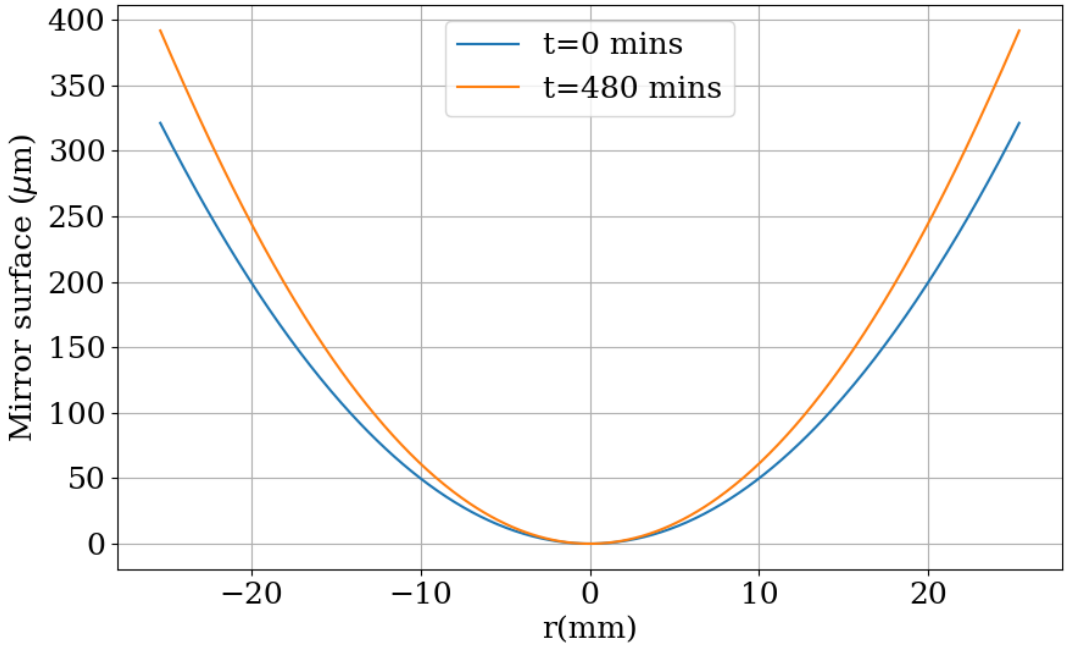
COMSOL model of Curved vs Flat Composite Mirror

Comparison in term of dynamic range and higher-order aberration

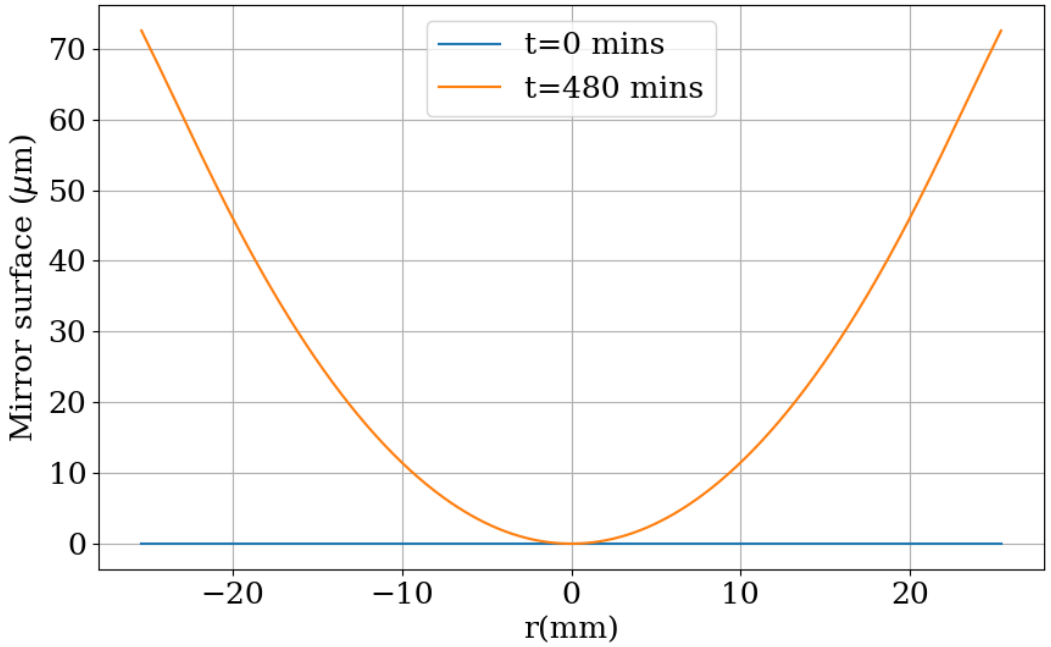
Concave mirror and Flat mirror

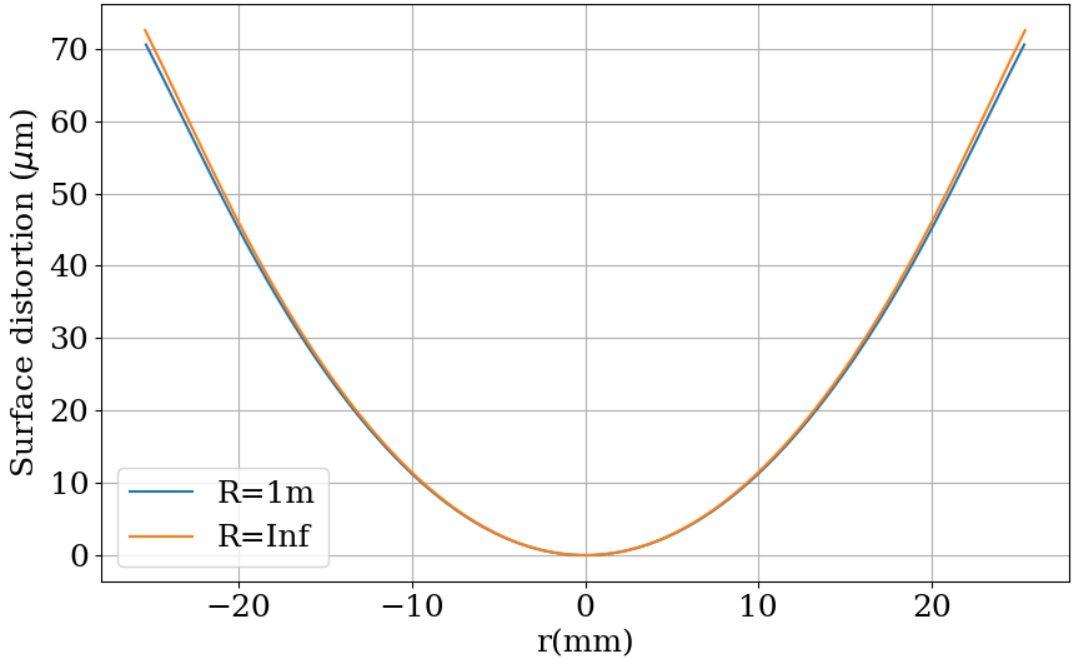
- Flat mirror bonded to Aluminium backing:
  - 6-mm thick, 2-inch fused Silica substrate
  - Input power= 2.5 W
  - Max temperature reached: 87°C (ΔT = 67°C)
- Spherical concave mirror bonded to Aluminium backing:
  - 6-mm thick at the centre, ROC = 1m (edge is 320 µm thicker)
  - Input power= 2.5 W
  - Max temperature reached: 86.5^{o}C (ΔT = 66.5^{o}C)

ROC=∞



ROC=1m





Dynamic range:

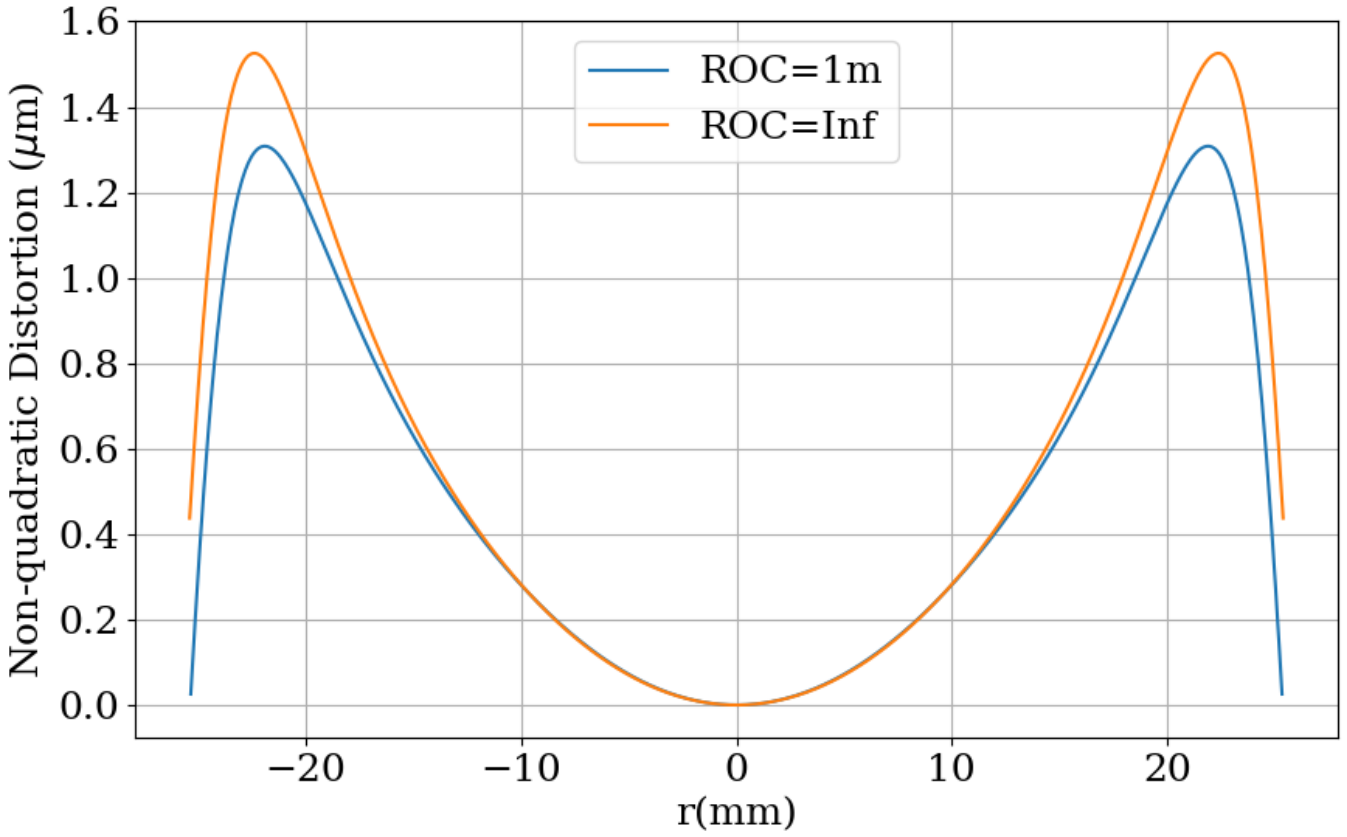
- ROC= ∞: Δ S = 447 mD

  R_{final} = 2.2 m
- ROC= 1m: Δ S = 451 mD

  R_{final} = 0.82 m

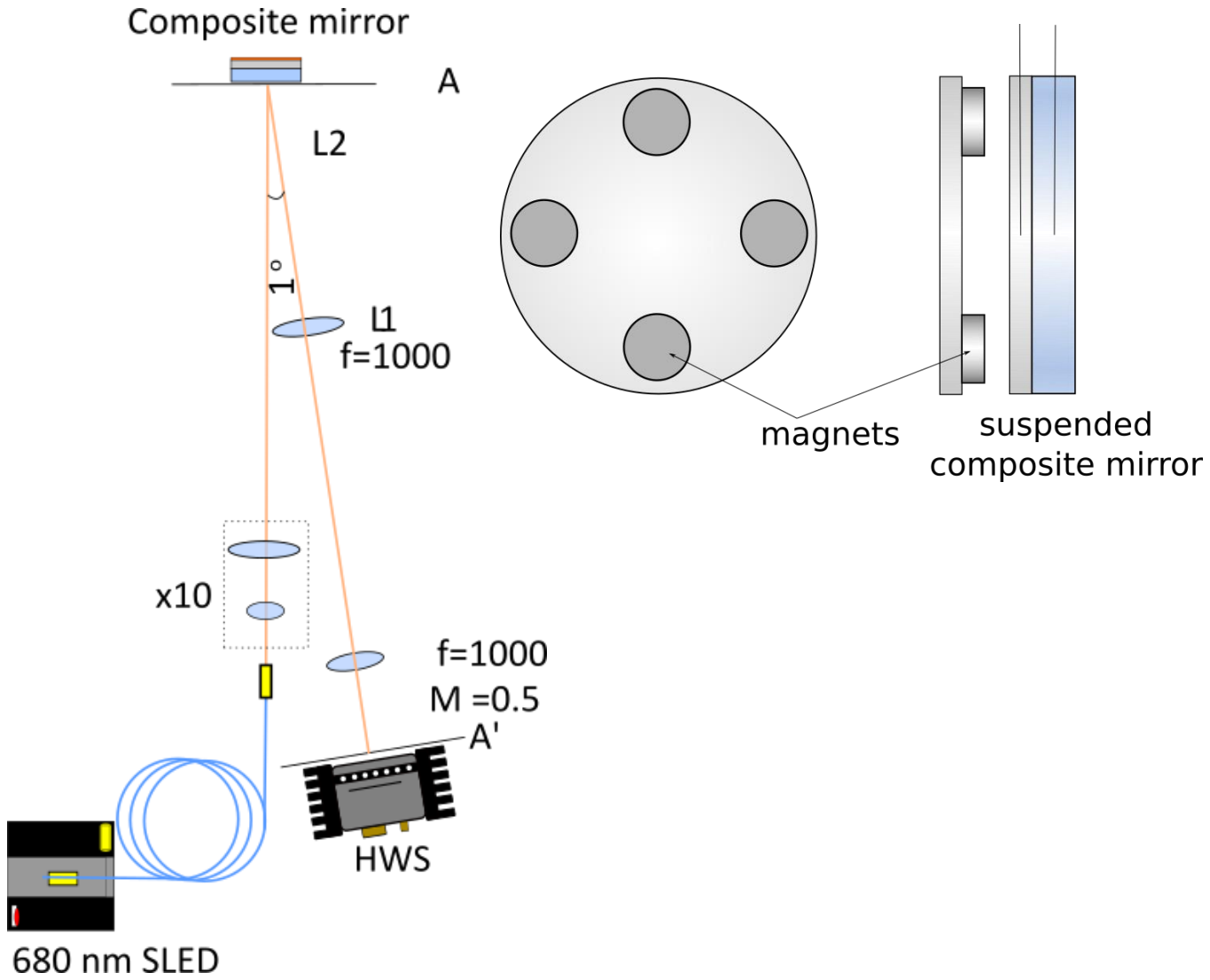
→ Similar actuation range

Higher-order aberration



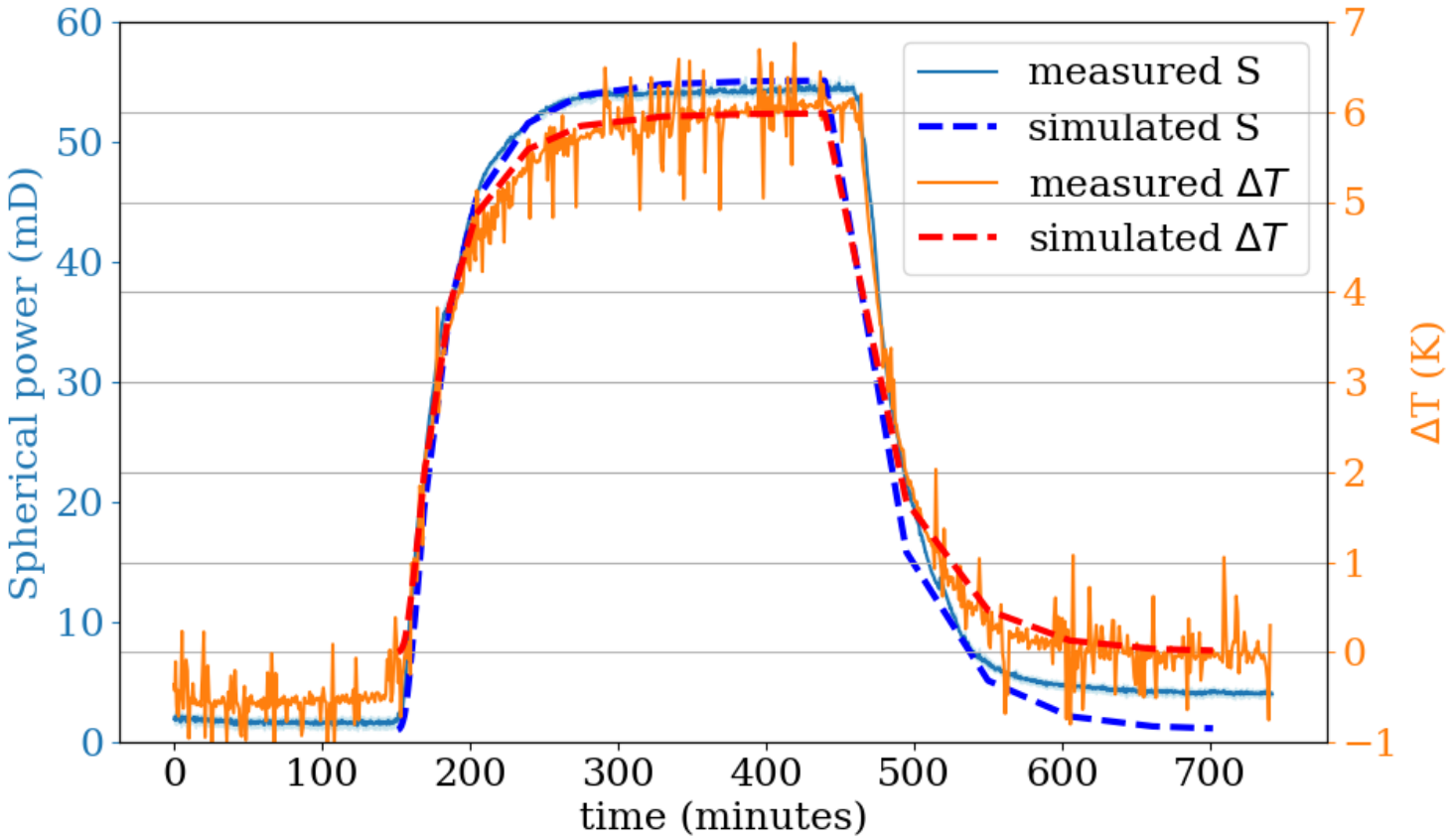
- Wavefront distortion is mainly quadratic (defocus)
- Next largest distortion is spherical aberration (due to spherical deformation) – mainly affects larger beam
- At beam size = 0.8 mm
  - ROC= ∞: Δ WF_{rms} = 0.107 nm
  - ROC=1m: : Δ WF_{rms} = 0.109 mm
    → Compatible higher order aberration performance

Experimental results with flat composite mirror

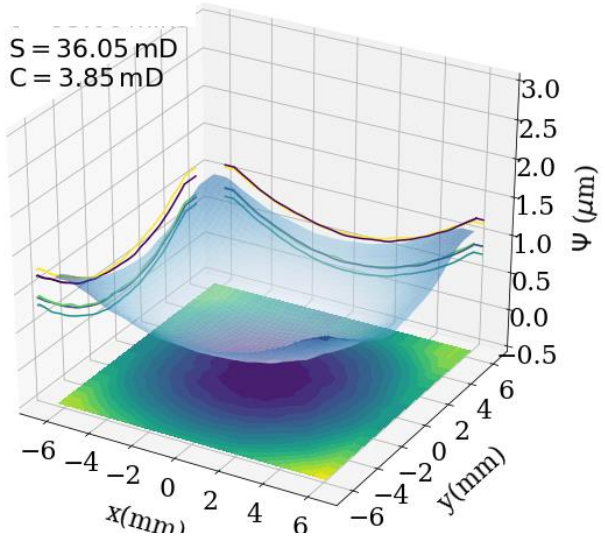


- Protected aluminum coated 2-inch mirror
- 6mm-thick fused silica substrate
- 3mm-thick aluminum backing
- Masterbond EP30-2, cured 48 hours and room temperature
- Suspended by 4 optical fibers I medium vacuum (2.2 mbar)
- No active control, eddy current damping by 4 magnets at the back of aluminum disc
- 2 inch Kapton heater in contact with aluminium disc
- Gauge 28 used wire for heater
- 0.22 W electrical power applied

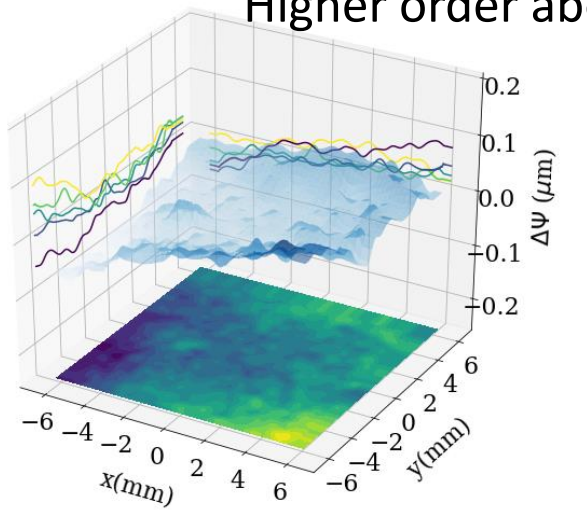
Experimental results with flat composite mirror



Total wavefront distortion



Higher order aberration



- >50 mD change at ΔT = 6K
- ΔWF_{rms} ~ 6 nm, mainly quadratic term
- Actuation range, time constant agree well with FEM model