

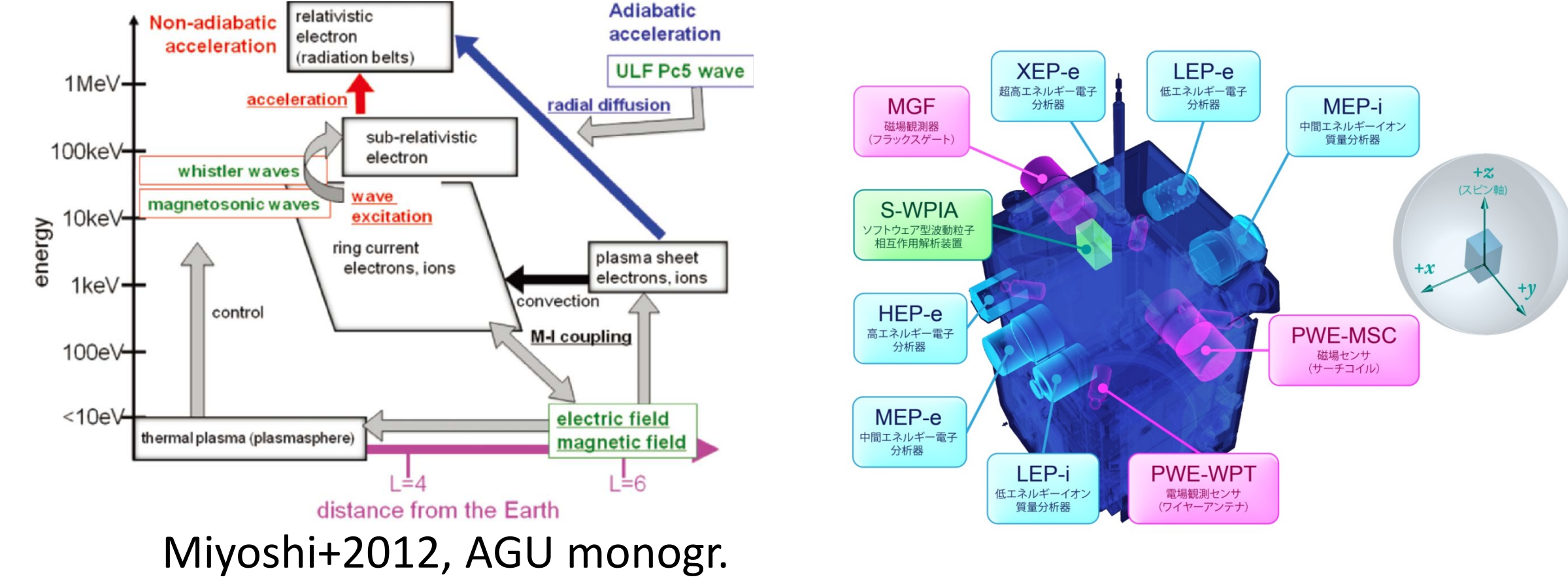
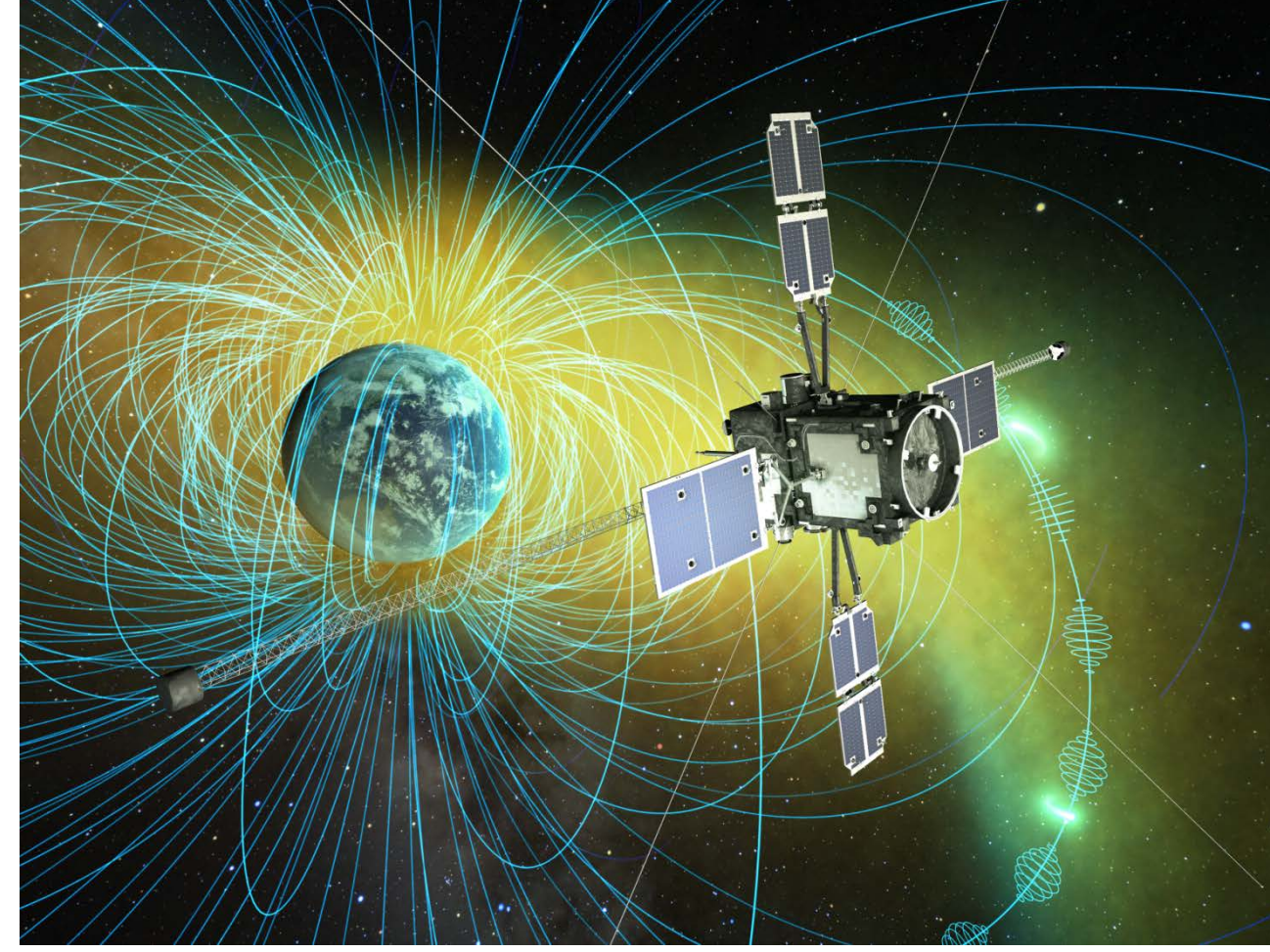
Charged particle measurements in the radiation belts by *ERG*

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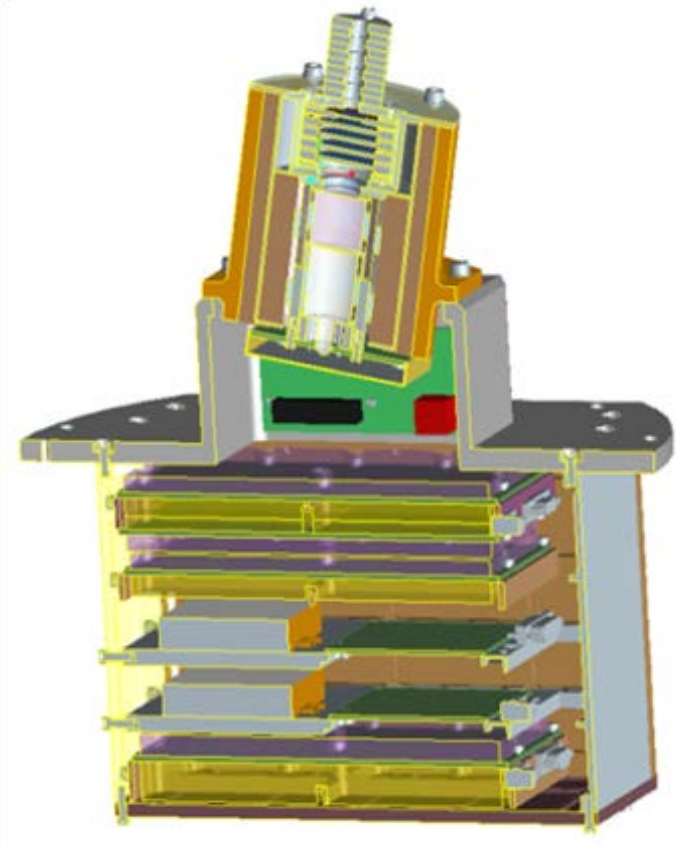
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Summary:

- Radiation belts show mysterious and dynamic variability during geospace storms
- The ERG spacecraft aims to observe the cross-energy coupling plasma physics behind the decay and enhancement of the radiation belts
- In order to cover the broad energy range from 10 eV up to 20 MeV, ERG is equipped with 6 particle instruments (XEP, HEP, MEP-e, MEP-i, LEP-e, and LEP-i)



XEP (eXtremely high-energy Electron exPeriments)



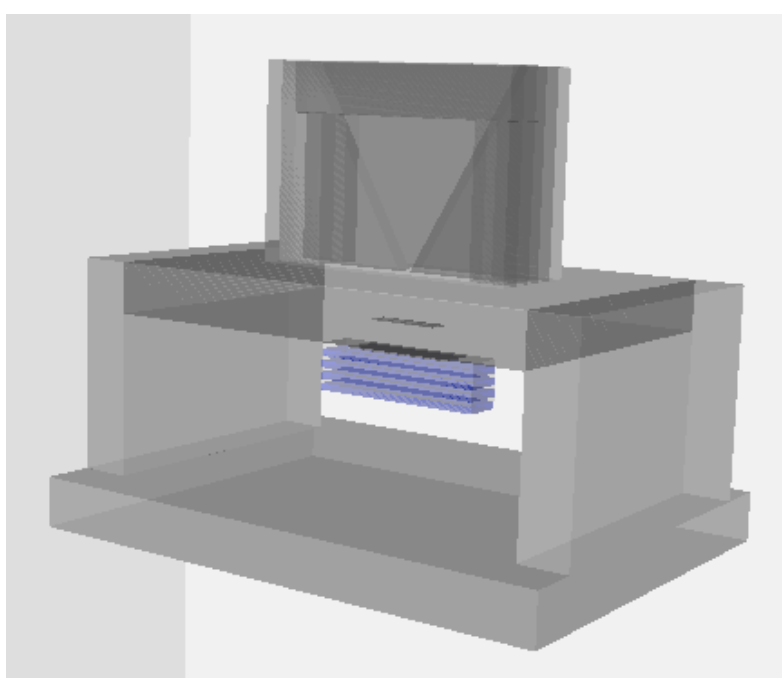
- Measures 0.4 – 20 MeV electrons
- Identifies the energy and direction of each incoming electron
- Uses SSD and GSO+PMT for the signal detection and energy analyses
- Also produces S-WPIA data (ultra-high time resolution data for wave particle interaction analyses)

計測方式	半導体センサ(SSD)×5枚+シンチレータ(GSO)		
観測対象	電子		
エネルギー範囲	400keV~20MeV		
エネルギー分解能(FWHM)	4MeV以下: 20%, 4MeV以上: 60%		
視野範囲	±10度 (1方向)		
Gファクター	0.0088cm ² sr ※SSD1前面において		
角度分解能	20度(視野角±10°)×22.5度(1spin/16分)		
重量	5.27kg(実測値)※CPU+PSU含む		
電力	項目	ICD値	
※1次電源電圧(実測値): 31.5V	(1) CPU ONモード (センサ OFFモード)	6.70W	5.04W
	(2)観測モード	19.8W	16.7W
	(3)校正モード	19.8W	16.7W
	(4)観測スタンバイモード	17.7W	14.5W
寸法	315.6mm×175.2mm×251.2mm		
出力データ	ミッションデータ: テープレコーダ(18ch×16A) ※校正用リストデータ切り替え可 S-WPIA用: リストデータ		

Energy range

20 MeV
|
400 keV
(electron)

HEP (High-energy Electron exPeriments)

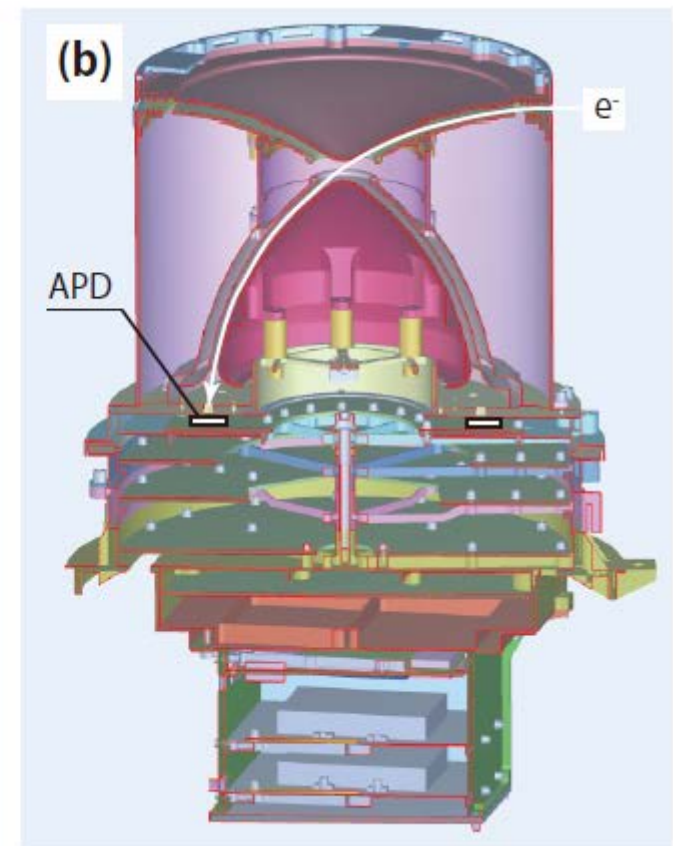


- Measures 70 keV – 20 MeV electrons
- Identifies the energy and direction of each incoming electron
- Uses single-sided silicon strip detectors for the signal detection and energy analyses
- Also produces S-WPIA data

	HEP-L	HEP-H
観測エネルギー範囲	70 keV~1 MeV	0.7~2 MeV
エネルギー分解能	20%程度	20%程度
視野範囲	HEP-L, HEP-H共に10度×180度程度	
角度分解能(ノミナル)	10度×22.5度程度	10度×15度程度
角度分解能(SWPIA)	5度×10度程度	10度×15度程度
感度 (cm ² sr)	0.0012	0.012
ダイナミックレンジ(Flux)	10 ⁴ - 10 ⁷ [1/cm ² /s/str]	10 ³ - 10 ⁶ [1/cm ² /s/str]
サイズ (mm)	330×210×250程度	
質量	6.8 kg	
電力	18W	
データ発生量(ノミナル)	60 kbit/spin程度	
データ発生量(SWPIA)	864 kbps程度	

2 MeV
|
70 keV
(electron)

MEP-e (Medium-Energy Particle experiments - electron analyzer)

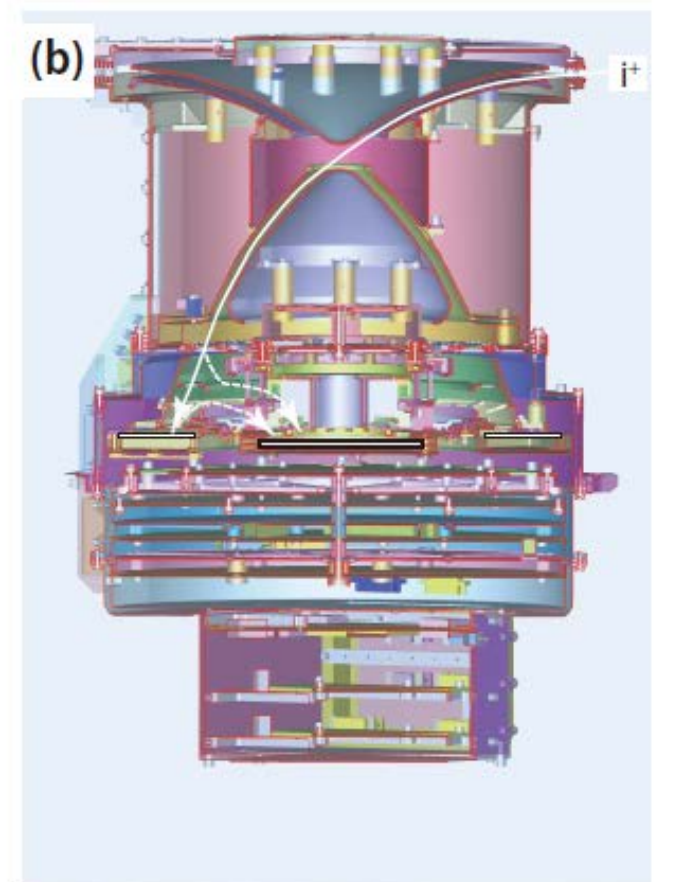


- Measures 10 keV – 80 keV electrons
- Identifies the energy and direction of each incoming electron
- Uses APDs and an electrostatic analyzer for the signal detection and energy analyses
- Also produces S-WPIA data

Parameter	Value	Notes
Energy range	<10 to 80 keV	
Energy resolution	8%	FWHM of the electrostatic analyzer response
Energy steps	16 steps per one scan	
Sensor field of view	360° (Azimuth) × 3.5° (Elevation)	Azimuthal gaps between detectors
Number of APDs	16	FWHM circularly aligned
Geometric factor	6.6 × 10 ⁻³ cm ² sr keV/keV per detector	APD efficiency not included
Time resolution	4 sec for full 3-D distribution function	For nominal spacecraft spin (8 sec)
	250 msec for one energy sweep	
	15.6 msec for one energy step	
Sensor size	φ318mm × 395mm	Including an electronics box for CPU and power supply unit (PSU)
Sensor mass	8.2 kg	
Power consumption	21 W	The efficiency of PSU is ~60%
Science data size	1.756 kB per one energy scan	Before compression and reduction. Including a packet header.

80 keV
|
10 keV
(electron)

MEP-i (Medium-Energy Particle experiments - ion mass analyzer)

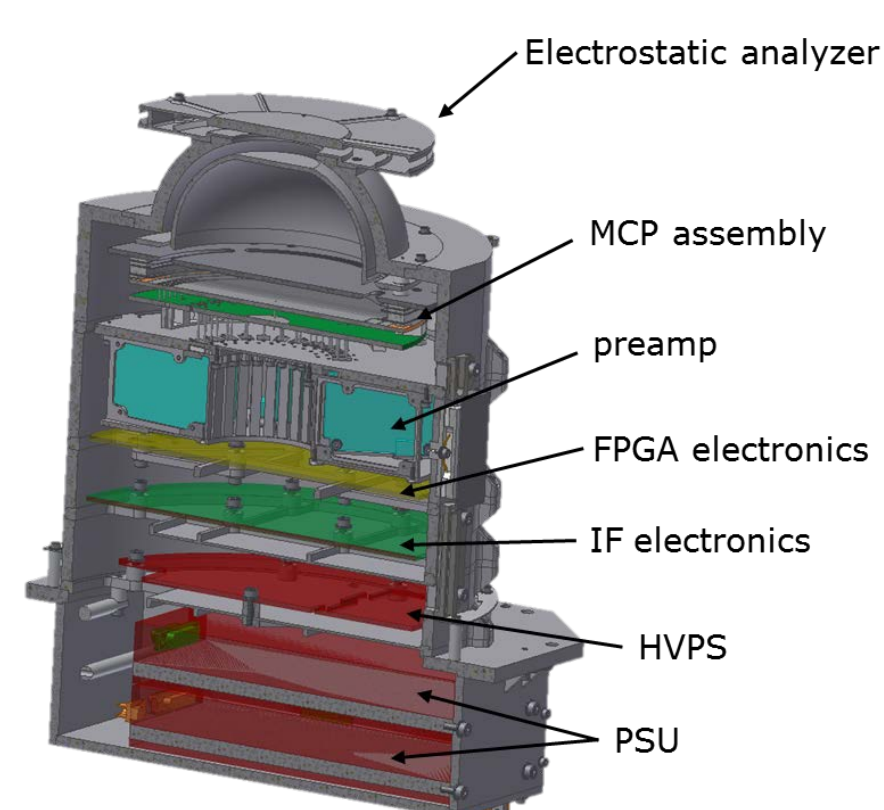
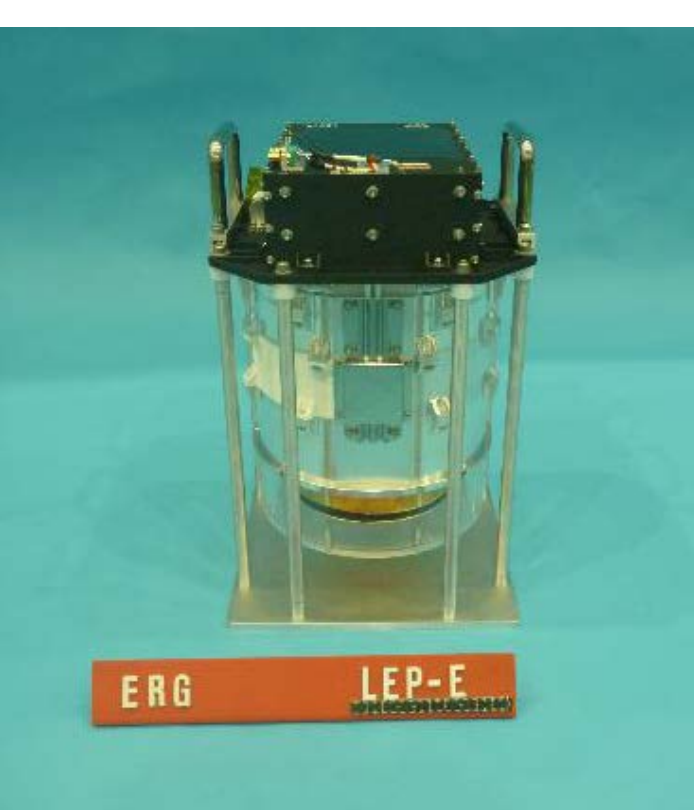


- Measures 10 keV/q – 180 keV/q ions
- Identifies the energy, mass, charge, and direction of each incoming ion
- Uses an MCP, SSDs, and an electrostatic analyzer for the signal detection and energy analyses
- TOF technique is used for mass analyses

Parameter	Value	Notes
Energy range	<10 to 180 keV/q	
Energy resolution	7%	FWHM of the electrostatic analyzer response
Energy steps	16 steps per spin	The first step is not used for analyses due to the slow rise of the high voltage
Mass discrimination	H ⁺ , He ⁺⁺ , He ⁺ , O ⁺ , O ²⁺	
Sensor field of view	360° (Azimuth) × 3.5° (Elevation)	FWHM circularly aligned
Number of anodes	16	TOF efficiency not included
Geometric factor	2.4 × 10 ⁻⁴ cm ² sr keV/keV/anode (normal)	
	1.9 × 10 ⁻⁵ cm ² sr keV/keV/anode (narrow)	
Time resolution	4 sec for full 3-D distribution function	For nominal S/C spin (8 sec)
	500 msec for one energy sweep	
	31.3 msec for one energy step	
Sensor size	φ310mm × 402mm	Including an electronics box for CPU and power supply unit (PSU)
Sensor mass	9.8 kg	
Power consumption	23 W	The efficiency of PSU is ~60%
Science data size	6.556 kB per one energy scan	Before compression and reduction

180 keV/q
|
10 keV/q
(ion)

LEP-e (Low-Energy Particle experiments – electron analyzer)

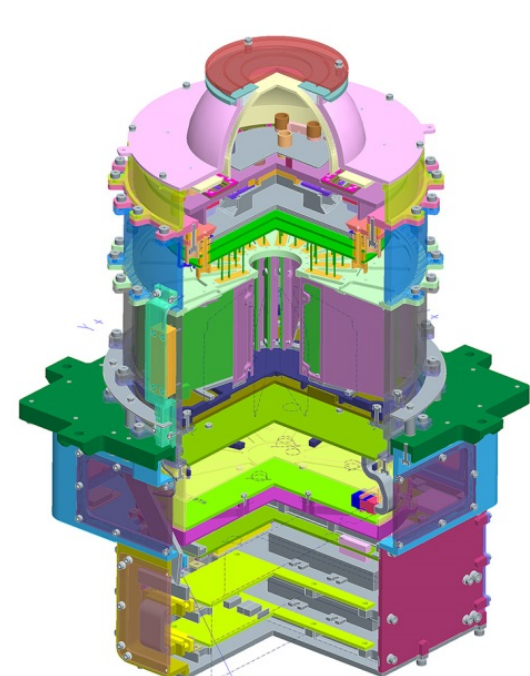
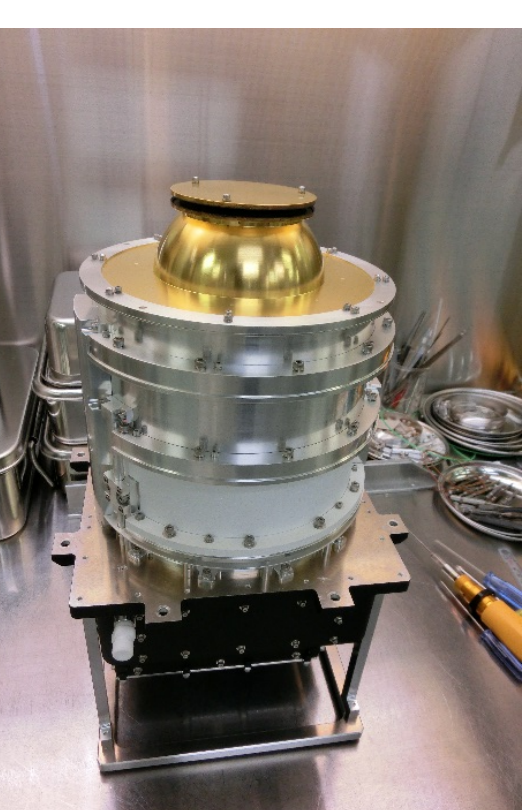


- Measures 10 eV – 19 keV electrons
- Identifies the energy and direction of each incoming electron
- Uses an MCP and an electrostatic analyzer for the signal detection and energy analyses

Parameter	Unit	Remark
G-factor		w/o mesh
	coarse 9.56e-4	cm ² sr keV/keV @22.5deg
	fine 1.51e-4	cm ² sr keV/keV @3.75deg
Energy range	-10~19,000	eV @4kV HV
Energy resolution	8.8	% FWHM
Field of view	2.86 × 270	deg
Angular resolution		
	coarse 2.86 × 22.6	deg EL × AZ, FWHM
	fine 2.86 × 3.75	deg EL × AZ, FWHM
Sub-channel coverage	80.3	% for 3.75deg channel width
Parameter	Unit	Remark
Dimension		
	upper part 180DIA × 200H	mm
	lower part 170D × 180W × 90H	mm
Mass	5.512	Kg
Power Consumption	8.8	W w/o PSU's efficiency
Raw data production	25	Kbyte/spin 32K × (12+12)EL × 16AZ × 16bit

19 keV
|
10 eV
(electron)

LEP-i (Low-Energy Particle experiments - ion mass analyzer)



- Measures 10 eV/q – 25 keV/q ions
- Identifies the energy, mass, and direction of each incoming ion
- Uses an MCP and an electrostatic analyzer for the signal detection and energy analyses
- TOF technique is used for mass analyses

Parameter	Unit	Remark
G-factor	2.0e-3	cm ² sr keV/keV @22.5deg
Energy range	-10~25,000	eV/q
Energy resolution	13	% FWHM
Mass resolution	> 4	M/ΔM
Field of view	5 × 290	deg
Angular resolution	5 × 22.5	deg EL × AZ, FWHM
Time resolution	8 (nominal)	sec spacecraft spin period
Parameter	Unit	Remark
Dimension		
	upper part 192DIA × 207H	mm
	lower part 235D × 235W × 155H	mm
Mass	6.94	Kg
Power Consumption	23.8	W including 3.1W consumed by CPU board and PSU conversion efficiency
Raw data production	553 [69]	Kbit/spin [Kbit/s] 32K × 15EL × 16AZ × 5M × 16bit

25 keV/q
|
10 eV/q
(ion)