# Small Angle X-Ray Scattering
# GeniX Cu Low Divergence

Application Note n° AN-G6


## Abstract

*The GeniX Low Divergence beam delivery system was tested at the Materials Research Laboratory of UCSB for SAXS applications.*

*The compact GeniX was installed in a 4-meter SAXS line in less than 1 day and diffraction patterns were collected from several samples. The results compare quite favorably to those obtainable using a traditional rotating anode generator.*


*Fig. 1 : The SAXS setup with GeniX in foreground.*

## GeniX beam delivery system successfully tested for SAXS applications

*Data courtesy of Dr. Youli Li, University of California, Santa Barbara, USA.*

## Introduction

Due to its small 50 µm source size, the GeniX beam delivery system has intrinsic advantages for small angle x-ray scattering applications, in which the source-to-detector distance is generally large (typically > 2 m).

To demonstrate the capability of the GeniX beam delivery system for SAXS applications, XENOCS recently provided a demo unit to Dr. Youli Li of the Materials Research Laboratory at the University of California, Santa Barbara, for a series of test experiments to characterize the performance of the system. The GeniX system was incorporated into an existing 4-meter long SAXS instrument (Fig.1) and the instrument was used to collect high quality SAXS data from multiple samples. The results validate the theory that when it comes to SAXS, the smaller (the source size, that is), the better.

## Experiment

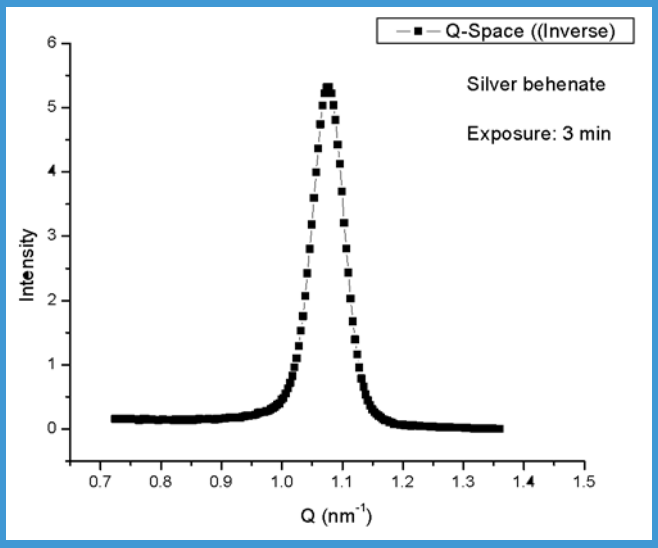
In a typical SAXS system, a series of pinholes or slits are used to control the beam size and divergence so that the desired low angle scattering data can be spatially separated from the main beam at the detector. A simple way to think about this configuration is to consider the set up as effectively imaging the source through successive apertures onto the detector. A SAXS system with a conventional source generally sacrifices a large fraction of the raw X-ray photon flux from the source in order to achieve the required angular resolution. A small source coupled to a high efficiency long-focusing optic is highly effective for SAXS because more flux can be squeezed through the tight pinholes (the beam size at the defining aperture is directly determined by the source magnification). Consequently, although the GeniX operates at low total power, it can provide usable flux levels for SAXS comparable to many high-powered generators. The experiments presented here convincingly demonstrate the advantages of this unique approach.

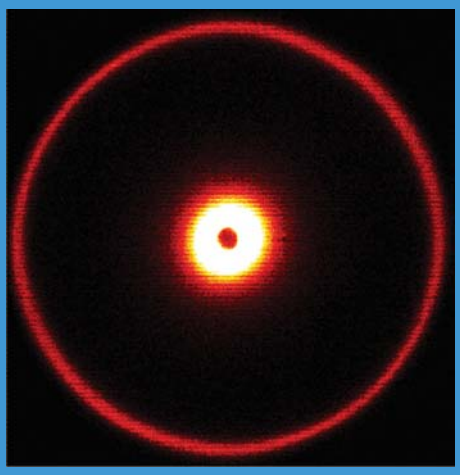
The test instrument was originally configured using a rotating anode generator with a 0.2 mm x 0.2 mm source size and a long focus double multilayer mirror primary monochromator (for details

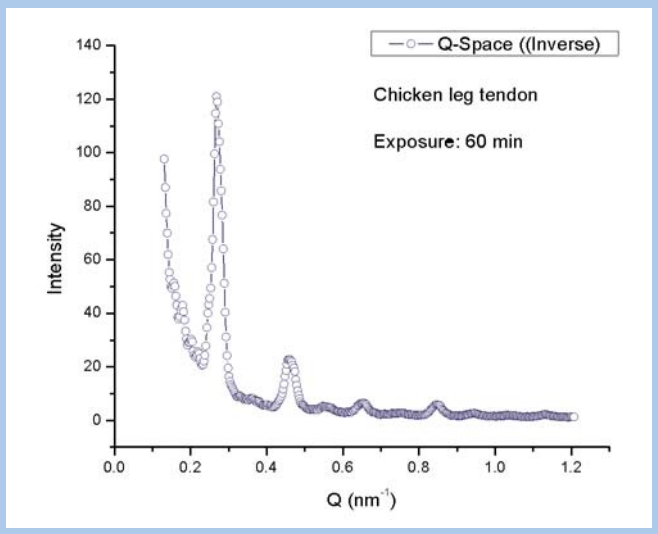
*TABLE I : Key parameters of SAXS setup with GeniX*

| | |
|---|---|
| **Source and monochromator** | GeniX |
| **Source-to-Sample Distance** | 1.8 meter |
| **Sample-to-Detector Distance** | 1.7 meter |
| **Beam Collimation** | 3 sets of motorized slits |
| **Detector** | Bruker HI-STAR multiwire detector |
| **Beam size at sample position** | 1 mm x 1 mm |
| **Qmin** | $1.0 \times 10^{-2}$ Å$^{-1}$ |
| **Beam Flux at sample position (50kV x 1 mA)** | $1.4 \times 10^{7}$/s * |

* Beam flux was measured with calibrated PIN diode during initial set up. Normal flux could be higher with further optimization.





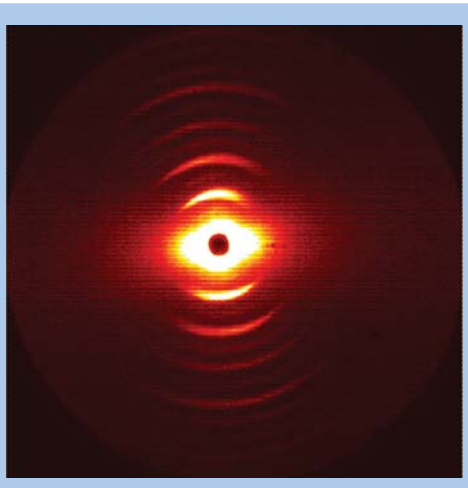



*Fig.2 : XS data collected with GeniX-powered SAXS system from a Silver Behenate (TOP) and a hydrated chicken leg tendon samples (BOTTOM).*

see *www.mrl.ucsb.edu/mrl/centralfacilities/xray/index.html*). During the test experiments, the GeniX system was inserted into the optical path near the current source to replace both the rotating anode source and the monochromator, with all other optical components and settings unchanged. The compactness of the GeniX system (including both source and monochromator) greatly eased the modification : the entire set up time took less than a day. Table I shows some of key parameters of this GeniX-powered SAXS instrument, which provided a flux level comparable to the same set up with the rotating anode at operating at approximately 30x higher power.

The high usable flux level permitted data collection with fairly short exposure times. In Fig. 2 SAXS data collected on Silver Behenate (3 minutes exposure time) and chicken leg tendon (60 minutes exposure time) are shown. These data demonstrate the excellent performance characteristics of the GeniX system for SAXS applications.

## Conclusion

The high beam delivery efficiency combined with ease of use and low maintenance make the GeniX beam delivery system an excellent choice for SAXS applications.

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