SAMS Meeting 13/12/2018 Adelaide update

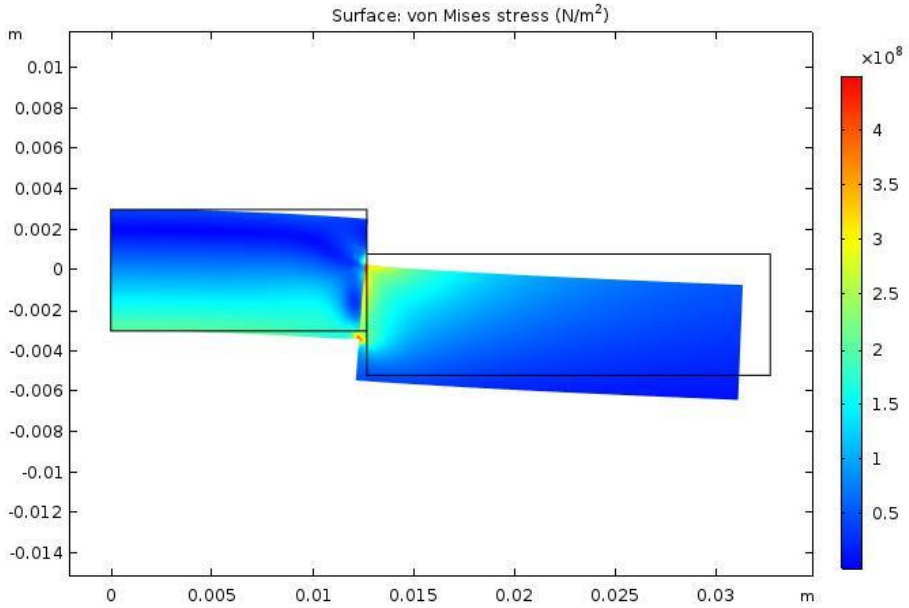
- Adhesive-free composite mirror

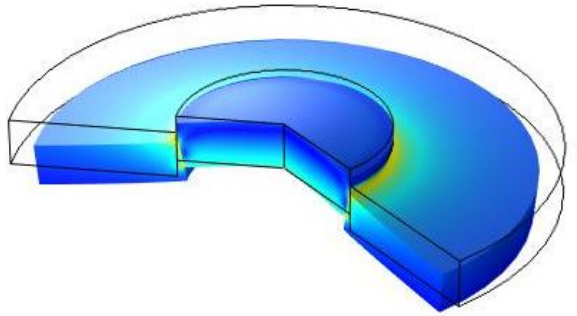
Compression-fit mirror

- Consists of:
  - Mirror element to be deform
  - Annular aluminium disc with inner radius < mirror radius at room temperature
- Both components heated up until fused silica mirror fall through hole
- Assembly is cooled down to room temperature
- Aluminium disc compresses and deforms mirror

Benefit:

- No adhesive required.
- COMSOL FEA shows significantly lower higher order aberration, compared to composite mirror.





Assembly

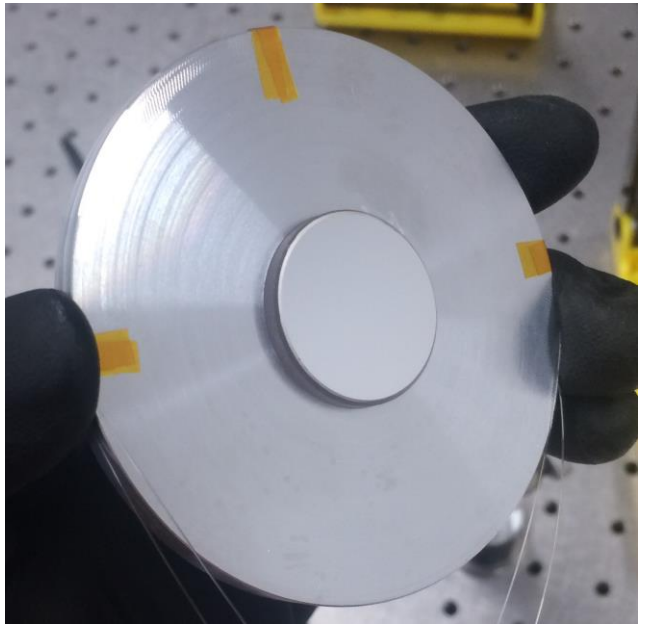
Fused silica mirror:

- ⌀ = 25.36 mm @ 22°C,
- 6 mm thickness

Al ring:

- ⌀inner = 25.33 mm @ 22oC,
- ⌀outer = 65 mm
- 6 mm thickness

- The line bisecting the mirror thickness (6mm) is offset by 0.2 mm from the front face of the aluminium. This was chosen to allow maximum distortion, according to FEA model
- Assembly heated to 100°C.
- Cooled down to room temperature over night
- Reflective surface is convex
- Kapton tape and Nichrome are used to create heater at the back

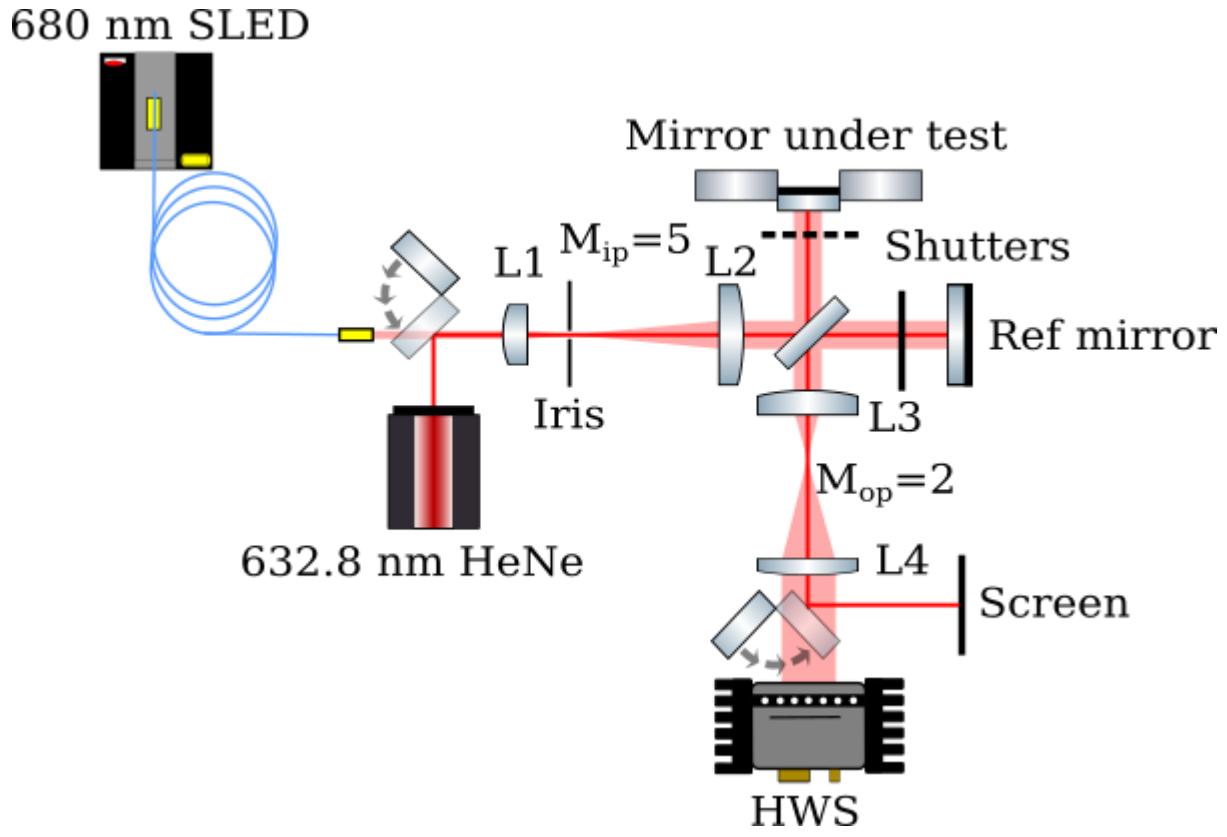




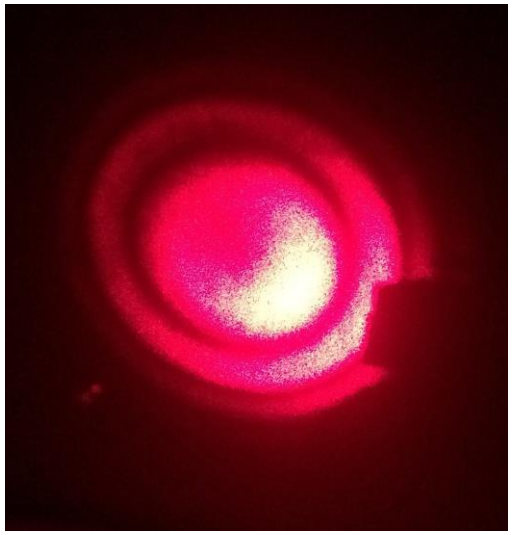


Static deformation test

- Set up can be used as either an interferometer or as a
- Hartmann sensing system.
- HeNe was used to first align such that two beams reflected from reference mirror and mirror under test are colinear.
- SLED was aligned to HeNe beam.
- Two flats mirror were first used to benchmark the result obtained with compression fit mirror



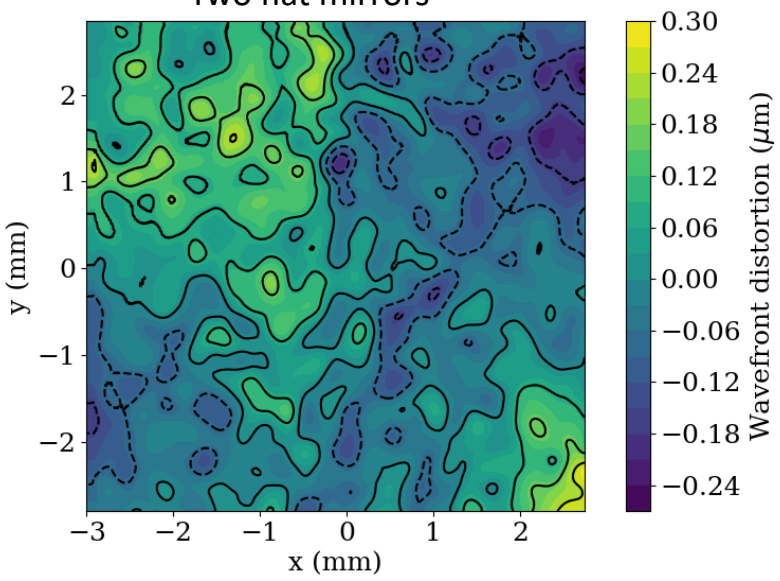
Static deformation



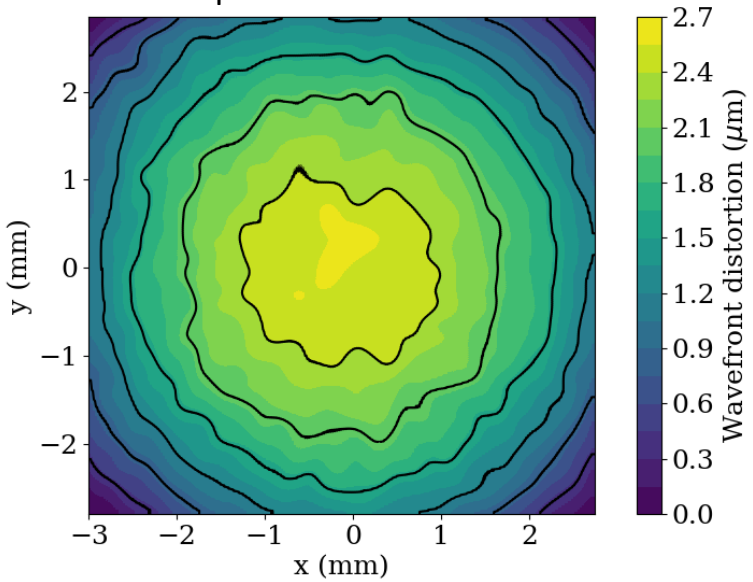
Interferometer result:

- Circular rings corresponding defocus distortion with compression-fit mirror under test

Two flat mirrors



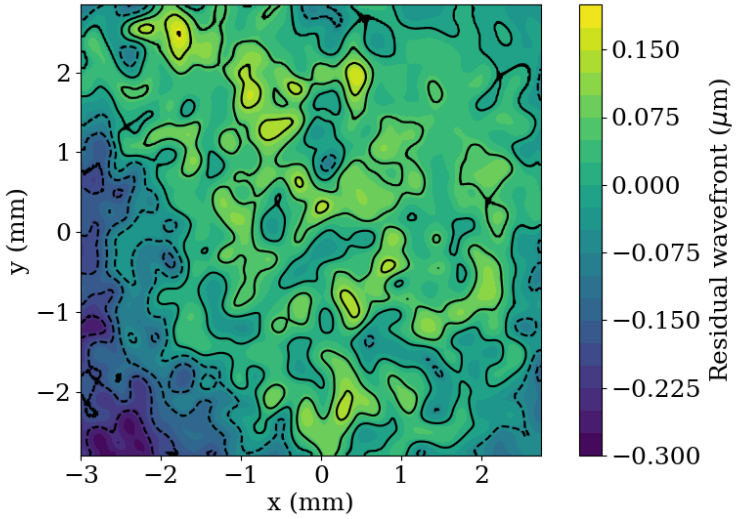
Compression fit mirrors



HWS

- Strong spherical power, c.a. 340 mD
- Low higher order aberration
- High spatial frequency noise potentially caused by poor quality optics

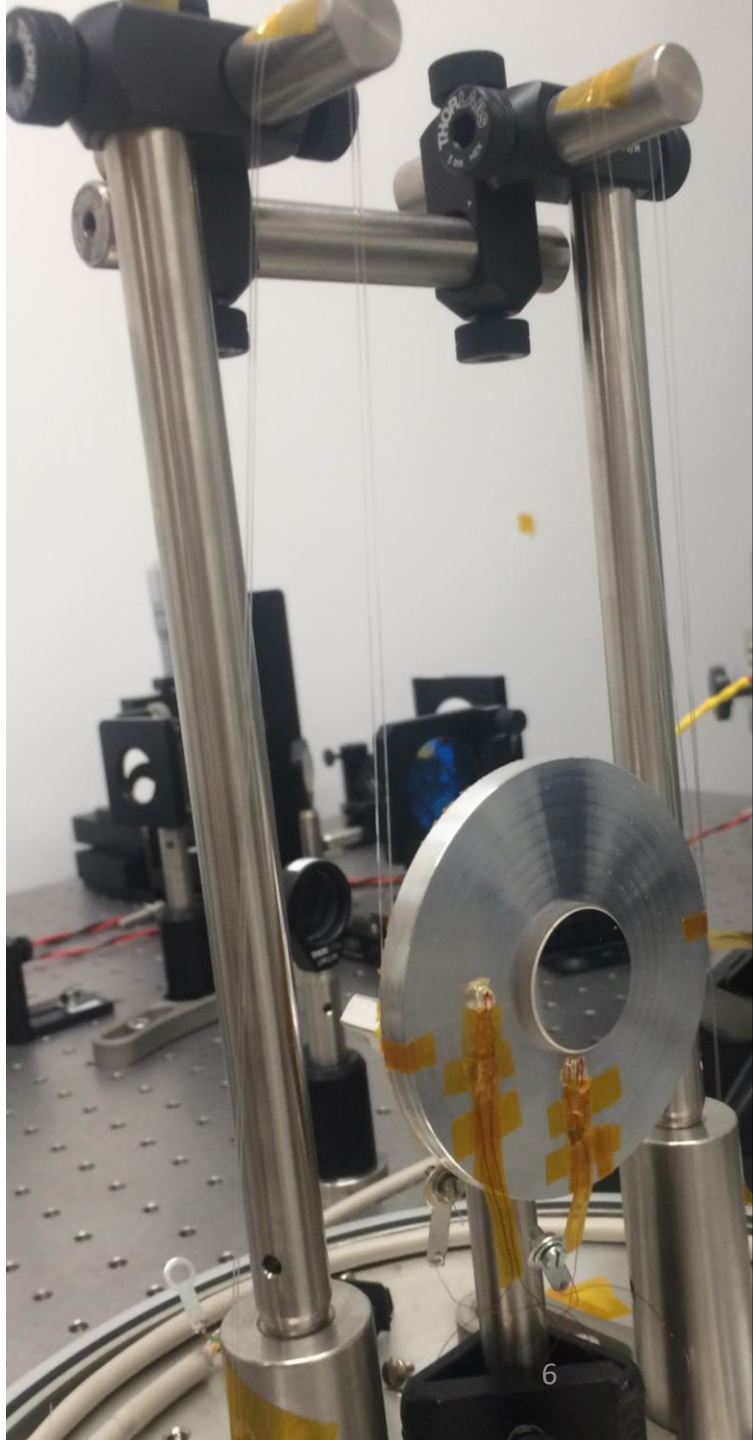
Higher order aberration residual



Thermal actuation

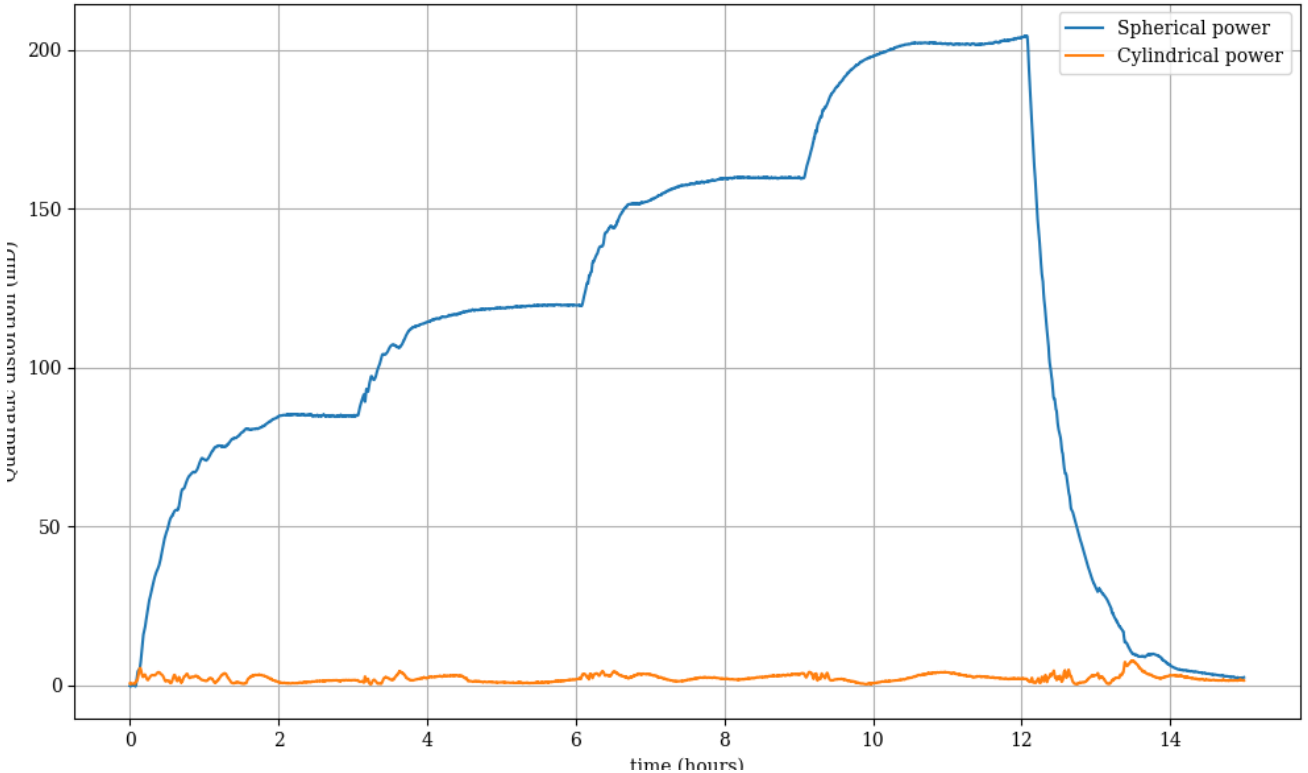
- Suspended in similar manner to composite mirror
- Two thermistors attached to the front of Al ring to record temperature
- Tested under vacuum, c.a. 1.9 mbar
- Heating schedule:

19/11/2018	20/11/2018	21/11/2018	22/11/2018	24/11/2018
5V - 0.13W - 3 hrs 7V - 0.27W - 3 hrs 9V - 0.44W - 3 hrs 11V- 0.66W- 3 hrs off	6V - 0.20W - 3 hrs 8V - 0.34W - 3 hrs 10V-0.55W - 3 hrs 12V-0.78W - 3 hrs off	10V-0.55W - 3 hrs 12V-0.78W - 3 hrs 14V-1.07W - 3 hrs 16V-1.40W - 3 hrs off	11V-0.66W - 3 hrs 13V-0.92W - 3 hrs 15V-1.23W - 3 hrs 17V-1.58W - 3 hrs off	4x(3 hours @ 16V + 2 hours @ 0 V)



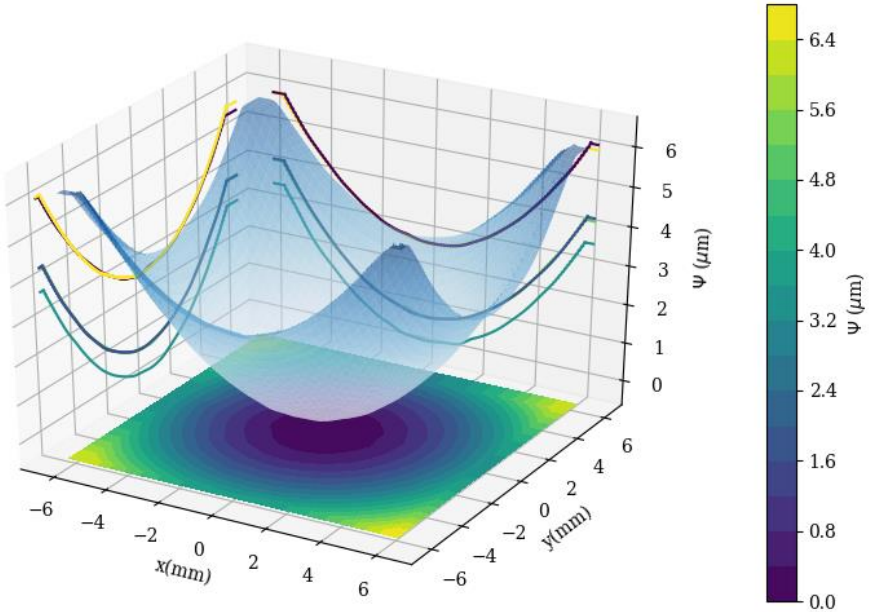
Results: Wavefront distortion quality

- Strong spherical power *S*
- Very small to zero cylindrical power *C* in wavefront. Constant *C* hovering between 5-8 mD independently of mirror's temperature.
- Change in *C* correlates with prisms signal and occur after current is turned on or changes → establishment of magnetic field due to current interfering with the magnetic field from the magnets used for eddy current damping

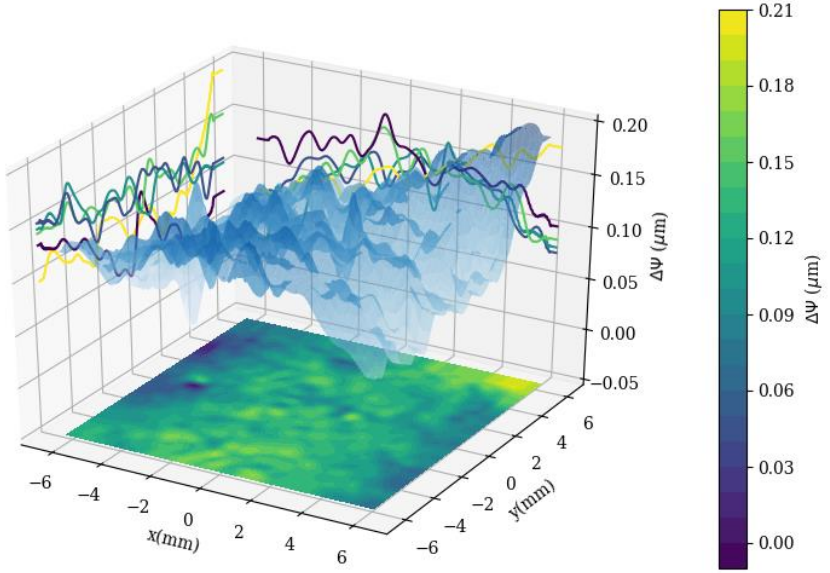


Results: Wavefront map

- Highest actuation in the heating schedule was 220 mD at 17V applied to optics. At 16 V, we have approximately 200 mD.
- On 23/11/2018, due to an error in the the script communicating with power supply, 6 V accidently applied to the mirror (3.7W), → ΔT=85K→ c.a.300 mD without the mirror. Below are the plots of the wavefront measured by Hartmann sensorat 16V applied to heater (left), and its residual after removal of quadratic components (right):



Wavefront measured by Hartmann sensor at 16V



Residual wavefront after removal of quadratic components

Results reproducibility

- Highly reproducible.
- Data from all tests show actuation rate of 7.06-7.07 mD/K.
- For reproducibility test (24/11/2018), the Δ*S* was always 200 mD at equilibrium when the mirror was heated up to 51 degree Celsius and return to 0 atroom temperature.
- No sign of hysteresis

