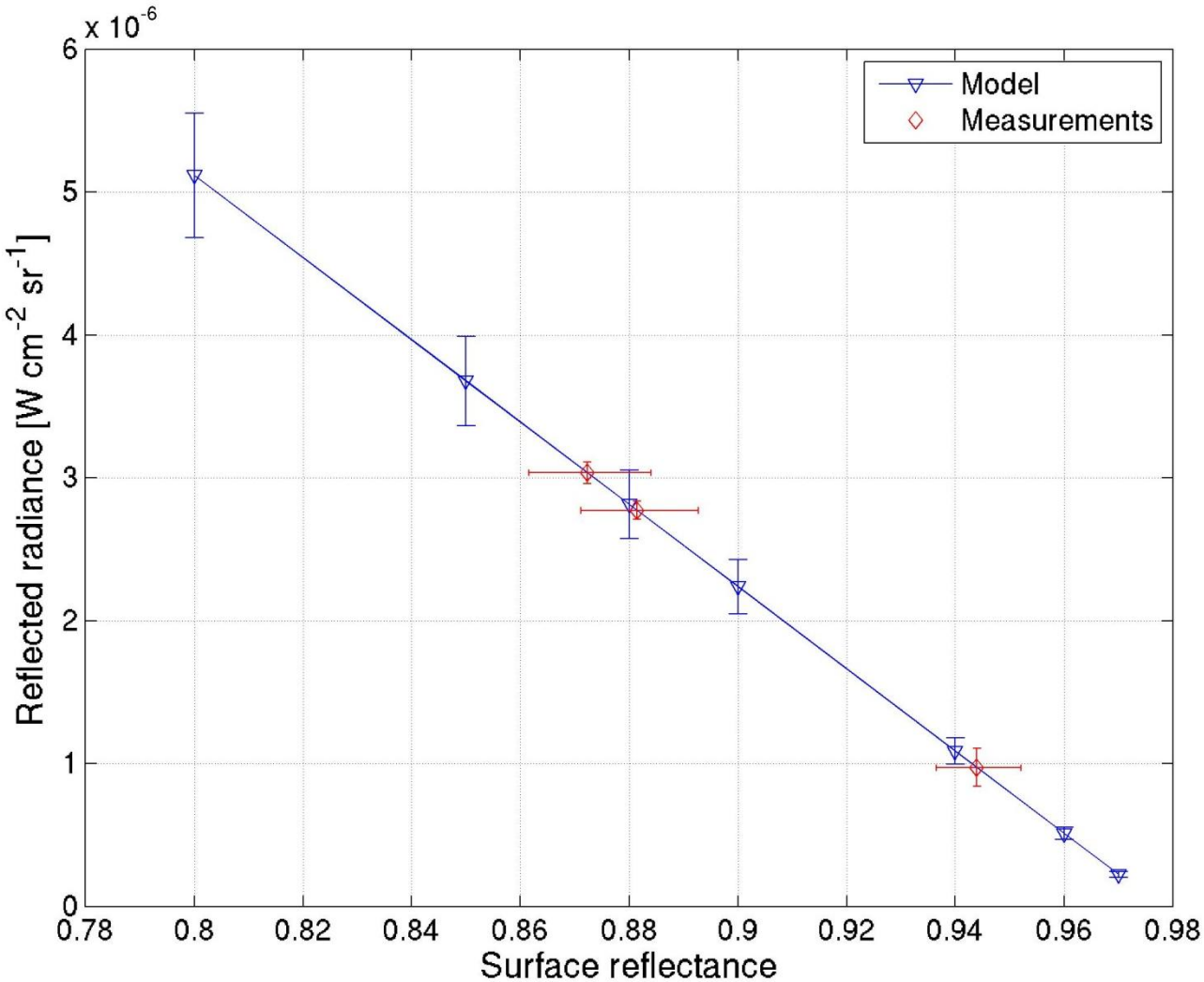
Dykema: CLARREC

Spectra, background removed

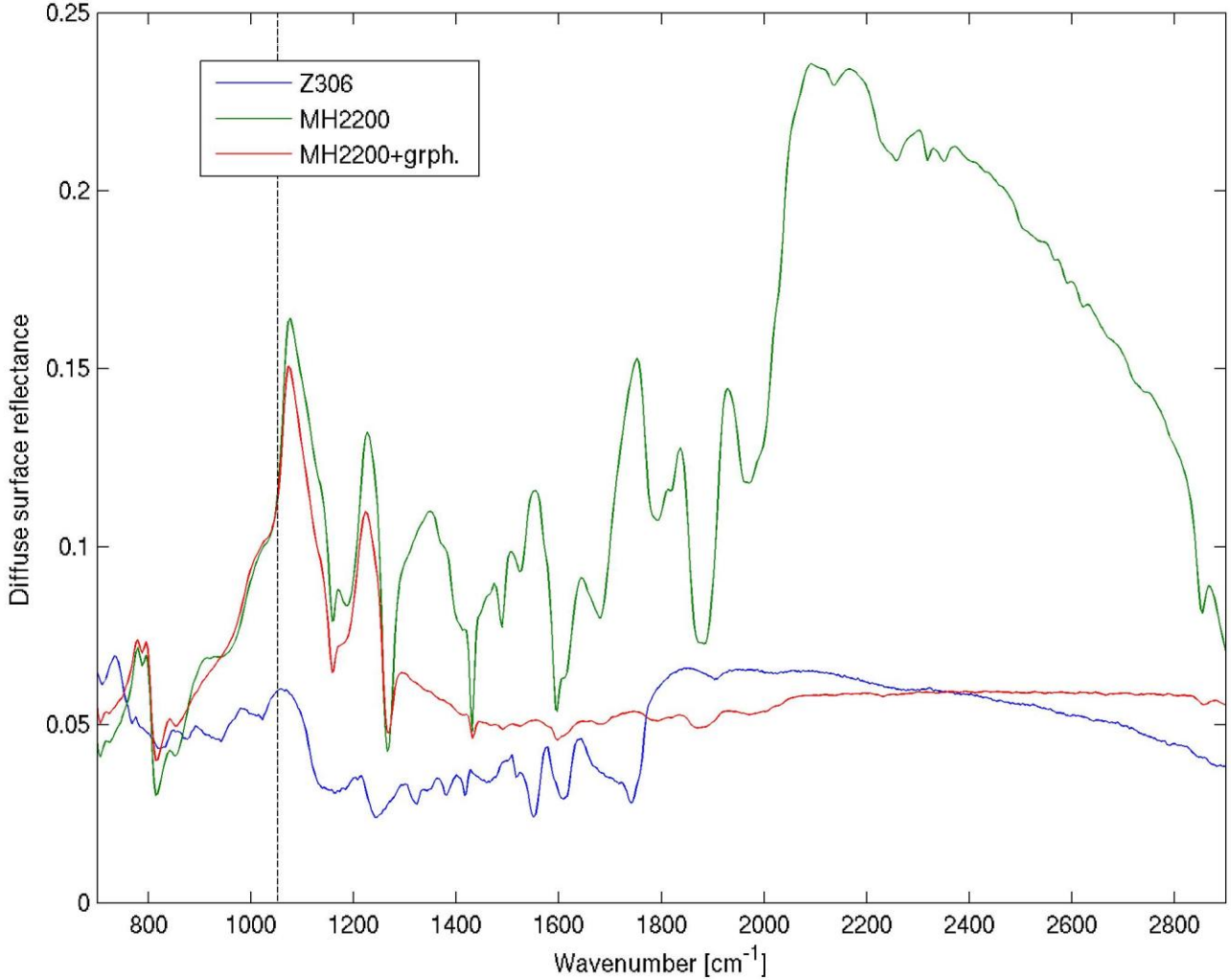




Inferred blackbody surface reflectance

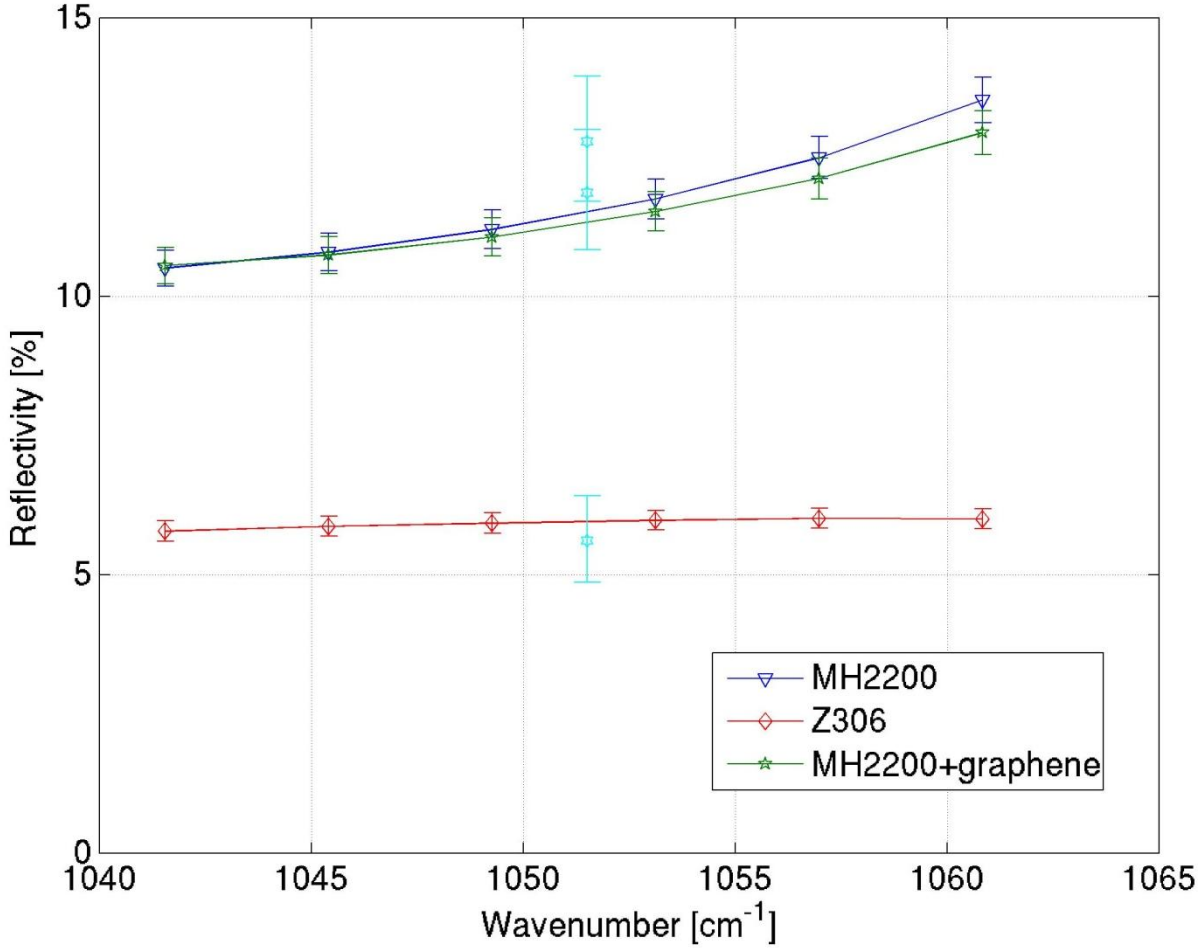


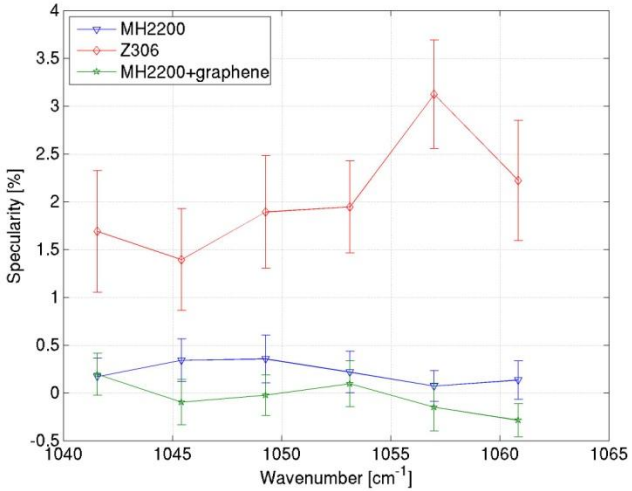
Black paint options



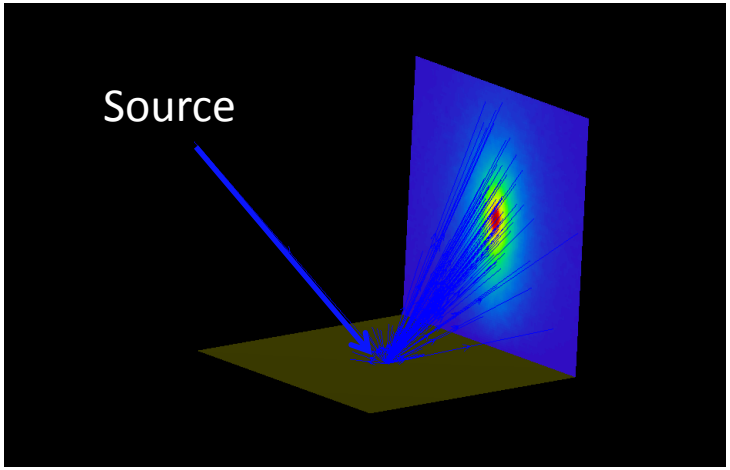
Measurements: Leonard Hanssen and Sergey Mekhontsev, NIST

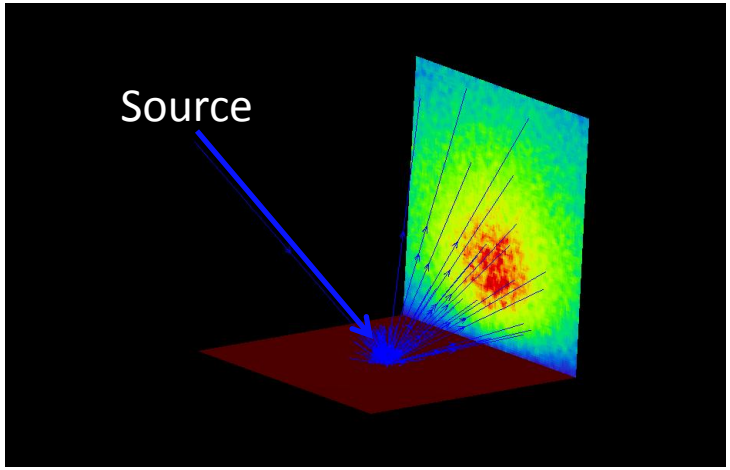
OCEM-QCL measurements vs. NIST

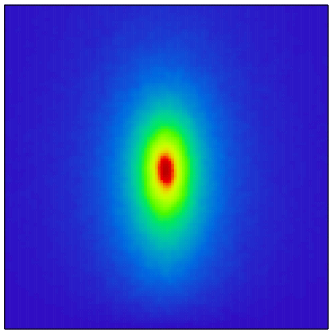




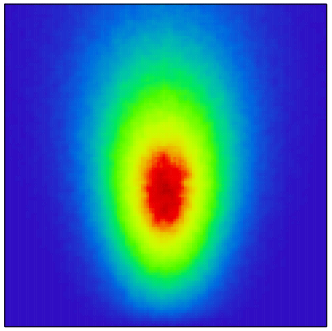
Scattering dependence



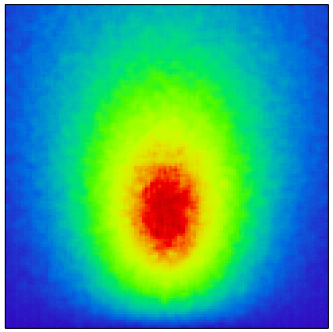




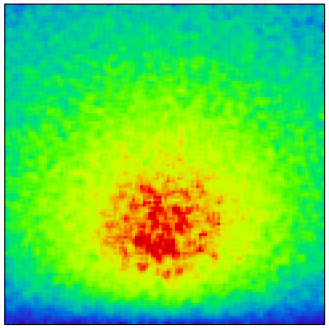
Abg (near specular)



Gaussian σ=0.25



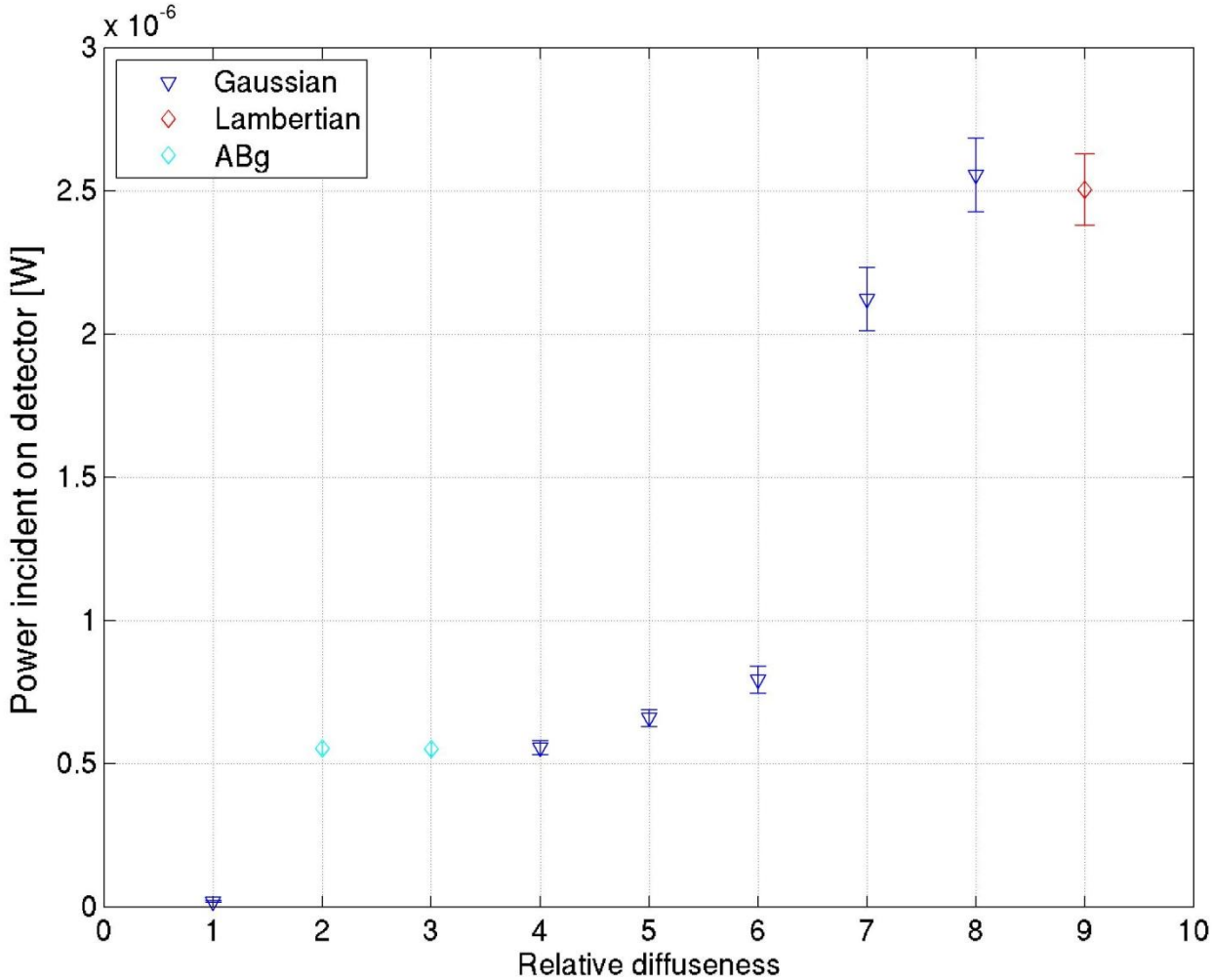
Gaussian σ=0.42



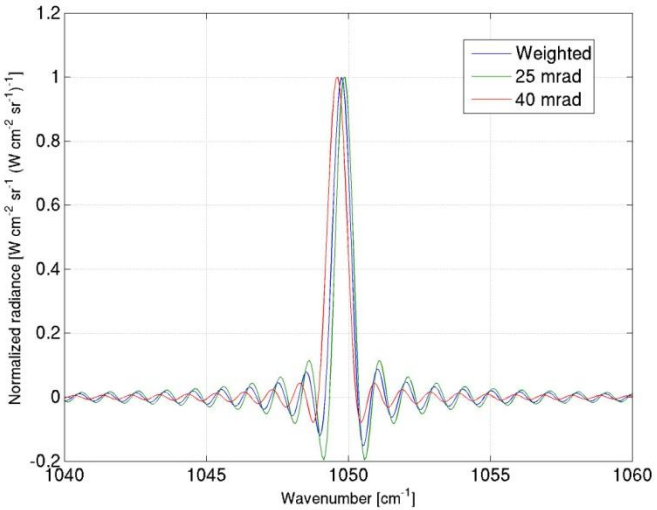
Diffuse

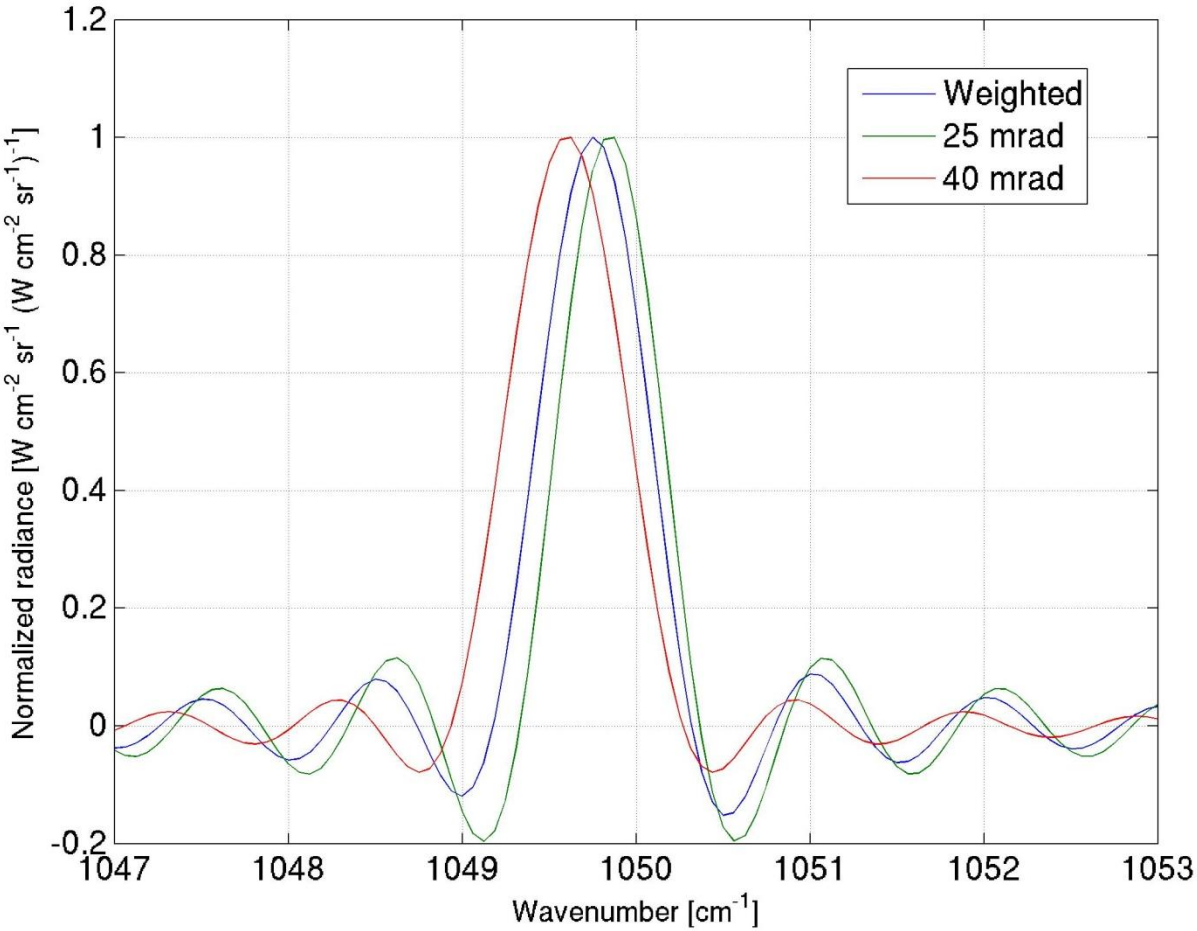
More scattering

Dependence of measured power on scattering

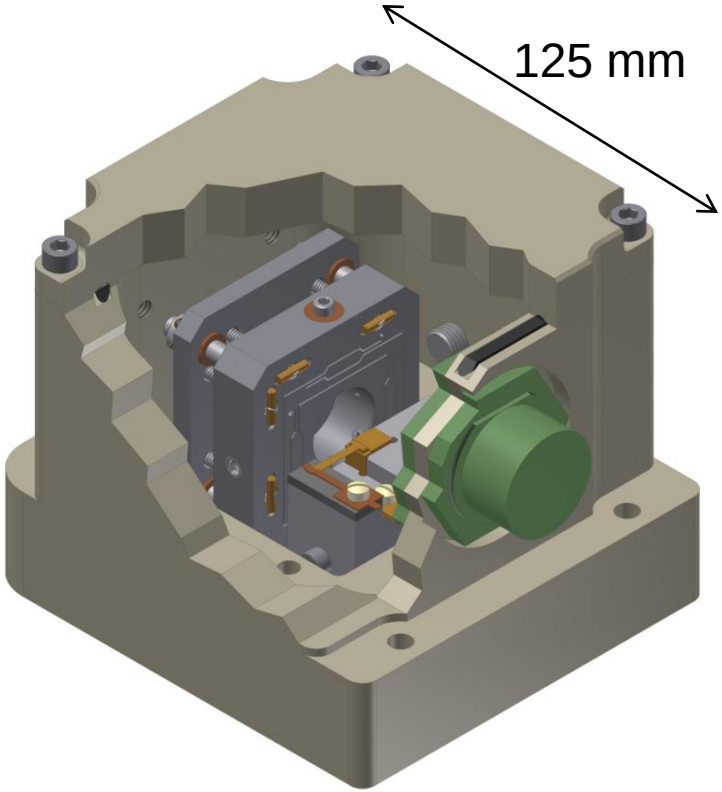


Using vignetting property to correct ILS

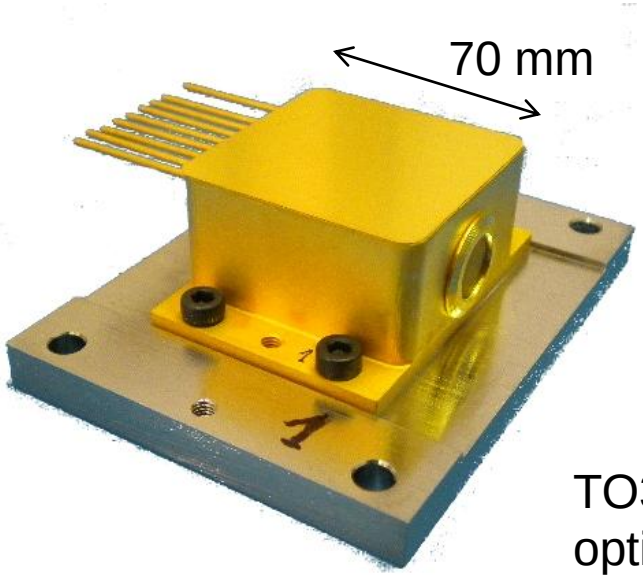




New directions: shrinking QCLs



Harvard housing with tunable collimation



Sealed housing with permanently aligned optic

TO3 can with integrated optic: pulsed laser only!

Further developments for QCL applications

B18 J. Opt. Soc. Am. B/Vol. 27, No. 11/November 2010 N. Yu and F. Capasso

Wavefront engineering for mid-infrared and terahertz quantum cascade lasers [Invited]

Nanfang Yu[1,2] and Federico Capasso[1,3]

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[3]e-mail: capasso@seas.harvard.edu

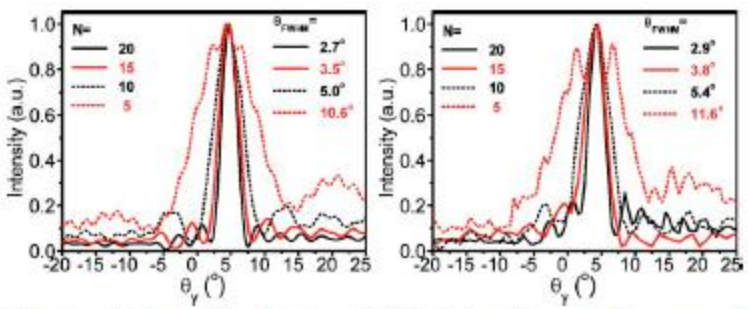
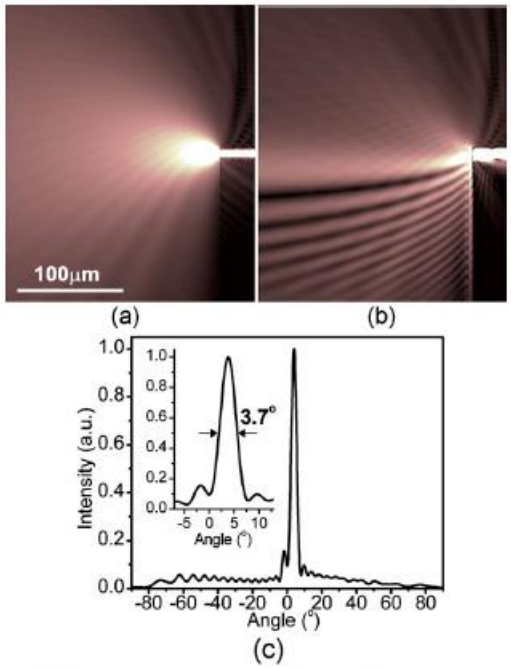
Fig. 8. (Color online) Left and right: Simulated and measured vertical far-field intensity profiles of devices with 1D collimators containing N grating grooves.