# Spherical Grating Monochromator (SGM) Beamline 11ID-1

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**BEAMLINE LEADER:**

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Beamline Overview

| | |
|---|---|
| Status | Fully Operational |
| Source | 45 mm pure permanent magnet planar undulator |
| Monochromator | Spherical grating |
| Spectral range | 250-2000 eV |
| Flux | $10^{12}$ -$10^{13}$ photons/sec/100mA at 0.1% bandwidth |
| Resolving power | Up to $10^4$ |
| Spot size | 0.5 x 0.5 mm |

## Introduction

The SGM is a successor beamline to that of the same name which operated for several years as part of the Canadian Synchrotron Radiation Facility (CSRF), at the Synchrotron Radiation Center in Madison, Wisconsin. A few components – the grating and exit slit chambers – were in fact relocated from CSRF, but the majority of the components are new. The beamline is intended for general purpose soft X-ray spectroscopy, with the intention to accommodate as wide a range of materials as possible. The energy range, achieved using three gratings, includes the *K*-edges of C, N and O, the *L*-edges of the first row transition metals, the *K*-edges of Mg, Al and Si, and the *M*-edges of the lanthanides.

Both photoemission and X-ray absorption endstations are routinely available, but a wide range of endstations can be accommodated, including those supplied by users.

## Layout

The photon source is a planar undulator, with both first and third harmonics used to cover the full energy range. The lower energy limit, around 240 eV, is dictated by the minimum physical undulator gap possible. Lower energies are available on the PGM beamline. The SGM beamline has a "Dragon"-type spherical grating monochromator, with the attendant required exit slit tracking. This mechanism is CSRF legacy equipment and its physical travel limit gives the practical upper limit to the energy range at around 2050 eV. There is still usable beam up to the P *K*-edge, but use at this edge is expected to transfer to the SXRMB beamline in the very near future.

In terms of flux and energy resolution, the beamline performance is comparable to the best soft X-ray beamlines worldwide. An example is shown in Figure 2, which compares SGM data for xenon gas with those from a 2007 publication from the BL25SU beamline at Spring-8 , in which the authors describe their data as "ultra-high" resolution [1]. As can be seen in Figure 2, SGM is at least competitive here.

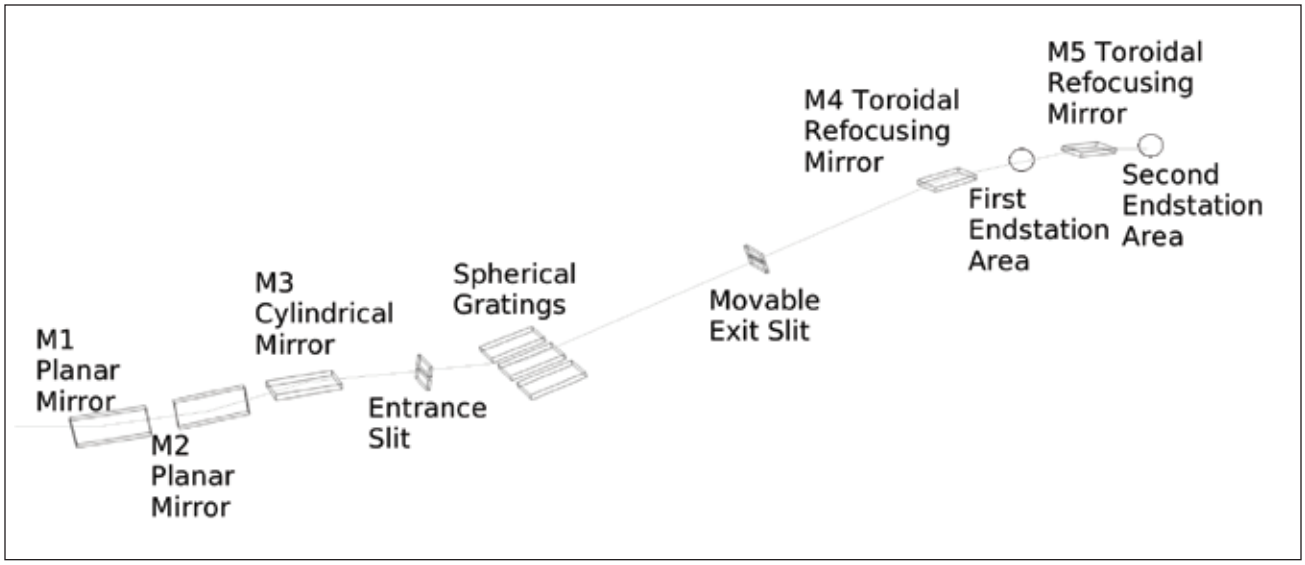


***Figure 1:*** Schematic diagram of the layout of the SGM beamline.

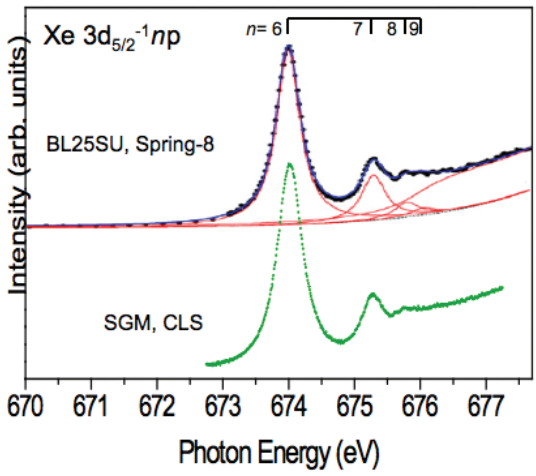


***Figure 2:*** "Ultra-high" [1] resolution X-ray absorption data for xenon gas - a comparison of SGM with one of the highest performing beamlines worldwide.

There are two endstation positions. The first permanently houses the UHV photoemission chamber, which has a Scienta 100 mm analyzer. The second endstation area usually houses the solid state XAS chamber. This chamber, which can reach UHV if required, has both total electron yield and total fluorescence yield detection, the latter using a channel-plate detector. This chamber is also routinely used for X-ray excited optical luminescence (XEOL) measurements, which are also possible in the Scienta chamber using a portable ex situ video detection system. There is also a gas cell between the solid state XAS chamber and the last valve, which allows the simultaneous acquisition of gas phase and solid state XAS data, which is extremely useful for high accuracy photon energy calibration. In addition, a gold evaporator allows the deposition of a fresh gold surface onto the Io mesh at any time without breaking vacuum – especially valuable to users studying the carbon *K*-edge.

## Update 2007

2007 was the first complete calendar year of full user operations, which commenced in July 2006. The beamline has become a true national (and international) facility, with active user groups from seven provinces and three foreign countries. Demand for beamtime remains high. With several months of productive operations already under our belt by the start of the year, there was a steady flow of publications appearing almost from day one. Notable papers included the first CLS photoemission paper [2], from an Alberta group, the first fruit of a Saskatchewan-Germany collaboration on nitrogen in soil [3], and a paper on luminescence from diamond from our beam team at the University of Western Ontario [4].

Tom Regier's user interface software was given a well-earned retirement in 2007, with the new software being written by summer student David Chevrier, now Science Associate on SXRMB.

2007 also saw the first hosting of a user endstation on SGM - David Hawthorn of the University of British Columbia brought a chamber that will ultimately form part of the REIXS beamline – some of the results obtained can be found elsewhere in this report [5].

Tom Regier presented the beamline to the pan-American synchrotron community at the SRI conference in Baton Rouge, Louisiana. The resulting paper [6] is both a useful and citable reference.

## Beamline Team

***Table 1:*** Beamline Design and Team

| **University of Western Ontario** | |
|---|---|
| T. K. Sham | Beamteam Leader |
| G. Mike Bancroft | Consultant |
| | |
| **Canadian Light Source** | |
| Robert Blyth | Beamline Scientist |
| Tom Regier | Science Associate |
| Yongfeng Hu | SXRMB Beamline Scientist |
| Lucia Zuin | PGM Beamline Scientist |
| Ian Coulthard | SXRMB Beamline Scientist |
| Jeff Cutler | Beamteam member |
| Glen Wright | Controls Lead |

## References


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