The ASPERA-3 Electron Spectrometer: Now at Mars

The MEX Status

ESA's Science Programme Committee finally decided at its meeting on May 20, 1999, in Bern, Switzerland, on Mars Express. The following text was unanimously approved:

Following its conditional approval of Mars Express in November 1998, and given the Executive's assessment that the conditions are fulfilled to the end of 2001, the SPC confirms that Mars Express can proceed"

In simple words: *Mars Express is fully approved within the 150M Euro budget and all previous restrictions are removed*.

The Mission Objectives

Mars Express is a mission of comparative planetology. It will make observations of the surface, atmosphere, surface - atmosphere and atmosphere - interplanetary medium interactions.

The Mission Objectives

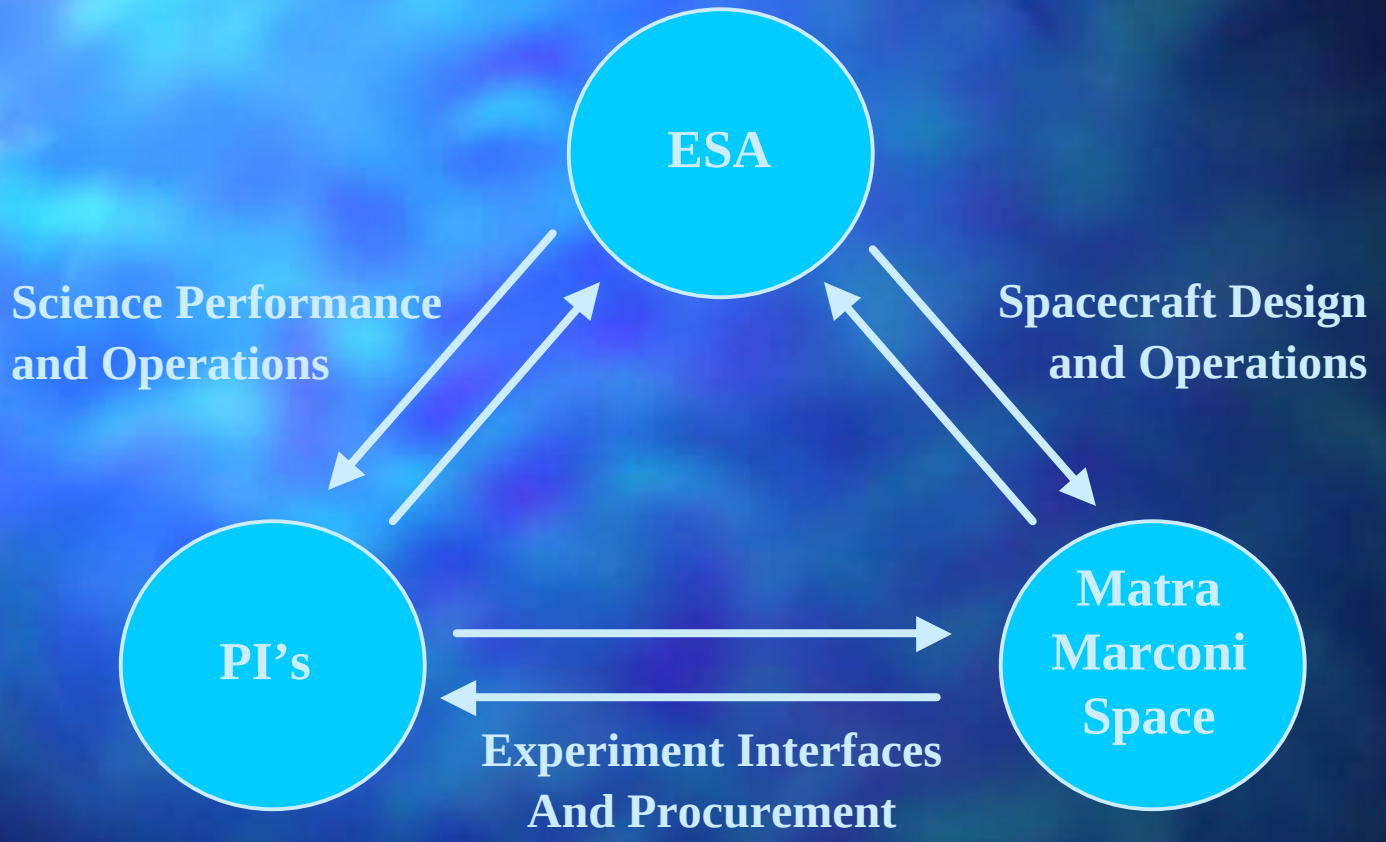
Mars Express is an imaging mission and will perform:

- **global high resolution imaging (photogeology)**
- **global high resolution IR imaging (mineralogical mapping)**
- **atmosphere composition monitoring (IR spectroscopy)**
- **global atmospheric UV imaging (mapping of atmospheric composition and circulation)**
- **subsurface remote sensing (radar)**
- **global energetic neutral atom imaging (plasma and neutral gas distributions)**

The MEX Background History

Mars Express is the first 'flexible mission' (F1) in the revised ESA long-term scientific programme and was launched towards Mars on June 2, 2003 with a Soyuz/Fregat launcher.

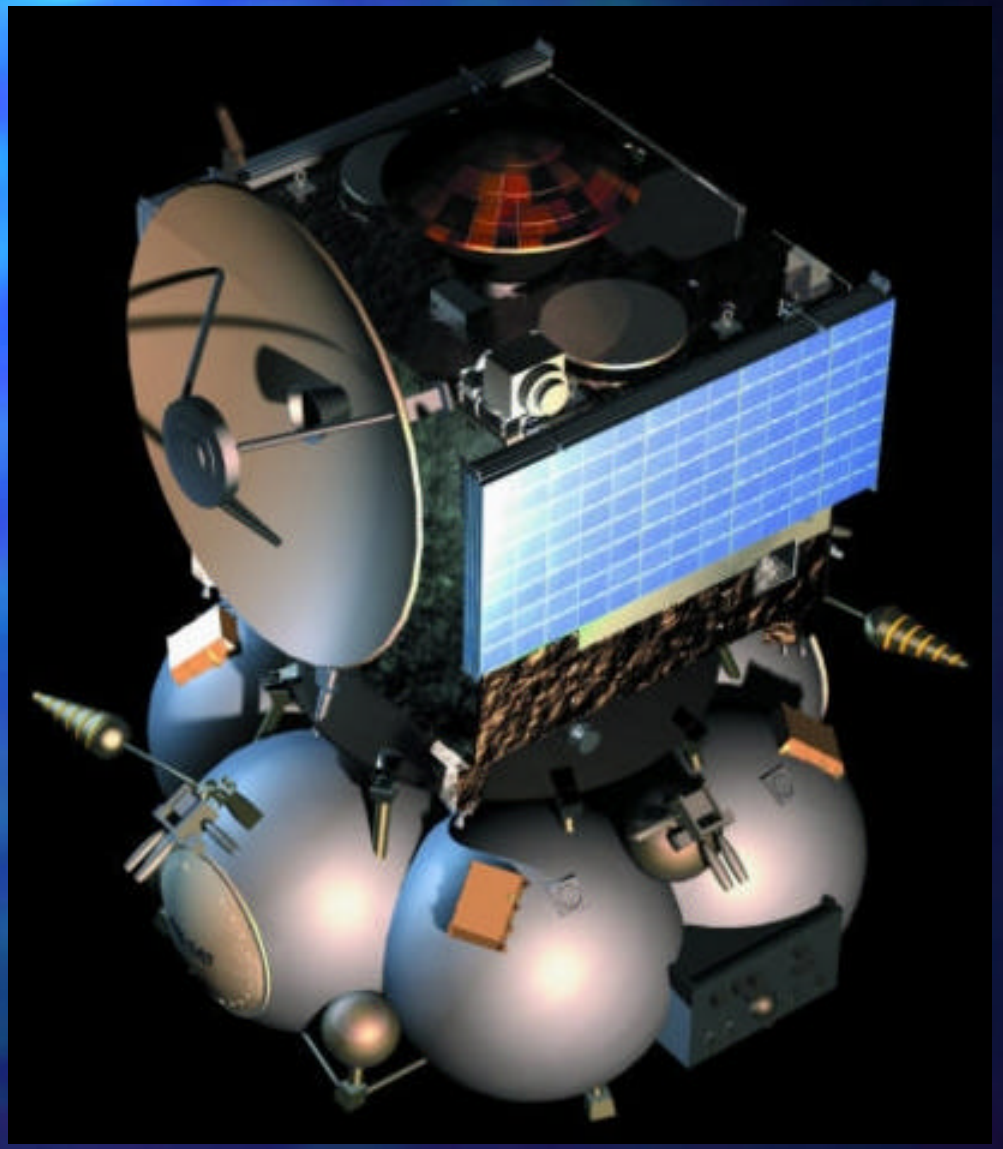
MEX Management Implementation



The MEX Payload

Instrument	Name	Principal Investigators	Institute
ASPERA	Energetic Neutral Atoms Analyser	R. Lundin	Swedish Institute of Space Physics, Kiruna, Sweden
HRSC	High Resolution Stereo Colour Imager	G. Neukum	Institut für Planetener-kundung, Berlin, Germany
OMEGA	IR Mapping Spectrometer	J. P. Bibring	Institut d'Astrophysique Spatiale, Orsay, France
PFS	Atmospheric Fourier Spectrometer	V. Formisano	Istituto Fisica Spazio Interplanetario, Rome, Italy
RSE	Radio Science Experiment	M. Paetzold	University of Cologne, Cologne, Germany
SPICAM	UV Atmospheric Spectrometer	J. L. Bertaux	Serviced'Aeronomy, Verrieres-le-Buisson, France
SSRA	Sub-surface Sounding Radar / Altimeter	G. Picardi	University of Rome, Rome, Italy
Beagle 2	Lander	C. Pillinger	Open University, Milton Keynes, UK

Mars Express on Soyuz Upper Stage



Spacecraft Facts

Launcher	*Launcher Capability*
Soyuz-Fregat	1060kg
Delta II	1100kg

S/C Item	*Current Mass*
Spacecraft Bus	439kg
Lander	60kg
Payload	116kg
Propellant	427kg
Launch Mass	1042kg
Spacecraft bus dimensions	1.5 x 1.8 x 1.4m
Solar array area	11.42m^2

Typical Mean Power	
Spacecraft	270 - 445 W
Payload	55 - 140 W

Built by Matra Marconi Space (MMS) in Toulouse and integrated at Alenia in Italy

Mission Profile

Launch	2 June 2003
Near Earth Commissioning	30 days
Interplanetary cruise	146 days
Lander separation	20 December 2003
Mars orbit insertion	25 December 2003
Routine operation	696 days
End of the nominal mission	30 November 2005
Extended operations	1095
End of the mission	30 November 2008

The MEX Payload

Inst.	Mass, kg Power,W	Measurements	Capabilities
ASPERA	8.2/ 13.5	ENA imaging in the range 0.1 - 10 keV Ion mass resolving measurements in the range 0.001 - 40 keV. Electron measurements 0.001 - 20 keV	Imaging and direct measurements of the solar wind flow and escaping planetary plasma
HRSC	21.4 / 40.4	TV camera with triple - stereo, four colors, and multiphase imagery capabilities	TV imaging with a spatial resolution of 12 - 15 m / pixel
OMEGA		Spectroscopy in the visible (0.5 - 1.5 mm) and infra-red (1.0 - 5.2 mm) ranges	Mineralogical and atmospheric (CO_2, CO, H_2O) mapping with a resolution of 1 - 5km
PFS	33.4 / 45 W	IR atmospheric spectroscopy in the range 1.2 - 45 mm	2 cm^{-1} spectral resolution 10 / 20 km special resolution
RSE	Not required	Radio signal from TT&C subsystem	Sampling of the atmosphere with a vertical resolution of 100 m (X - band). Sampling of the ionosphere from 90 to 300 km with the resolution 100 el/cm^3. (S-band)
SPICAM	3.8 / 9.5	UV spectroscopy in the range 118 - 320 nm	Vertical profiling of emissions (CO2, O3, O2, H, C, O, CO2+, CO) with a few km resolution and ozone mapping
SSRA	15 / 60	Radar measurements in the bands centered at 1.9, 2.8, 3.8, and 4.8 MHz	Penetration depth down to 5 km in the 5 x 10 km footprint

ASPERA Team

R. Lundin, S. Barabash, H. Andersson,	
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K. Asamura	***JAXA / ISAS, Sagamichara, Japan***
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H. Koskinen, E. Kallio, P. Riihela, T. Säles	***FMI, Helsinki, Finland***
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J. Luhmann	***SSL /U. of California in Berkeley, USA***
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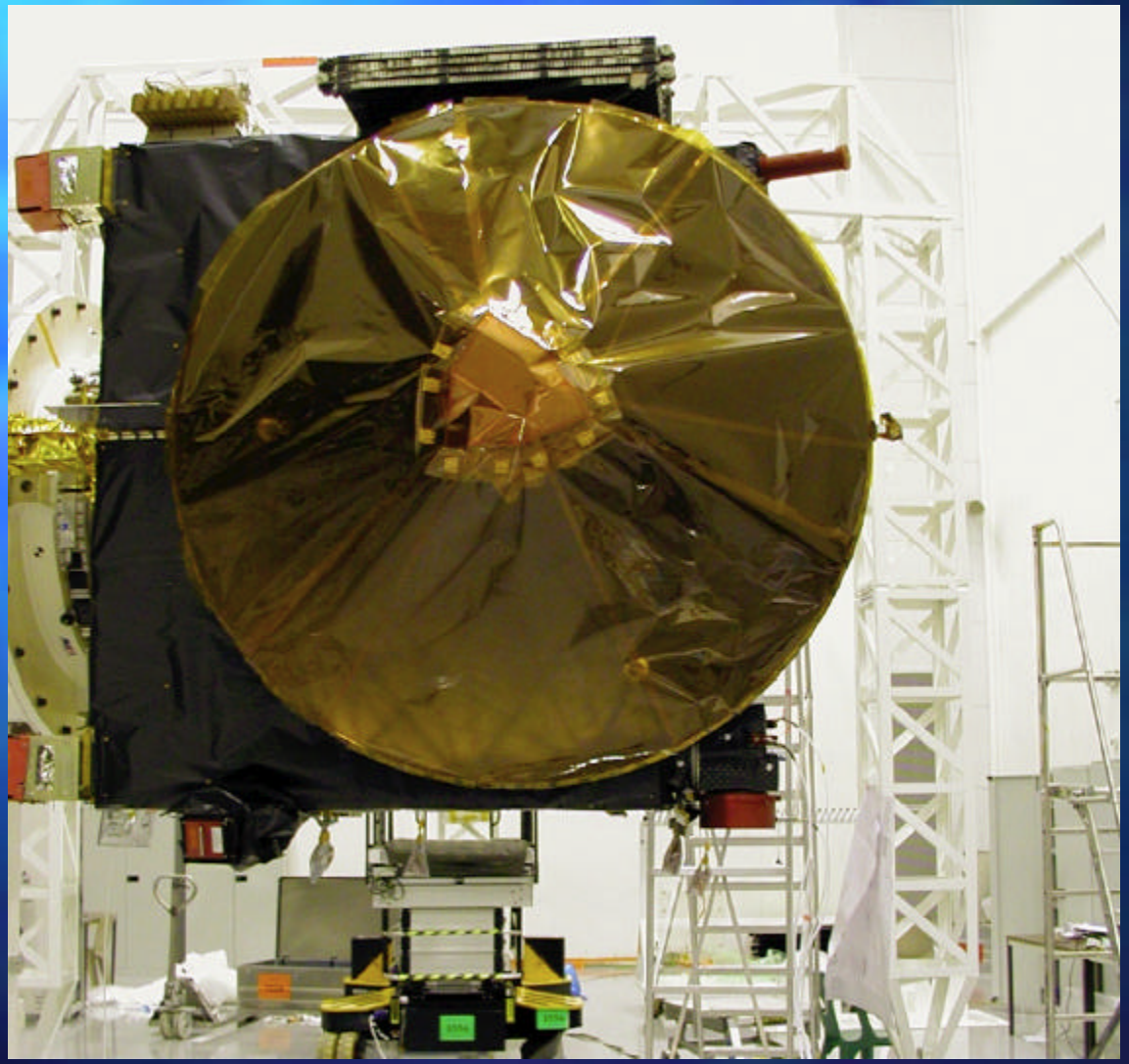
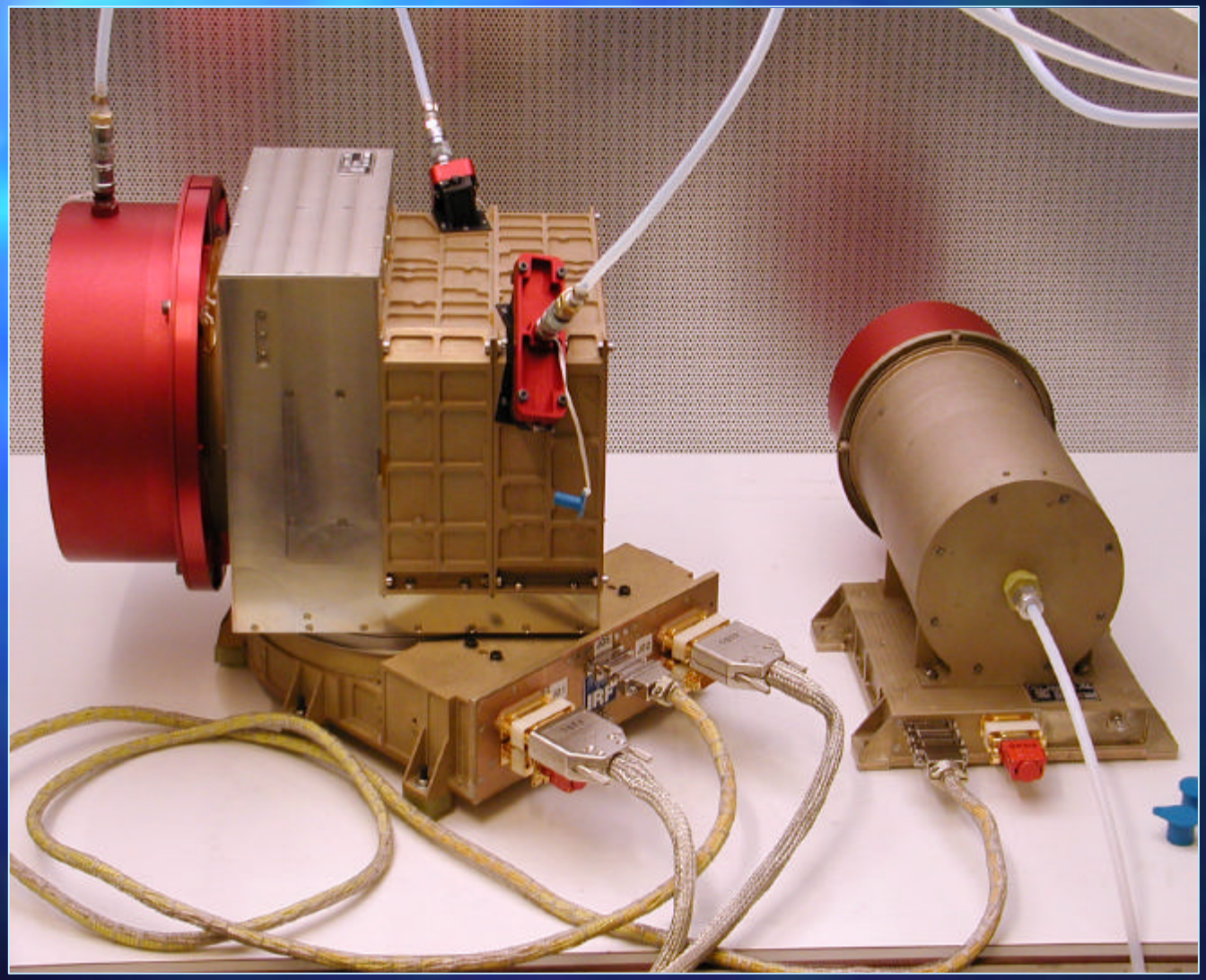
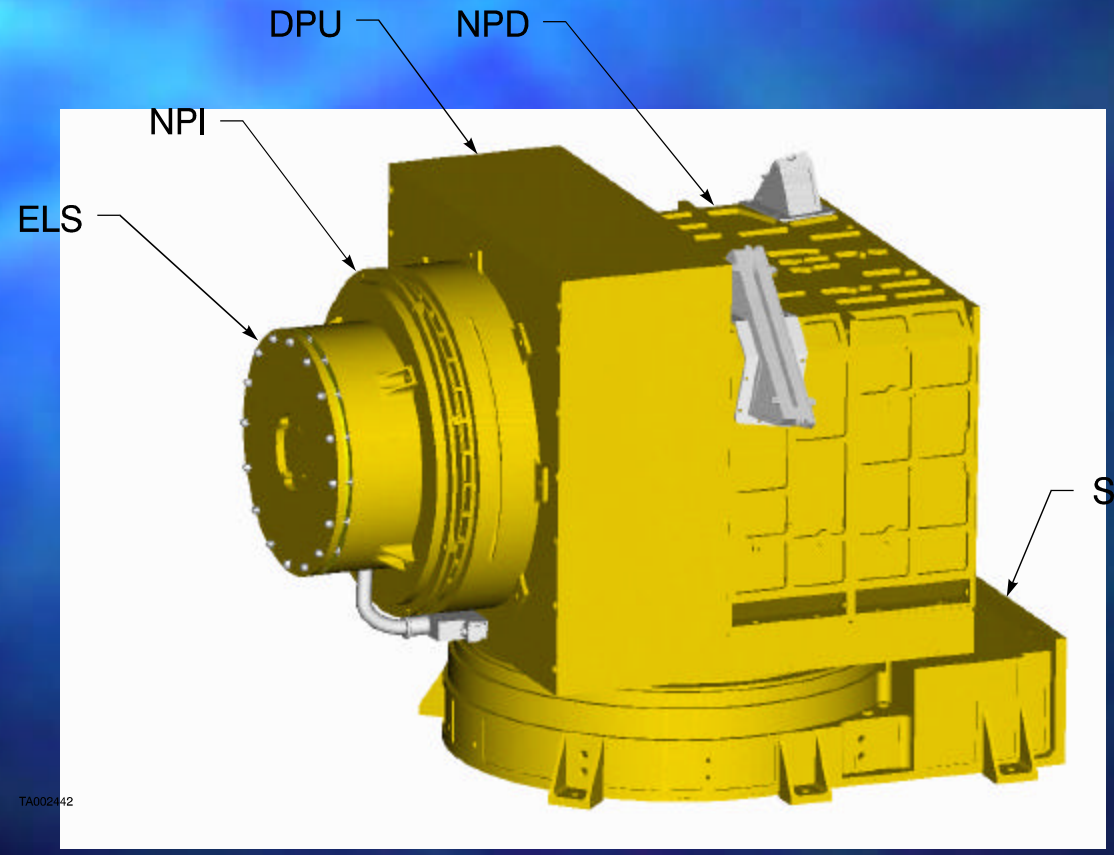
E. Roelof, D. Williams	***APL /JHU, Laurel, USA***
J.-A. Sauvaud, A. Fedorov, J.-J. Thocaven	***CESR, Toulouse, France***

Location on S/C

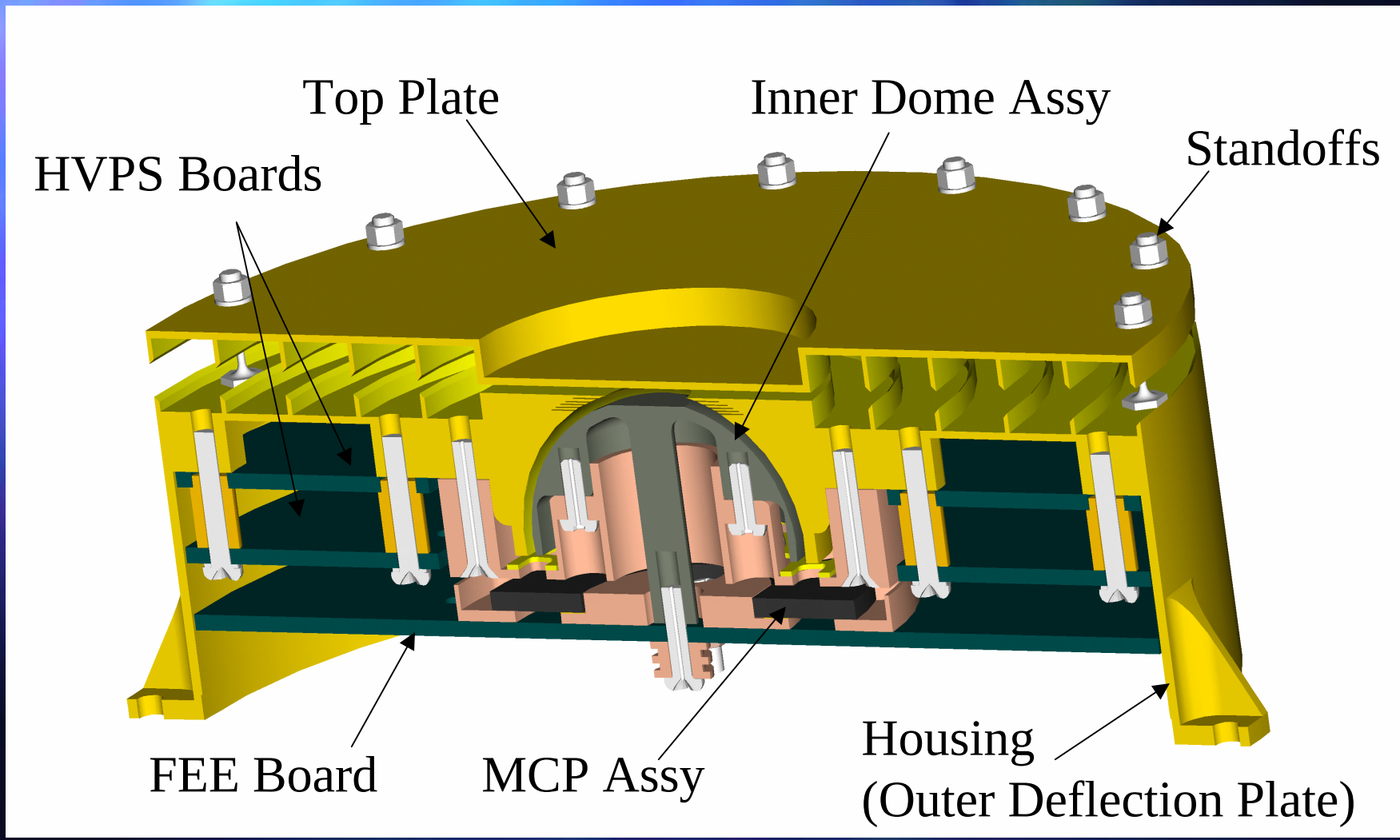


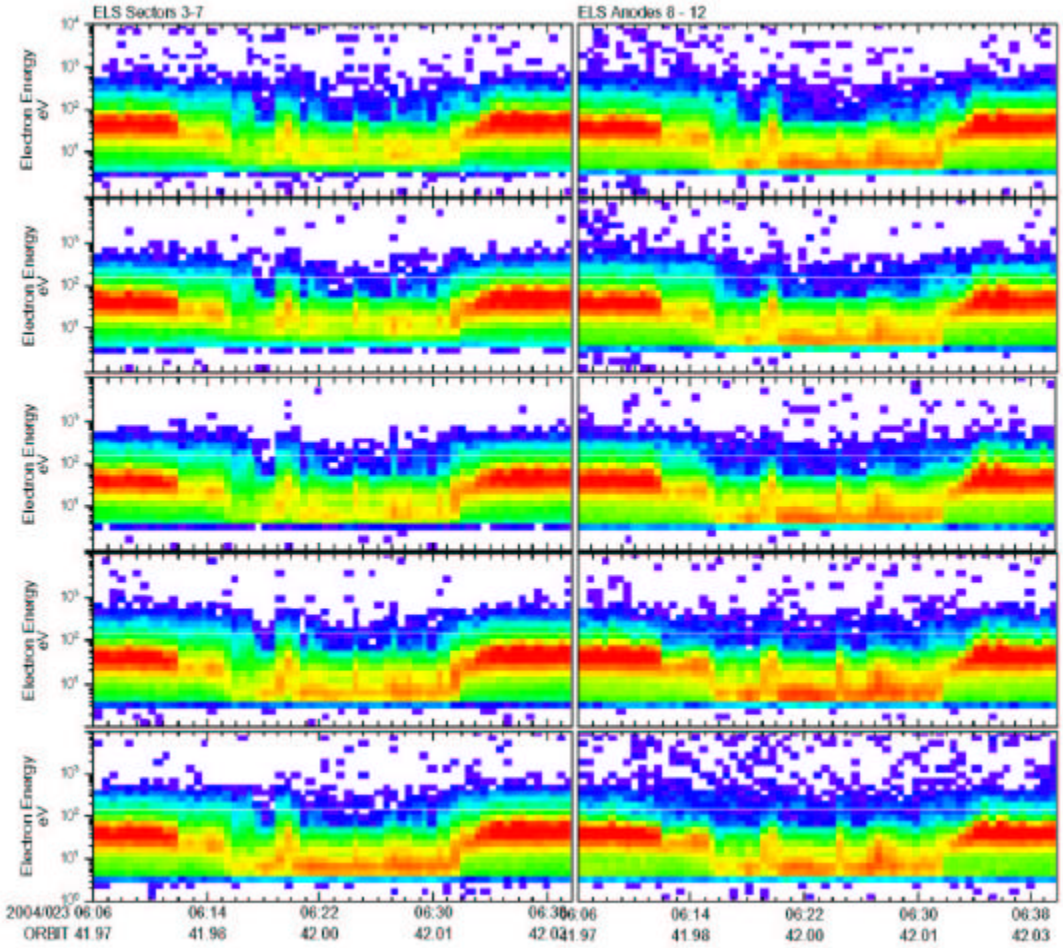


ASPERA-3
SCANNER INSTRUMENTATION



ELS Layout


Top Plate
Inner Dome Assy
HVPS Boards
Standoffs
FEE Board
MCP Assy
Housing
(Outer Deflection Plate)


ELS Sectors 3-7
ELS Anodes 8 - 12
Electron Energy eV
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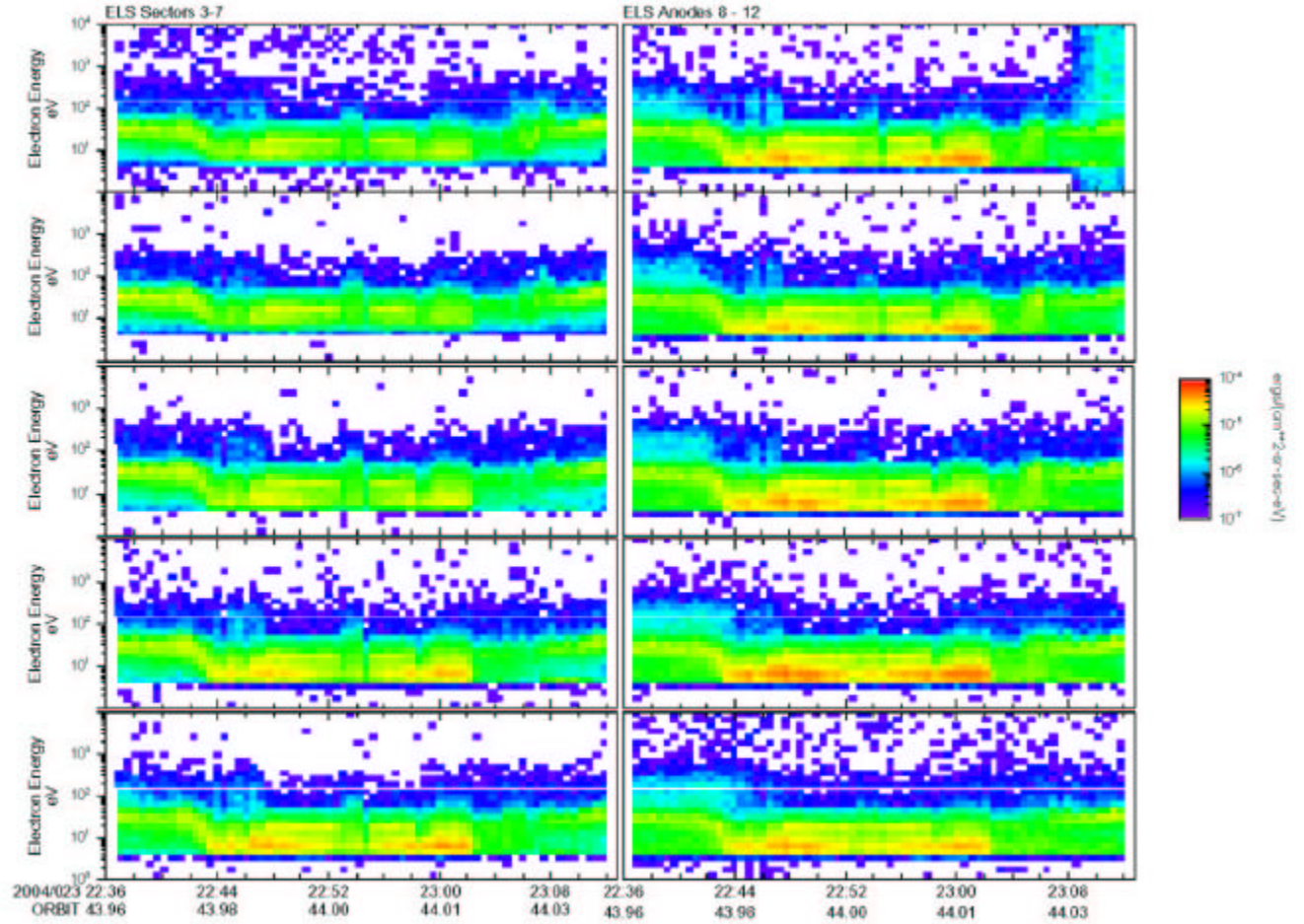
ORBIT 41.97
06:14
41.98
06:22
42.00
06:30
42.01
06:38
42.03


ELS Sectors 3-7
ELS Anodes 8 - 12
Electron Energy eV
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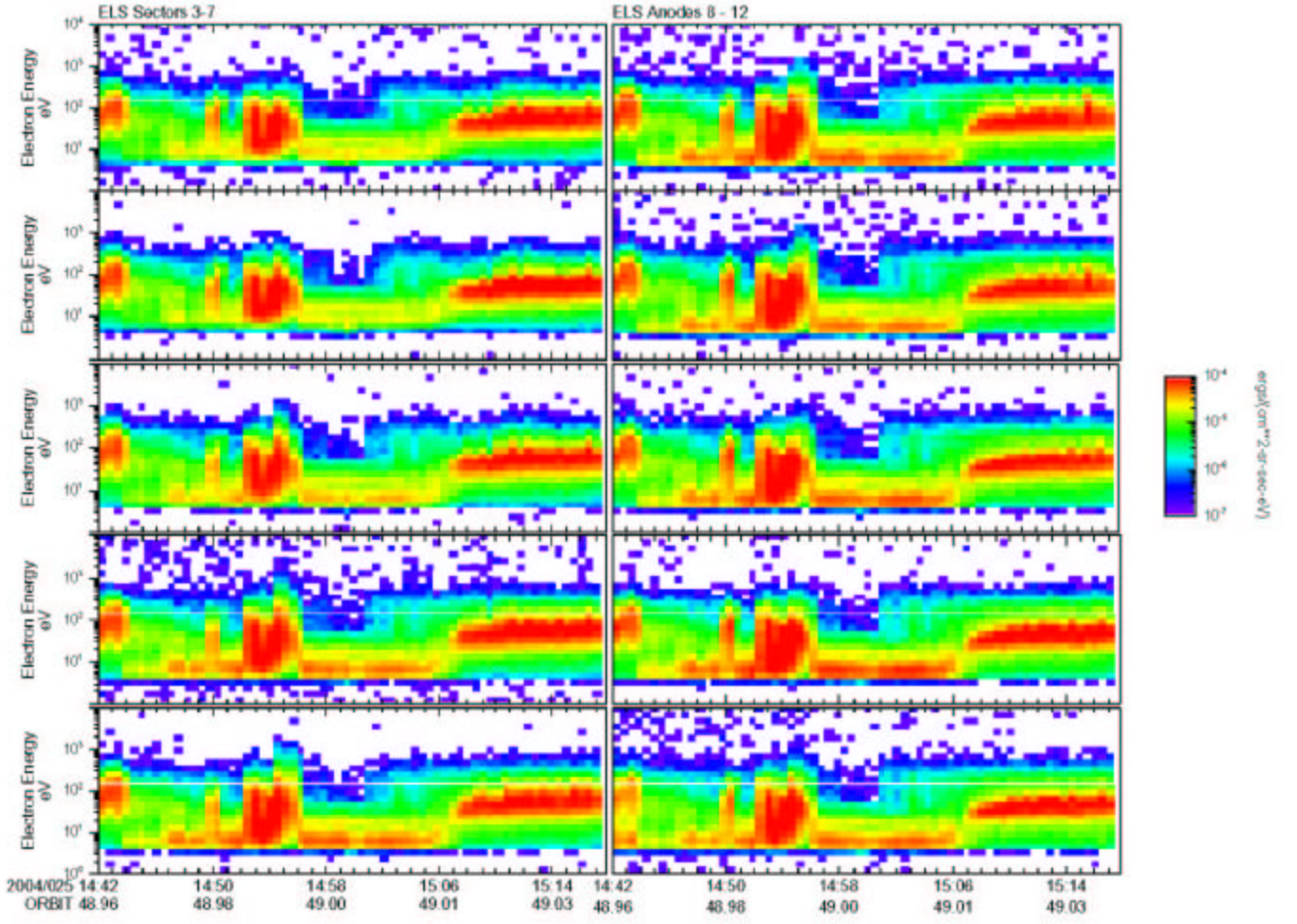
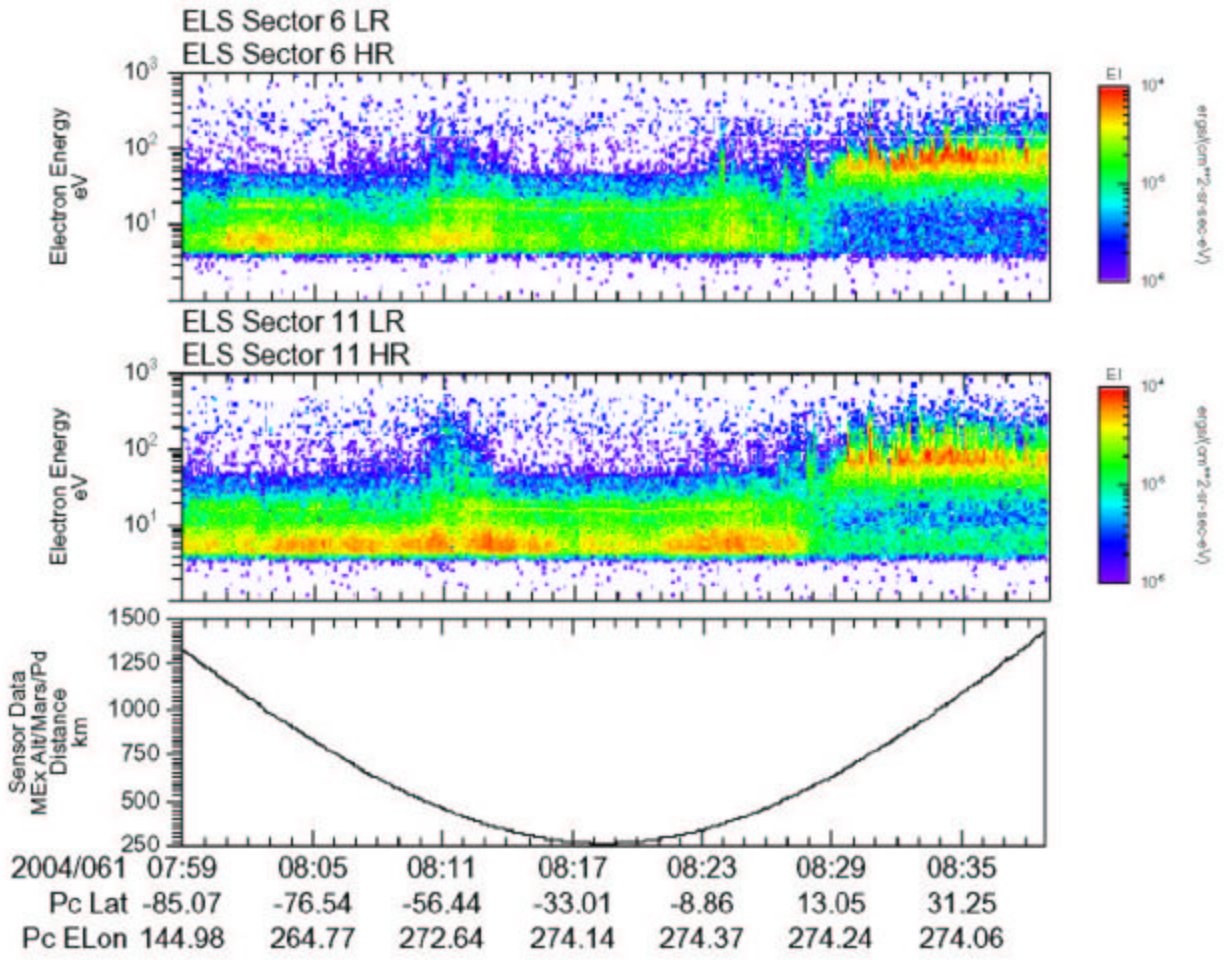
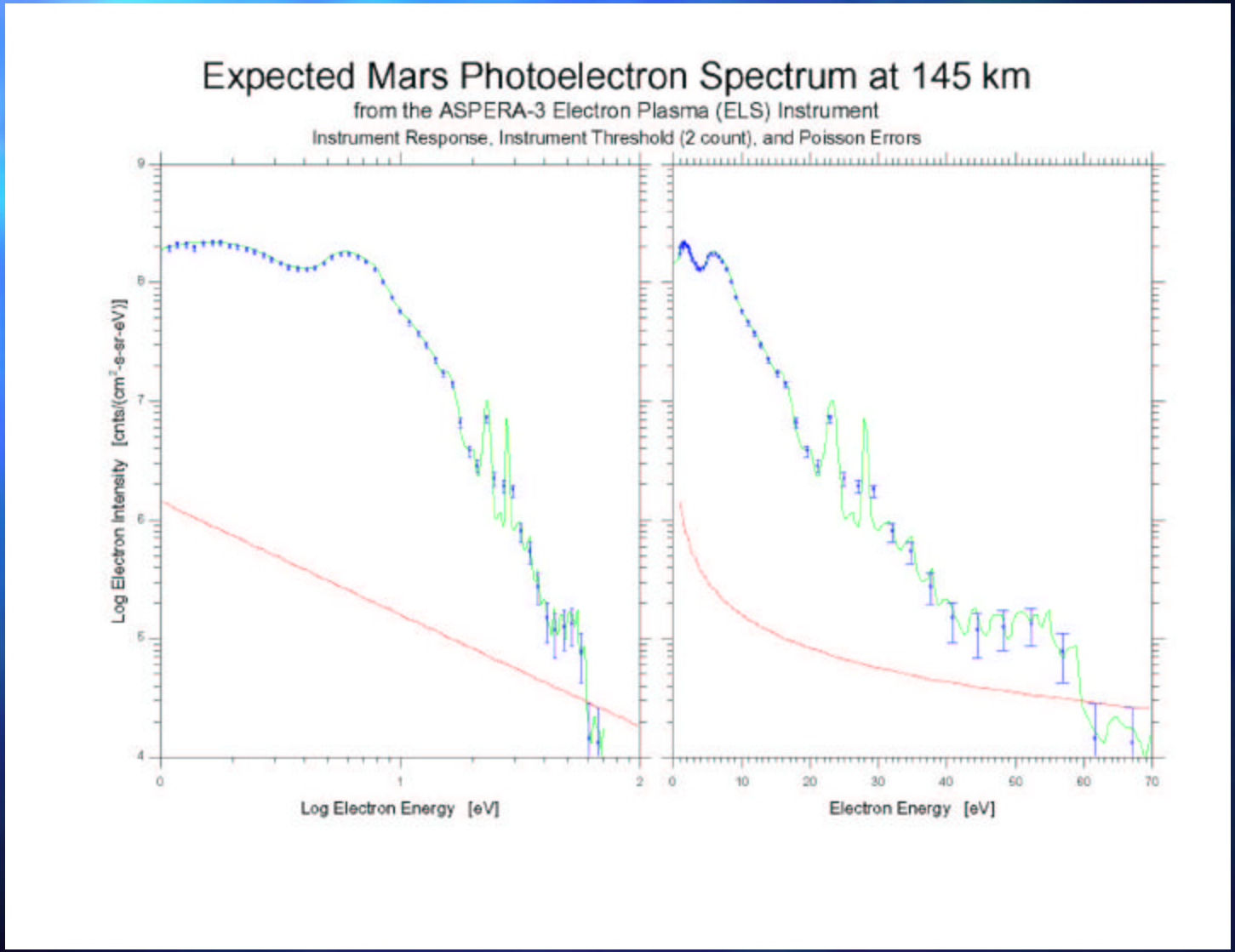
ORBIT 43.96
22:44
43.98
22:52
44.00
23:00
44.01
23:08
44.03


ELS Sectors 3-7
ELS Anodes 8 - 12
Electron Energy eV
2004/025 14:42
ORBIT 48.96
14:50
48.98
14:58
49.00
15:06
49.01
15:14
49.03
ergs/(cm**2-sr-sec-eV)


ELS Sector 6 LR
ELS Sector 6 HR
Electron Energy
eV
ELS Sector 11 LR
ELS Sector 11 HR
Sensor Data
MEx Alt/Mars/Pd
Distance
km
2004/061 07:59 08:05 08:11 08:17 08:23 08:29 08:35
Pc Lat -85.07 -76.54 -56.44 -33.01 -8.86 13.05 31.25
Pc ELon 144.98 264.77 272.64 274.14 274.37 274.24 274.06

Contiguous Sampling Achievement



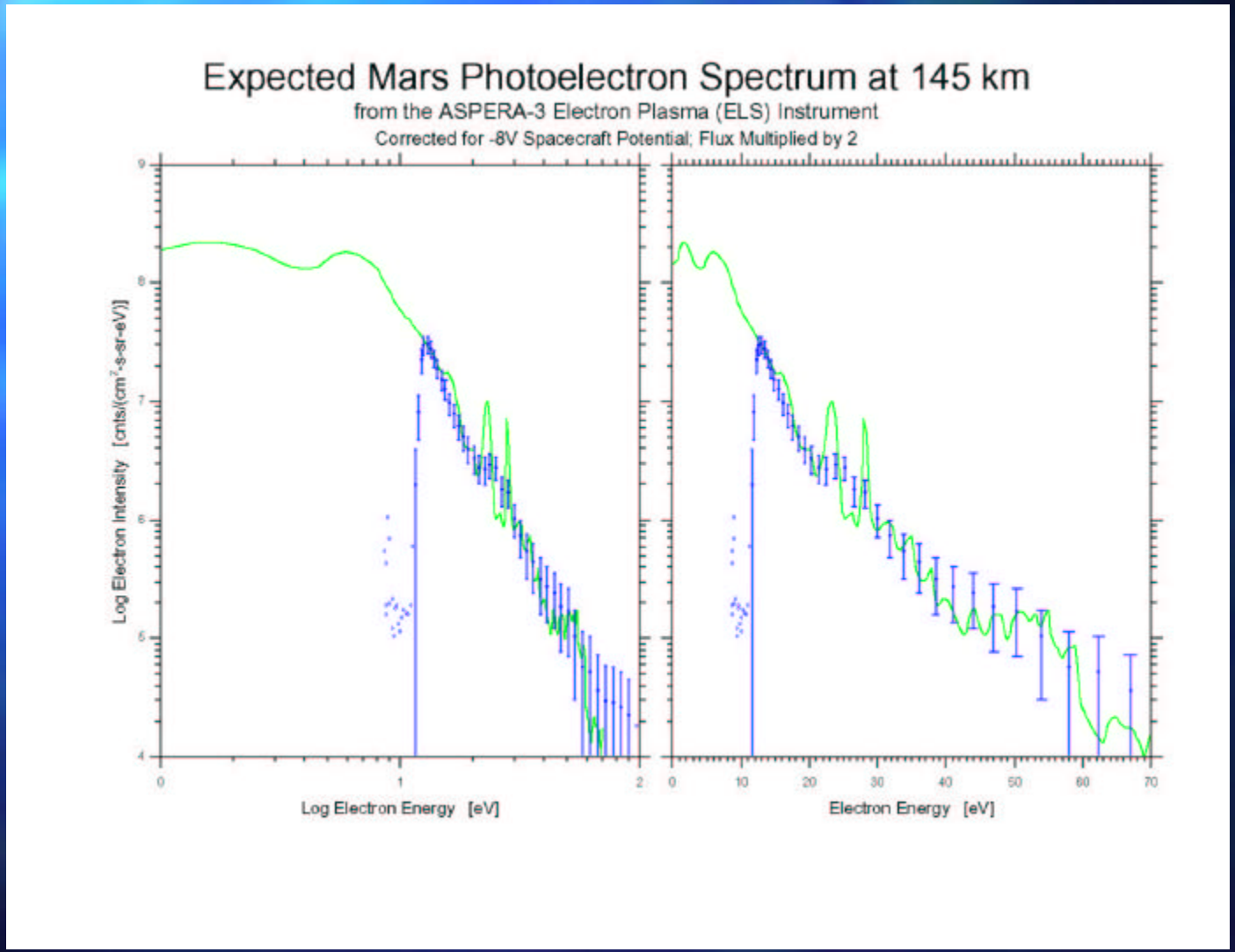
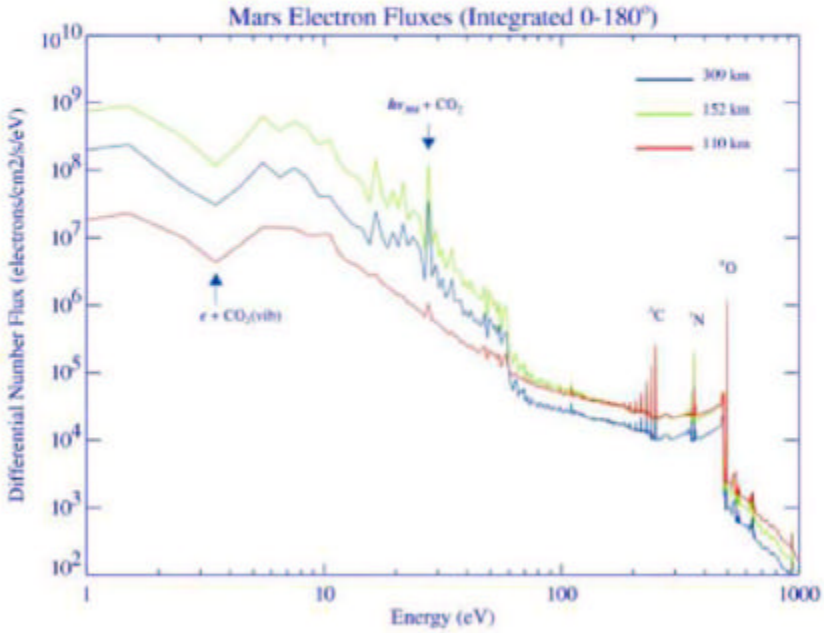
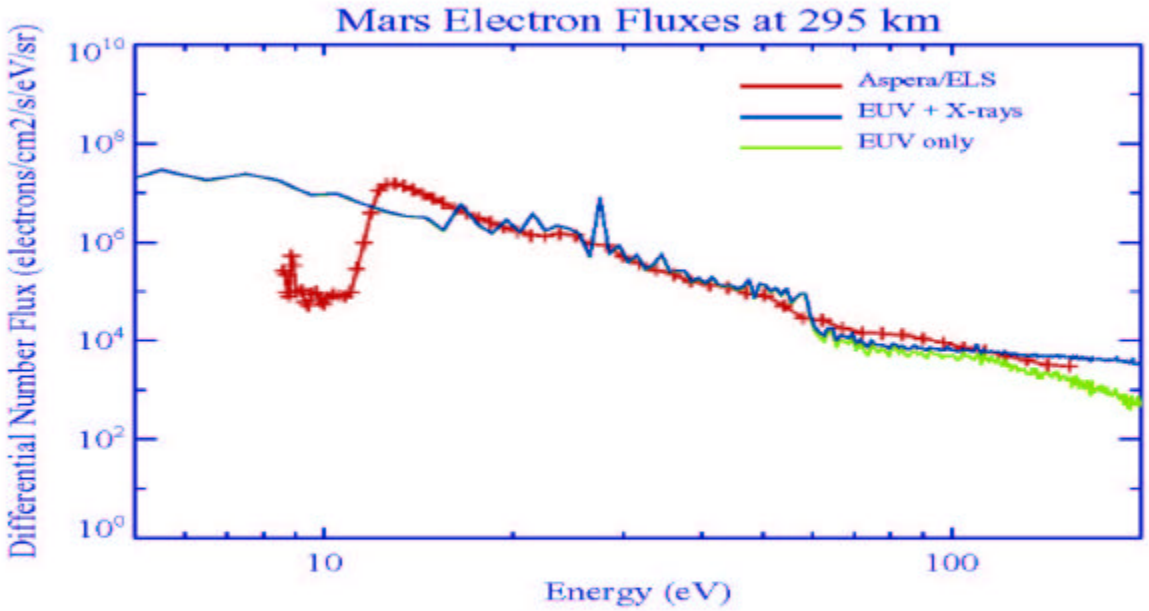

Expected Mars Photoelectron Spectrum at 145 km
from the ASPERA-3 Electron Plasma (ELS) Instrument
Corrected for -8V Spacecraft Potential; Flux Multiplied by 2
Log Electron Intensity [cnts/(cm²-s-sr-eV)]
Log Electron Energy [eV]
Electron Energy [eV]

Figure 2


Mars Electron Fluxes (Integrated 0-180°)
Differential Number Flux (electrons/cm2/s/eV)
Energy (eV)
300 km
152 km
110 km
hν + CO2
e + CO2(vib)
13C
15N
1O
10^10
10^9
10^8
10^7
10^6
10^5
10^4
10^3
10^2
1
10
100
1000


Mars Electron Fluxes at 295 km
Differential Number Flux (electrons/cm2/s/eV/sr)
10^{10}
10^{8}
10^{6}
10^{4}
10^{2}
10^{0}
10
100
Energy (eV)
Aspera/ELS
EUV + X-rays
EUV only

Oversampling Spectral Resolution Achievement