SOLAR-B
EIS
EUV
Imaging
Spectrometer

Instrument Specifications

Title	Instrument Specifications
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Ver	3
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see also
System Hierarchy EIS-sys-des-hieararc
Electrical Block Diagram EIS-sys-des-elekblok
Physical Block Diagram EIS-sys-des-physview

Details of the optical train can be found in (1)
"Hardware Functional Requirements for US Provided Subassemblies"
NRL Phase A Study Document [hardware_requirements.pdf]

	Parameter		Value	Units	Status	Reference
Optics generally			Off-axis paraboloid normal incidence telescope slit exchange mechanism normal incidence reflection grating all optics multilayer coated to define two EUV bandpasses spectra focussed stigmatically on two CCD detectors			
	Number of reflections		2			
	Wavelength bands		170-210, 250-290	Å		limits of the detector
	Useful Wavelength bands		180-204, 250-290			limits of the multilayers centered around SOT FOV
Field of View	extent of EW FOV		2480	arcsec on sun		given by sum of coarse and fine telescope positioning
	max EW scan range, fine only		240	arcsec		
	max extent of NS FOV		512	arcsec		determined by CCD size
	Spectral scale		0.0223	Å per pixel		
	Spectral resolution		see EIS7Tr4200 plots			function of wavelength and field angle
	Spatial scale		1	arcsec per pixel		
	Spatial resolution		see EIS7Tr4200 plots			function of wavelength, field angle and slit size
	Effective Area					function of wavelength
	Scattered light					
Filters	Type		Aluminium foil on support mesh and quadrant fra			Luxel supplied
(FIL)	Transmission		riable as per 1500 Å Al			(1) Fig 4
	Stray light throughput		tween 10^-4 and 10^-5	pinhole transmittance rati		slit also acts as spatial filter
	Obscuration		0.8	fraction transmitted		possible degradation with age / debris
Telescope	type		off-axis paraboloid			
(MIRror)	aperture		15	cm clear		
	Area		88.4	cm^2 per band		
	focal length		1934	mm		
	f-number		12.9			
	off-axis distance		70	mm		from edge of mirror
	plate scale at focus (slit)		9.37	microns/arcsec		
	Multilayer		Mo/Si			
	Number of repeats		20			
	Layer period, short wavelength		105	Å		
	Layer period, long wavelength		145	Å		
coarse positio	method		stepper			
	range ±		1000	arsec solar image motion		motion causes blur at slit plane,
	precision		TBD	per step		see table 3 in (1)
	repeatability		TBD	steps		
	speed		TBD	time / step		
fine positionin	method		PZT			servo loop control
	range ±		240	arcsec solar image motion		
	precision		1/3	" per step		
	repeatability		TBD	steps		
	speed		TBD	time /step		
Spectrometer						
Slits	Number of Slits		4			
(SLA)		1	1" x 512"		tbc	slit height 12 mm
		2	50" x 512"		tbc	slot height 12 mm
		3	TBD		TBD	
		4	TBD		TBD	
	slit change time		TBD	s		
	alignment		during integration			no focus mechanism
	exchange mech step size		15	arcmin		stepper with resolver
	tolerance perp. to optical axis		1	microns	goal	insignificant position error
	tolerance p'lel to optical axis		13	microns	goal	will not cause defocus
Shutter	Type		Rotary vane			Lockheed heritage
(SHT)	Position in optical system		adjacent to slits			
	Maximum exposure time			s		could be infinite if desired
	Minimum exposure time		50	ms	goal	determined by vane velocity
	Repeatability of exposure time		5	% of minimum	goal	= photometric accuracy
	Lifetime		6.00E+07	operations		
Filters	Type		Aluminium foil on support			Luxel supplied
FFA	Transmission		riable as per 1500 Å Al			(1) Fig 4
	Stray light throughput		tween 10^-7 and 10^-8	pinhole transmittance ratio		
	Obscuration		TBD	fraction transmitted		
Grating	Mount		magnifying			
(GRA)	Slit Distance		1	m		
	Detector Distance		1.4	m		approx
	Diameter of Optic		100	mm		90mm clear aperture
	Figure		Toroid			
	Figure parameters - Rs		1182.940	mm		Radius of curvature in Saggital
	Rt		1178.280	mm		and Tangential directions
	Substrate					
	Surface roughness, <		5	Å RMS	requirement	
	Ruling density		4200	l/mm		
	Ruling Type		Holographic with straight laminar grooves, uniform line spacing			

	Parameter	Value	Units	Status	Reference
	groove depth	58	Å		
	Multilayer	Mo/Si			identical to Telescope
	Number of repeats	20			with antidiffusion interlayers
	Layer period, short wavelength	105	Å		
	Layer period, long wavelength	145	Å		
FPA	Number of detectors	2			
	Detector technology	back-illuminated CCD			
	Manufacturer	EEV Ltd.			www.eev.com
	Type	CCD-42-10			
	Format - columns	2048	pixels		
	Format - rows	512	pixels	TBD	or 1024 (42-20)?
	Orientation of readout register	parallel to rows			
	Image mode	full frame			i.e. not frame transfer
	Pixel size	13.5	microns		square. This is value to use for "per pixel"
	Minimum read noise	2	electrons	TBC	
	Summing well capacity	6	pixels		
	Full well capacity - image	120000	electrons	TBD	depends on resistivity and depletion depth
	Full well capacity - image	6667	photons (190 A)		
	Full well capacity - image	8759	photons (250 A)		
	Full well cap. - serial reg.	200000			
	Ant-blooming structures	none			
	Quantum Efficiency	0.8		TBC	
	Cosmetic grade				
	hot pixels	TBD	per detector		
	column defects	TBD	per detector		
	Operating temperature			TBD	
	Position resolution FWHM	16	microns	TBD	contribution to system PSF due to charge spreading
	Dark Current		e/pix/s		known reliably when T is known
	Electrons per photon @ 190 A	18	electrons		proportional to photon energy
	Electrons per photon @ 250 A	13.7	electrons		
	Charge Transfer Inefficiency	TBD		TBD	depends on image, clock rate, temperature, radiation damage
	Shielding	3	mm-Al equivalent	TBD	
ROE	Read-out Electronics	MSSL			
	Digitisation Level	14	bits		
	Gain		electrons per DN		
	Number of readout ports	2	per CCD		
	Read-out time	variable			refer to "Pixel Calculator", cjm@mssl
	Number of ADC-chains	4			
	simultaneous CCD operation	yes	TBD		
	output links to ICU	2			
	Number of windows	TBD		limited by FPGA/memory size	
	Restrictions of windows	uniform	height		selectable
		multiples of 32x32		depends on requirements of compression algorithm	
ICU	Instrument Control Unit	MSSL			
	CPU	ADSP21020			
	CPU speed	20	MHz		
	Instruction per cycle	1	!		
	Instruction word length	48	bits		
	SEU rate		events/year		
	1 - PROM - fixed program and boo	TBD	kBytes		
	2 - EEPROM - rewritable program	TBD	kBytes		
	3 - RAM for running program	TBD	kBytes		
	4 - RAM data (working) memory	TBD	kBytes		
	5 - Mass memory - CCD data	TBD	kBytes		
Data Compres	Algorithm	hcompress	type	TBD	
	Compression factor	5	factor	goal	
	Output data format	16	bits	TBD	
	Instructions/pixel			TBD	
	Restrictions			TBD	e.g. need for cosmic ray removal prior to compression
Data Rate	CCD pixel rate	500	ksamples/sec	TBD - could be lower	"pixel_calculator" exists
1-science	ROE-ICU xfer rate	16	Mbps	TBD	ieee-1355
	Number of channels	2			
	ICU-MDP data rate	1	Mbps	16 bit serial link	
MDP-DHU/DF	raw link rate	2000	kbps		
	Duty Cycle for EIS	0.083			
	Net transfer rate	166.7	kbps		
2-status/hk	Sampling rate	2-8	s	variable	.5 s response time !
Data Recorde	Capacity	2.40	Gbits		Net due to downlink rate and pass duration, max = 3 Gbit
	EIS typical share	0.125			changeable by commands
	Net EIS volume	0.300	Gbits		
	time to fill @ full MDP-DR rate	31.5	minutes		
Telemetry	link rate (DR, X-band)	4	Mbps		Refer to "Telemetry and Commands"
	link rate (realtime, S-band)	256	kbps		T Sakao - March 99 Plenary Meeting
Commanding	Uplink rate (realtime, S-band)	4	kbps		Full design standards doc (J-lang)
	EIS typical share	0.33			was issued 1/Sep/99
					Other downlink stations may be available
					e.g. Wallops @ 6 Mbps
Operations	Contact Schedule	5	passes per day		dawn and dusk at KSC
	contiguous passes, up to	3			e.g. 2 at dawn, 3 at dusk
	Duration of Contacts	10	mins		This is the minimum useful duration