

A Fizeau interferometer system for characterising and optimising large synchrotron mirrors

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Summary

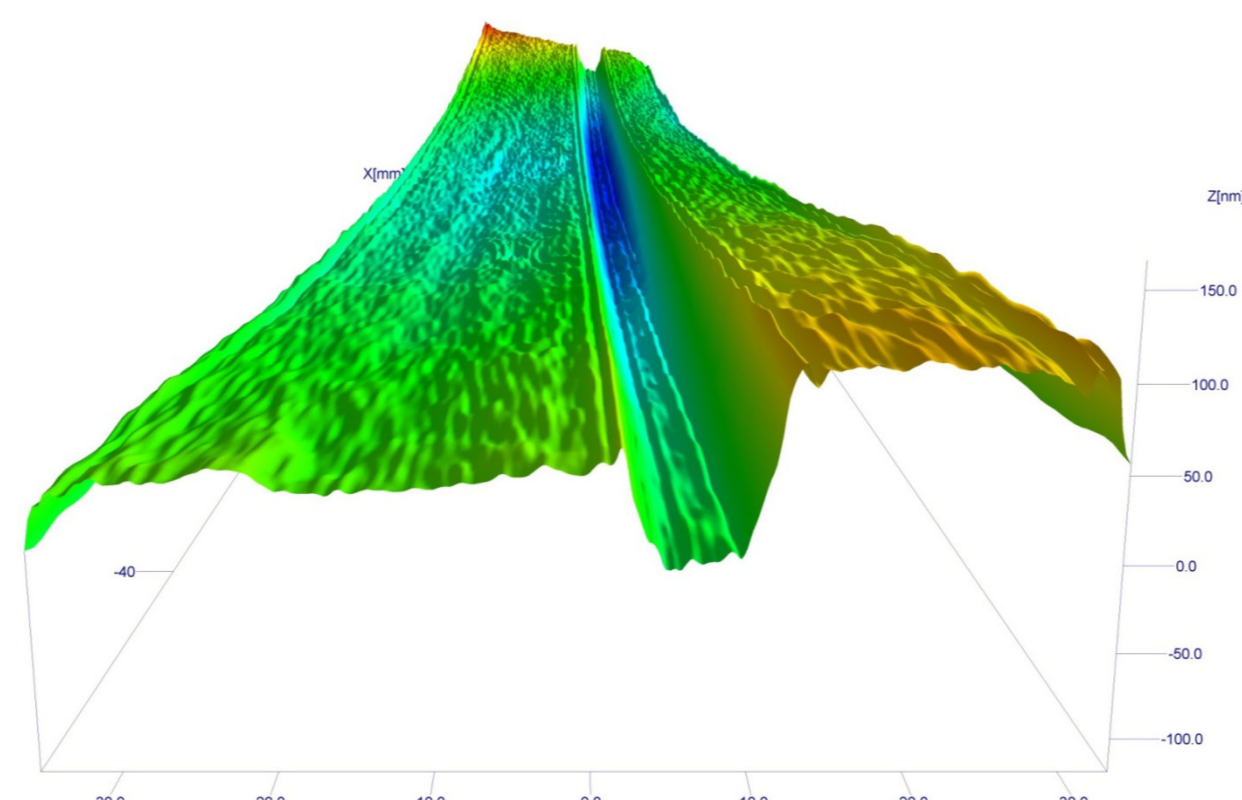
A Fizeau interferometer system, using a MiniFiz150, has been developed to characterise and optimise the figure error of large synchrotron mirror assemblies using single-pass, double-pass, or stitching modes [1, 2]

System Parameters

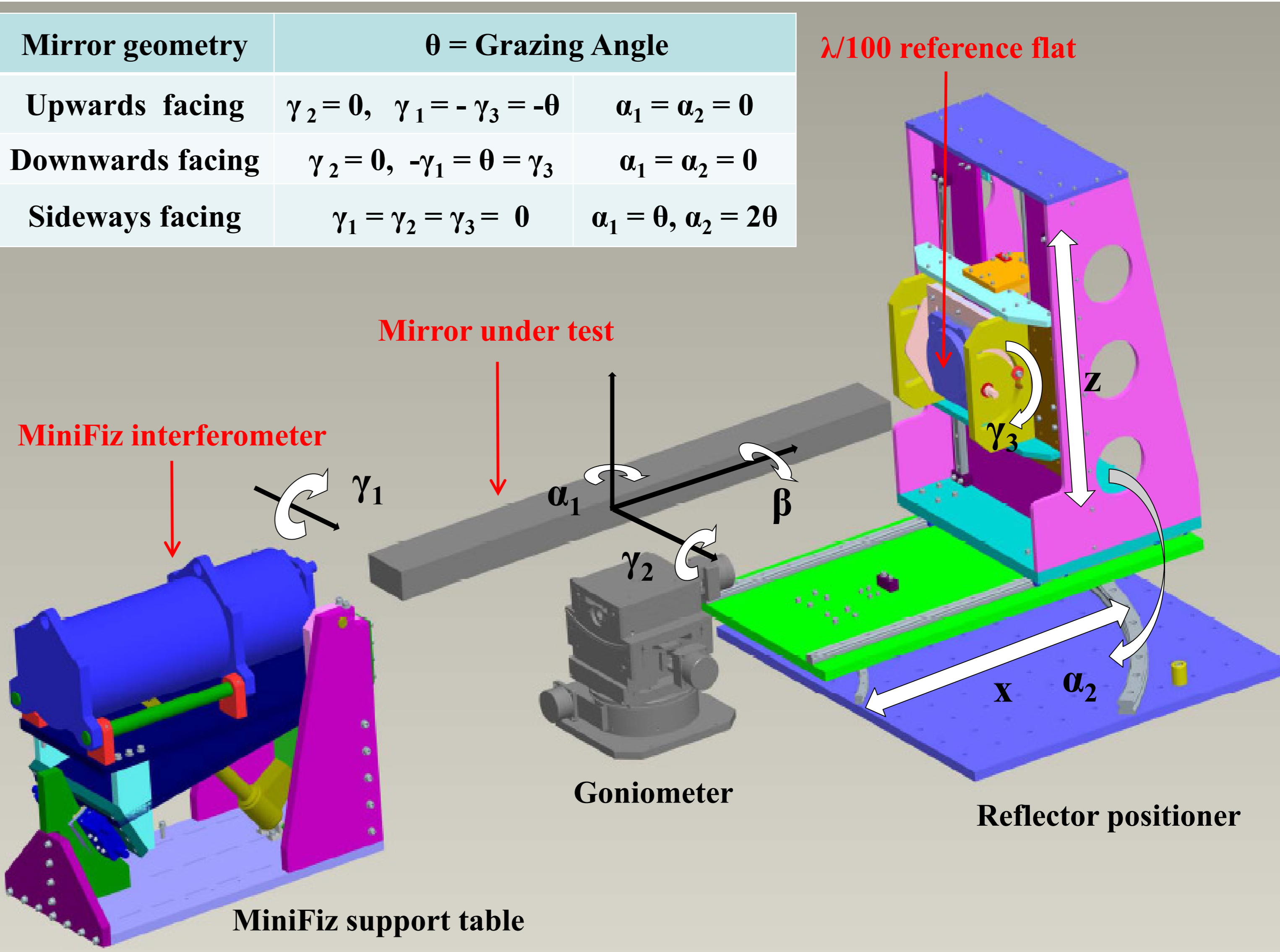
- Designed to measure mirrors <0.15m in single-pass mode using $\lambda/100$ PV reference flat
- Mirrors from 0.15m - 2m long are characterised in double-pass mode using $\lambda/100$ and $\lambda/20$
- Accommodates upwards, downwards, and sideways facing mirrors in double-pass mode
- Load capacity >100kg enables entire, mounted mirror assemblies to be investigated
- Optimised system repeatability of $\sim 2\text{nm rms}$ is sufficient for most synchrotron optics

Advantages

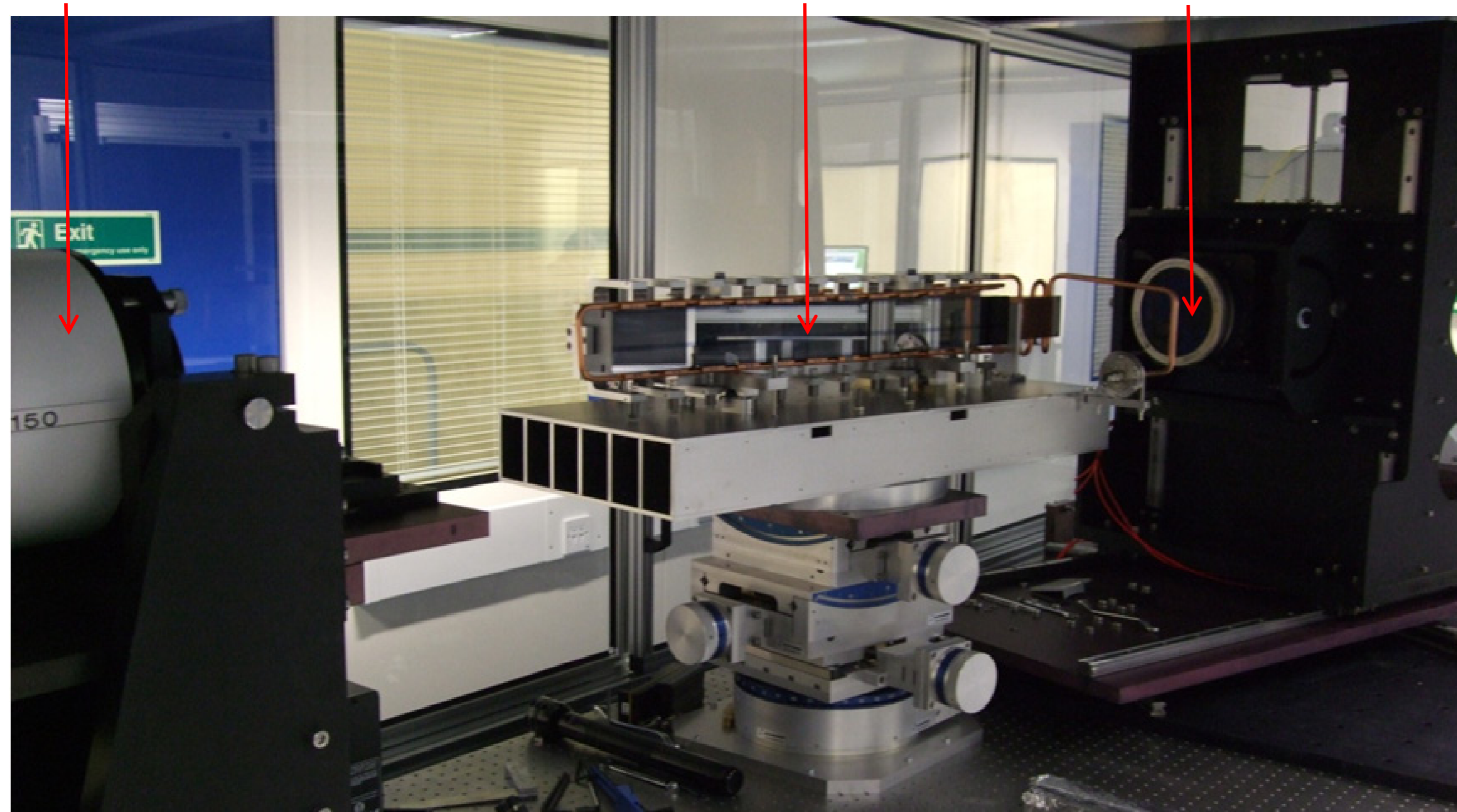
- Quick and simple to switch between operating modes
- 2-D figure data captured for entire optical surface
- Short acquisition times (<1min) enable dynamic surface changes to be investigated
- Complementary to slope-measuring profilers, such as the Diamond-NOM [3]



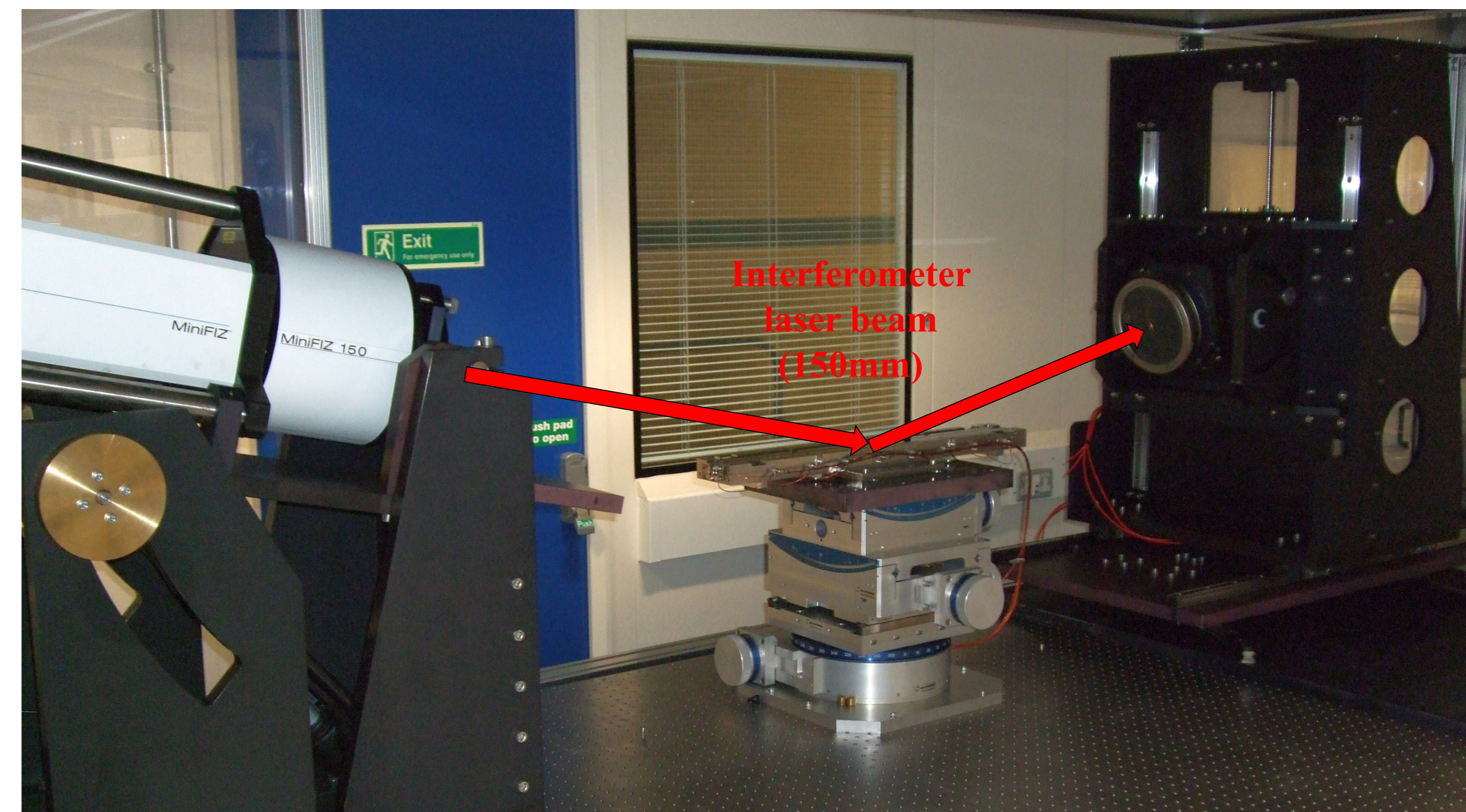
System Schematic and Degrees of Freedom



MiniFiz Mirror under test $\lambda/100$ Reference Flat

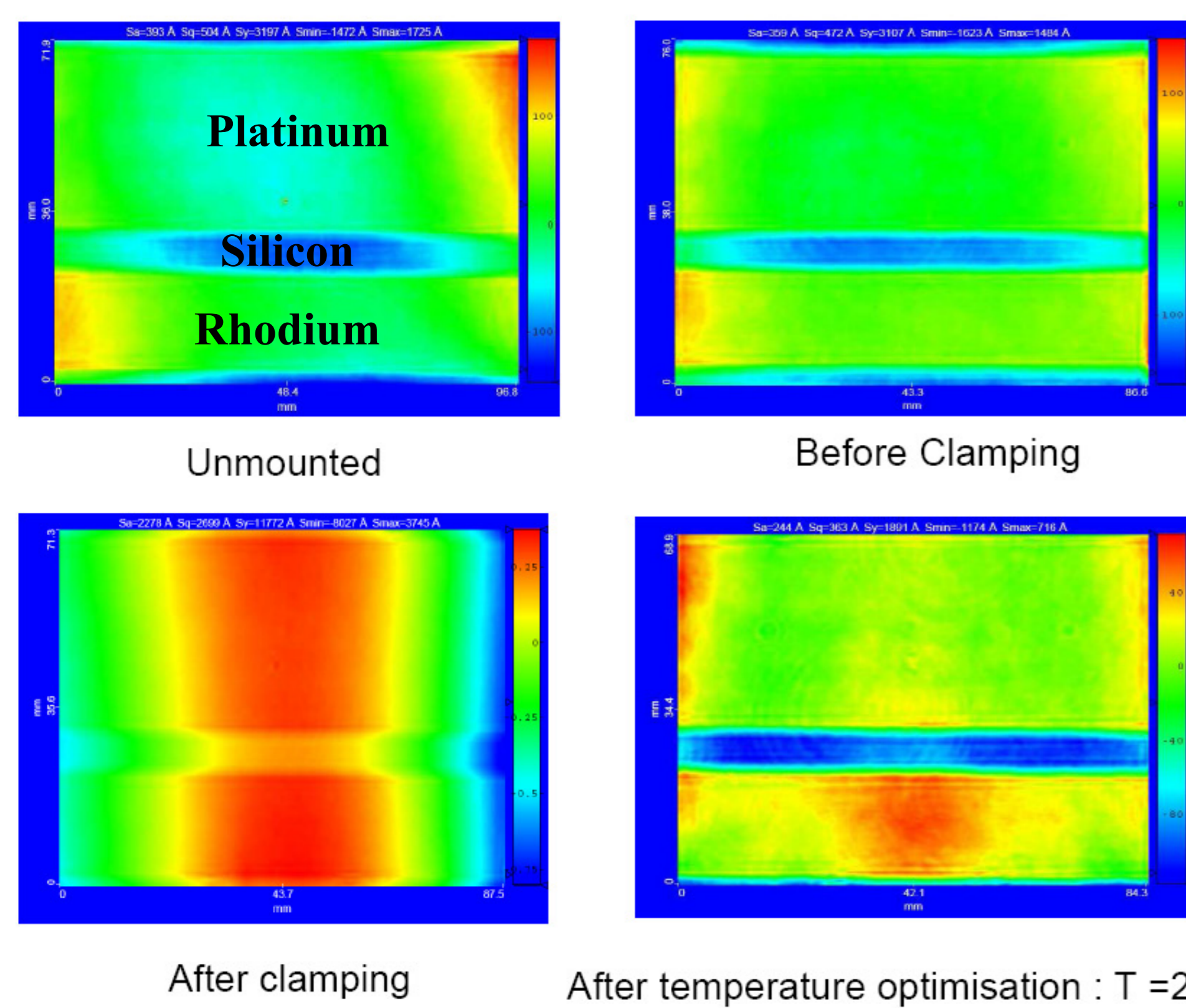


Mounted mirror (I13) tested using double-pass mode, sideways configuration



VFM bimorph mirror (I04) tested using double-pass mode, upwards configuration

Using the MiniFiz to optimise the figure error of mounted mirror systems



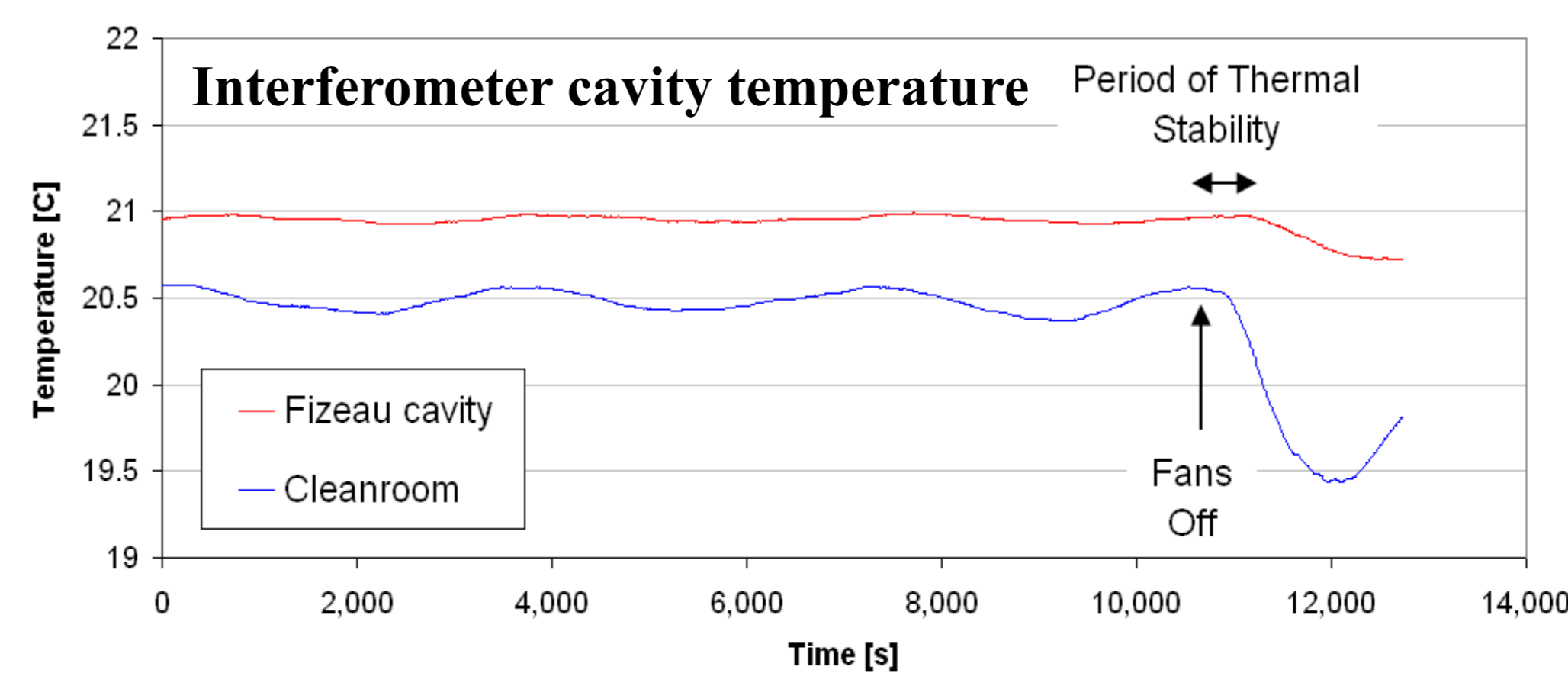
Effect of Mirror mounting

Optimum clamping and cooling conditions can be determined prior to beamline installation

- Unmounted mirror of high quality and flatness (-429nm)
- Mounted & unclamped mirror very similar to unmounted.
- Clamped mirror becomes distorted (-52nm) and worse figure error
- After iteratively changing the clamping and cooling water temperature, mirror is optimised

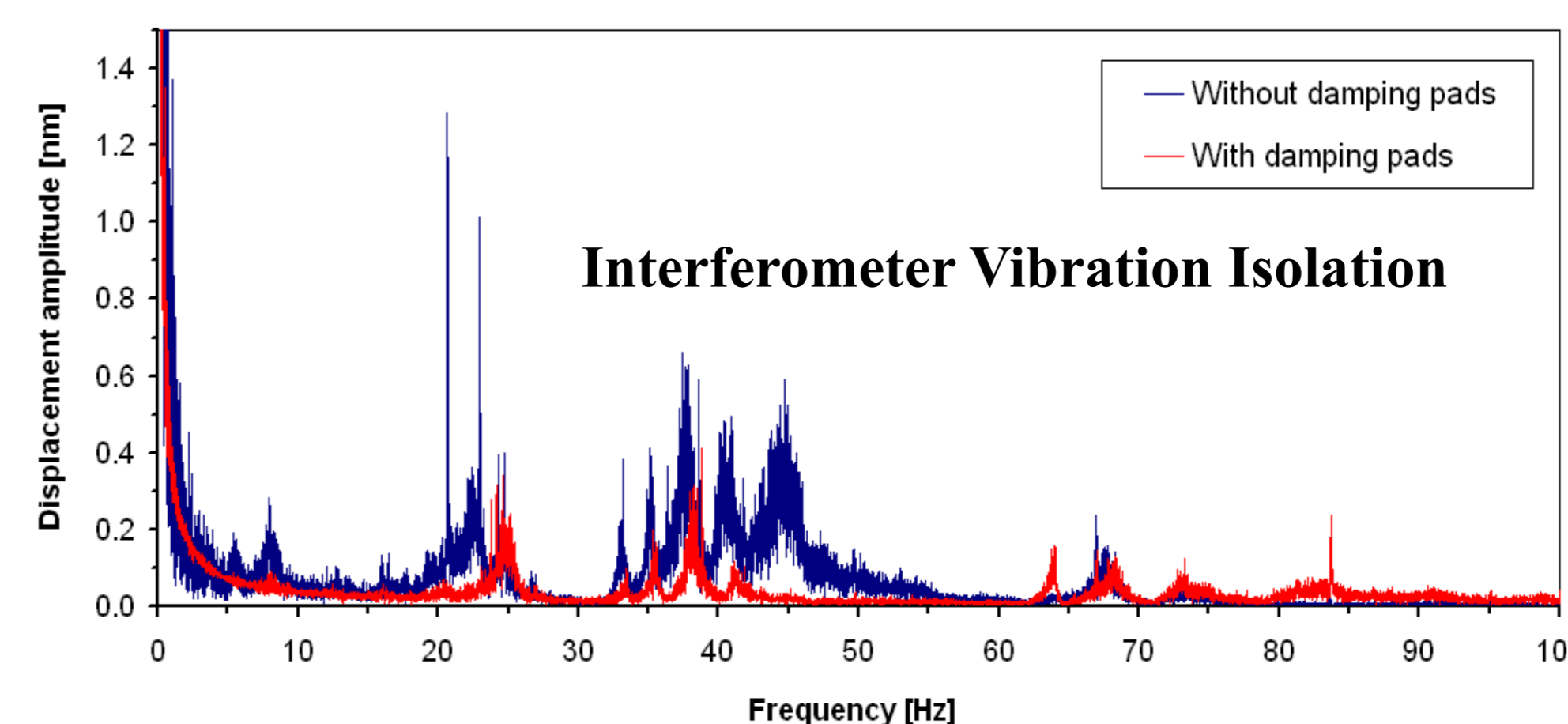
Thanks to Ulrich Wagner (I13) for participating in the above tests

Environment Considerations



For optimum quality, data acquired when:

- Cleanroom fans turned off
- Interferometer cavity is thermally stable (10min "time window")
- Optical bench vibration isolated



Laser vibration sensor used to identify and help reduce sources of vibration:

- Damping pads added to enclosure
- More robust opto-mechanics
- Mechanical clamps added

References

- [1] Ludbrook G.D., Alcock S.G., Scott S., "A double-pass Fizeau interferometer system for measuring the figure error of large synchrotron optics." Proc. SPIE 7801 (2010).
- [2] Ludbrook, G. D., Alcock, S. G., and Sawhney, K. J. S., "A Fizeau interferometer system, with double-pass and stitching for characterising the figure error of large (>1m) synchrotron optics", Proc. SPIE 7389 (2009).
- [3] Alcock, S. G. *et al.*, "The Diamond-NOM: A non-contact profiler capable of characterizing optical figure error with sub-nanometre repeatability," Nucl. Instr. and Meth. A 616, 224-228 (2010).

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