

BEAM DELIVERY SYSTEMS BASED ON ASPHERIC MULTILAYER OPTICS NEW OPPORTUNITIES FOR XRD AND SCATTERING APPLICATIONS



Reflecting Future Technology

Pierre Panine, Vincent Roger, Blandine Lantz, Peter Høghøj, 19, rue François Blumet, F-38360 Sassenage, France

XENOCS supplies :

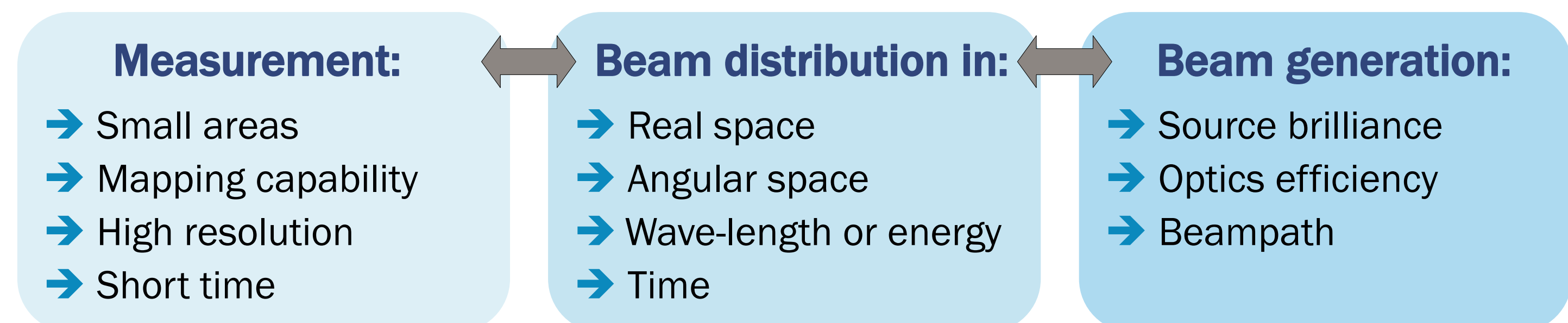
- innovative x-ray multilayer optics
- X-ray beam delivery solutions



Applications presently covered :

- Single Crystal Diffraction
- High pressure diffraction
- SAXS
- Powder diffraction
- X-Ray Reflectometry
- High Resolution XRD
- High Resolution XRD

X-ray Beam considerations

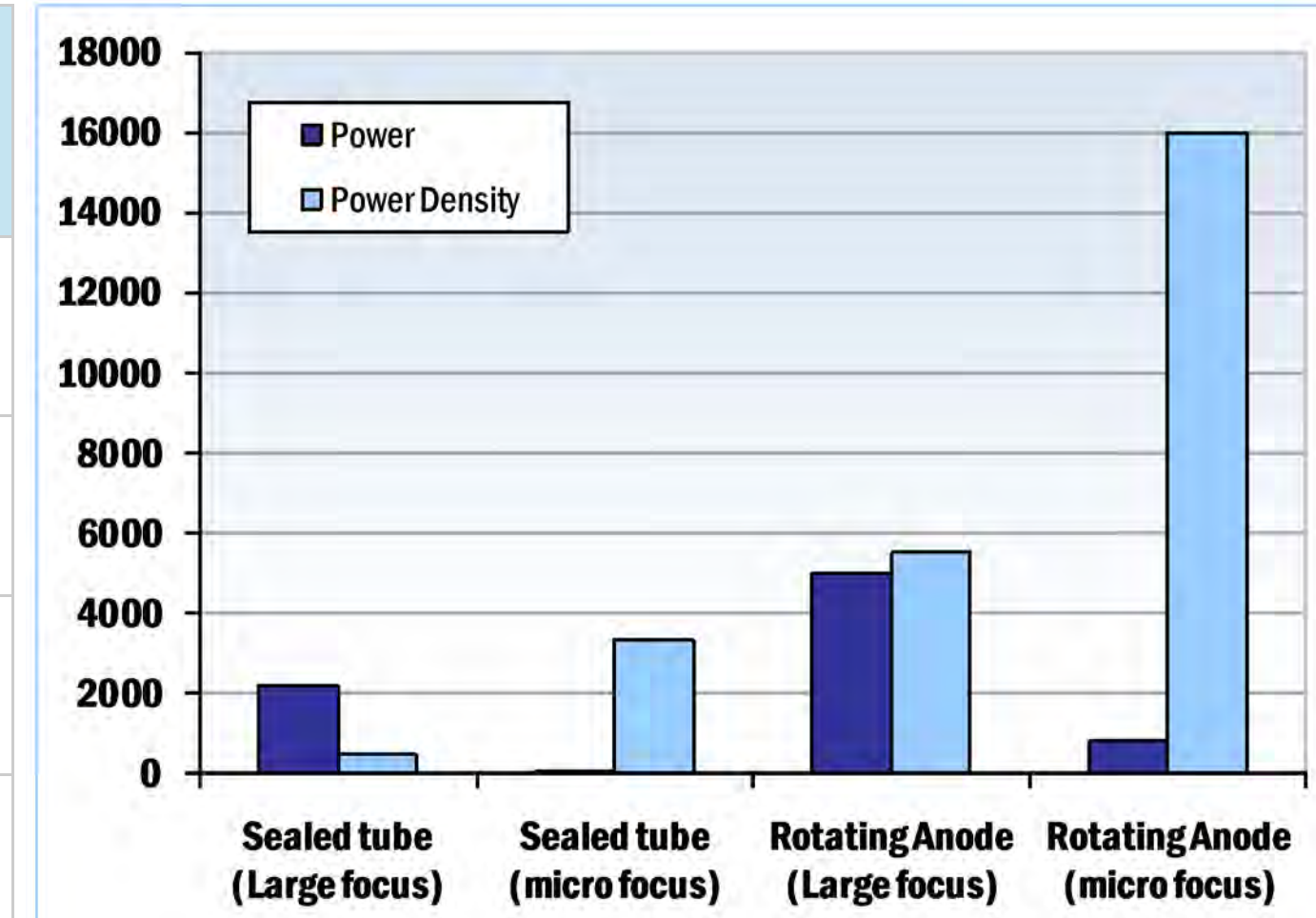


Brilliance: $\text{Ph/mm}^2/\text{mrad}^2/\text{s}$ in relevant part of spectrum

- Brilliance starts with the source.
- At best, optics, beam path preserves brilliance while transforming beam to a useful (optimum) distribution in phase-space.

Performance ~ Brilliance (power versus power density)

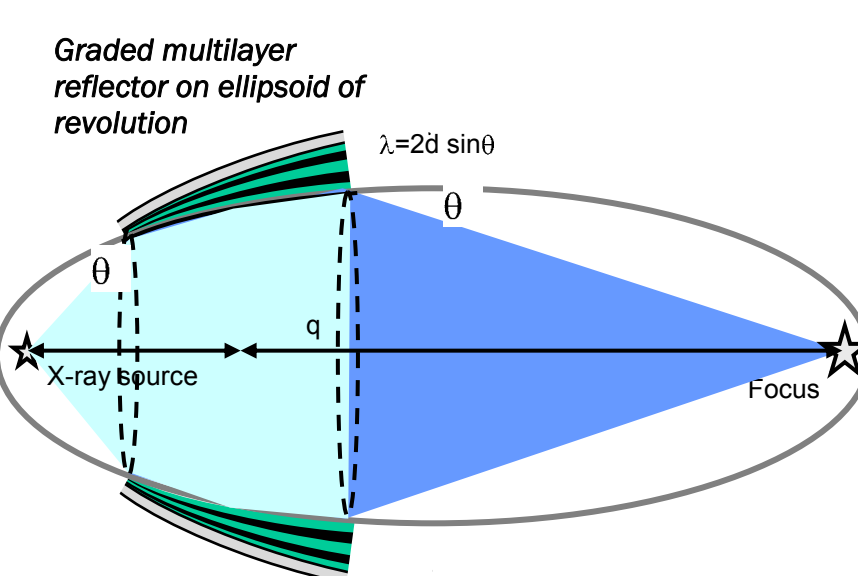
X-ray Generator Type	Power (W)	e-beam spot (mm ²)	Power Density (W/mm ²)
Sealed tube (large focus)	2200	12 x 0.4	460
Sealed tube (micro focus)	50	0.3 x 0.05	3330
Rotating anode (large focus)	5000	3 x 0.3	5500
Rotating anode (micro focus)	800	0.7 x 0.07	16000



◆ Microfocus sources provide very high brilliance at low power

Aspheric Multilayer Coated Optics

- X-ray multilayer coatings
 - high reflectivity
 - tailored spectral purity
 - highly curved aspheric substrates
 - large collection angles
 - Single Reflection
- ◆ Advanced X-ray optics (FOX 3D optics)



◆ FOX 3D optics preserve source brilliance

- high efficiency/reflectivity
- larger collection angle
- high stability
- easy to align

Beam Delivery Systems

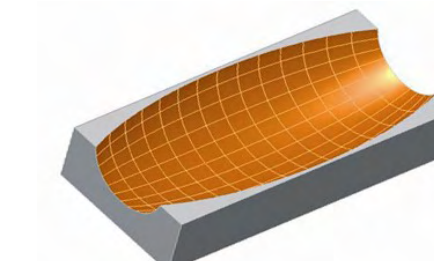
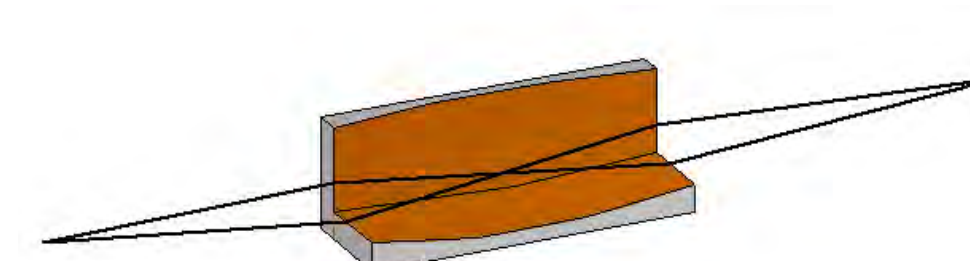


Optics Efficiency : Montel and FOX 3D optics

Simulation for Cu source 50 μm , source to optic p= 14cm, mirror length is 100 mm

Montel Mirrors : Two reflection design

FOX 3D optics : Single reflection design

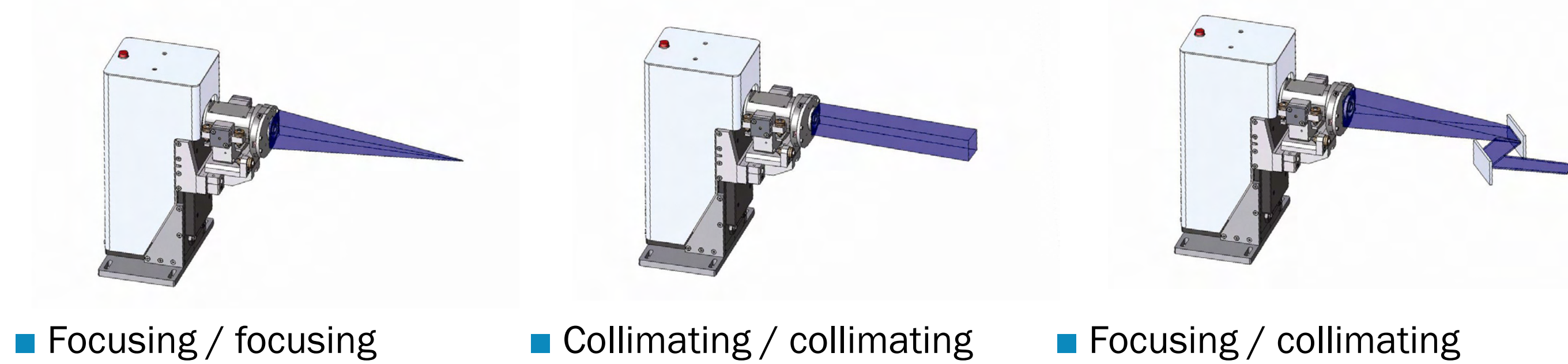


Mirror Type	Montel Mirrors	FOX 3D Mirrors
Optic Efficiency	Eff = 42 %	Eff = 62 %

(Calculated over mirror length)

GeniX configurations

Configuration	Applications	Typical Flux _{vac}	Spot _{focus} (FWHM/ μm^2)	Divergence
GeniX CU VHF	Proteomics	310 Mph/s	200 x 200	5.4 x 5.4 mrad ²
GeniX CU High Flux	Proteomics	230 Mph/s	230 x 230	4.7 x 5.2 mrad ²
GeniX CU Low Divergence	SAXS, High Resolution	150 Mph/s	1500 x 1500	0.8 x 0.8 mrad ²
GeniX CU High Convergence	Thin Film Metrology	>600 Mph/s	80 x 80	4 x 2 deg ²
GeniX Mo Low Divergence	SAXS	5 Mph/s	750 x 1200	< 0, 4 mrad ²
GeniX MO High Flux	Small Molecule	30 Mph/s	200 x 200	3 x 3 mrad ²
GeniX MO Small Spot	High Pressure	5 Mph/s	80 x 80	4 x 4 mrad ²



- Focusing / focusing
- Collimating / collimating
- Focusing / collimating

Features

- Micro-focus Source (50W)
- High performance optics
- Compact system
- Collimation system
- Control & Command unit
- Safety & Fast Shutters
- Remote Operation (Ethernet)
- Water cooling (closed loop)

Benefits

- High brilliance
- Extreme beam stability
- Easy to integrate
- Ease of Alignment
- Ease of Use
- Low power consumption
- Low maintenance
- Limited Floor Space requirements

GeniX Mo Low Divergence for SAXS/WAXS Applications

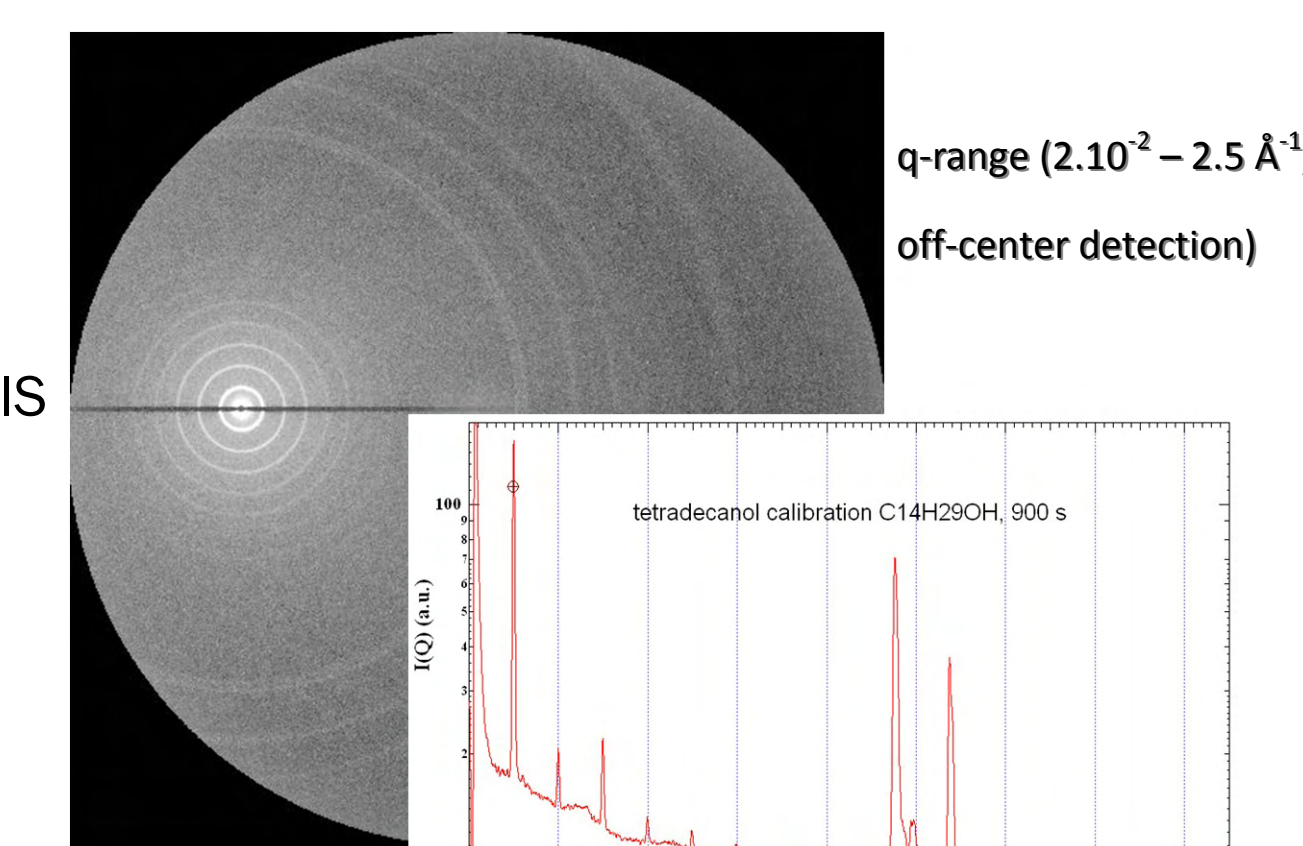


Set-up

- GeniX Mo Low divergence
- Anti-scattering slits vacuum slits (special mounted edges) from FORVIS
- Large (350 mm diameter) detector from MAR Research for small and wide angle regime acquisition

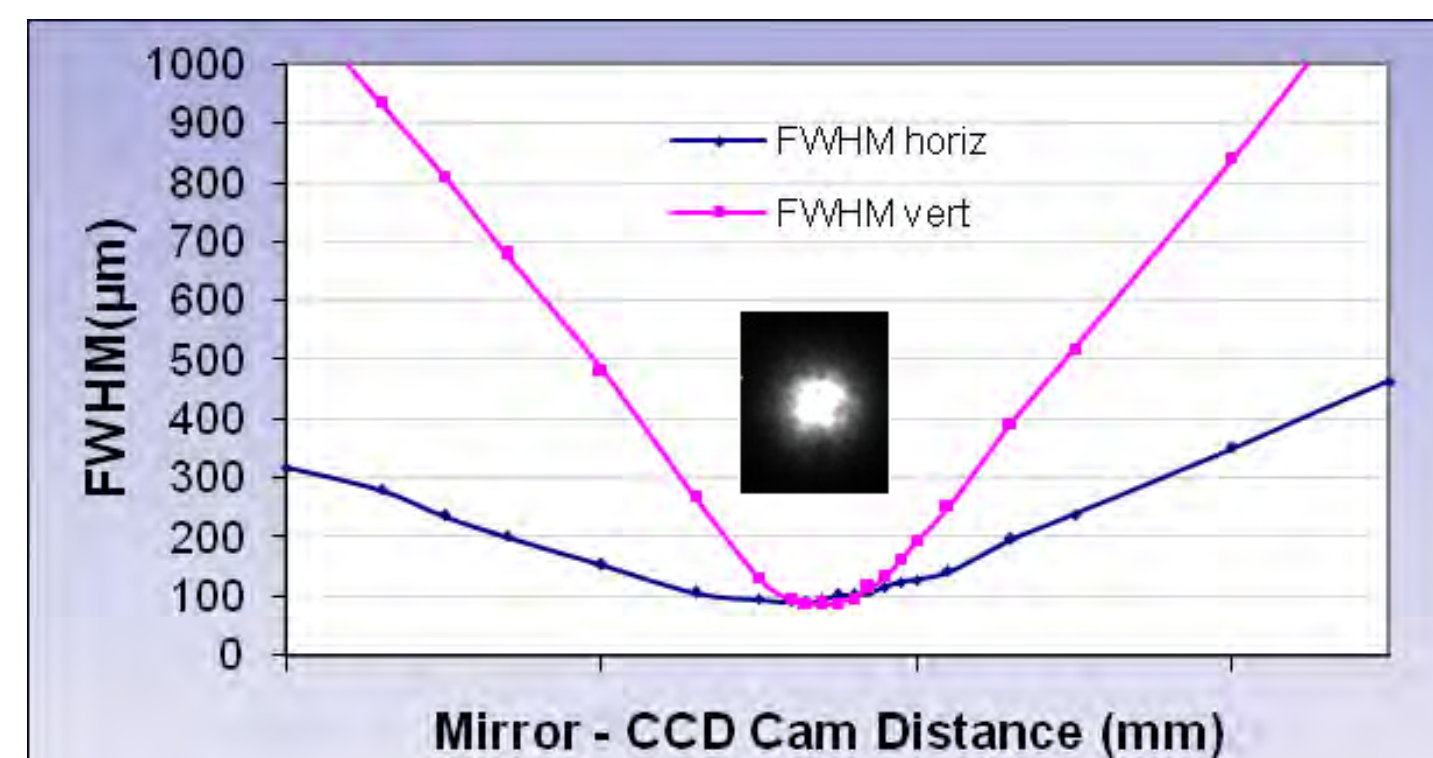
* Data courtesy of Dr Olivier Diat, Institut de Chimie Séparative, CEA Marcoule

SAXS/WAXS on high Z element materials



Raw SAXS/WAXS data of Tetradecanol C₁₄H₂₈OH calibration collected for 900 s illustrating the access to small and wide angle regime

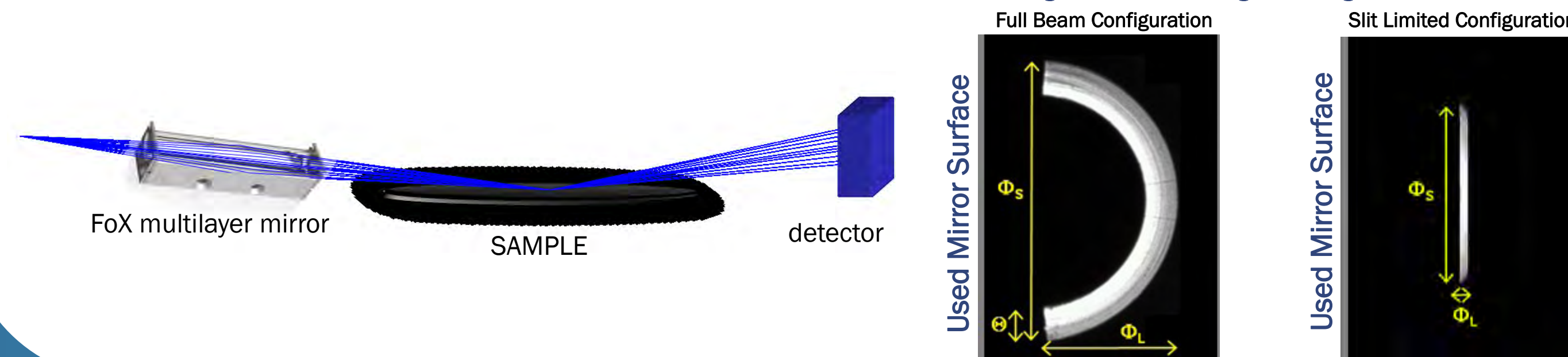
GeniX CU High Convergence



Focusing curves & CCD image of beam profile at focus (inset)

Beam configuration	Full Beam	Slit-limited Beam (customizable)
Typical flux	> 600 x 10 ⁶ ph/s	> 26 x 10 ⁶ ph/s
Beam convergence	$\Phi_S \geq 4$ deg $\Phi_L \geq 2$ deg $\theta = 0.54$ deg	$\Phi_S = 2.6$ deg $\Phi_L = 0.05$ deg
Spot size at focus FWHM	~80 μm	~80 μm
Applications	X-Ray Reflectometry Micro XRF Micro Diffraction	Scanning Reflectometry with surface mapping

CCD images of GeniX Cu High Convergence at the mirror exit



- is a stable, high brilliance, low power microfocus beam delivery system.
- is proven to outperform standard sealed tubes and to provide performance equivalent to traditional rotating anode generator in a number of applications.
- is an affordable solution metrology with reduced maintenance, facilities requirements and running cost.
- is validated by a number of equipment makers and academics

Xenocs SA
19 Rue François Blumet
38360 Sassenage -France
www.xenocs.com
sales@xenocs.com
phone +33 4 76269540
fax +33 4 76269549