FURST Grating Specification

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1 Introduction

The Full-sun Ultraviolet Rocket SpecTrometer (FURST) is a *proposed* NASA sounding rocket mission to obtain well calibrated FUV spectra of the full sun from 120-200 nm. This document describes the FURST grating. *We are presently requesting a quotation for budgetary purposes, to support the proposal process.*

The spectrometer is a Rowland circle (Abney mount) spectrograph designed for an aberration limited resolution of $\lambda/\Delta\lambda \sim 20,000$. The spectrograph is fed by a convex cylindrical mirror that produces a tall, narrow ($\sim 15\,\mu$m), virtual image of the full sun in lieu of a slit. The feed optic is moved along the Rowland circle to select the wavelength range that falls on the detector. The angles of incidence and diffraction are on the same side of the grating normal, with the shortest wavelengths imaged at near Littrow configuration, to minimize the overall size of the instrument. A Zemax model of the instrument is available upon request.

2 Grating Description

Table 1 lists requirements for the diffraction grating. Dimensions and layout are specified in figure 1. The specifications are written around the assumption of a holographic grating, with the aim of minimizing visible stray light (alignment sections will be covered in flight), but we are open to manufacturer recommendations. Visible stray light also drives the roughness requirement. We suspect that the tabulated requirements can be met with a replica grat-

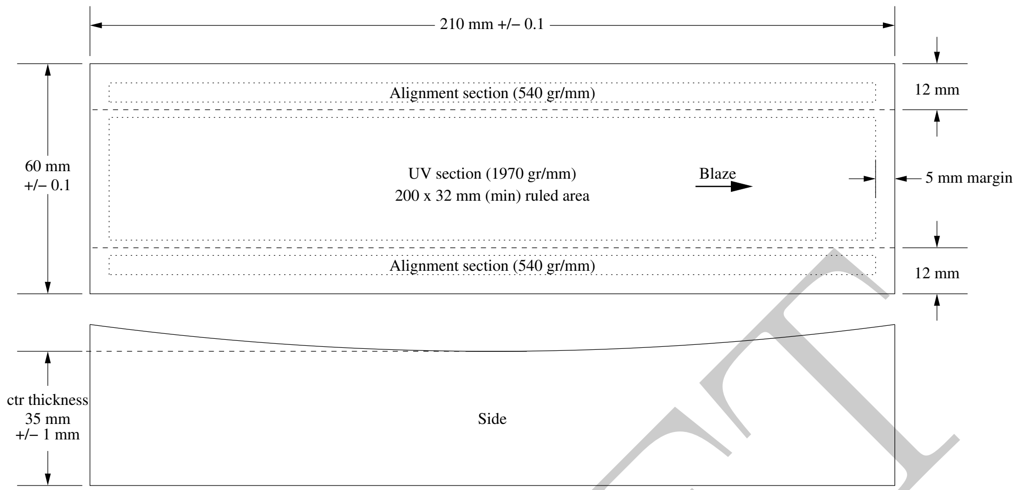

Figure 1: Sketch of the grating design. Note the two alignment sections, intended for light in the vis-IR, 400-800 nm.

ing. If so, replicas may be most economical since we plan to procure two (§ 4).

We recognize that throughput and resolution measurements can be challenging in vacuum ultraviolet. Some combination of modeling and testing (the latter perhaps off band) is likely to be necessary. *For purposes of our proposal budget, we request an efficiency estimate supported by calculation.* Verification plan TBD....

3 Contamination Control

TBD...minimize both particulate and molecular contamination, consistent with best practice for FUV optics.

4 Deliverables

1. Two coated gratings per specification (flight grating plus spare).

2. Conformance report for each grating, including all test results relevant to this specification.

Table 1: Requirements Table for the FURST grating. Verification methods are T (test), M (measurement), I (inspection), C (calculation), D (design/mfg process).

Specification	Requirement	Verification
Type	Concave holographic reflectance grating	D
Mounting	Rowland circle (modified Abney)	D
Geometry	Per fig 1	I
Figure	Sphere, $R = 1500\,\mathrm{mm} \pm 0.5\%$	M
Groove profile	(quasi-)sinusoidal, optimize for $\lambda 120\,\mathrm{nm}$	D
Groove period	UV and alignment regions per fig 1	D
Spectral order	$m = 1$	D
Groove orientation	UV and alignment regions parallel $\pm 0.2^\circ$	M
	Grooves perpendicular to long edge $\pm 0.2^\circ$	M
Roughness (along grooves)	$< 3.6\,\mathrm{nm}$ RMS, periods 0.5-50 μm	M
Coating	Broad band FUV, 120-200 nm	D
UV Section Throughput	> 0.2 $m = 1$, λ120-200 nm	C, T
Align Section Throughput	> 0.2 $m = 1$, λ400-800 nm	C, T
UV Spectral resolution	$\lambda/\Delta\lambda > 20,000$	C, T
Incidence angle	$9.10^\circ < \alpha < 20.60^\circ$	D
Diffraction angle	$3.51^\circ < \beta < 4.69^\circ$	D
Finish	Fine grind non-optical sides (5)	I