Pupil Mapping (aka PIAA)

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2007 March 16

What DO We Know Today

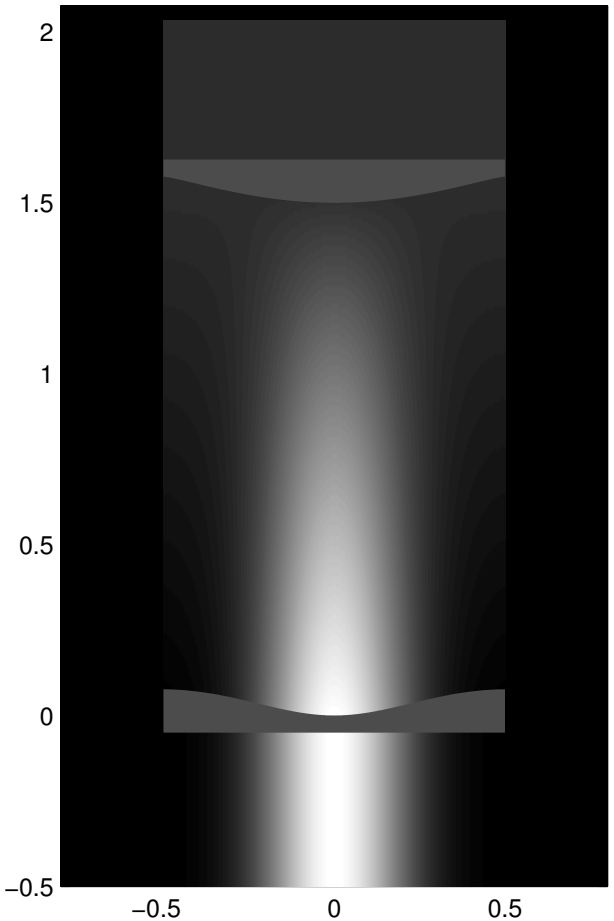
TPF-Lite Meeting
Princeton University

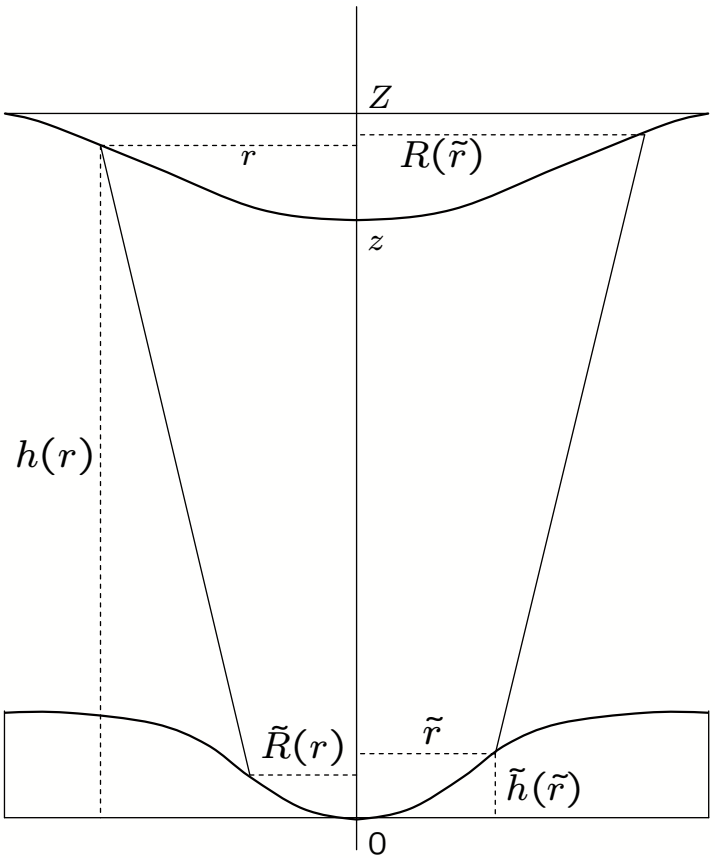
http://www.princeton.edu/∼rvdb

Pupil Mapping—Summary

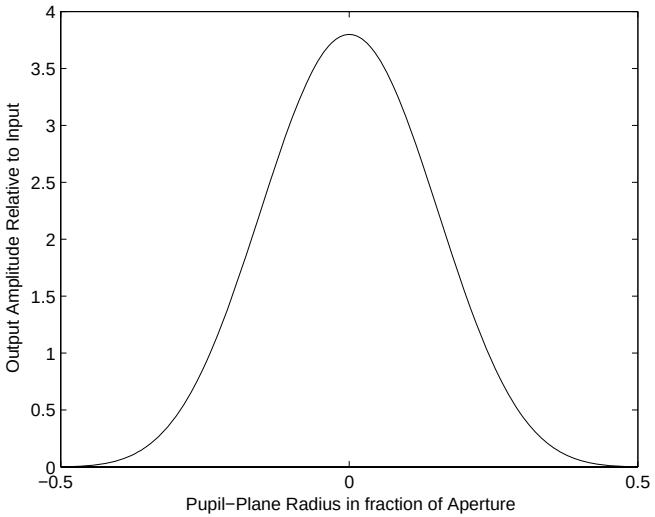
- Create a nonuniform amplitude profile using a pair of mirrors
- Diffraction limits contrast to 10^{-5}
- Pre- and post-apodizers restore desired contrast at expense of throughput and achromaticity
- High throughput and small iwa
- Sensitive to low-order aberrations
- Difficult to manufacture

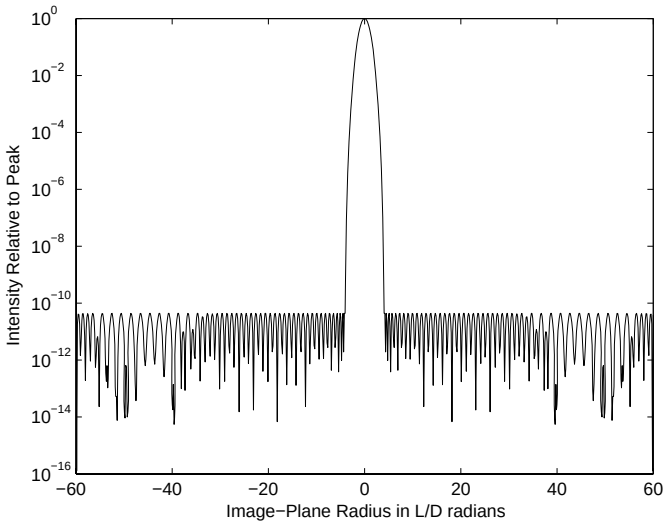
The Pupil-Mapping Concept



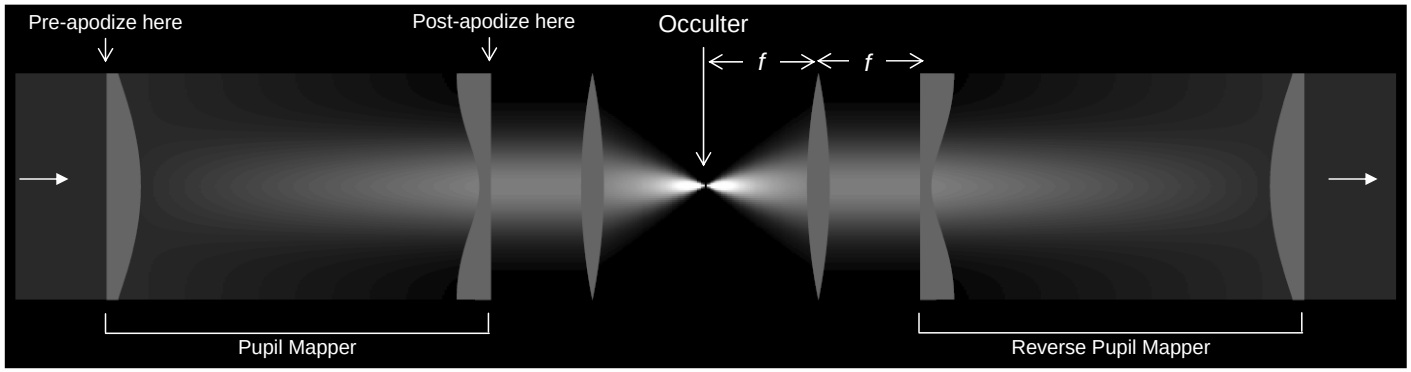


High-Contrast Amplitude Profile

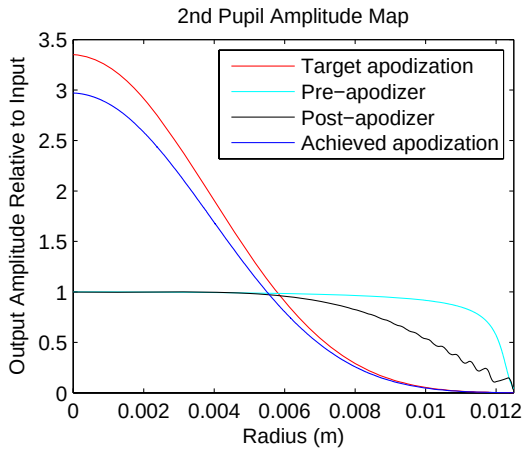


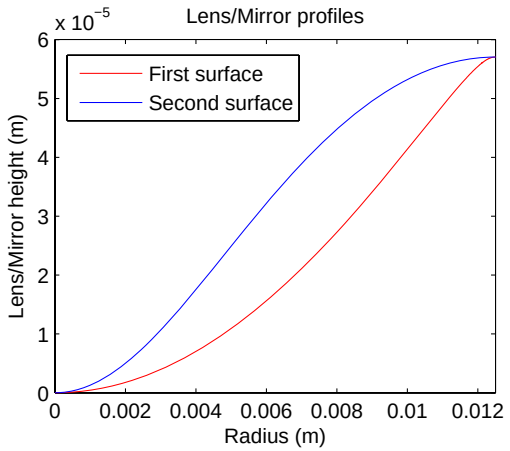


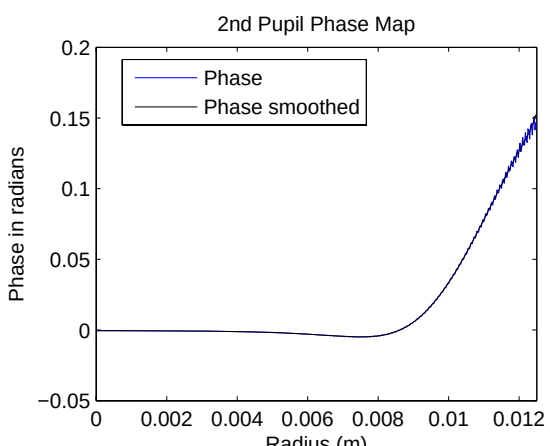
Full Pupil-Mapping System

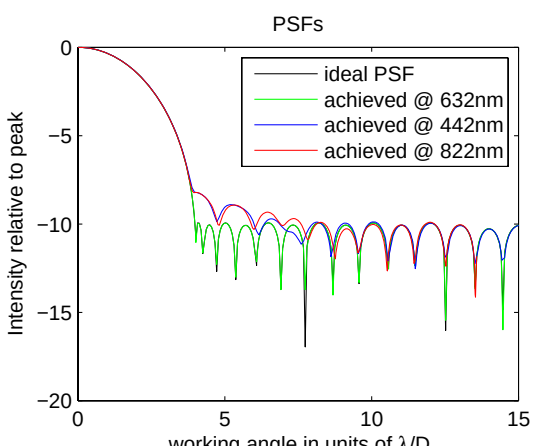


Diffraction Analysis of Apodized Pupil-Mapping

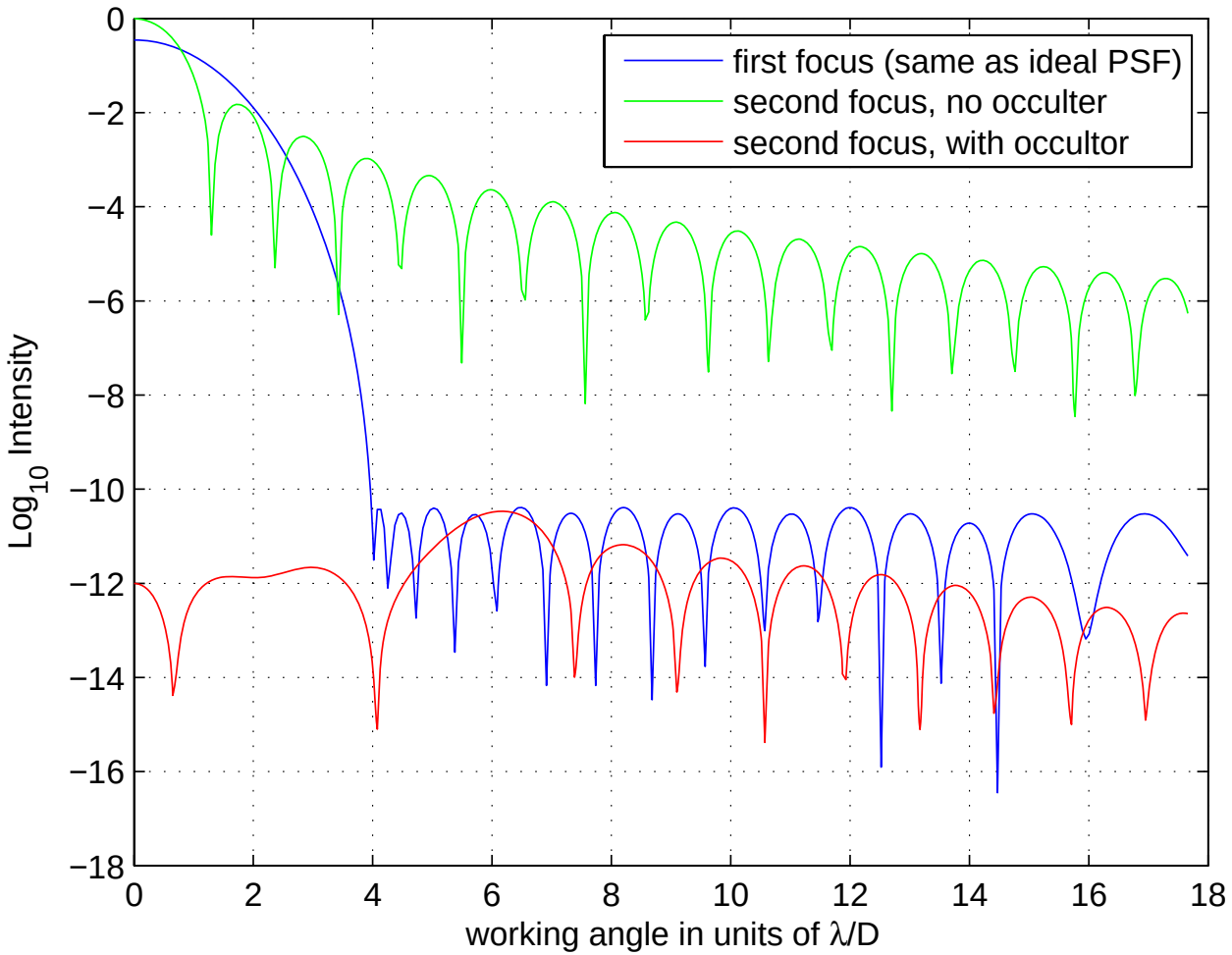




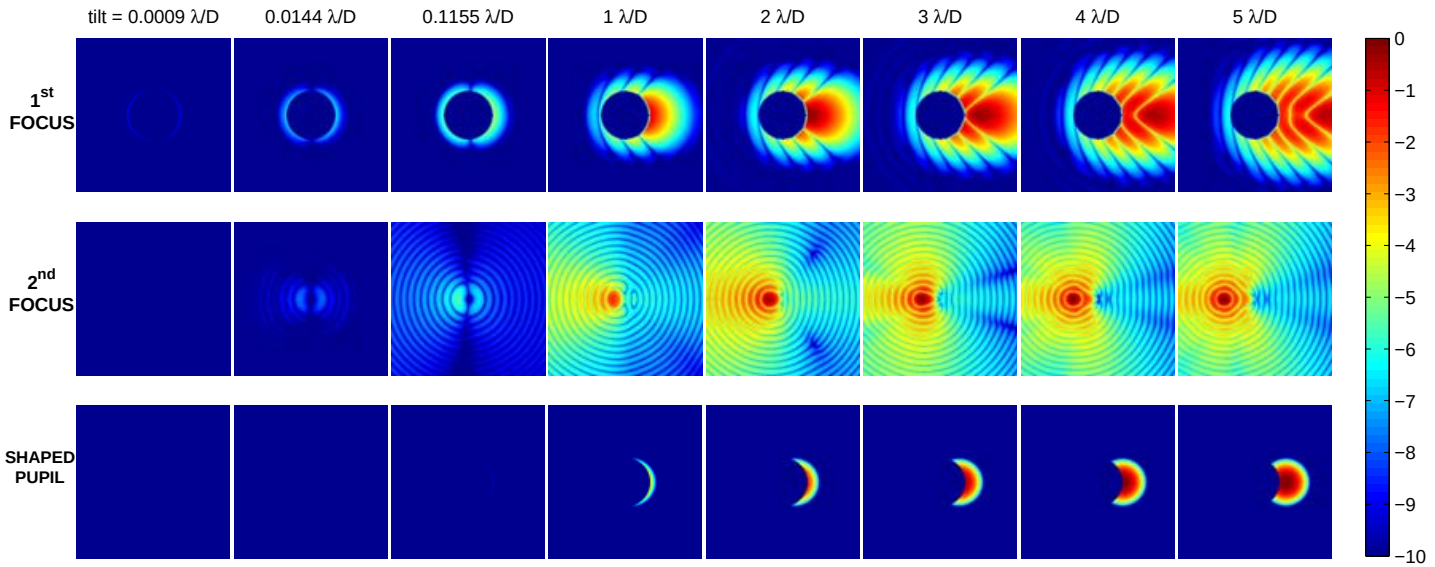




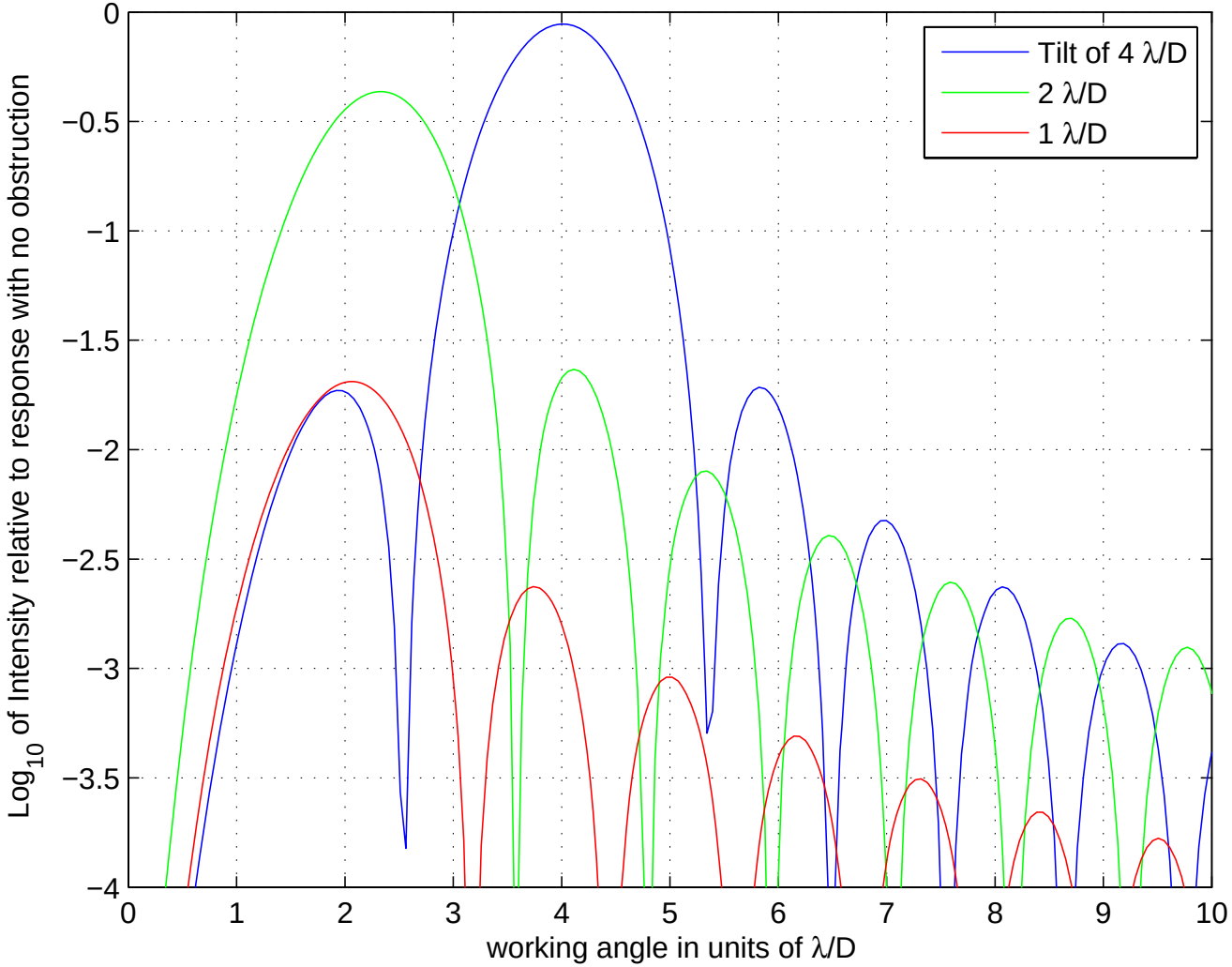
On-Axis PSF at 1st and 2nd Focus



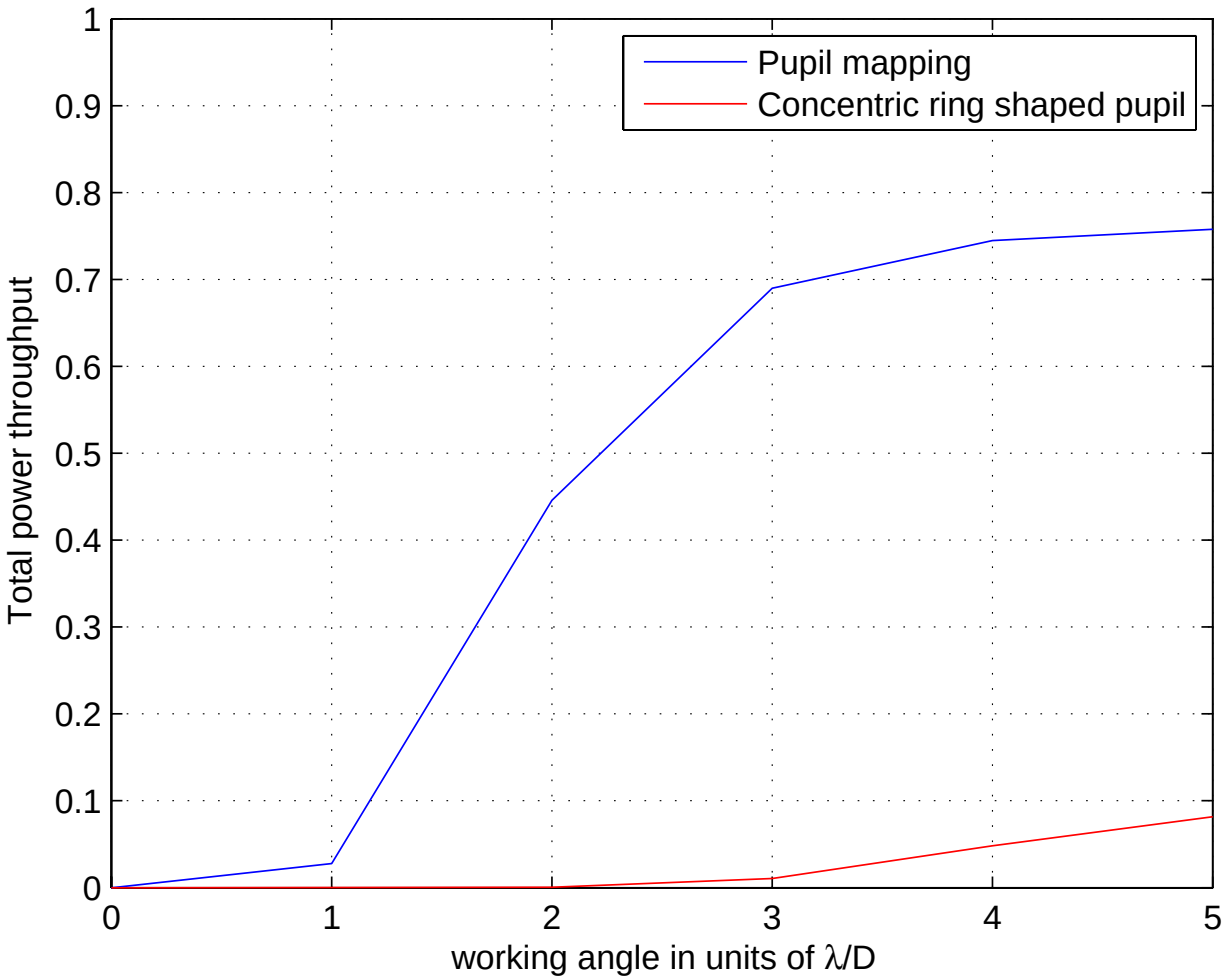
Off-Axis PSFs



Cross-Sectional Plot

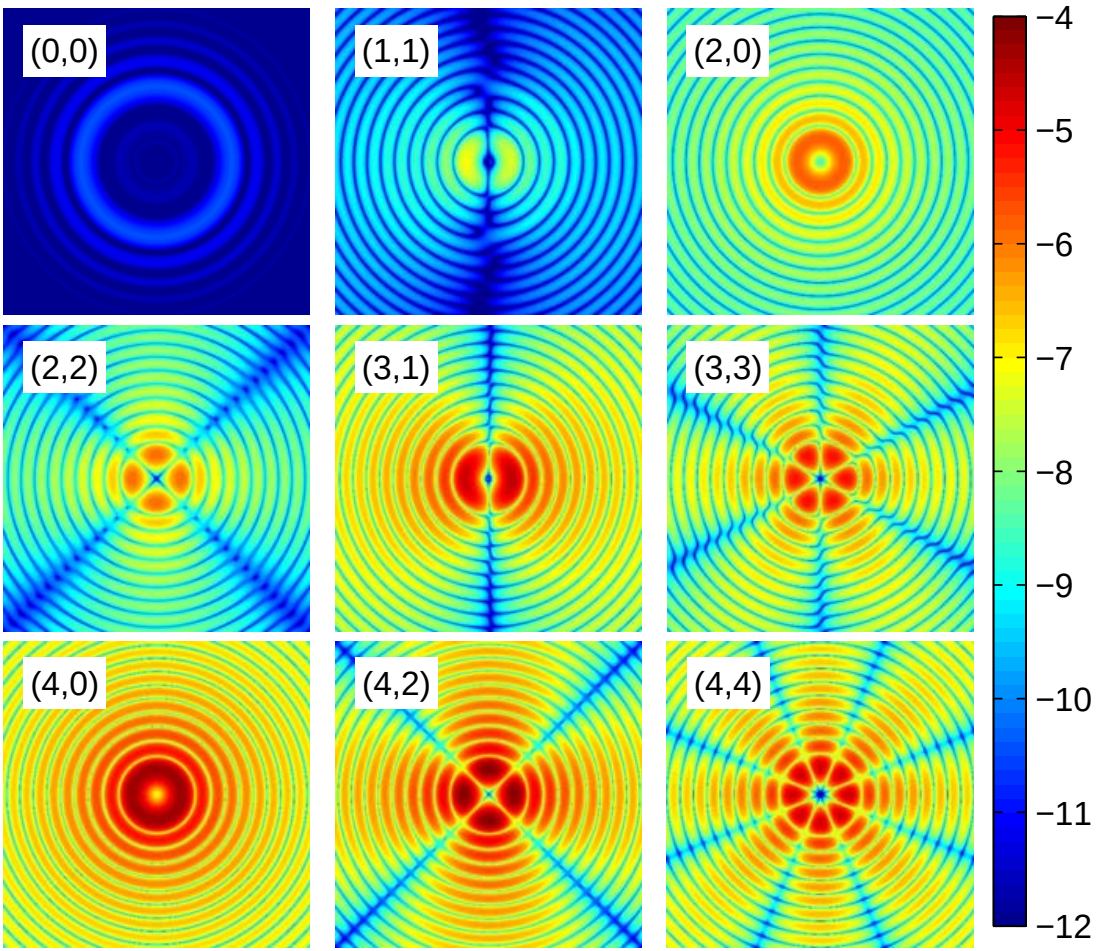


Throughput vs. Angle



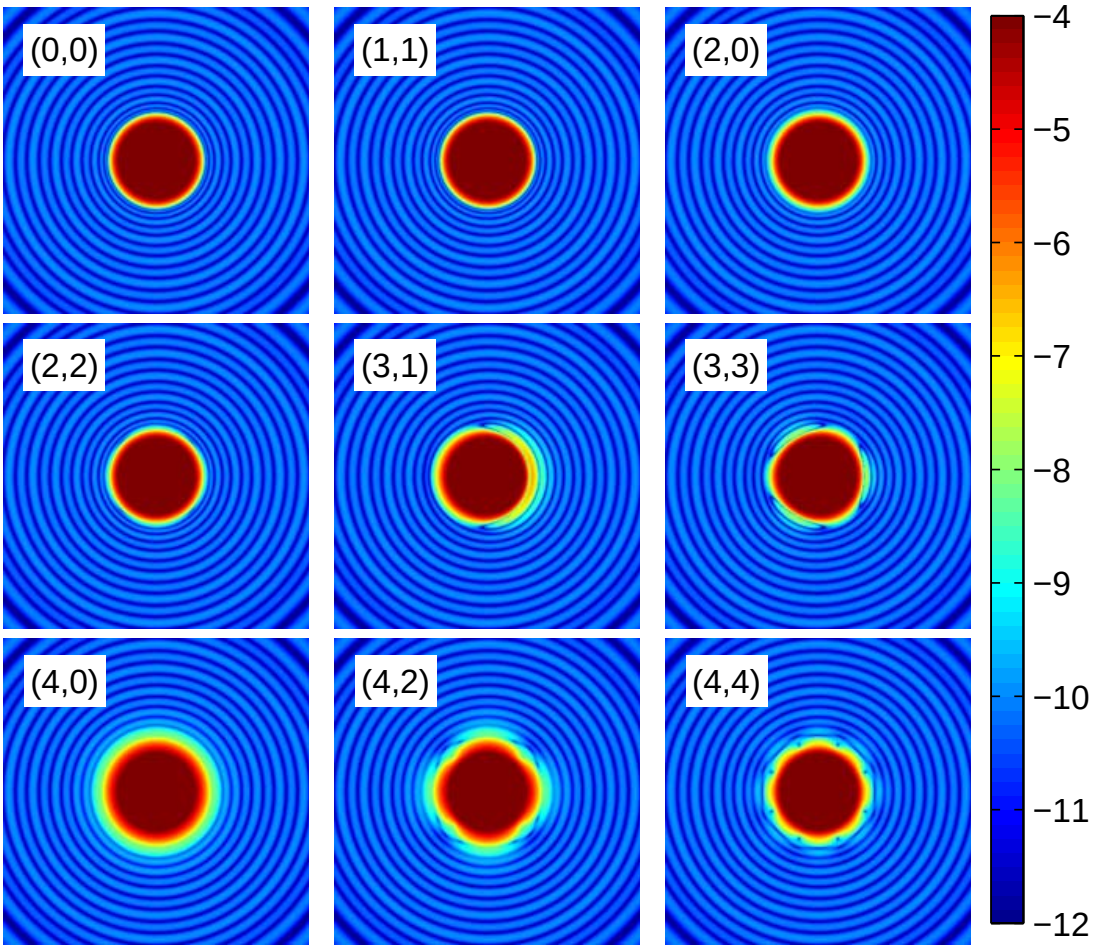
Sensitivity to Zernikes

Pupil Mapping



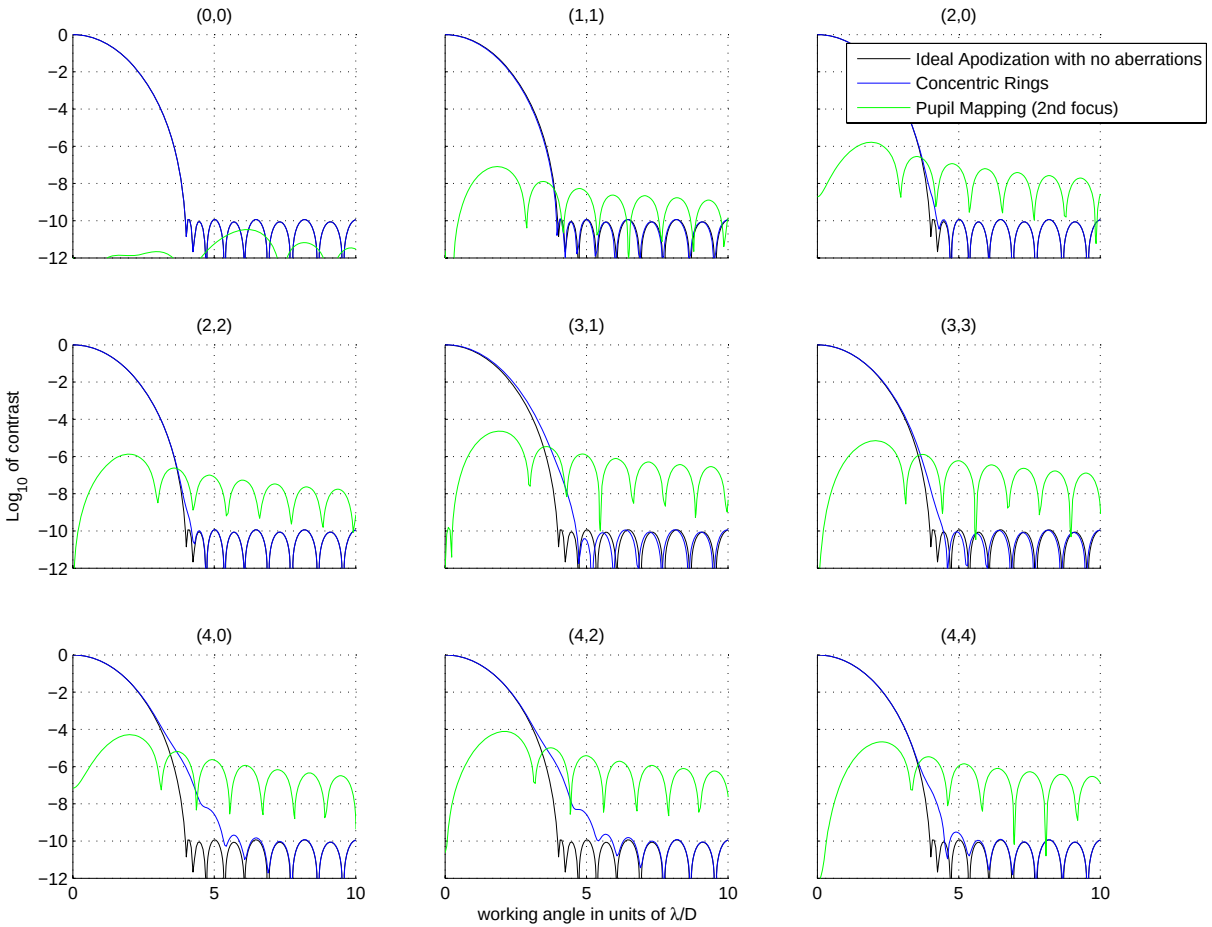
Sensitivity to Zernikes

Concentric Rings

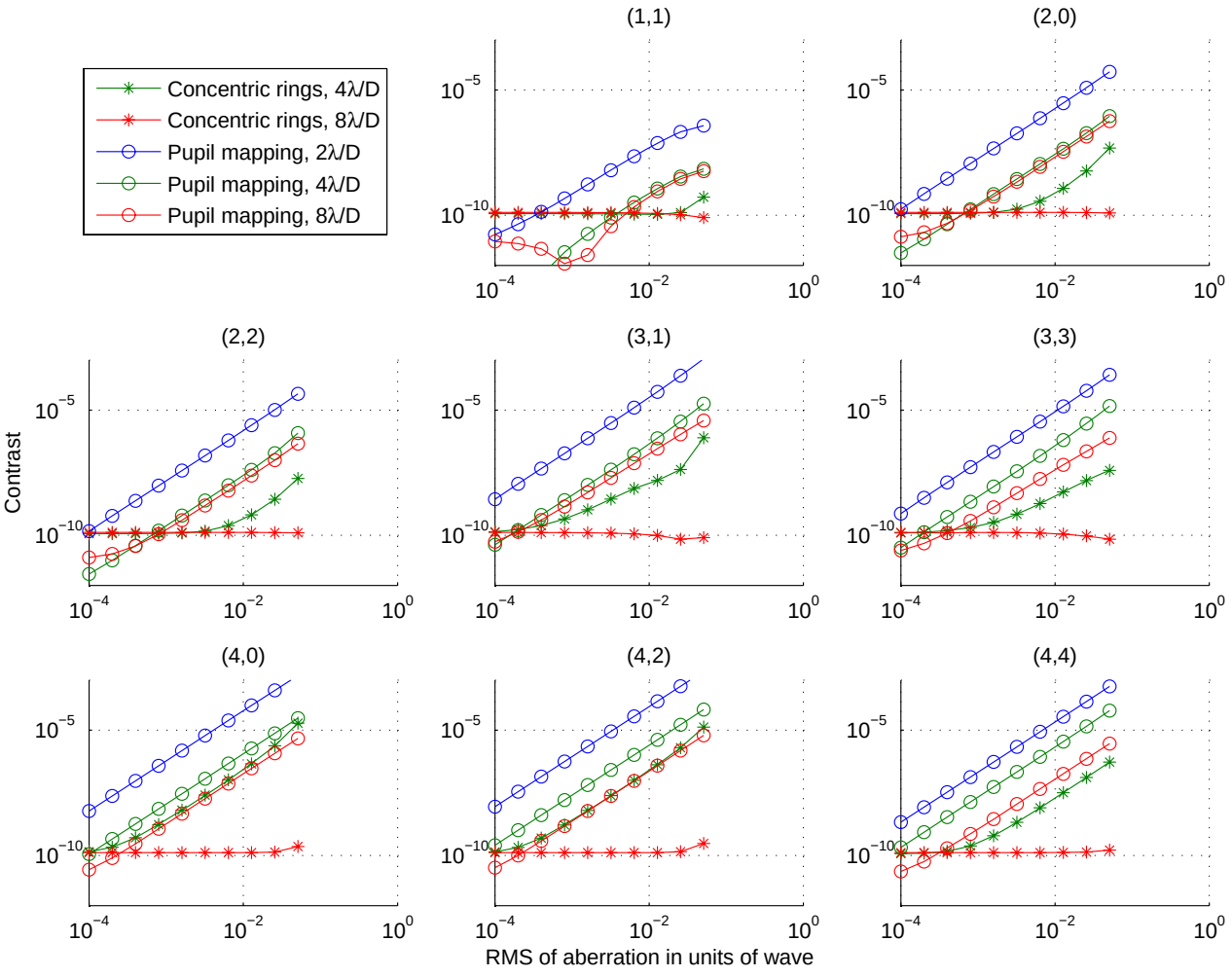


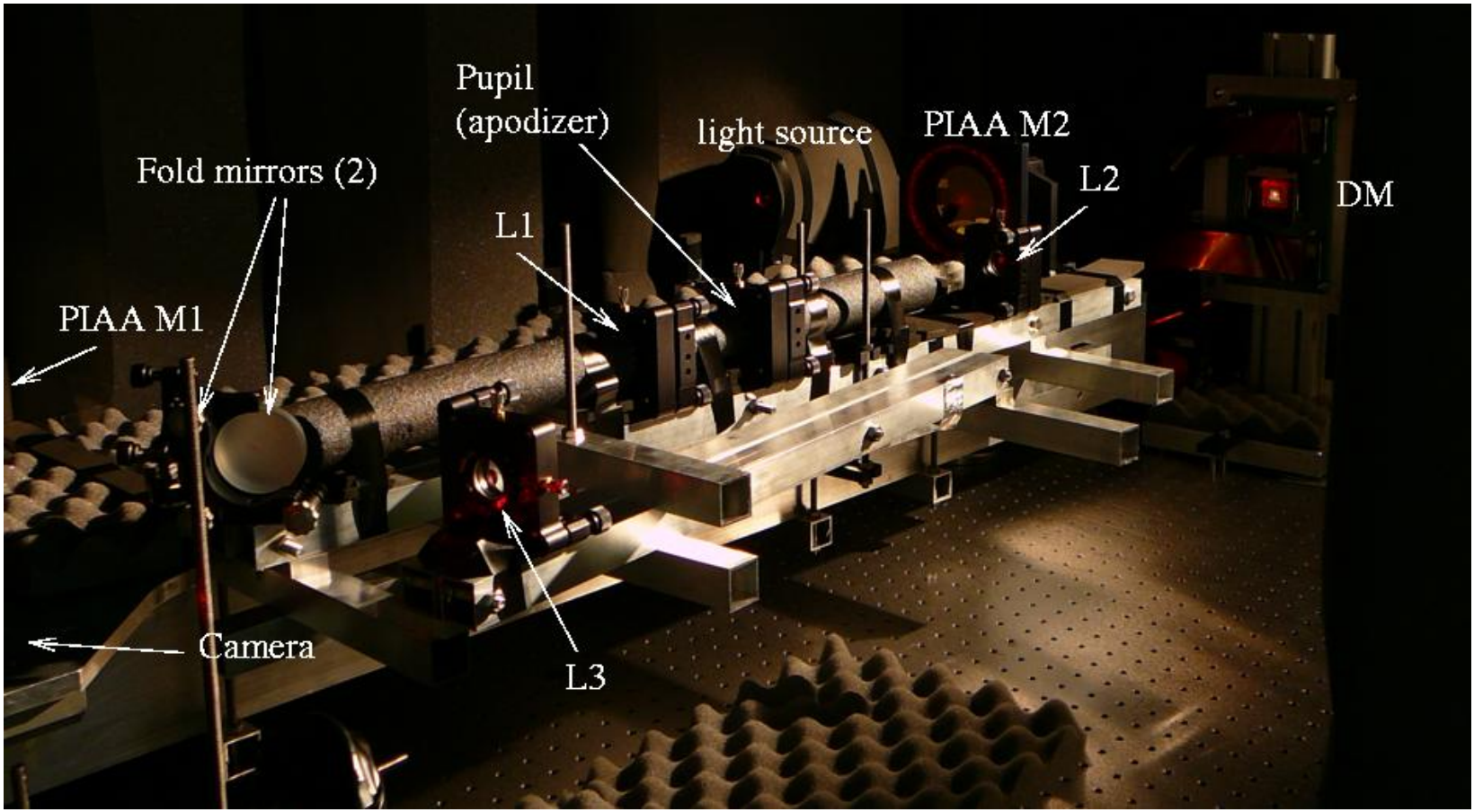
Sensitivity to Zernikes

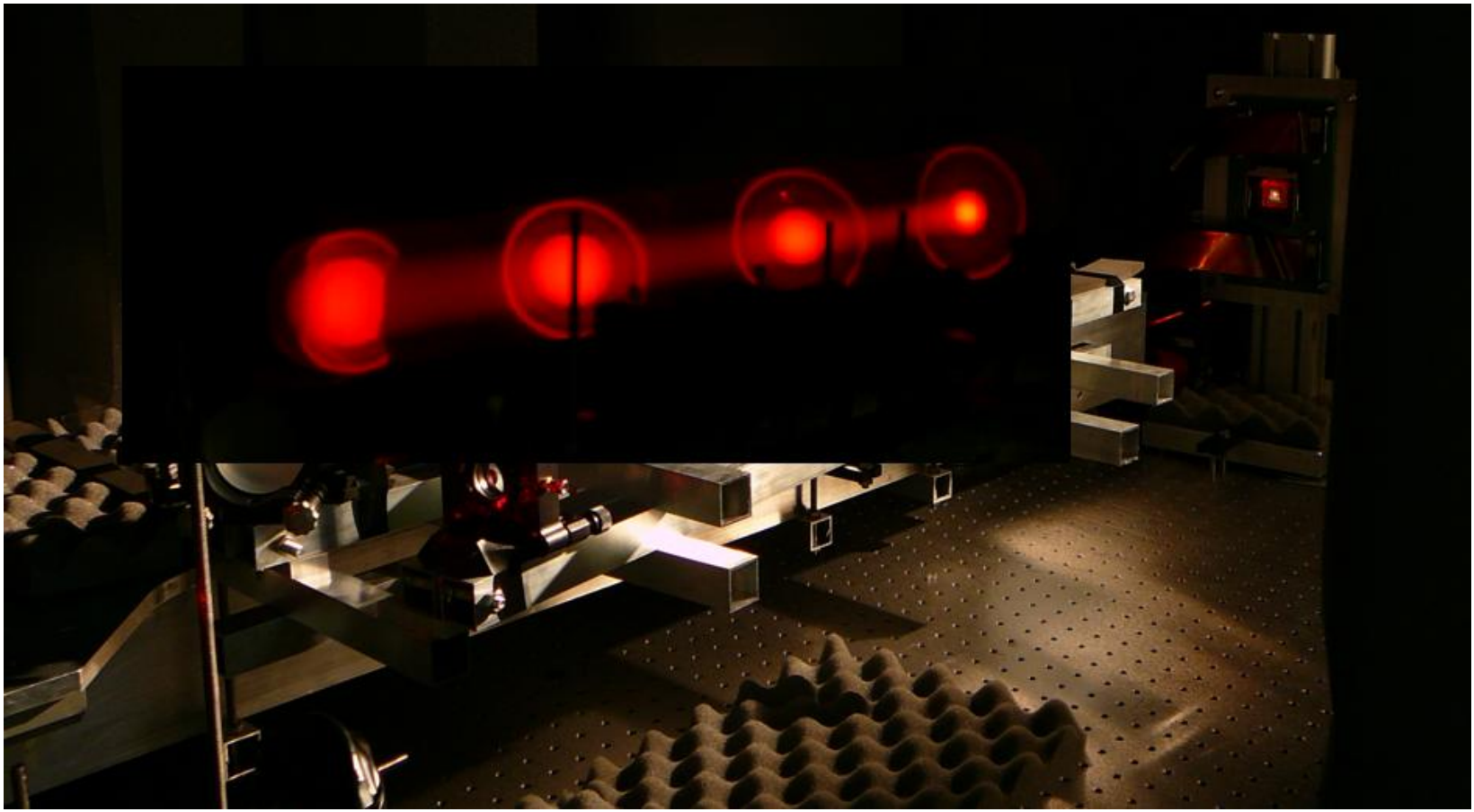
Radial Profiles

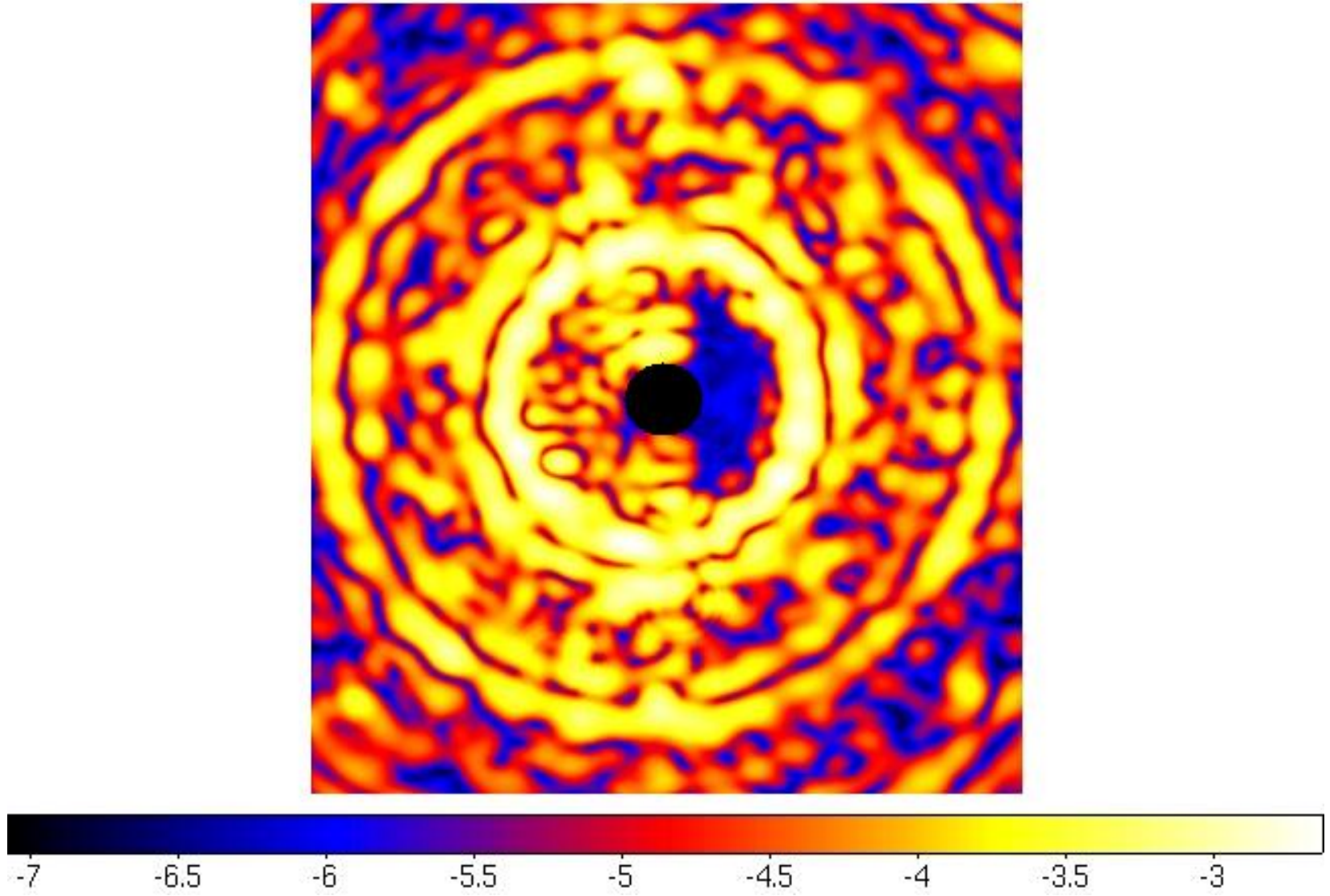


Shaklan Plots

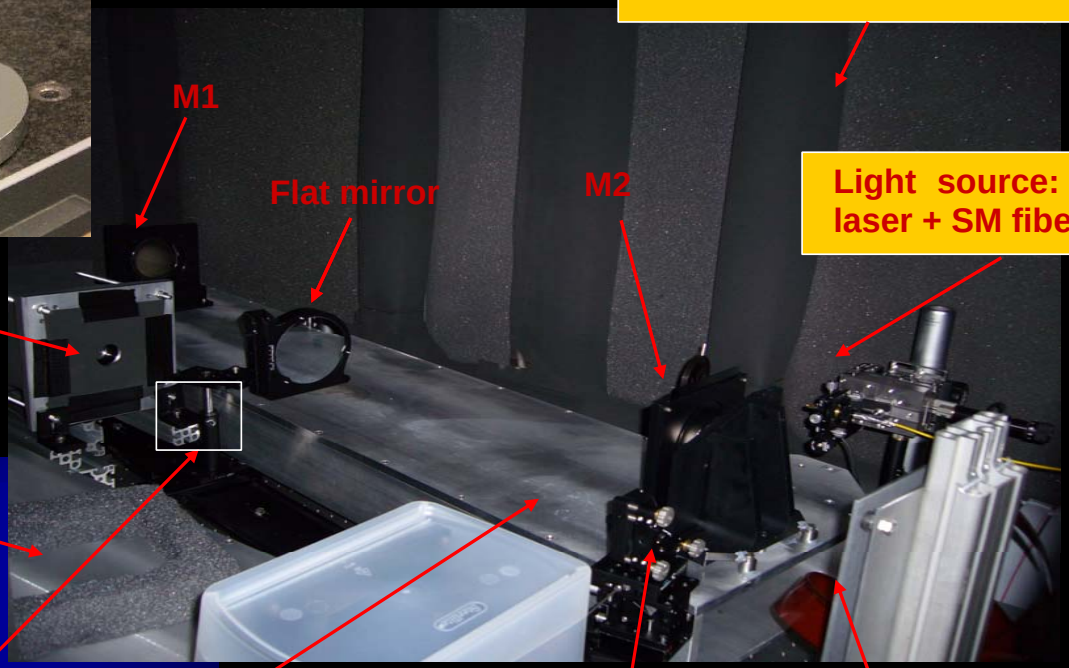



Pupil
(apodizer)
light source
PIAA M2
Fold mirrors (2)
L2
DM
L1
PIAA M1
Camera
L3




-7
-6.5
-6
-5.5
-5
-4.5
-4
-3.5
-3

Pupil Mapping Lab *(Subaru Telescope)*



Wavefront control and a classical apodizer (binary mask) have been included in the experiment..

Guyon's Lab Results

Contrast $\approx 6 \times 10^{-4}$