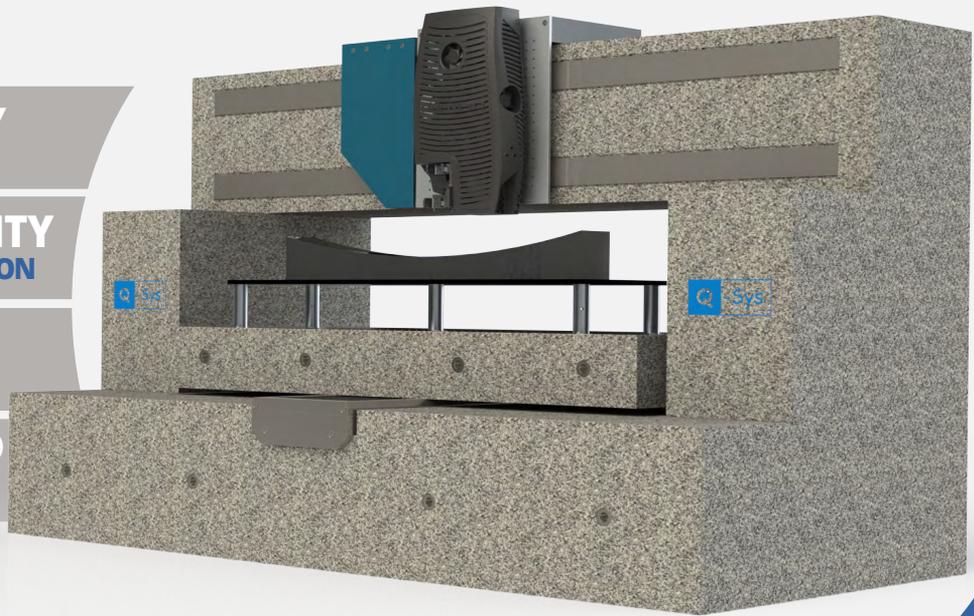


**HIGH ACCURACY**  
**2D SLOPE MEASUREMENT**

**FOR HIGH QUALITY**  
**MIRROR CHARACTERISATION**

**COMPLETE**  
**METROLOGY PLATFORM**

**50 NRAD RMS<sup>1)</sup>**  
**SLOPE ACCURACY**



**2D optical slope measuring tool  
for x-ray mirrors**

SHARPeR was born from a Eurostars project that aims at developing a new high accuracy automated metrology platform for extremely high quality optical components needed for example in synchrotron beamlines, EUV lithography systems and telescopes. Meter-scale X-ray mirrors will be characterized with a slope error accuracy better than 50nrad rms<sup>1)</sup>.

The system includes three main elements:

- A highly stable and repeatable motion platform with rotation and tip-tilt stage
- A high precision wavefront sensor with an absolute accuracy of  $\lambda/1000$  rms
- An advanced stitching algorithm for high accuracy results

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The new ultra-high precision Shack-Hartmann wavefront sensor is integrated in an optical head coupled with a dedicated motion platform to provide 2D slope/height maps. The surface under test can be oriented horizontally or vertically to match the actual used configuration. Customers can specify both longitudinal (scanning direction) and transversal travelling ranges to expand the range of characterization area. Motorized rotation and tip-tilt axes (RTT) are added to the motion system. This enables the user to automatically flip the optical component under test without disturbing the measurement environment by manual interference. This complete metrology platform is designed to help the off-line manufacturer of extreme precision optical surfaces used, for example, to transport or to focus x-rays in synchrotron applications. The SHARPeR platform should sit in a special enclosure to ensure the best possible environment for ultimate measurement results.

## HASO UHP

For more than 20 years of experience in the Shack-Hartmann technology, Imagine Optic develops the ultra-high precision Shack-Hartmann wavefront sensor (HASO UHP) with exceptional wavefront measurement accuracy up to  $\lambda/1000$  rms in absolute mode ( $\lambda/2000$  rms in relative mode) and with high repeatability.

## STITCHWAVE

StitchWave is a unique software tool which enables precise characterization of large surfaces using HASO wavefront sensors. Thanks to its advanced stitching algorithms that minimize translation stage effects, the user can acquire and reconstruct a complete wavefront from multiple sequential measurements. Surface diagnostic tools such as fitting and power spectral density are included.

## STAMP

The motion system includes innovative techniques for maximizing the stability and repeatability of measurements while reducing angular errors to a minimum. Special features that can be referred to in this context are cut-off air supply to the air bearings to minimize turbulences that can disturb the measurements and a special design to couple the driving force to the optics carriage. The motion platform including the RTT makes it possible to have an appropriate combination of different positions of the optical component, orientations and scanning directions. This will result in significant suppression of the contribution of the systematic error to the measurements. In order to minimize thermal effects the power of the RTT can be switched off during measurements without compromising the overall accuracy.

Mirror tangential and sagittal slope accuracy	< 50 nrad RMS <sup>1)</sup>
Mirror radius	From flat down to 1.7 m <sup>2)</sup>
Sampling length (microlens size)	1.2 mm
Maximum mirror slope	± 4 mrad
Measurement configuration	Horizontal and vertical
Mirror surface	With and without coating
Maximum mirror length	1.5 m
Transverse axis length	300 mm
Rotation	305°
Tip-tilt range	± 5°
Gantry dimension / weight	2.5 m x 1.1 m x 1.7 m / 5700 kg
Power consumption	<3 W <sup>3)</sup>
Acquisition time	10 min / 300 mm <sup>4)</sup>

1) Please contact us for measurement conditions  
3) Including gantry

2) For highly curved mirrors, multi-incident scans are required.  
4) For one forward or backward scan