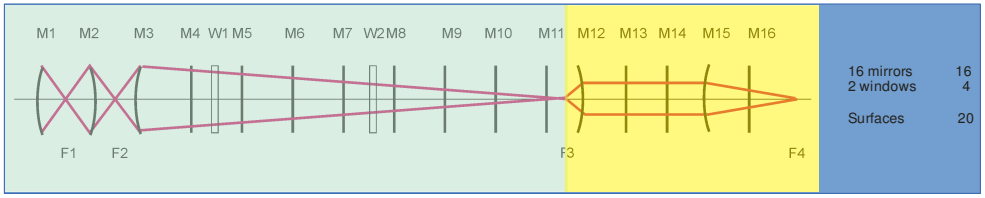
GREGOR
Some remarks about the optical performance

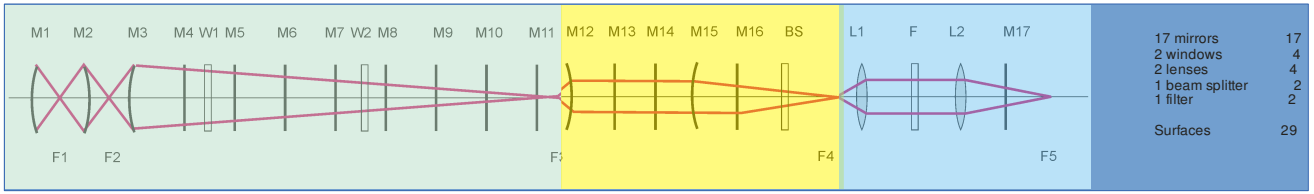
D. Soltau

KIS

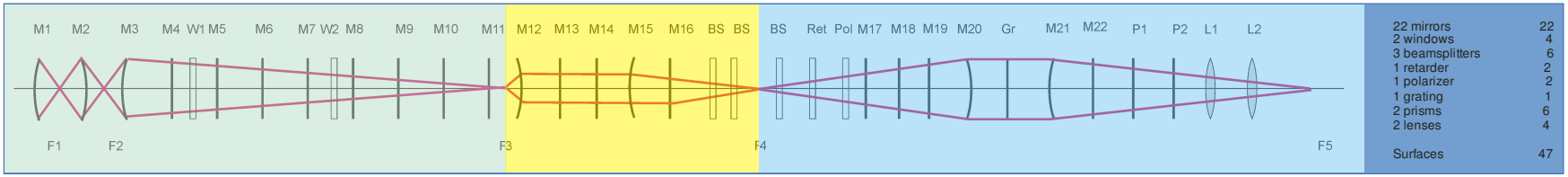
GREGOR compressed

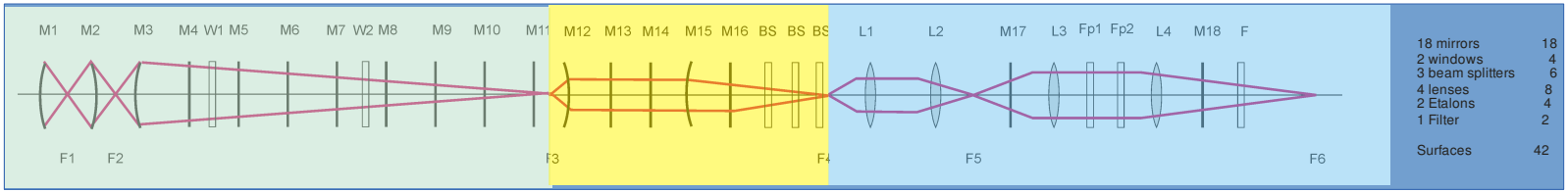


F4: 20 Surfaces
16 mirrors



BBI: 29 Surfaces
17 mirrors





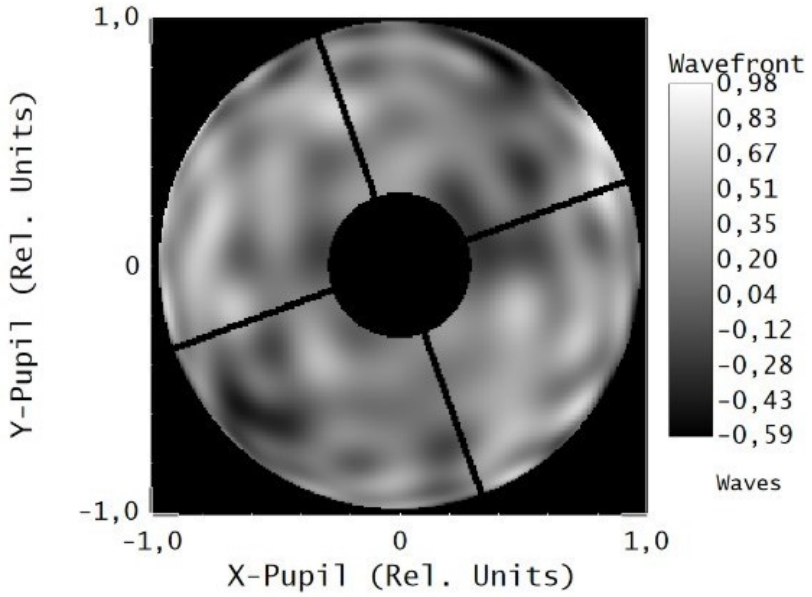
GREGOR: appr. 20 mirrors

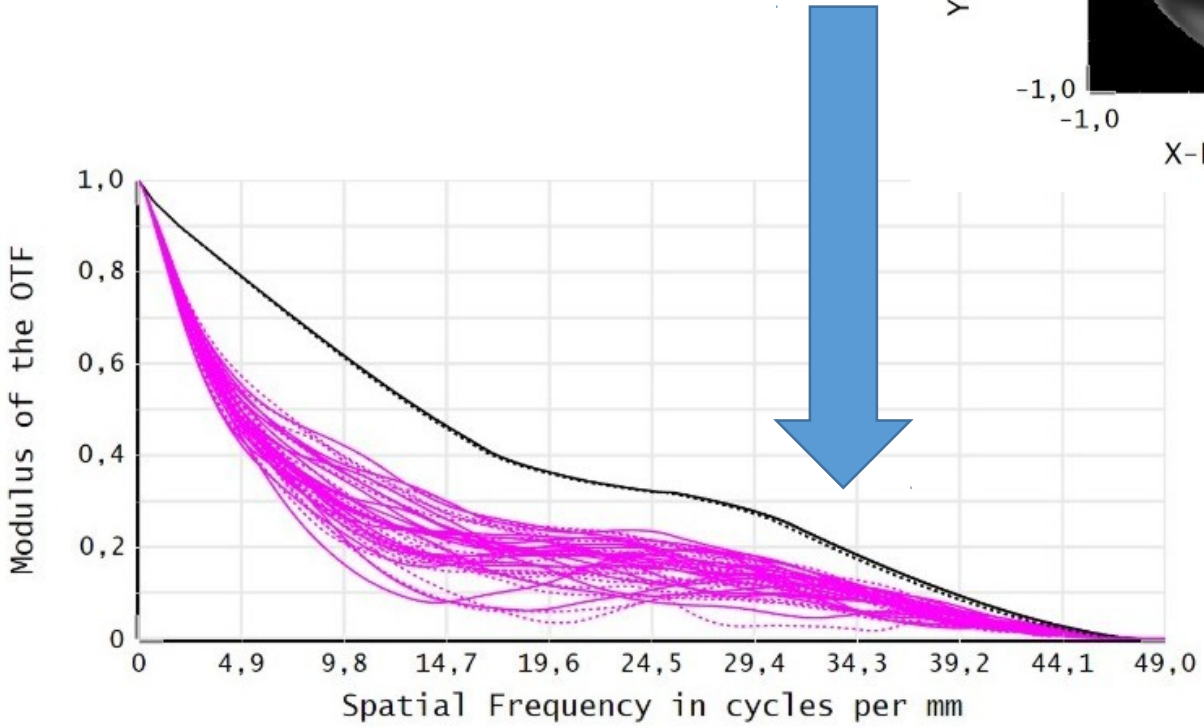
Best mirror quality: $\lambda/20$ = 30 nm (rms)

- GREGOR WFE > SQRT(20)*30 = 130 nm (rms)

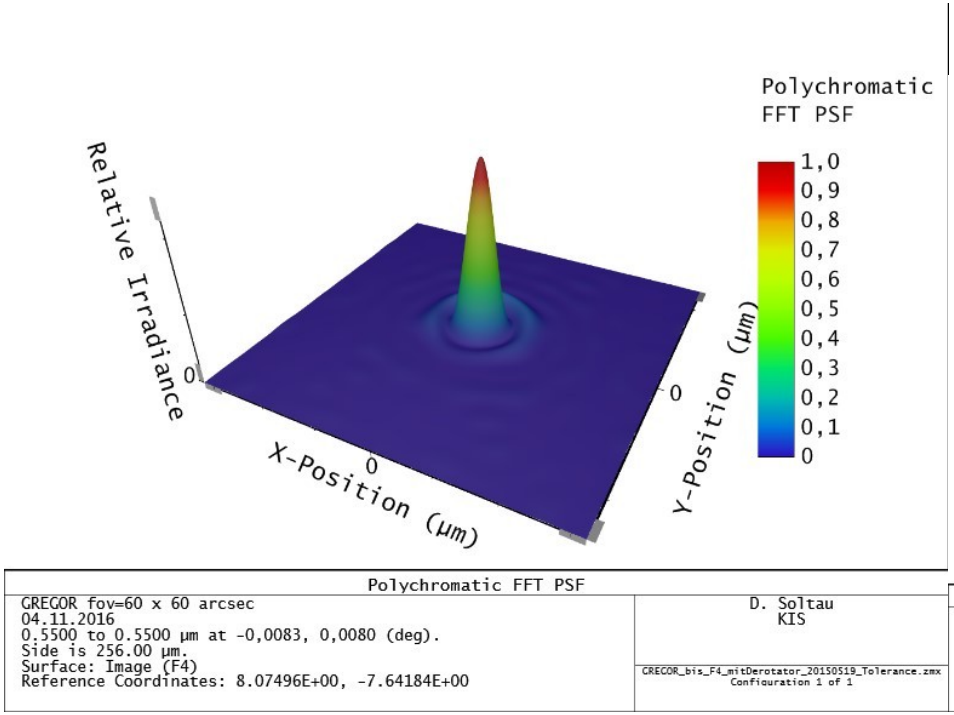
Monte Carlo

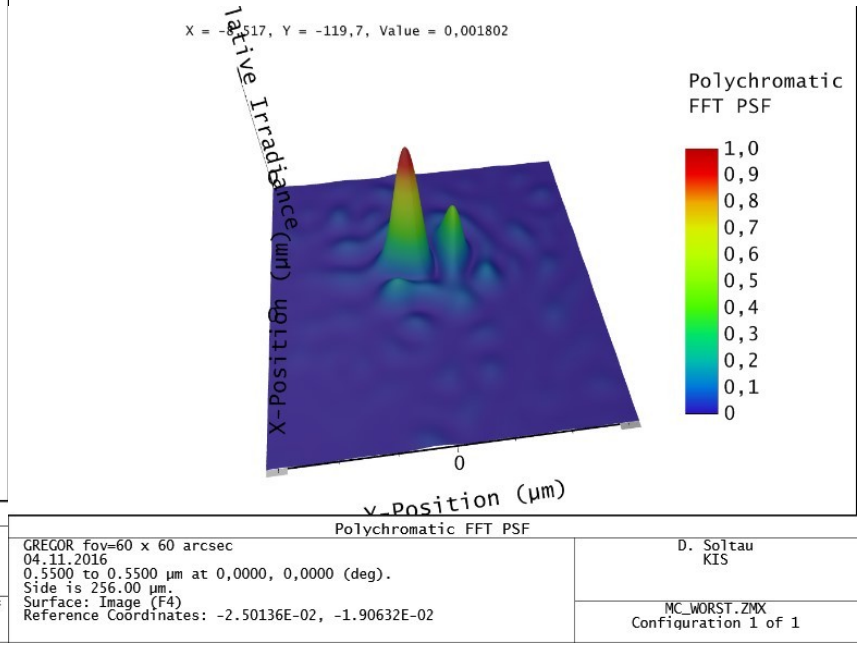
0.1 arcsec





PSF


Polychromatic
FFT PSF
Relative Irradiance
X-Position (µm)
Y-Position (µm)
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
Polychromatic FFT PSF
GREGOR fov=60 x 60 arcsec
04.11.2016
0.5500 to 0.5500 µm at -0,0083, 0,0080 (deg).
Side is 256.00 µm.
Surface: Image (F4)
Reference Coordinates: 8.07496E+00, -7.64184E+00
D. Soltau
KIS
GREGOR_bis_F4_mitDerotator_20150519_Tolerance.zmx
Configuration 1 of 1


X = -2,517, Y = -119,7, Value = 0,001802
Relative Irradiance
X-Position (µm)
Y-Position (µm)
Polychromatic
FFT PSF
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
Polychromatic FFT PSF
GREGOR fov=60 x 60 arcsec
04.11.2016
0.5500 to 0.5500 µm at 0,0000, 0,0000 (deg).
Side is 256.00 µm.
Surface: Image (F4)
Reference Coordinates: -2.50136E-02, -1.90632E-02
D. Soltau
KIS
MC_WORST.ZMX
Configuration 1 of 1

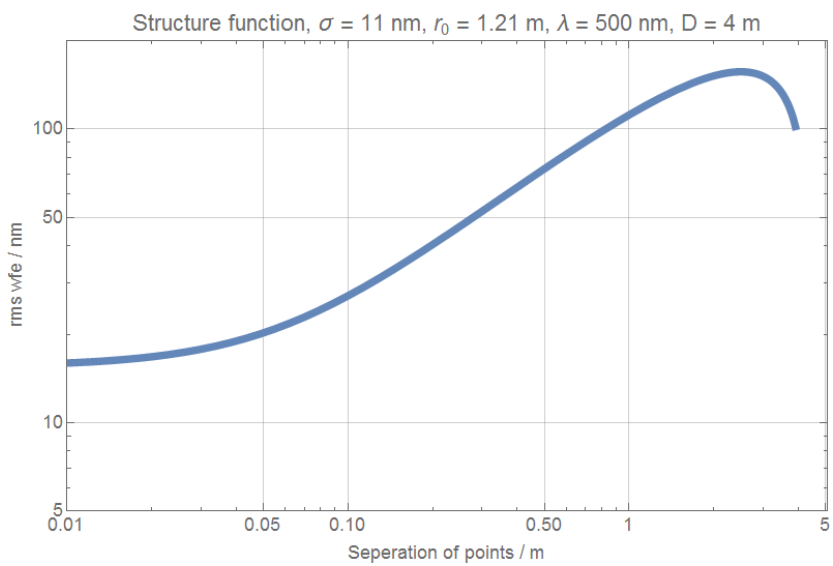
Error size distribution: Structure function

$$D_{\Phi}(r) = \left\langle \left[\Phi(x+r) - \Phi(r) \right]^2 \right\rangle$$

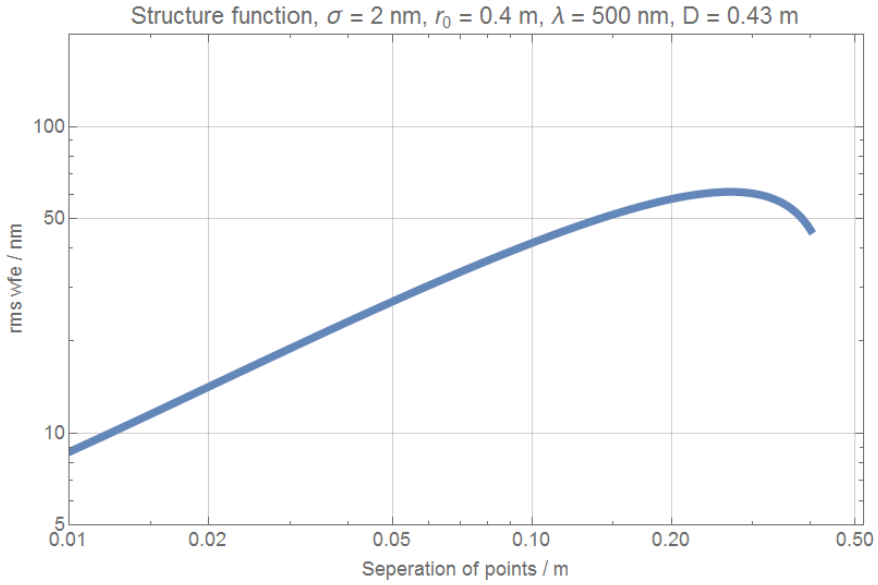
$$\mathrm{S}(x) = \sqrt{2 * \sigma^2 + \left(\frac{\lambda}{6.28}\right)^2 * 6.88 * \left(\frac{x}{\mathrm{r0}}\right)^{\frac{5}{3}} \left(1 - 0.975 * \left(\frac{x}{D}\right)^{\frac{1}{3}}\right)};$$

Examples :

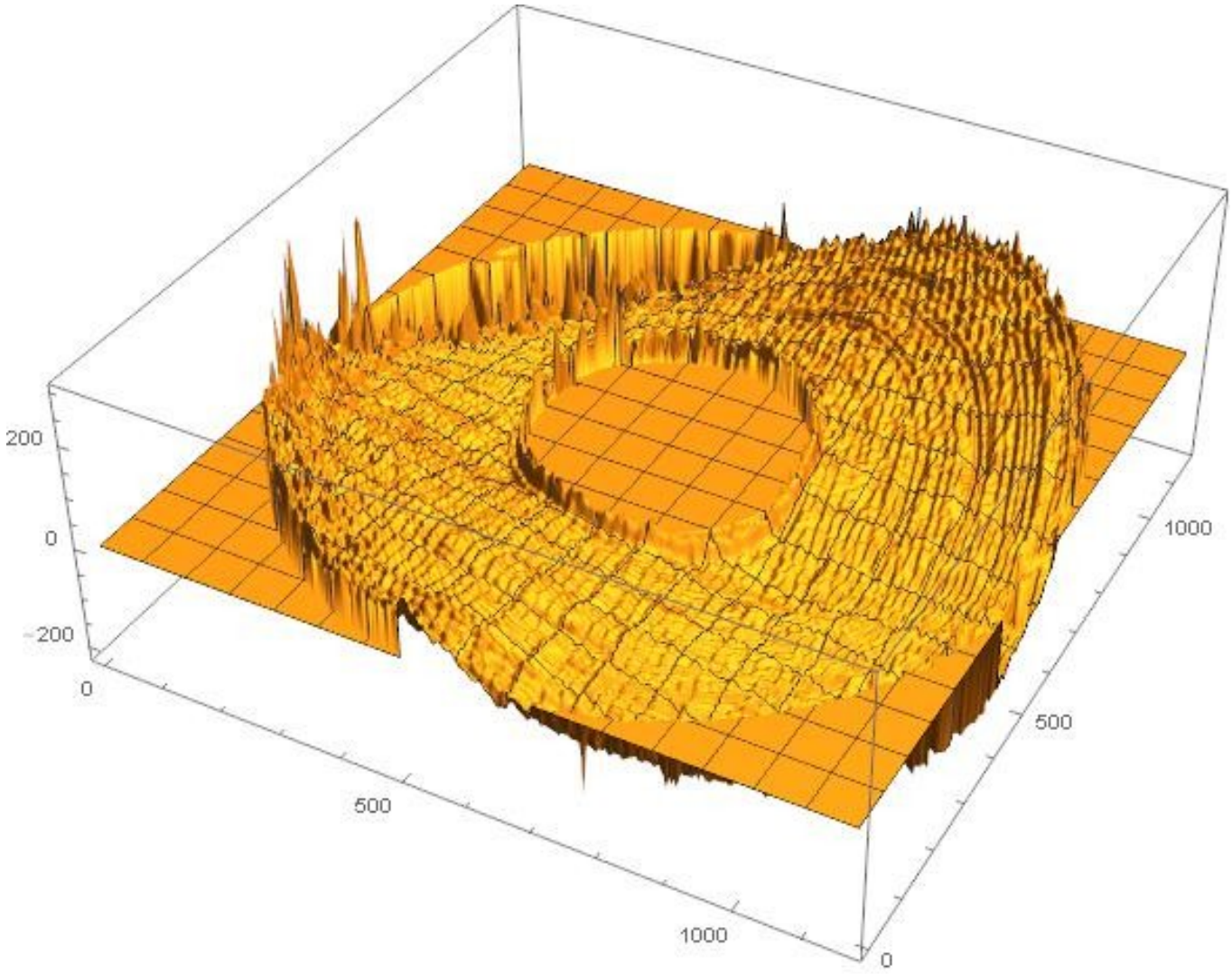
LSST



GREGOR M2

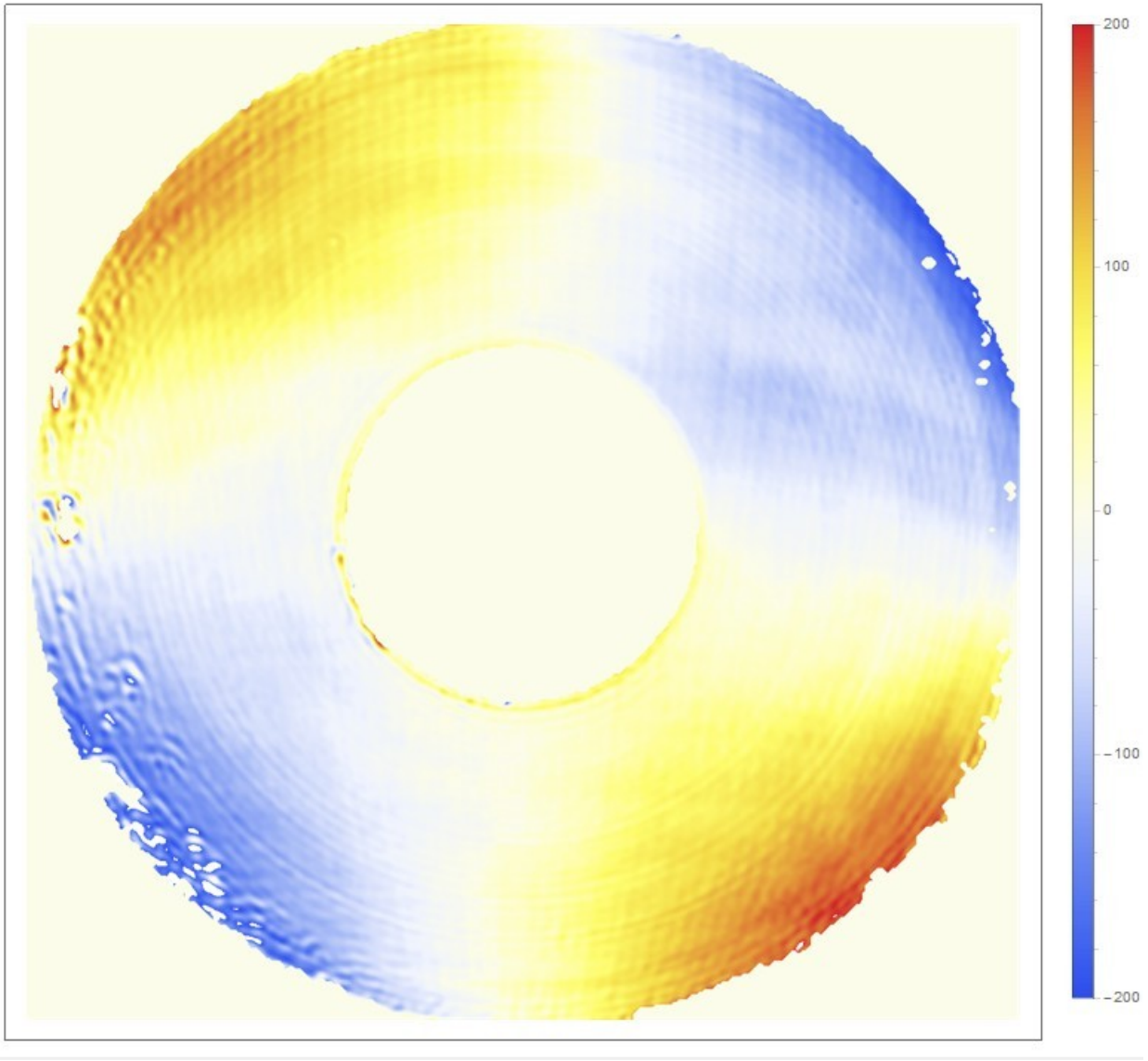


M1

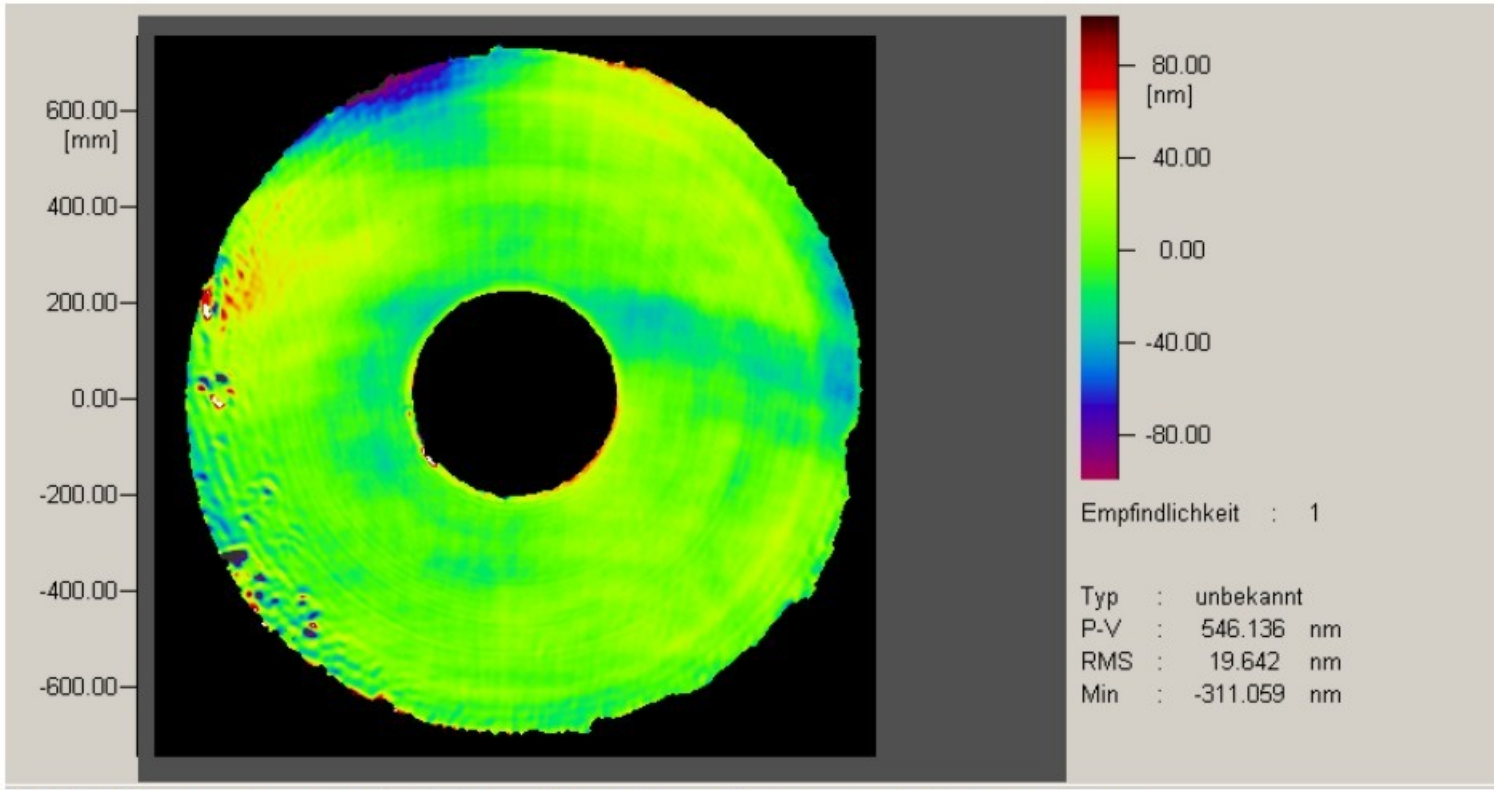


M1

- WFE (rms) = 70 nm

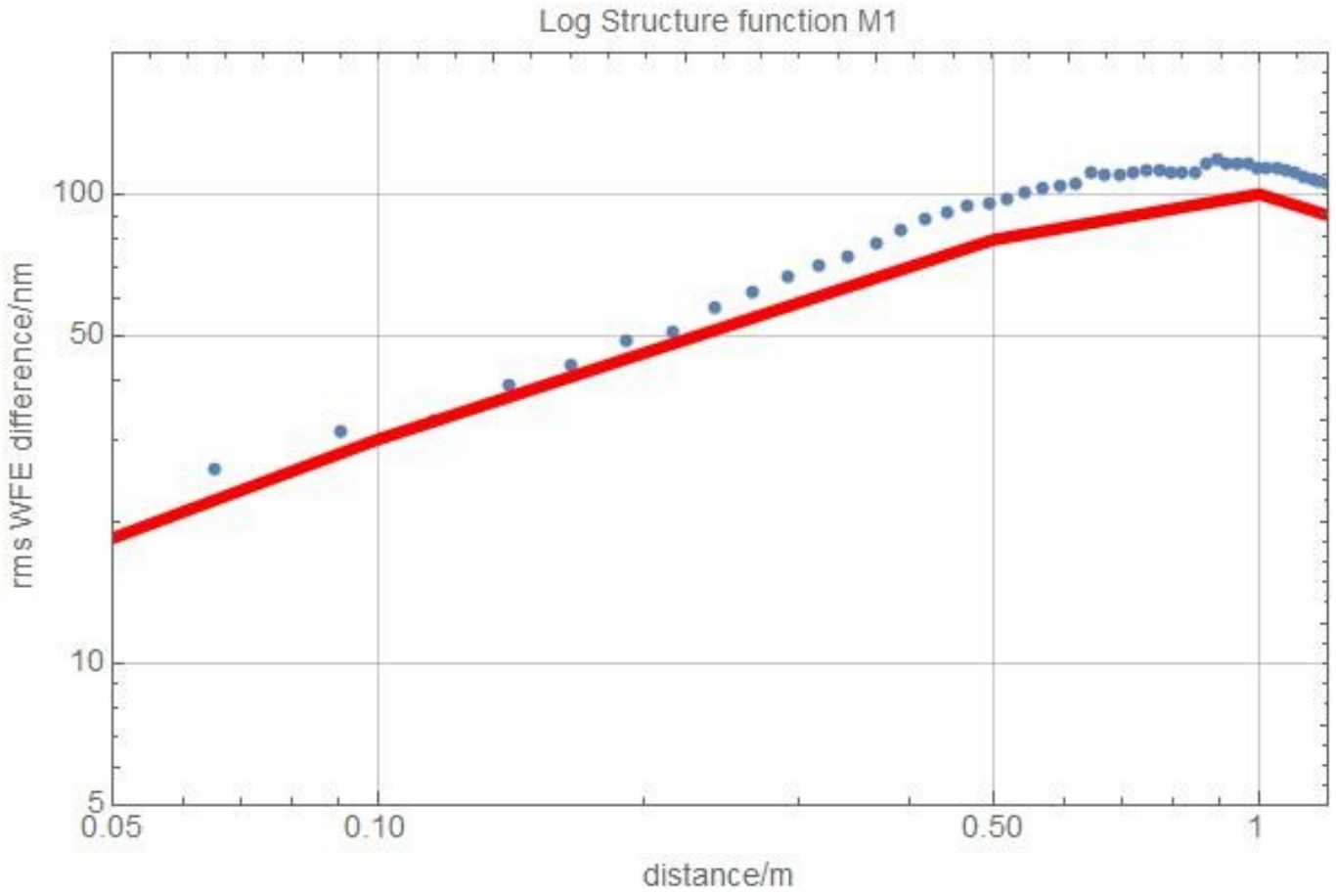


M1 ohne Ast

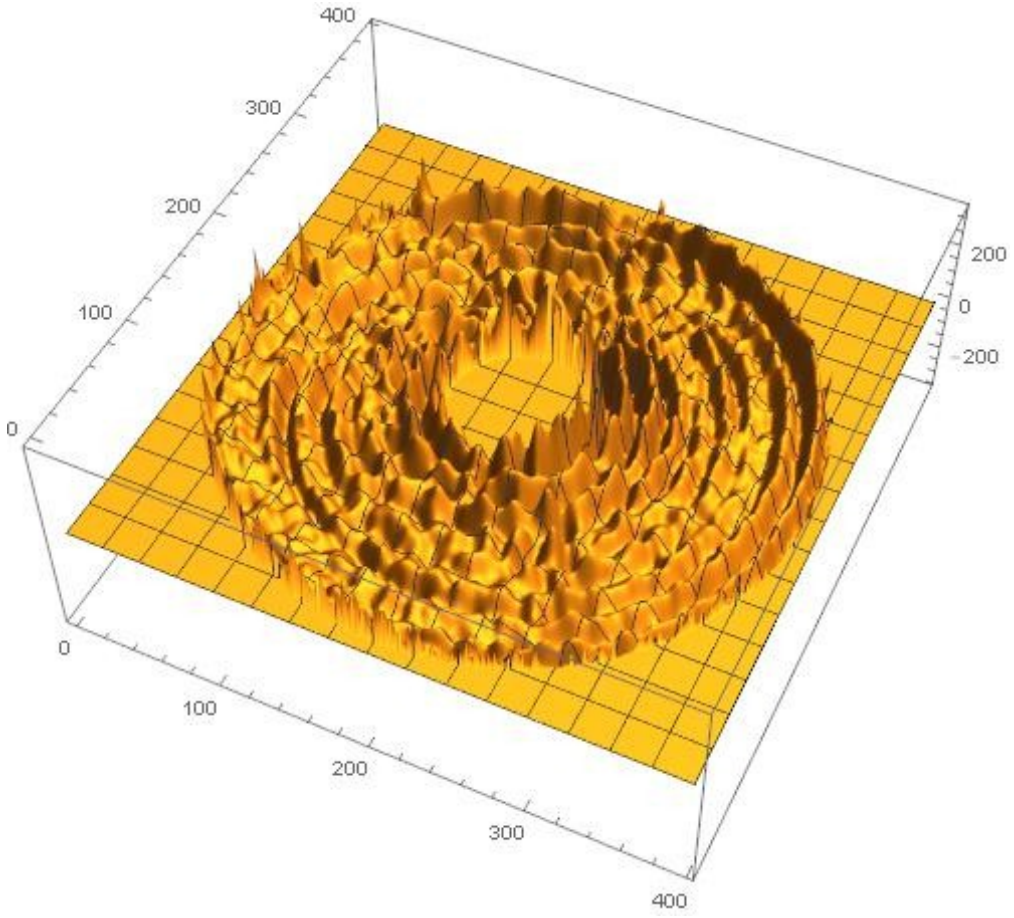


IFM-Measurement 06.04.11 – Wavefront Error excl. Astigmatism

M1 Structure function

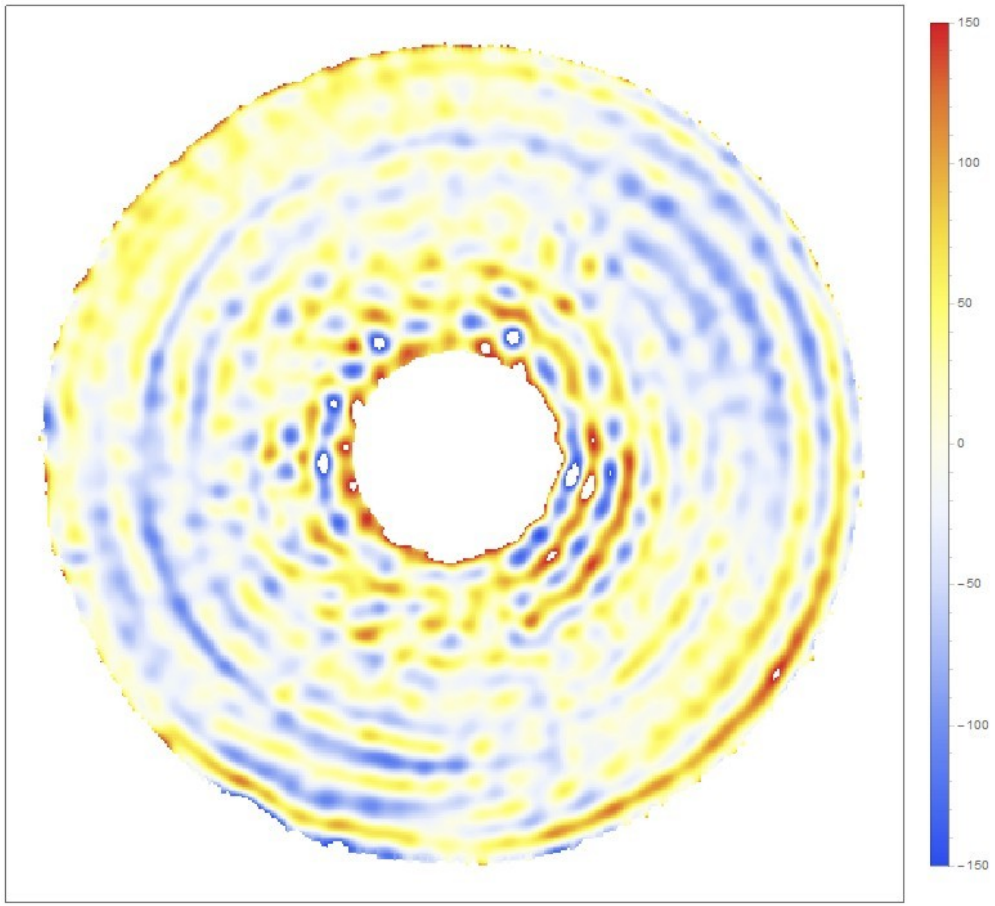


M2



M2

WFE rms = 45 nm



M2: Spec for new one vs. measurement of old one

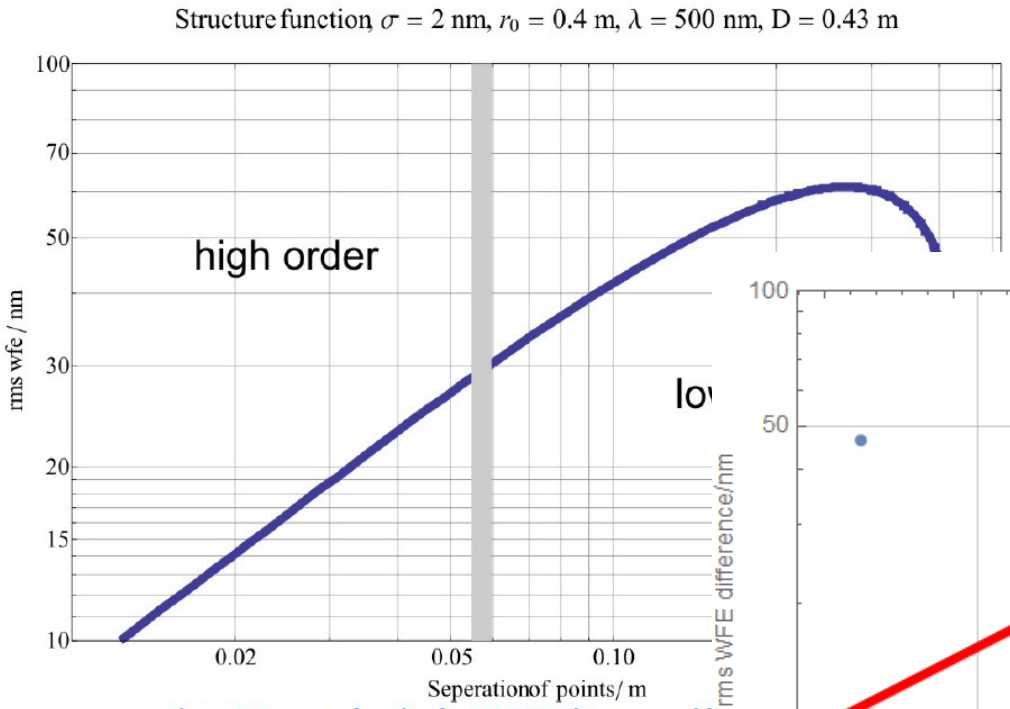
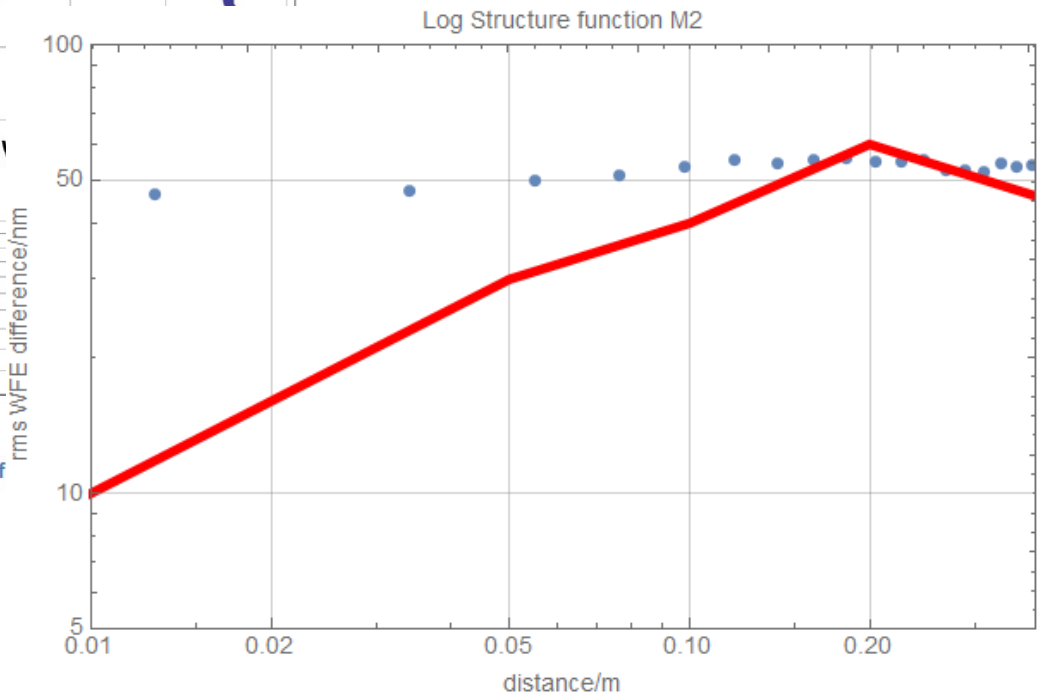
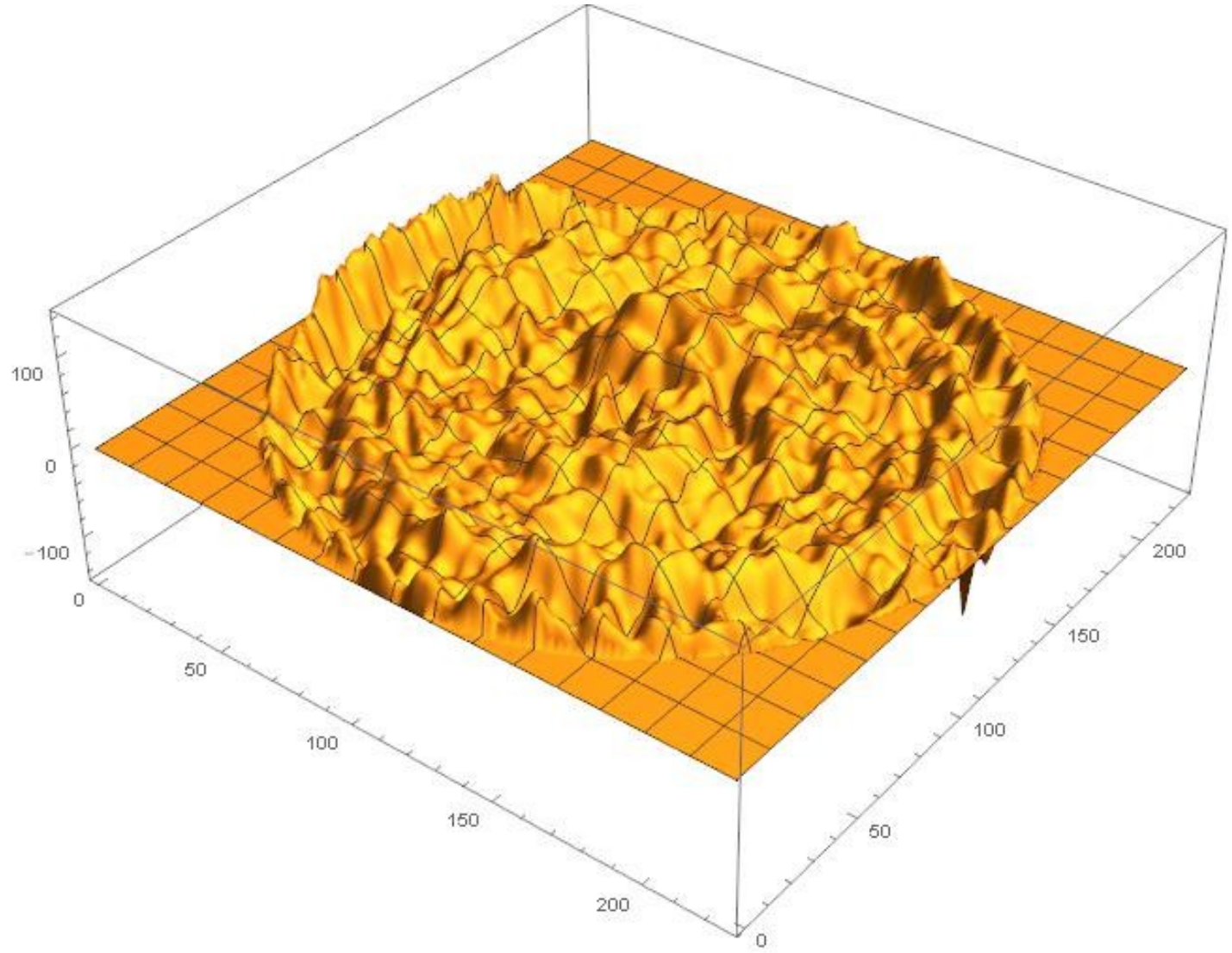


Figure 7: Structure function for M2 WFE. The measured f

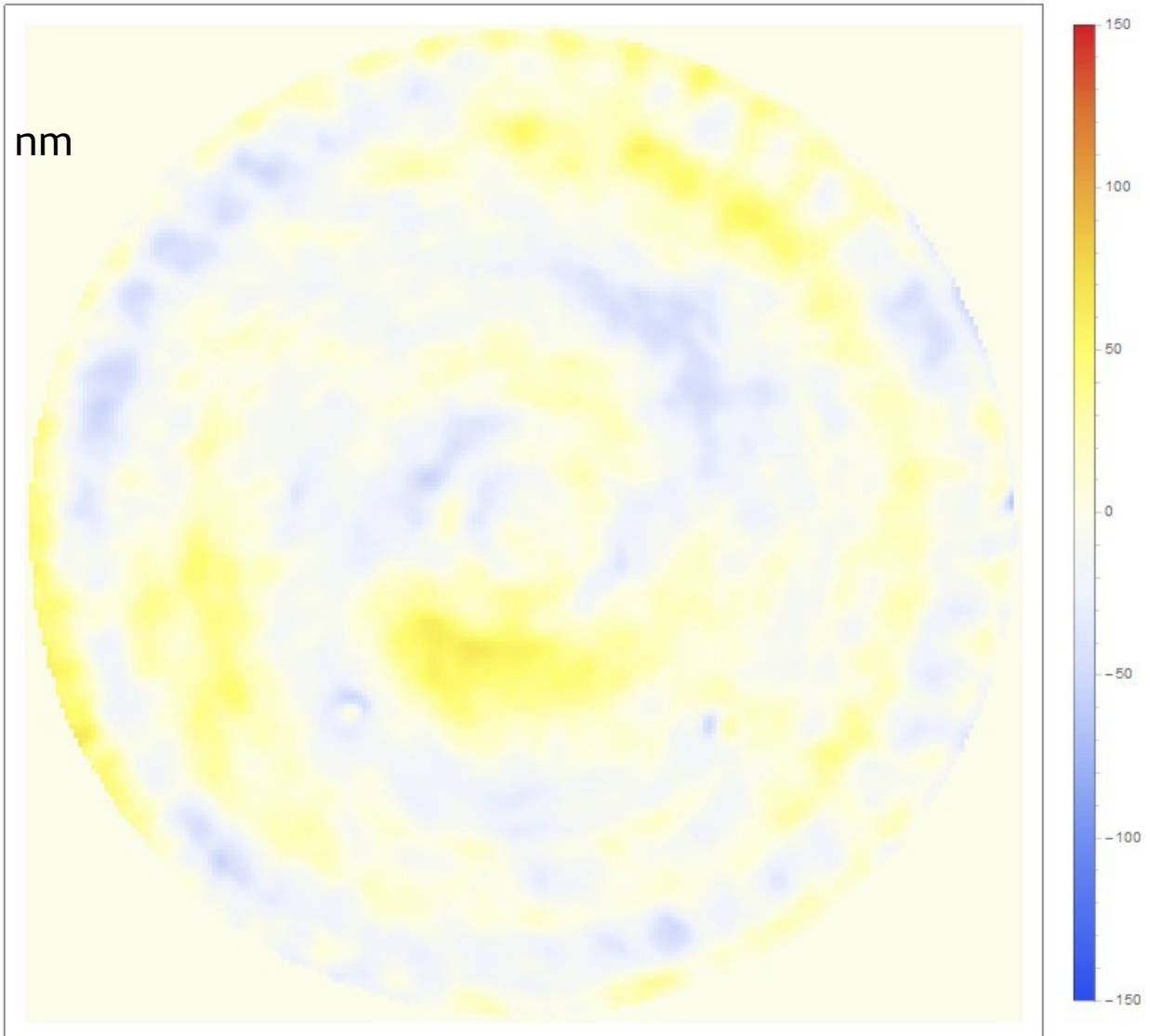


M3

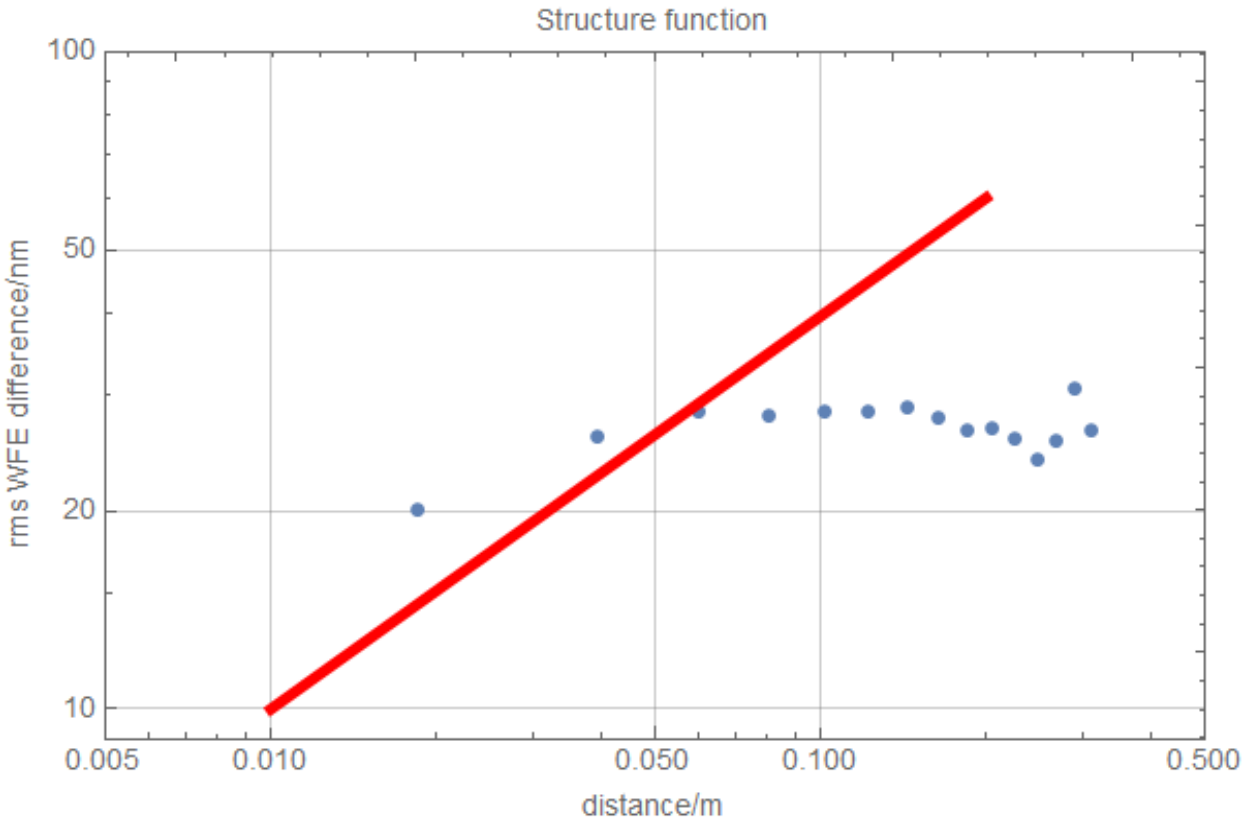


M3

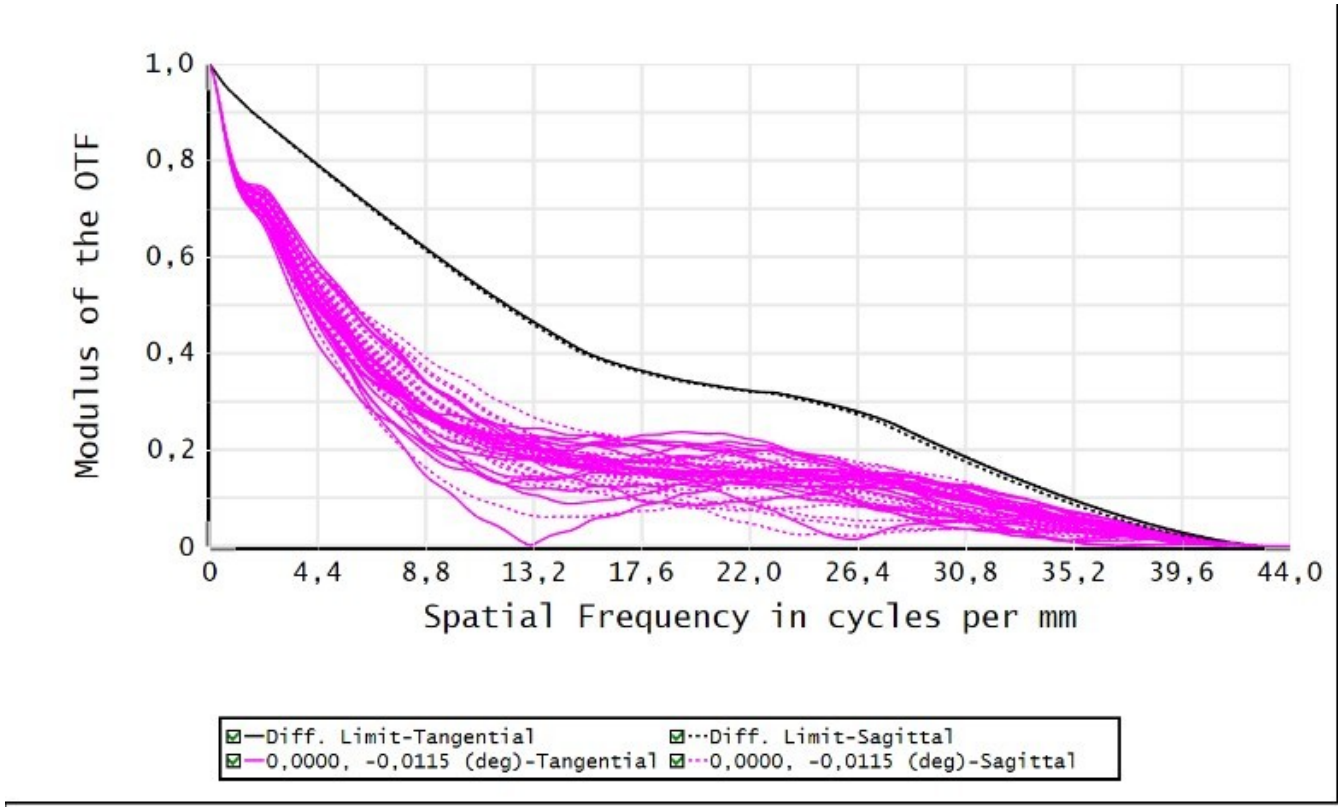
WFE rms = 19 nm

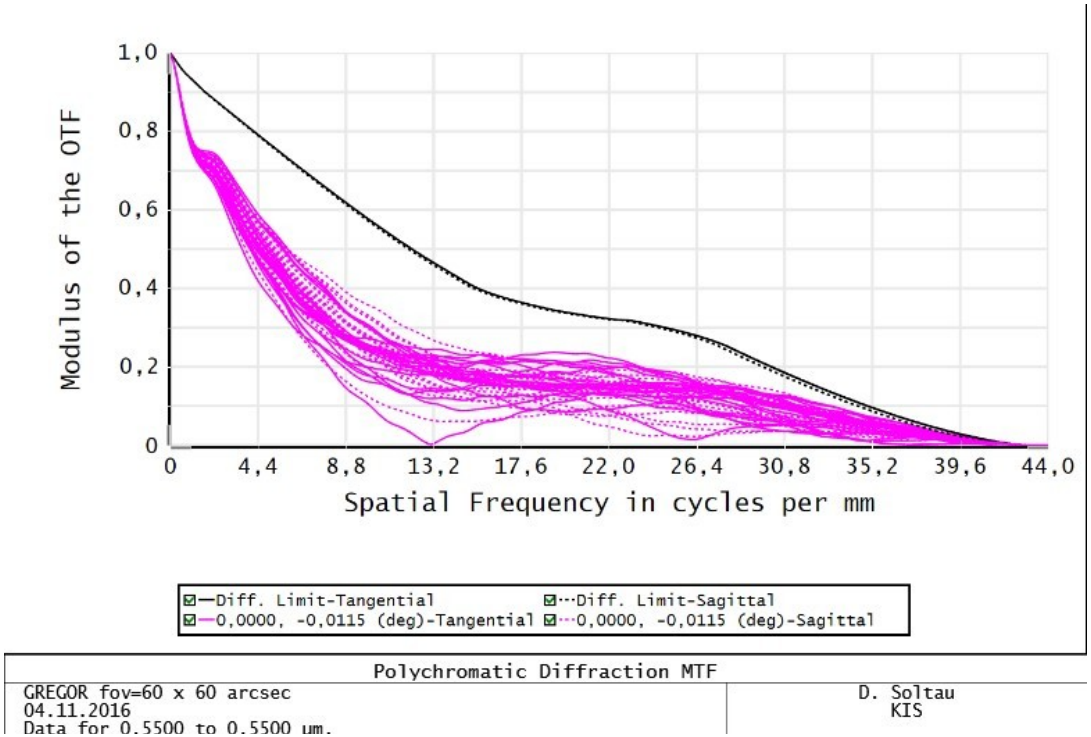


M3

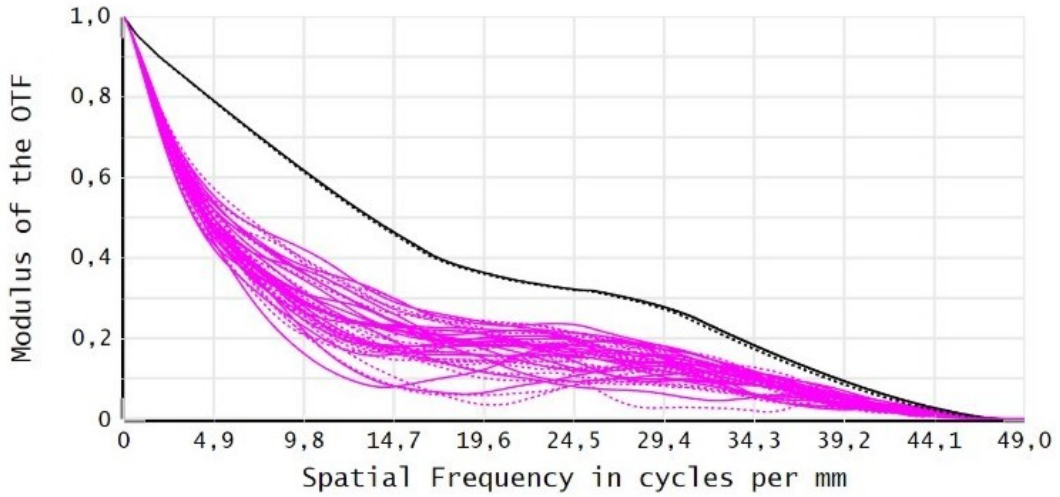

Structure function
100
50
20
10
rms WFE difference/nm
0.005
0.010
0.050
0.100
0.500
distance/m

Known surfaces + 30nm mirrors



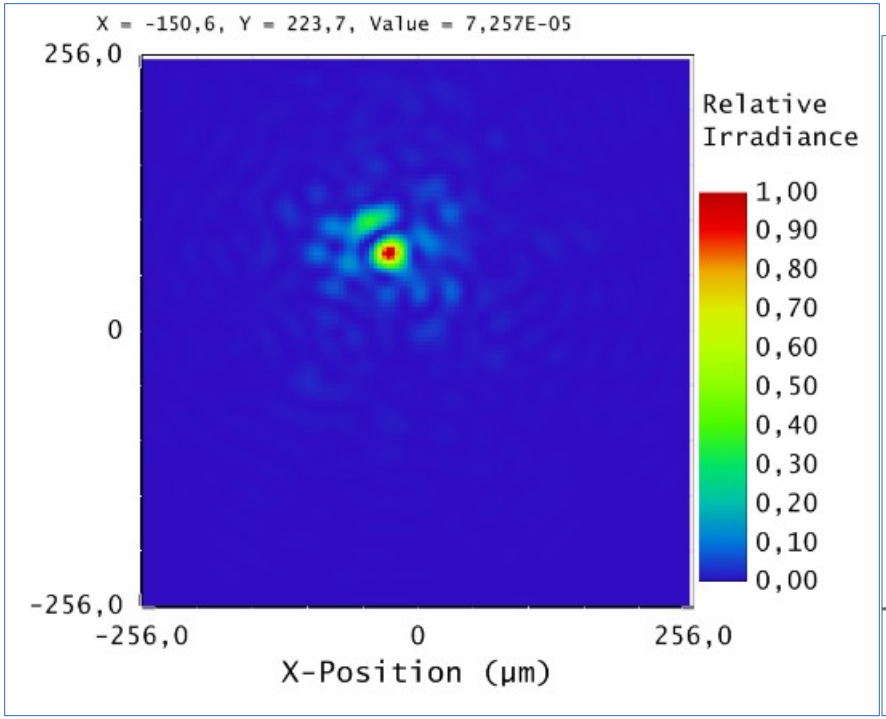


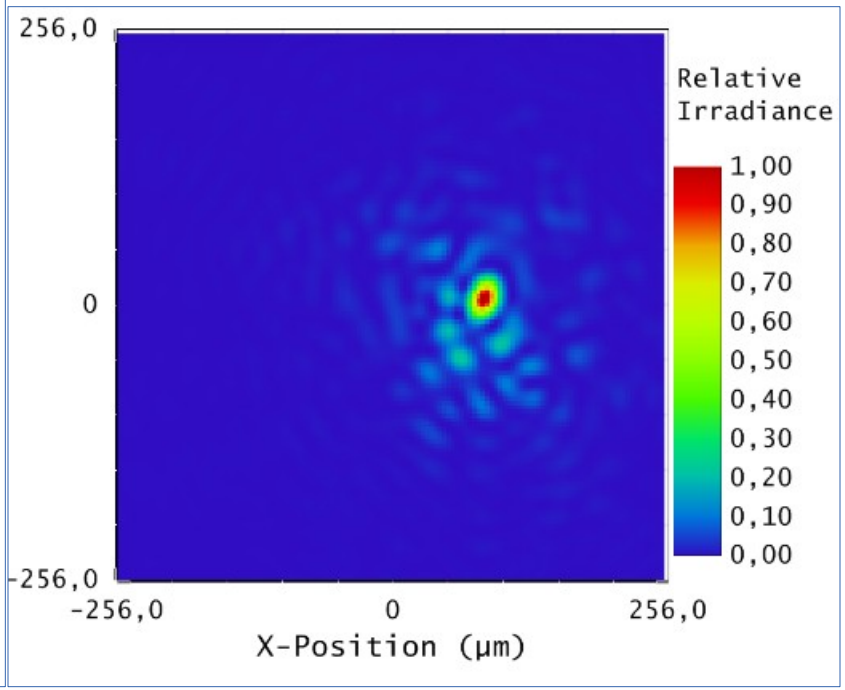
With current M2



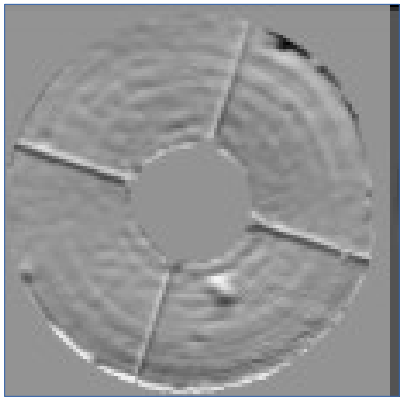
With ideal M2

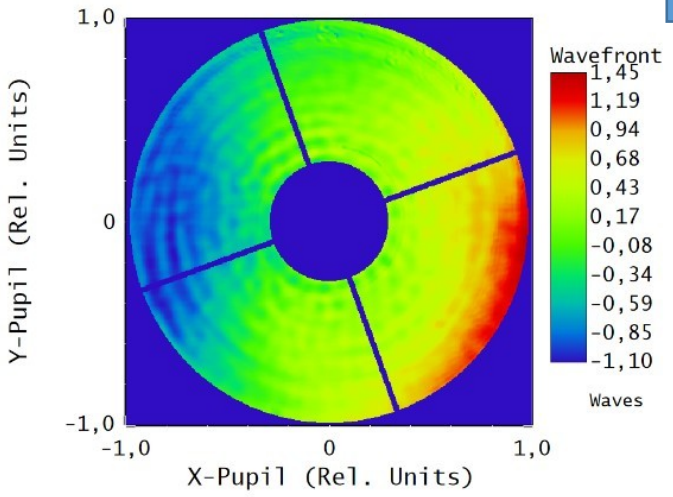
Examples: Best and worst for 40 nm mirrors



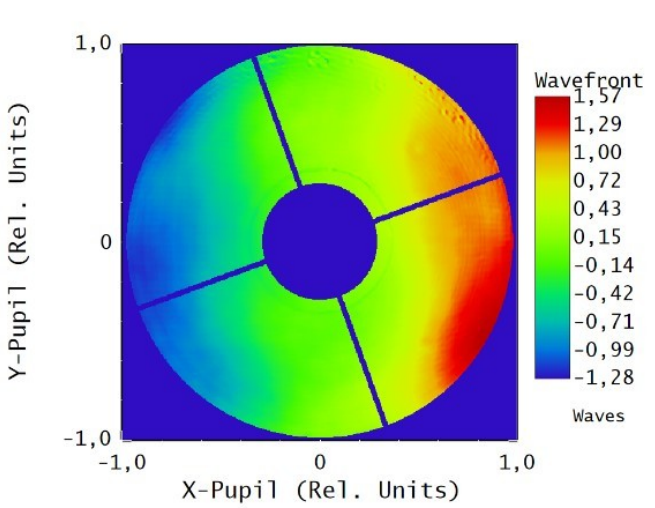


Will M2 make the difference?





Wavefront Function	
GREGOR fov=60 x 60 arcsec 04.11.2016 0.5500 µm at 0,0000, 0,0000 (deg) Peak to valley = 2.5507 waves, RMS = 0.5707 waves. Surface: Image (F4) Exit Pupil Diameter: 7.2168E+03 Millimeters	D. Soltau KIS gregMC_WORST.ZMX Configuration 1 of 1



Wavefront Function	
GREGOR fov=60 x 60 arcsec 04.11.2016 0.5500 µm at 0,0000, 0,0000 (deg) Peak to valley = 2.8513 waves, RMS = 0.6978 waves. Surface: Image (F4) Exit Pupil Diameter: 5.8719E+03 Millimeters	D. Soltau KIS gregidealM2MC_WORST.ZMX Configuration 1 of 1

Summary

- Many surfaces produce wfe on different unknown scales
- Probably the reason why AO correction extends of pretty large FOV
- New M2 should reduce high order WFE significantly and should improve the WFS performance
- The total Strehl of the whole telescope + backend instruments will not change dramatically