

KAOS Focusing Mirror System

The Ultimate Kirkpatrick-Baez Active Optics Composite Focusing System



Highlights

Feature	Benefit
Turn-key system.	Complete solution from customisation to commissioning and training.
Ultimate spot size at the opto-mechanical limit of the system (typically a few μm FWHM in both directions). The spot can be modified in a controllable way.	Possibility of increasing the spot size on the sample and/or moving the focal spot downwards along the beam propagation direction guarantees the success of your experiments.
A tested system used successfully on several user beamtimes matching different needs in terms of spot sizes and positions.	Plug and play!

How Does It Work?

KAOS is the only active optics refocusing system in the world that is operative in EUV/Soft x-ray free electron laser user facilities. The specificity and uniqueness of the system lies in the fact that it operates at quite "large" incidence angles (2°) with 400mm-long mirrors, thus requiring deformations to the optical substrate to the order of $200\mu\text{m}$ in the central part of the mirror itself (sagitta).

KAOS is a composite refocusing system composed of:

- a vertical deflecting mirror (optional),
- two mechanically bendable mirrors in a KB arrangement,
- the vacuum vessels with their support frames (customisable),

- all the mechanics (internal and external) required to operate the mirrors (including bending and possible optical coating selection).

The first KAOS system was put in operation in 2012 at FERMI and it was soon followed by the systems installed on different FERMI and FLASH2 beamlines (see references). It has been constantly upgraded as experimental findings have come to light. Several thorough spot size characterization campaigns have been carried out using different investigation techniques using wavefront sensors, different scintillators (Ce:YAG, P in different forms, etc.), and indentation on different materials (PMMA, Si, Ce:YAG, etc.).

Specifications

1) GEOMETRY (customisable)

- by default: 2°-incidence angles on all the two mirrors: KB- Vertical (KB-V) and KB-Horizontal (KB-H)
- KB-H-exit arm ≥ 1000 mm
- KB-H KB-V distance = 500 mm

2) MECHANICAL LAYOUT

- incoming beam from a generical chamber placed ≥ 1500 mm before KB-V
- KB-H as the last mirror of the system
- option to work with an unfocused beam
- (a beam passing through the KB vacuum chamber)

3) MIRROR MOVEMENTS

- KB-V and KB-H: pitch, roll, Z translation, lateral translation for coating selection

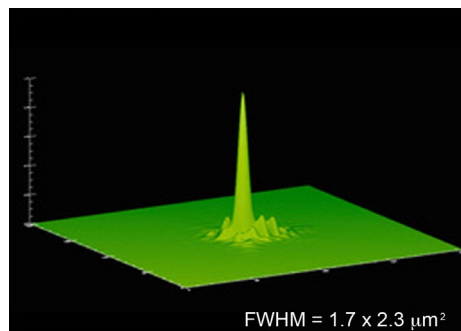
4) MIRROR OPTICAL PARAMETERS (customisable)

	KB-V	KB-H
Material	Fused silica	Fused silica
L×W×T (mm ³)	400×40×10	400×40×10
Incidence angle	2°	2°
Optical shape	Plane	Plane
Coating*	Pt or Au or Ni	Pt or Au or Ni

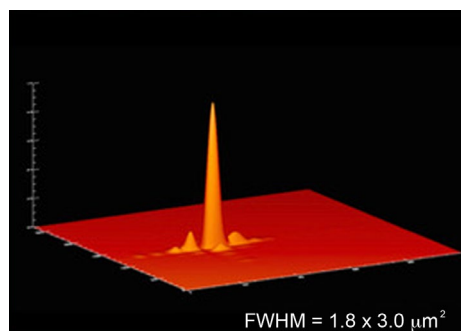
Optical useful area dimensions: 360×20 mm²

Micro roughness < 0.3 nm rms (2 μ m < spatial period < 0.5 mm)

* Multi-coating possible as an option



Simulated spot 4nm

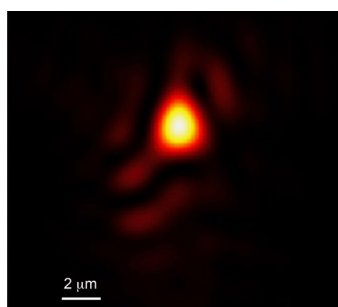


Measured spot (best) 4nm

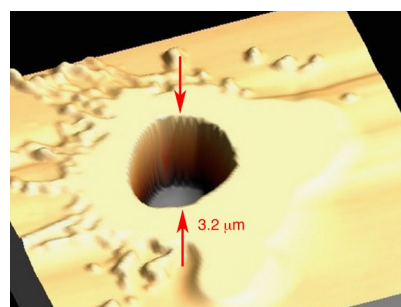
Deliverables

- Turn-key KAOS Refocusing Mirror System customised to your specific needs.
- Optical characterisation of the system carried out in the dedicated Elettra metrology lab.
- Installation of the KAOS System into your FEL photon beam transport system (including vacuum-related issues).

- Hands-on commissioning and optimisation of the KAOS system.
- Full training on the KAOS System based on the unique experience gathered during the system's operation (over 10 years of experience and more than 100 distinct user experiments).



WFS best spot @ wavelength 4.14 nm



AFM Image

References

- LDM FERMI beamline, Elettra Sincrotrone Trieste
- DiProI FERMI beamline, Elettra Sincrotrone Trieste
- MagneDYN FERMI beamline, Elettra Sincrotrone Trieste

- FLASH II beamline FL24, DESY
- FLASH II beamline FL23, DESY
- FLASH beamline under construction, DESY



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Contact us!

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