

HOW TO ACHIEVE A CLEAN BEAM WITH HIGH BRILLIANCE FOR LABORATORY SAXS SET-UPS



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New beam delivery system: GeniX3D



- High brightness low power x-ray tube** with closed loop water cooling for ultrahigh stability
- Fixed, referenced output x-ray beam** mechanically defined. Remains unchanged during maintenance
- Aspheric FOX 3D multilayer optics** Single reflection optics with close source-optic coupling
- Compact, robust optical block** Motion free with high clearance. Simple plug-in interface for downstream instruments
- X/Y stage for straightforward alignment** Source is aligned towards a fixed optical block
- Smart and intuitive control unit** User friendly touch screen, automatic ramp up and shut-down to extend tube lifetime

GeniX3D's inside:

- X-ray multilayer coatings
 - Aspheric substrate
 - Advanced X-ray optics
- high reflectivity
→ monochromatic beam
- large collection angles
→ small spot-size
- FOX3D preserves brilliance and focuses the X-ray beam on the sample**

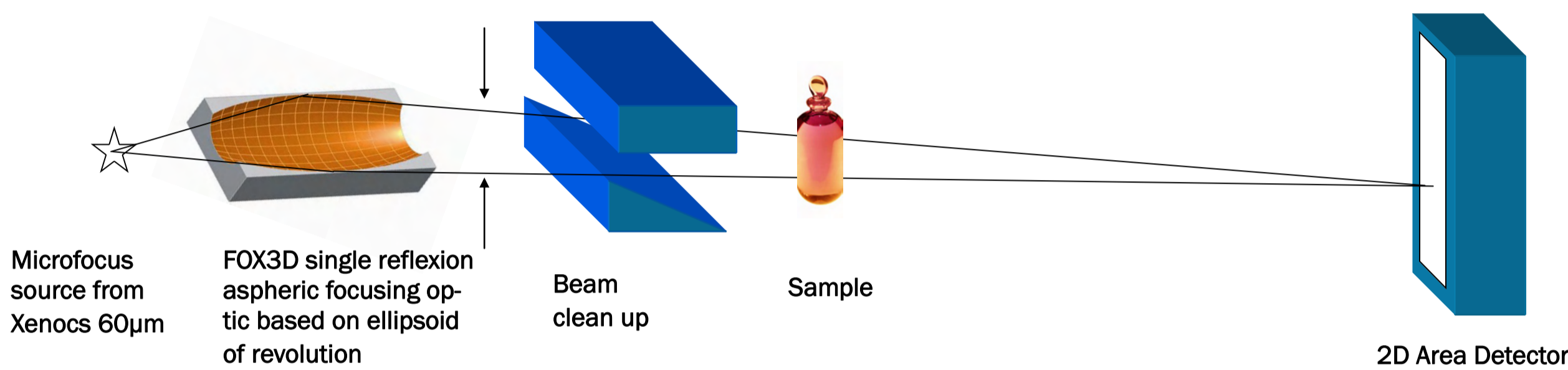
Features

- Low Power Source (30 or 50W)
- High performance optics
- Compact system
- Control & Command unit
- Safety Shutter
- Remote Operation (Ethernet)
- Water cooling (closed loop)

Benefits

- Low power consumption
- High brilliance
- Easy to integrate
- Ease of use
- Space clearance from sample
- Low maintenance
- Extreme beam stability

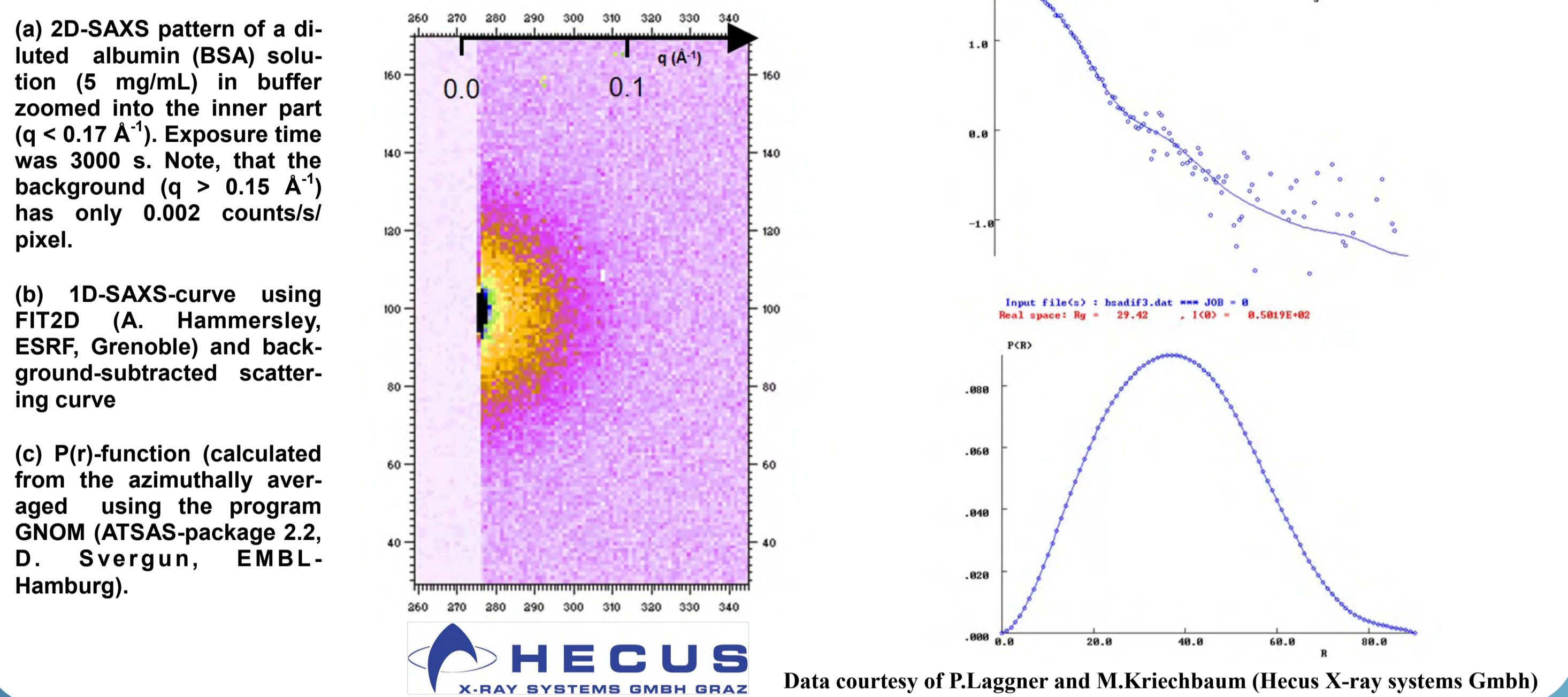
Principles of compact SAXS with focusing optic



- Large solid angle collection
- Single reflexion multilayer optic allows matching focus size with detector resolution
- Compact beam clean up (Kratky Collimation)
- High flux monochromatic beam illuminates the sample (>30Mph/s)

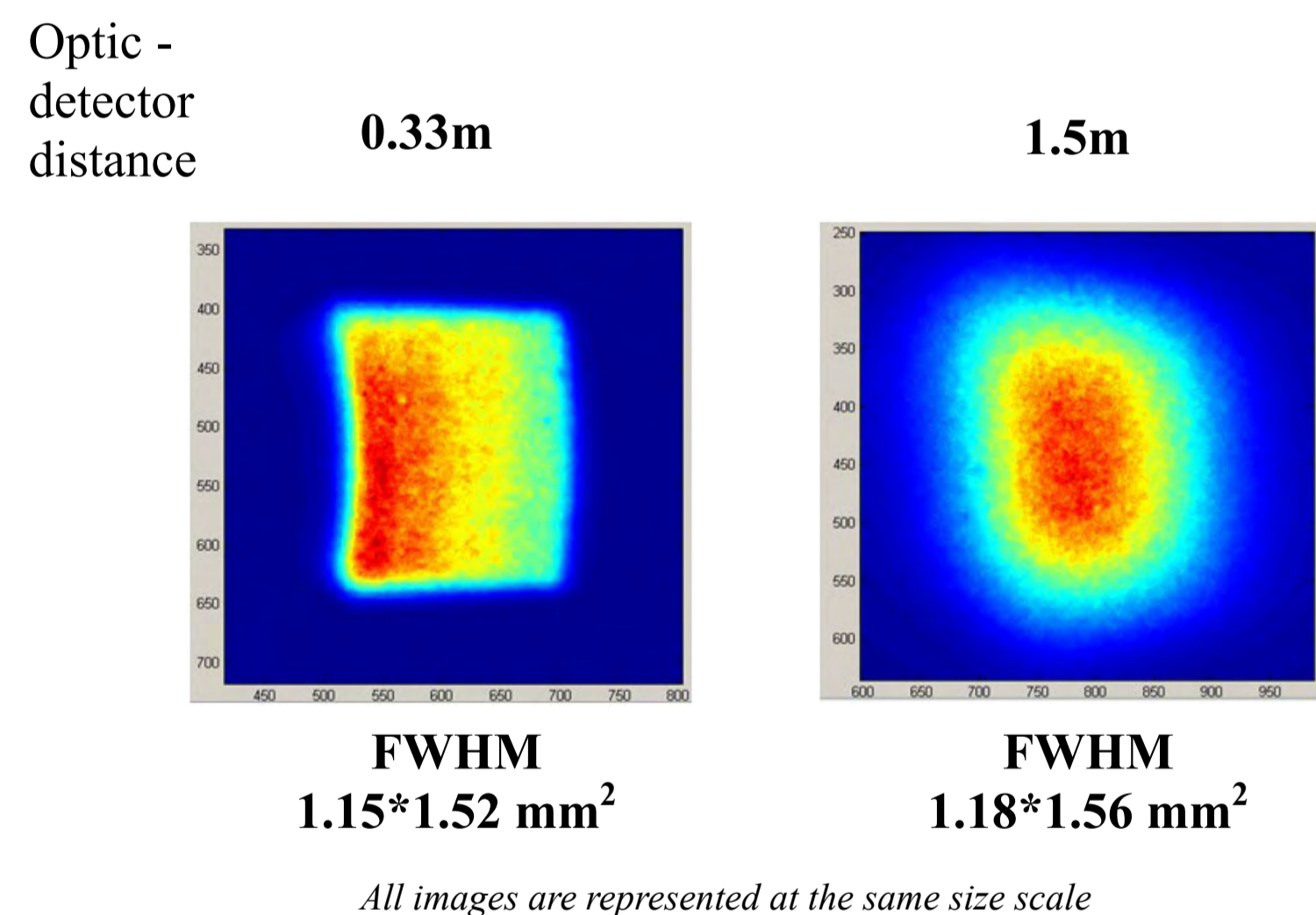
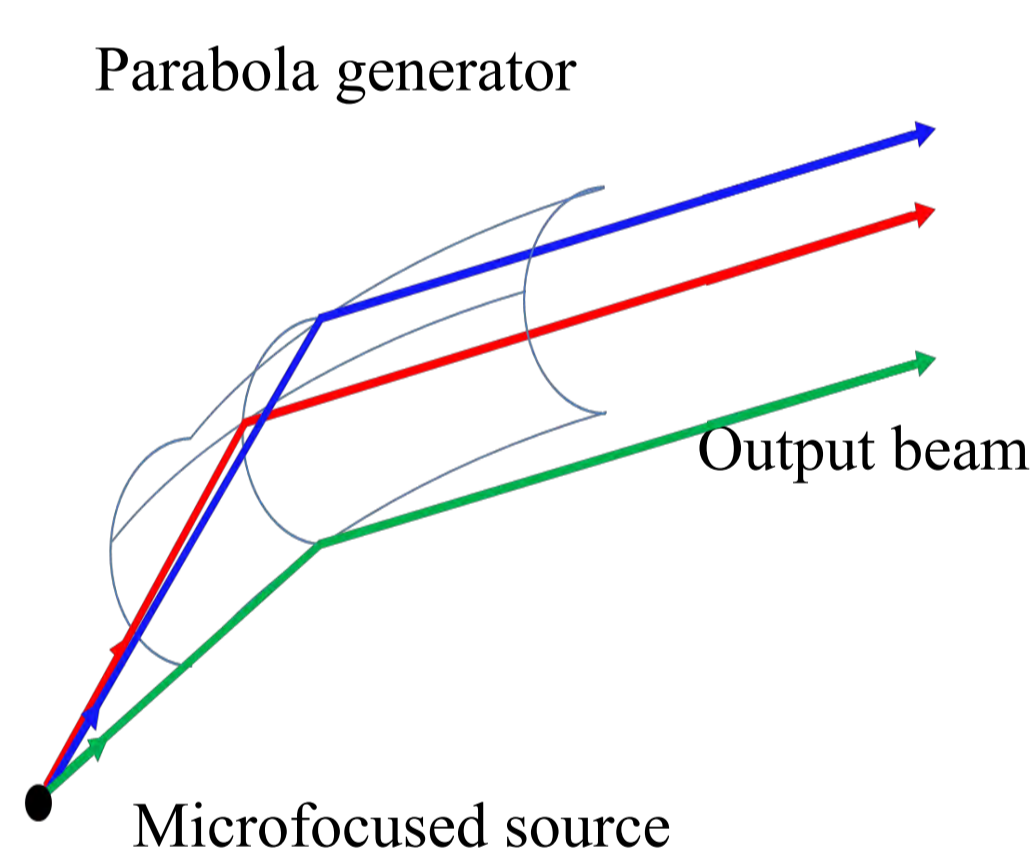
With a focus size matching the detector resolution, highest flux and reduction of collection time is obtained. Sample illumination is therefore maximized. Position sensitive 2D Area detector allows for anisotropy study or data statistics quality enhancement by azimuthal averaging.

Low scattering solution example with compact SAXS set-ups



FOX3D Low Divergence optic for long SAXS set-ups

- FOX3D optic : a paraboloid of revolution to preserve source brightness (single reflection design)
- Highly collimated beam : control of beam propagation for large sample to detector distances

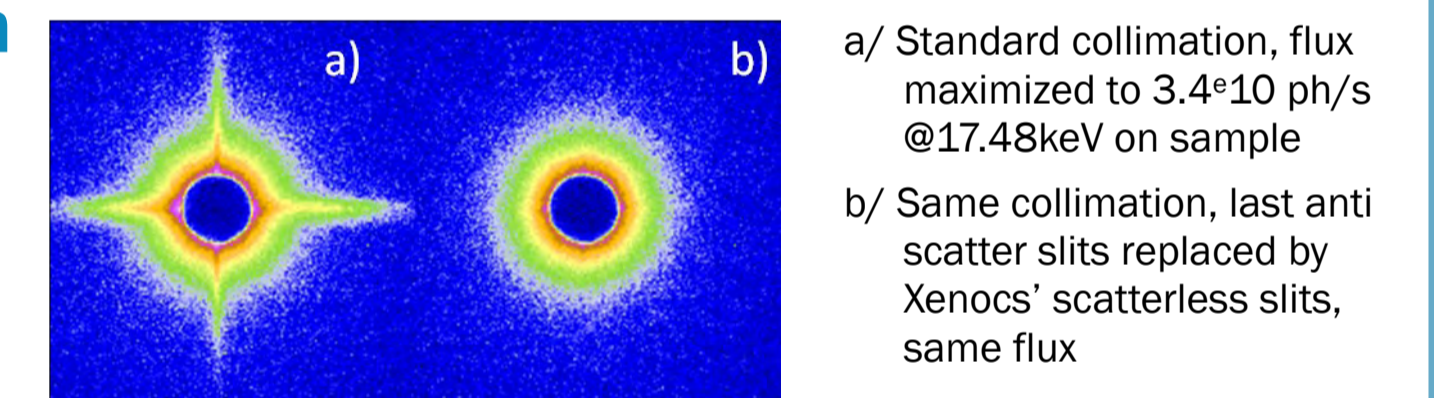


- Divergence of the optic is characterized by a Ge220 rocking curve. Value of 0.6mrad were obtained with XOP fitting routine of $K\alpha_1$ reflection.

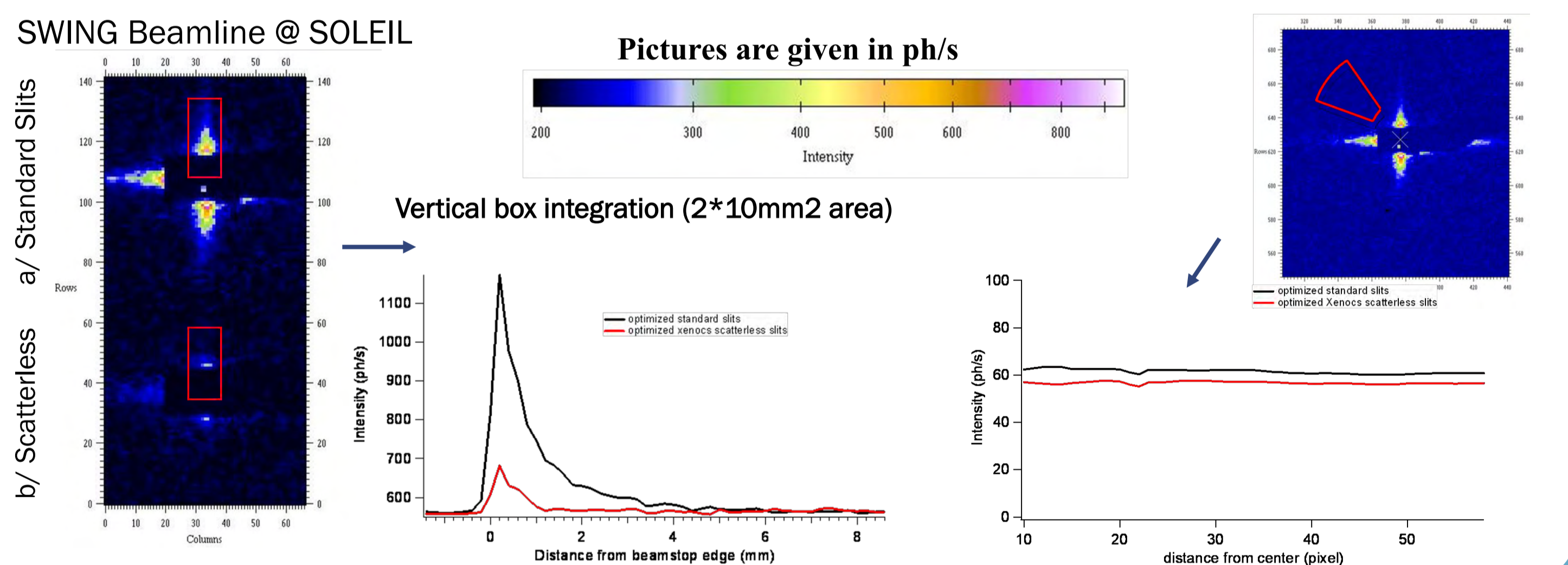
Scatterless technology for optimum beam collimation

Low parasitic scattering demonstrated on synchrotron @ 17,48 keV

(D2AM, European Synchrotron Radiation facility)

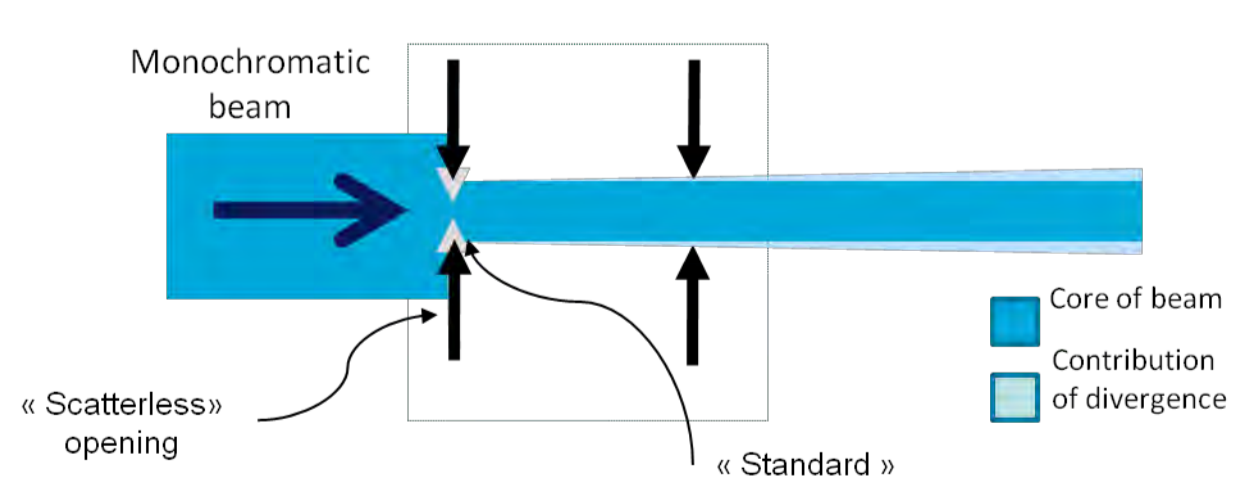


Background comparison @ 12 keV



Application of scatterless collimation in laboratory

Collimation with scatterless slits



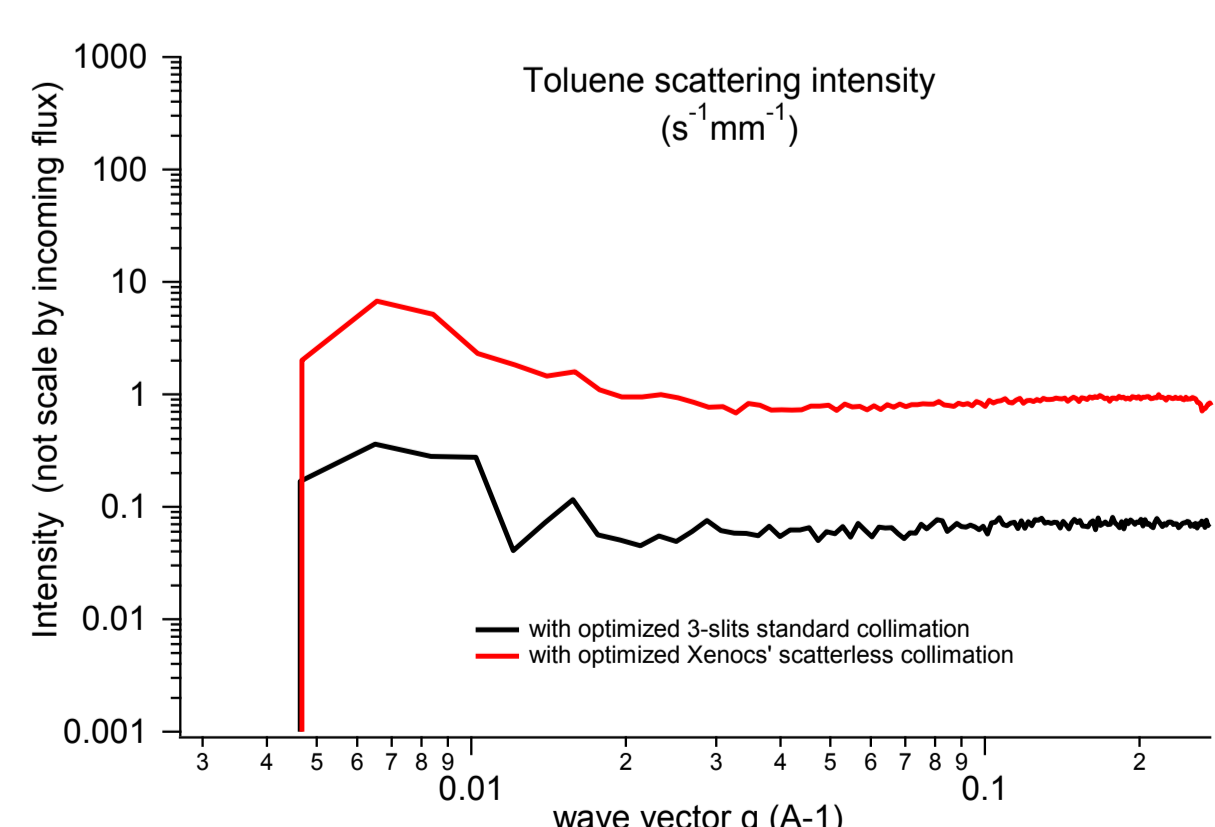
Benefits

- Shorter collimation length
- Increase of the useful flux
- Reduction of collimation length
- Complete parasitic elimination
- Resolution (q_{\min}) become mainly divergence limited

Demonstration of better collimation performance on lab source MM007

(Data courtesy of J. Eyssautier, Institut Français du Pétrole)

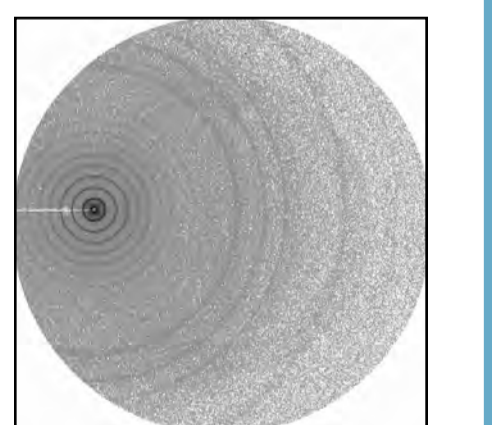
Data not corrected from flux
Data is corrected from sample absorption, thickness and exposure time
Ratio of intensity New / Old > 14



Typical example of a long camera system with Mo radiation

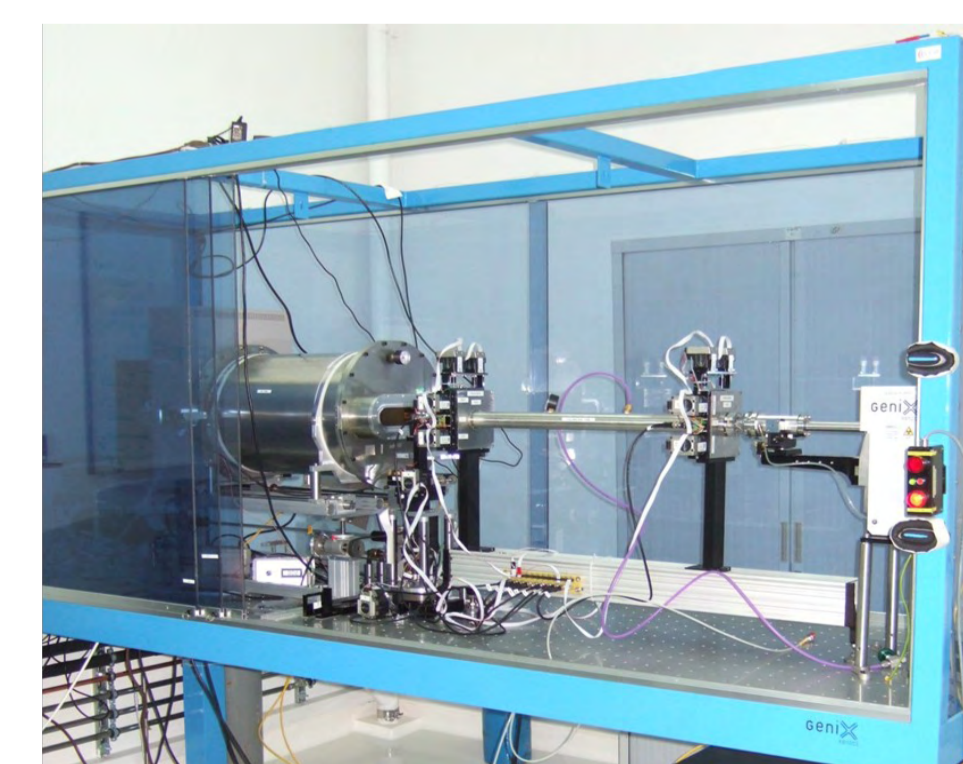


The high brilliance microfocus installed at ICSM, CEA, France, employs Molybdenum radiation (0.71Å). The choice of this radiation offers a higher penetration and allows studies of high-Z species containing samples (heavy metals and lanthanide/actinide ions, dense material...) and very complex and absorbing containers. ICSM is in charge of fundamental research linked to new aspects and needs of renewal of processes for development of sustainable and environment-responsible nuclear energy.



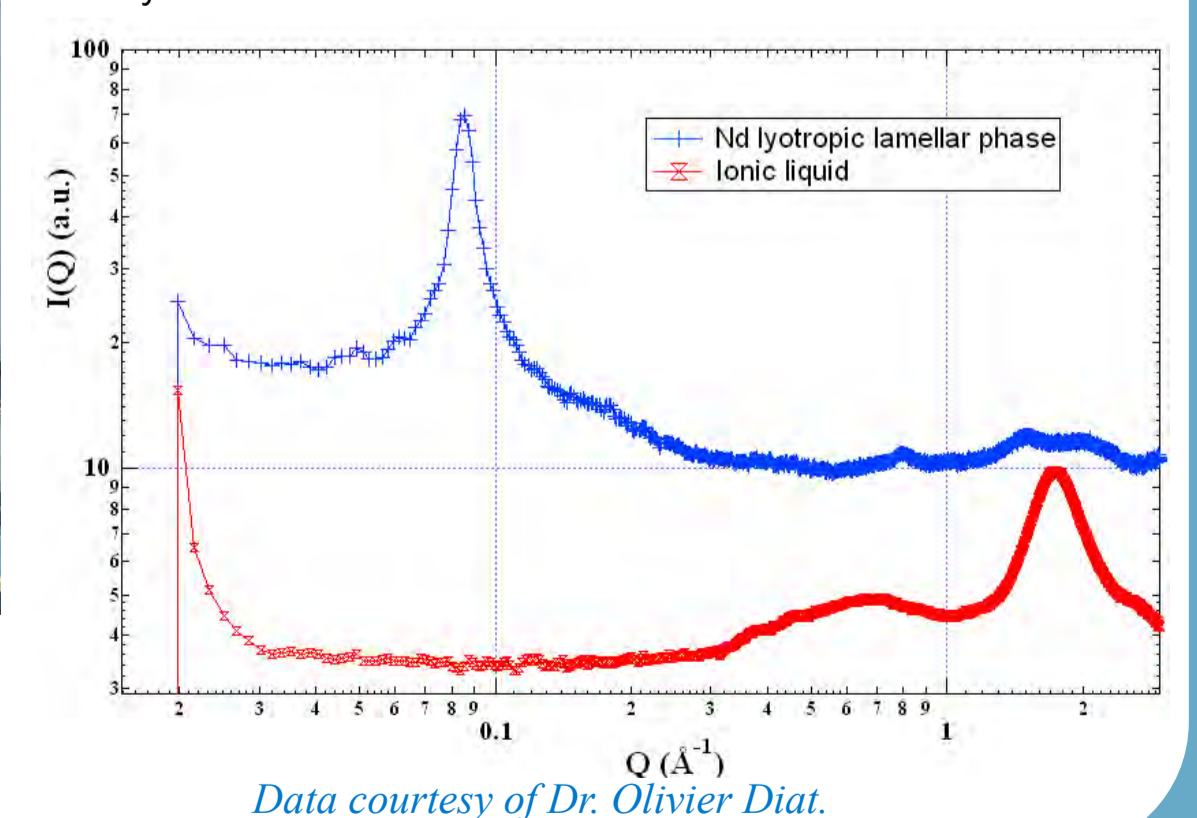
Configuration of the small angle x-ray scattering at Institut de Chimie Séparative de Marcoule, CEA, France

- High Brilliance microfocus GeniX Low Divergence source
- Mo radiation
- Collimation with scatterless slits
- Distance source - sample: ~1.0m
- Distance sample - detector: ~0.7m
- Collimation flight path evacuated
- Scattered flight path in Helium
- Beamstop adjustable in position, placed in vacuum before exit window
- Detection with a 2D area detector (Mar345)
- q_{\min} : 0.02 \AA^{-1}
- q_{\max} : 2.5 \AA^{-1}
- Flux on sample: 366 ph/s



q-range ($2.10^{-2} - 2.5 \text{ \AA}^{-1}$) (off-center detection)

Typical challenging sample for SAXS: High-Z lamellar phase containing 0.1M Neodyme, 50% surfactant and extracting agent in a 3mm capillary. This model systems mimicks multivalent ions extraction systems.



The use of hard x-ray allows for reaching SAXS and WAXS simultaneously



- is a new platform with increased performance and improved ease of use
- FOX3D true aspheric optic provides better source brightness preservation
- combination with scatterless collimation provides ultimate flux

Xenocs provides excellent solution for SAXS laboratory beamlines, specially for challenging systems such as low concentration or high Z elements samples

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