Design of a High Resolution X-ray Reflection Grating Demonstration

T. Johnson1,*, L. S. Casement1, D. Henderson1, C. Lillie1
Randall L. McEntaffer2, Webster Cash3
1Northrop Grumman Corporation, 2University of Iowa, 3University of Colorado
*tim.johnson@ngc.com; One Space Park, MS 201A/5127, Redondo Beach, CA 90278

Abstract
The International X-ray Observatory (IXO) has baselined a soft X-ray grating spectrometer as part of its instrument complement to provide spectral resolution (R) of >1250 over the 0.3 – 1 keV band. Current generations of reflection gratings have demonstrated R of a few hundred with very small telescopes. The same basic technology can be used with a higher resolution telescope such as IXO to provide R of up to 3000 with only small modifications. We have developed a test article which will be placed in the X-ray beamline facility at GSFC using a mirror pair developed as a technology demonstration for IXO. The test article will demonstrate the current baseline requirement for resolution. We present test data (as available) and performance predictions, as well as an approach to get to R~3000, well in excess of IXO requirements.

• High performance X-ray telescope mirrors at GSFC have measured spatial resolution of 15 arcsec.
• Used with test grating of groove density 4500 gr/mm (and other parameters of set-up) we should measure spectral resolution R~200 before applying subaperture.
• Applying subaperture to telescope will increase spectral resolution (R) by decreasing blur at detector.
• Because R is a strong function of telescope resolution (see below), this should increase measured R to upwards of 3000.
• Only tradeoff of subaperturing is that it also decreases light through system thus lower signal to noise ratio (SNR) at detector.
• Thus as we increase telescope resolution the tradeoff is a reduction in SNR.
• Note: detector pixels are smaller than blur size thus does not limit measurement.

Spectral Resolution or Resolving Power (R = λ/Δλ) is a strong function of Mirror Spatial Resolution.

References

Example detector plot. Grating orders from Cu-L line. R can be calculated using spot width and distance between orders [1].

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Conical Diffraction
Grating Equation [2]