Pramāṇa – J. Phys., Vol. 35, No. 2, August 1990, pp. 187–191. © Printed in India.

# A note on grating based soft X-ray monochromators

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MS received 2 March 1990

**Abstract.** A few facts related to the aberrations for toroidal and plane gratings are presented. Some design aspects of the plane grating-based monochromator devised by Petersen (1982) are discussed. We also point out that for a cylindrical grating astigmatic correction can be reduced and suggest that following Petersen's scheme some improvements in the monochromator performance could be achieved with such a grating.

**Keywords.** Soft X-ray monochromator; cylindrical grating; aberration corrections.

**PACS Nos** 07·85; 33·20

## 1. Introduction

The development of soft X-ray grating monochromators for use with synchrotron radiation sources has seen consistent advances over the last two decades. A comprehensive list of references and an updated status of most of these developments has recently been provided by Padmore (1989). Principally, the thrust of most of the developments, whether using plane, spherical or toroidal gratings has been to devise configurations so as to reduce the aberration corrections (and thus increase the resolving power). Concurrently, technological improvements in the surface quality of optical elements and designs of the drive mechanisms used for tracking, have upgraded monochromator performance remarkably over the years. In this note we propose to recapitulate some of the optimization schemes used for reducing aberration corrections and then turn to some design aspects of the Petersen's plane grating monochromator. We also point out a new way, based on the use of a *cylindrical* grating, to achieve an improved monochromator performance. A brief summary of the geometrical optic approach to grating aberrations is presented in § 2. Some practical aspects of Petersen's monochromator are examined in § 3. In § 4 we discuss the case of cylindrical grating and a summary of our conclusions is given in § 5.

## 2. Aberrations for different grating shapes

We begin by recalling basic facts of geometrical-optic-grating-abberation theory and in particular some facts relating to toroidal and plane gratings.

Assume $O$ is the centre of a grating of some specific shape (toroidal, spherical, plane, elliptical etc.) whose surface is given by an equation of the form

$$z = f(x, y). \tag{1}$$