

## Use of spherical gratings in a toroidal grating mount for vuv-soft x-ray synchrotron radiation

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**Abstract.** A toroidal grating monochromator (TGM) based beamline was designed earlier and it is being setup on the 450 MeV Indus-1 synchrotron radiation source. This beamline operates in 40–1000 Å wavelength range and gives a moderate resolution ( $\sim 500$ ) at high throughput. Now-a-days, spherical gratings are giving very high resolution in some complex monochromators. We have evaluated the use of spherical gratings in the simple rotation mount of a TGM. The motivation has been to evaluate if the existing TGM beamline, without any hardware changes, can be used with the much cheaper spherical gratings. The two monochromators, employing toroidal and spherical gratings respectively, have been compared by performing detailed ray tracing calculations. Our study shows that, with the same mechanical hardware, a real spherical grating monochromator gives better performance compared to the conventional TGM with respect to the spectral resolution and the flux. Furthermore, for moderate resolution this improvement is realized even when the exit slit is not moved to keep the spherical grating in-focus.

**Keywords.** Synchrotron radiation; beamline; monochromator; soft x-ray.

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### 1. Introduction

A number of synchrotron radiation facilities exist world wide, many of which emit radiation in the soft x-ray and vacuum ultra violet (XUV) wavelength range (10–1200 Å). In this wavelength range, grazing incidence optics in ultra high vacuum (UHV) environment has to be used. Many designs of the monochromators to be put up on beam lines for this wavelength range exist [1, 2] and are based on plane, toroidal or spherical gratings. Many of these designs require stringent closed coupled movements of the optical elements in the UHV environment and are therefore difficult to realize in practice and are quite expensive. In most cases, these complicated designs are essential to derive the best resolution from the monochromators. However, there are many application areas like photoelectron spectroscopy, reflectometry and radiometry where the requirement is not for very high resolution but of good throughput at moderate resolution ( $\lambda/\Delta\lambda \sim 500$ –1000). Relatively simple monochromator designs can deliver these requirements leading to a great deal of simplicity in the instrumentation. One such design [3] that has been quite popular during the eighties is the use of toroidal gratings in the constant deviation geometry (TGM) wherein a simple sine bar drive rotates the grating about its axis for