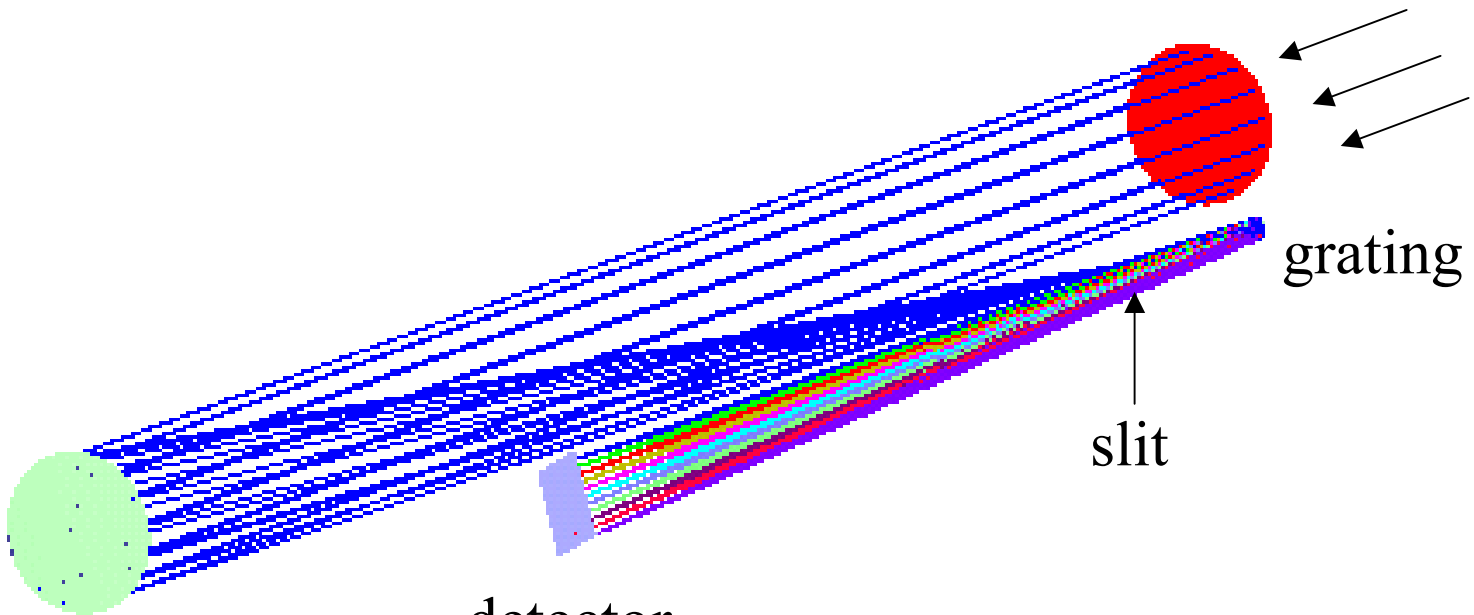
Compact, High-Resolution EUV Spectrograph for Solar Orbiter

- How compact ?
  - $160 \times 18 \times 11$ cm^3 optical envelope
  - Compact $\Rightarrow$ Lighter $\Rightarrow$ Cheaper
- Only two reflections
  - Higher throughput
  - Easier to align
- Simple optics: parabolic telescope + spherical grating
  - Easily fabricated
  - Super high-quality surfaces can be achieved

Compact, High-Resolution EUV Spectrograph for Solar Orbiter

- Magnifying spectrograph
  - $R_I / R_O \geq 5$
  - Large plate scale in small physical length
  - Most efficient use of available volume
  - Aberrations corrected by SVLS rulings
- Thermal advantages
  - All optics see ≤ 1 solar constant
  - Primary at back: allows shielding and direct radiative cooling
  - Unwanted light can be reflected out the front

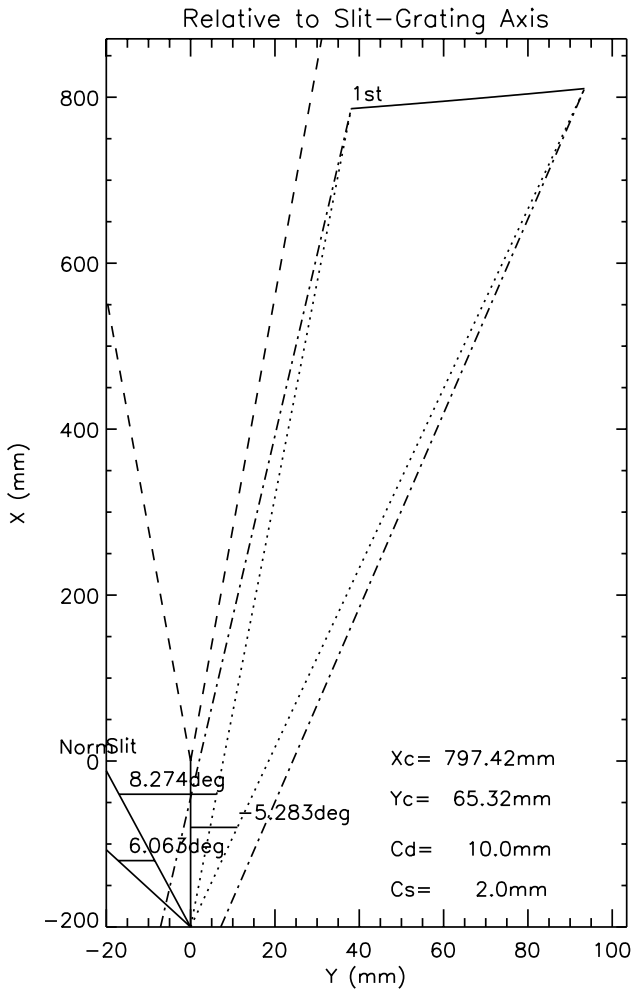

grating
slit
detector
parabolic
primary

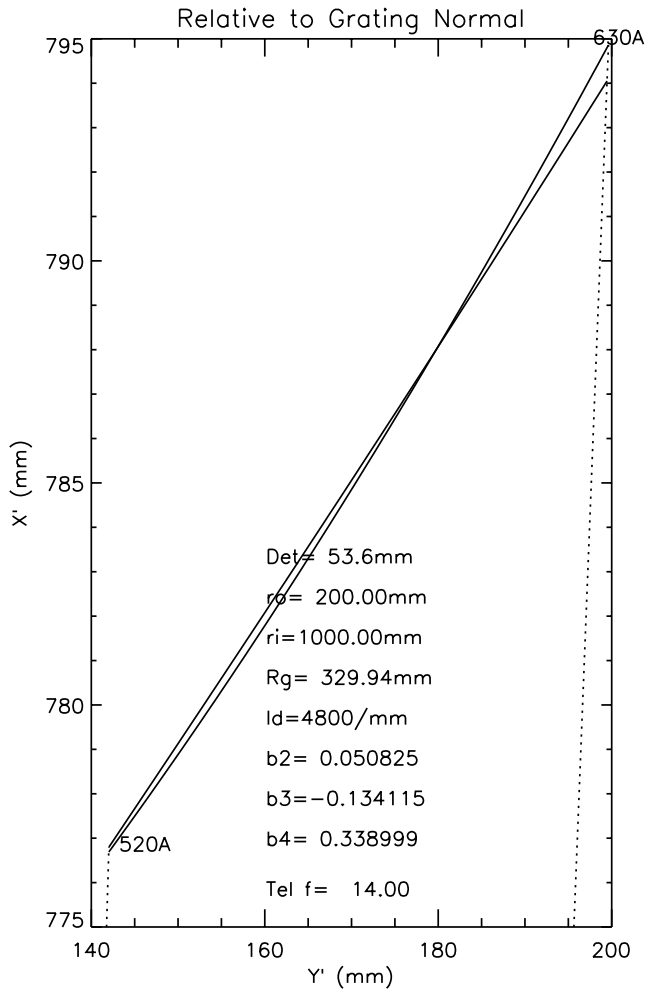
Throughput Comparison of EUNIS to SERTS and Solar B / EIS

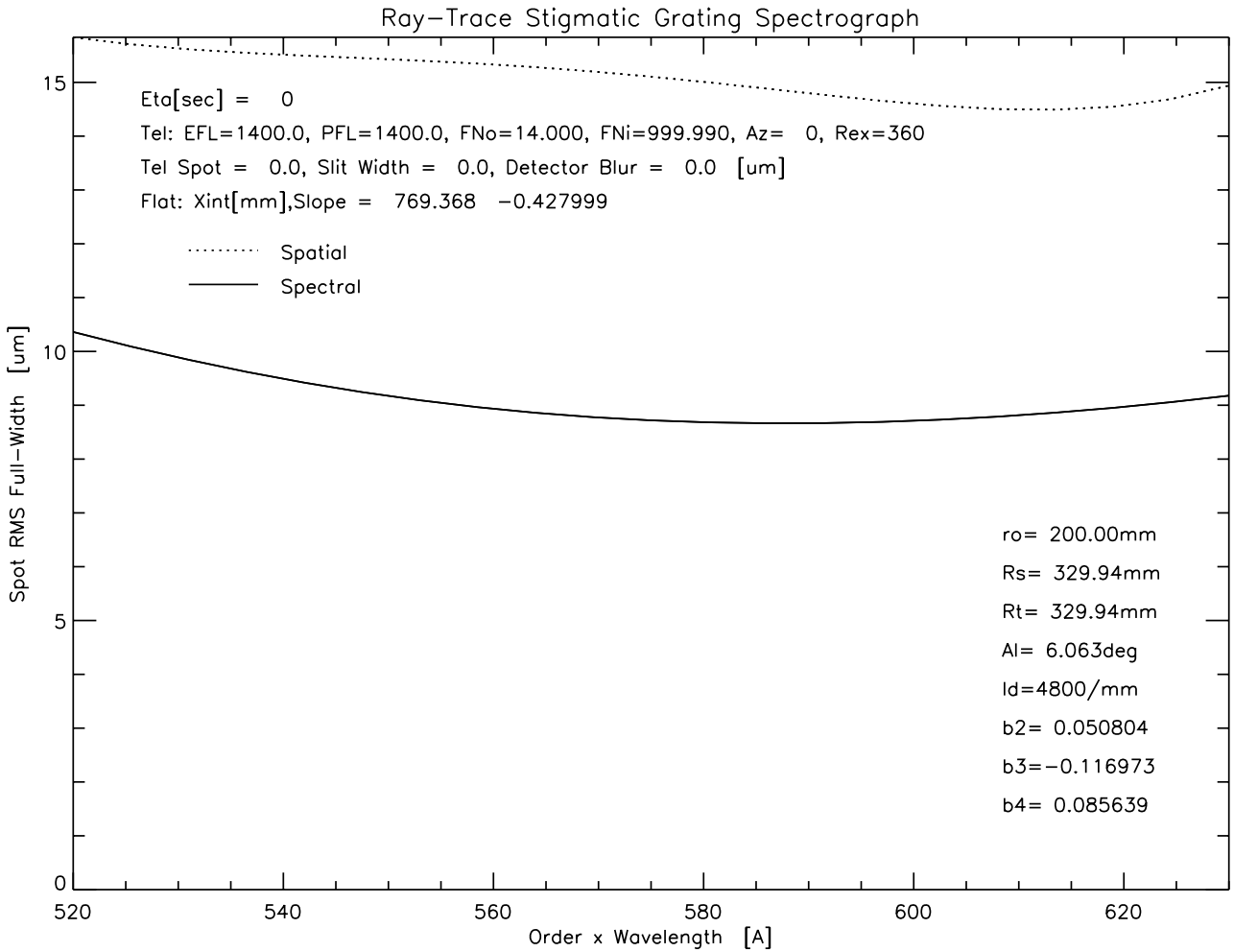
Characteristic	Units	EUNIS	SERTS-99	SERTS-95	Solar B / EIS
Geometric Area	cm^2	95	94	22	88
Telescope Efficiency	-	0.20	0.04	0.25	0.20
Grating Efficiency	-	0.09	0.03	0.04	0.08
Filter Transmission	-	1.00	0.40	0.60	0.50
Detector QE	-	0.45	0.15	0.05	0.80
Effective Area	mm^2	77.	0.68	0.66	56.

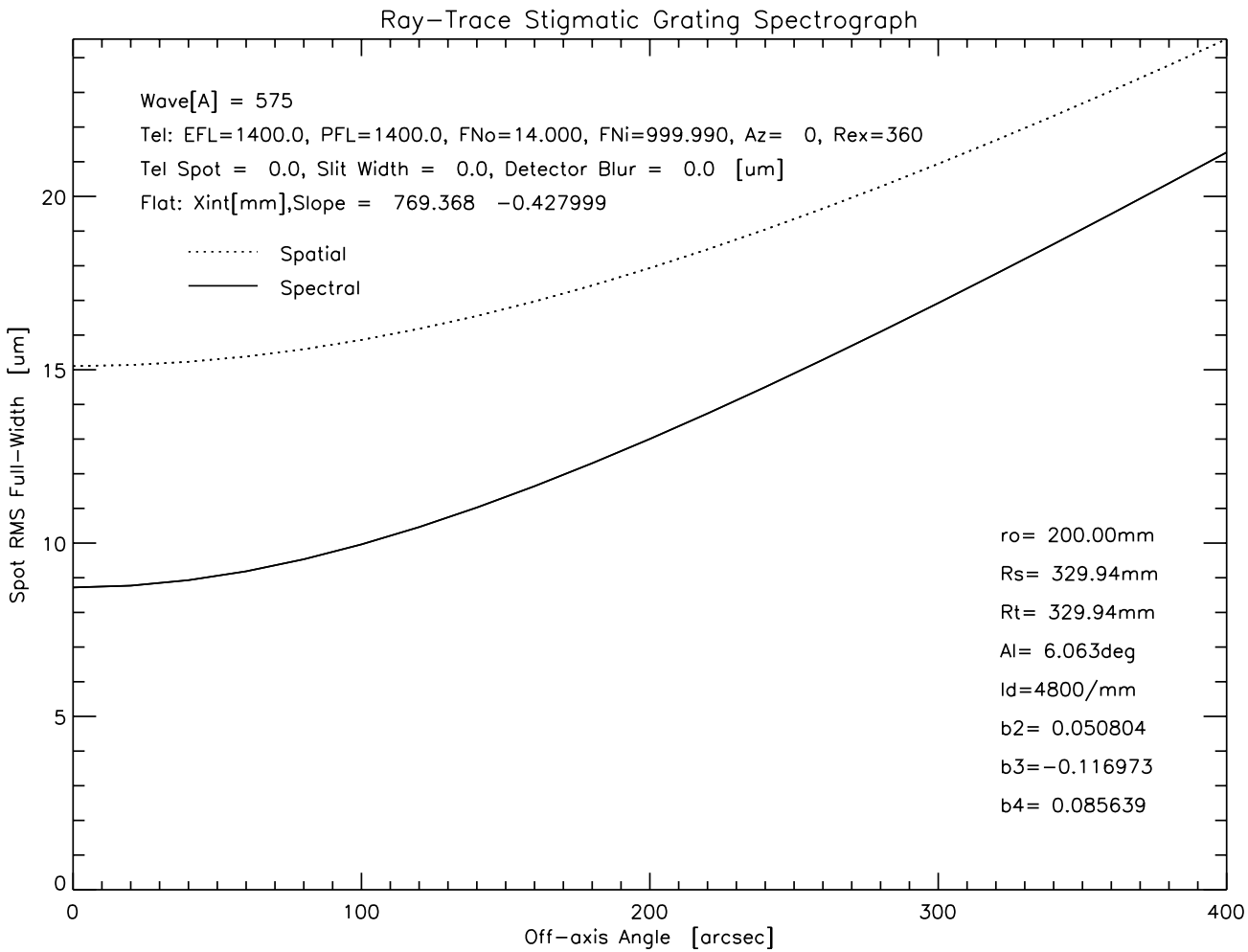
New Science Capabilities

Parameter	Capability	New Science
Faster Readout	Full spectra at ~ 1 sec cadence	♦ Studies of transient coronal phenomena. ♦ Observations of rapid loop dynamics. ♦ Searches for evidence of magnetic reconnection or wave heating.
Higher Sensitivity	Useful measurements of faint sources	♦ Detailed spectra of coronal holes. ♦ Measurements up to 3 $R_\odot$ above limb, at the base of the solar wind. ♦ Improved density and temperature sensitive ratios.
Broader Spectral Bandpasses	Additional wavelength coverage	♦ Better DEM analysis. ♦ More diagnostic line ratios. ♦ Extended underflight calibration of SOHO/ CDS and EIT. ♦ New underflight calibration of TRACE, Solar B/EIS, STEREO/ EUVI, and Solar Orbiter (?).


Relative to Slit−Grating Axis
1st
Norm Slit
8.274deg
−5.283deg
6.063deg
Xc= 797.42mm
Yc= 65.32mm
Cd= 10.0mm
Cs= 2.0mm
X (mm)
Y (mm)


Relative to Grating Normal
630A
520A
Det= 53.6mm
ro= 200.00mm
ri=1000.00mm
Rg= 329.94mm
Id=4800/mm
b2= 0.050825
b3=−0.134115
b4= 0.338999
Tel f= 14.00
X' (mm)
Y' (mm)


Ray−Trace Stigmatic Grating Spectrograph
Eta[sec] = 0
Tel: EFL=1400.0, PFL=1400.0, FNo=14.000, FNi=999.990, Az= 0, Rex=360
Tel Spot = 0.0, Slit Width = 0.0, Detector Blur = 0.0 [um]
Flat: Xint[mm],Slope = 769.368 −0.427999
Spatial
Spectral
ro= 200.00mm
Rs= 329.94mm
Rt= 329.94mm
Al= 6.063deg
ld=4800/mm
b2= 0.050804
b3=−0.116973
b4= 0.085639
Spot RMS Full−Width [um]
0
5
10
15
520
540
560
580
600
620
Order x Wavelength [A]


Ray−Trace Stigmatic Grating Spectrograph
Wave[A] = 575
Tel: EFL=1400.0, PFL=1400.0, FNo=14.000, FNi=999.990, Az= 0, Rex=360
Tel Spot = 0.0, Slit Width = 0.0, Detector Blur = 0.0 [um]
Flat: Xint[mm],Slope = 769.368 −0.427999
Spatial
Spectral
ro= 200.00mm
Rs= 329.94mm
Rt= 329.94mm
Al= 6.063deg
ld=4800/mm
b2= 0.050804
b3=−0.116973
b4= 0.085639
Spot RMS Full−Width [um]
Off−axis Angle [arcsec]
0
5
10
15
20
0
100
200
300
400