A high-throughput, high-resolution spectrometer for mapping the heliopause and 3-D Solar Wind using He+ 30.4nm

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How does the 3D solar wind respond to coronal variability?

How does the boundary between the fast/slow solar wind regions vary ?

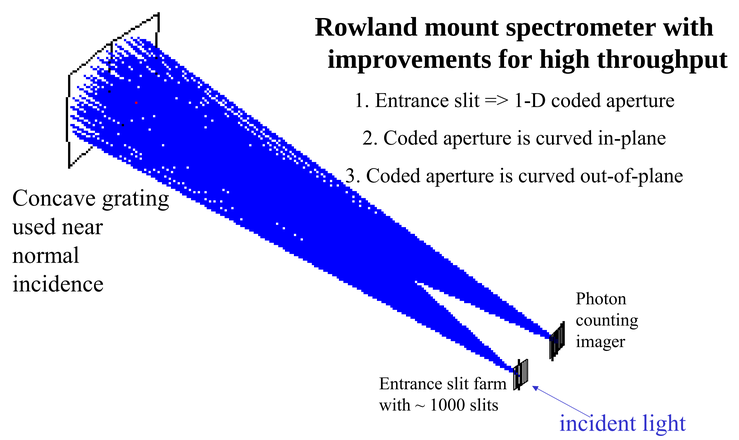
What is the shape of the heliopause?

How does the heliopause vary during the solar cycle?
What is the ionization state of the LISM? Interstellar magnetic field?
What are the processes at the boundary?
What are the time and space variations?
=>

30.4nm He+ Doppler spectroscopy and mapping

Helium Ion Spectroscopy Explorer

Mapping concept: cover 75% of sky every 14 days
(Sun avoidance keeps us from pushing 100%)
Each mapping pixel = 5deg x 5deg = 0.006 steradian
1 kilosecond dwell time on each pixel
Instrument bandpass spans 30 to 31 nm
Resolving power $\lambda/\Delta\lambda$ =6000 => 50km/sec
Need to reach 1 milliRayleigh sensitivity with good SNR
Instrument package size ~ 1 meter
But... conventional Rowland has inadequate throughput
>> Need a higher throughput diffuse EUV spectrometer <<



Why Multiple Slits?

A farm of >1000 tall parallel entrance slits permits sampling 30.4 nm with a very high multiplex advantage and throughput.

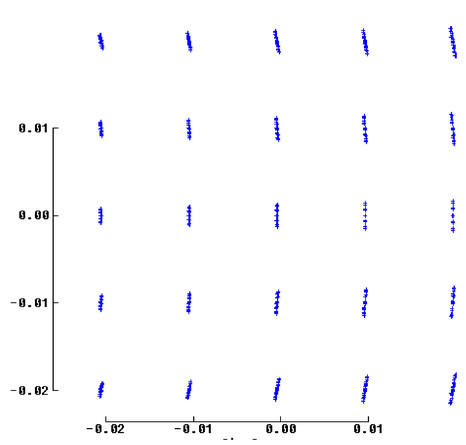
Why Curved Slits?

With **straight** vertical input slits, astigmatism & rotation broadens lines to 500umFWZ.

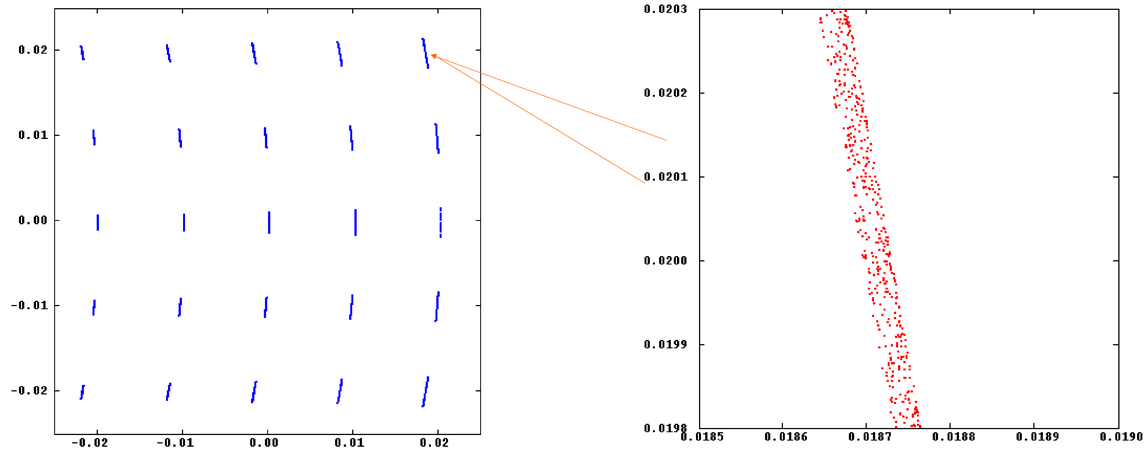
Curving the input slits delivers 10umRMS and 30umFWZ.

Why Encode?

Encoding an orthogonal binary pattern allows deconvolution of the spectrum in the presence of noise and dramatically increases sensitivity to line features.



The problem: image w/ straight slits



The solution: image with curved input slits

Many Optical Configurations Studied

Rowland (in-plane); Eagle; Toroidal-grating

One example: f/12, 0.006 ster, 5x10cm * 50%

Resolving power = 6000; length=1.25m

Throughput with reasonable QE etc: 1cps/mR

Suitable detector: Microchannel Plate

5cm x 10cm photon counting imager

2-D delay line readout w/ anticoincidence

or active multi-megapixel digital event counter

Example Sky Survey Mission

3-year duration MIDEX class, sun-pointed spinner or 3-axis

location outside magnetosphere and geocorona (e.g., L2)

1-10 kilosec dwell each sky field

Sensitivity at 30.4: ten sigma in 1 ksec and 1mRayleigh!

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