EUV Imaging Spectrometer (EIS)

The Extreme-Ultraviolet Imaging Spectrometer (EIS) is one of the three major scientific instruments of the Solar-B. The EIS instrument was designed and is being developed by an international collaboration of the United Kingdom, the United States, and Japan. It utilizes an off-axis parabolic primary and a toroidal diffraction grating in a normal incidence optical layout with high-reflectance Mo/Si multilayer coatings. The multilayer coatings have high reflectance in two wavelength ranges, 170–210 Å and 250–290 Å, and these wavelength ranges are simultaneously observed with two large back-illuminated CCDs. Many EUV emission lines from the transition region, the corona, and flares are contained in the wavelength ranges and observers can select spectral windows up to 25 in the imaging area of two CCDs. There is a slit/slot exchanger that contains two narrow slits (1″ & 2″ width) and two wide slits (40″ & 250″ width) at the prime focus of the primary mirror, and two dimensional EUV images are obtained with one of the narrow slits in a raster observation by a pivot rotation of the primary mirror in the east-west direction or with one of the wide slits in a slot observation of no primary-mirror motion, though the velocity information is convolved in the latter case. The center of the field of view can be changed by ±800 arcsec in the east-west direction by a translational motion of the primary and it enables to see a high-altitude region of the corona at the limb or to see the region near the limb when the nominal observing region of the Solar-B is located near the center of the sun.

Overview and instrumental performance of EIS are summarized in Tables 1 and 2.

Table 1. EUV Imaging Spectrometer Overview

Telescope				
Off-axis parabola		15 cm diameter; half area:170–210Å, the other half: 250–290Å		
Focal length		1934 mm		
Off-axis distance		70 mm		
Plate scale at slit		9.4 microns/arcsec		
Multilayer coating		Mo/Si pairs		
Slit & Slot		1″, 2″, 40″, and 250″ width at primary focus		
Fine mirror scan range		±3 arcmin solar image motion Max. FOV of raster (EW×NS): 360″×512″		
Large FOV translation		±800 arcsec shift of FOV center in East-West direction		
Spectrometer				
Grating		Toroid Holographic laminar, uniform line spacing		
Wavelength range		Maximum coverage	170–210Å, 250–290Å	
		Useful coverage	180–204Å, 250–290Å	
Dispersion		1.65 Å/mm or 0.0223 Å/CCD pixel		
Pixel equivalent width		34.3km/s@195Å, 26.1km/s@256Å, and 23.6km/s @284Å		
Plate scale at CCD		1.0 arcsec/CCD pixel		
CCD camera	CCD	Device	Marconi 42-20, MPP	
		Format (Spatial×Spectral)	1024×2048 pixels	
		Pixel size	13.5 μm	
	Readout electronics	Window size	512×2048 max.	
		Num. of spectral windows	25 max.	

Table 2. EIS Instrumental Performance

Instrument Performance		
Effective Area	0.5 cm^2 peak @ ~195Å for 170–210Å band 0.2 cm^2 peak @ ~270Å for 250–290Å band	
Expected line intensity from 1″ × 1″ area	Quiet Sun	~30 photons/s for Fe XII 195 ~6 ph/s for He II 256
	Active Region	~9×10^2 ph/s for Fe XII 195 ~4×10^1 ph/s for He II 256 ~4×10^2 ph/s for Fe XV 284
	M2-class Flare	~1×10^5 ph/s for Fe XXIV 192 ~3×10^3 ph/s for He II 256 ~2×10^4 ph/s for Fe XXIV 255 ~1×10^3 ph/s for Fe XV 284
Accuracy of measurement	Doppler velocity: δv=1.0 km/s for ~1×10^3 photons (Fe XV 284) δv=1.0 km/s for ~2×10^4 ph (Fe XXIV 255)	
	Line width: δw=1.0 km/s for ~5×10^3 photons (Fe XV 284) δw=10 km/s for ~2×10^3 photons (Fe XXIV 255)	
Data compression in MDP	Bit compression: 16-to-12 bit or 14-to-12 bit compression	
	Image compression: DPCM or 12bit-JPEG	
Data rate	~1/8 of total telemetry; ~40kbps after compression	
Control of EIS observation	Observing sequence in EIS ICU	