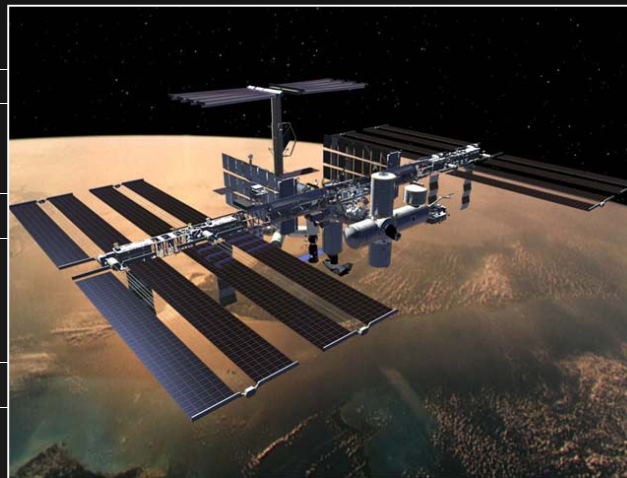


ESA's Space Radiation and Plasma Monitoring Programmes

P. Nieminen, E. Daly, A. Mohammadzadeh, A. Hilgers
ESA/ESTEC, The Netherlands

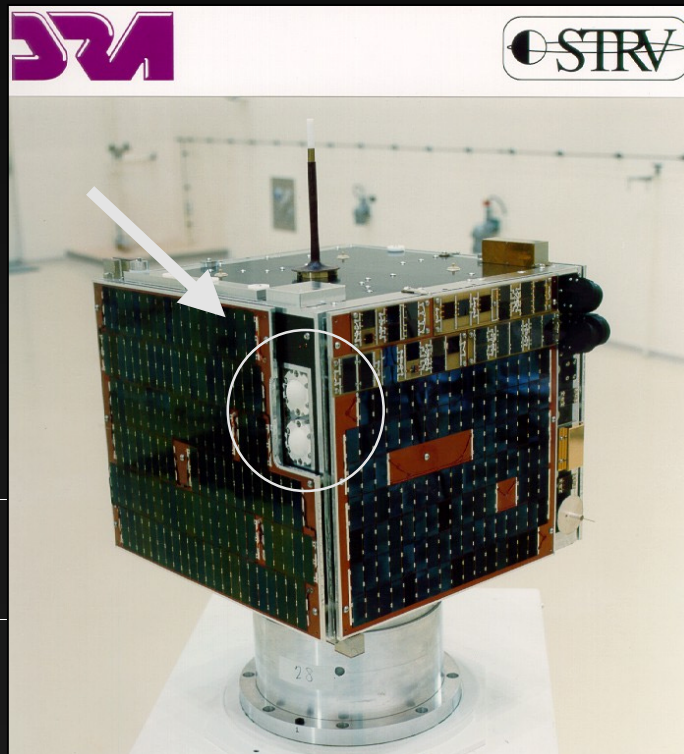
P. Bühler, W. Hajdas
PSI, Switzerland



Space Radiation and Plasma Monitoring: Rationale

- Effects of the space radiation and plasma environment are varied and complex: instrument “background”, component & material degradation, SEP, spacecraft anomalies, ...
- New technologies → new problem areas
- Modelling: Need for continuous measurements with adequate spatial, energy and particle species coverage

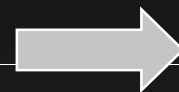
Radiation Environment Monitor (REM)



STRV-1b

Two units:

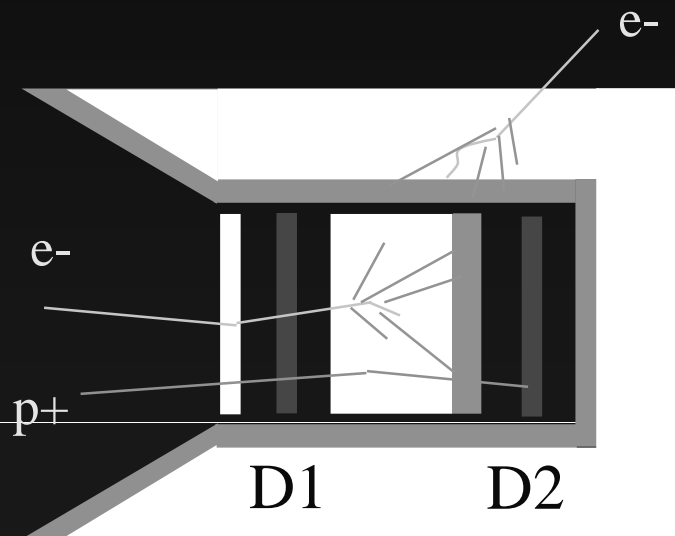
- STRV-1b microsatellite (1994 - 98)
- MIR space station (1994 - 96)



Wealth of data on
electron belt dynamism,
E-W proton anisotropy,...

Standard Radiation Environment Monitor (SREM)

- Aluminum
- Tantalum
- Silicon (detectors)



Improved:

- Performance
- Cost
- Mass (2.5 kg)
- Volume (2 l)



Optimised Al-Ta “Sandwich structure”.
Simulation outcome: modularity (D3).
Further electronics miniaturisation underway.

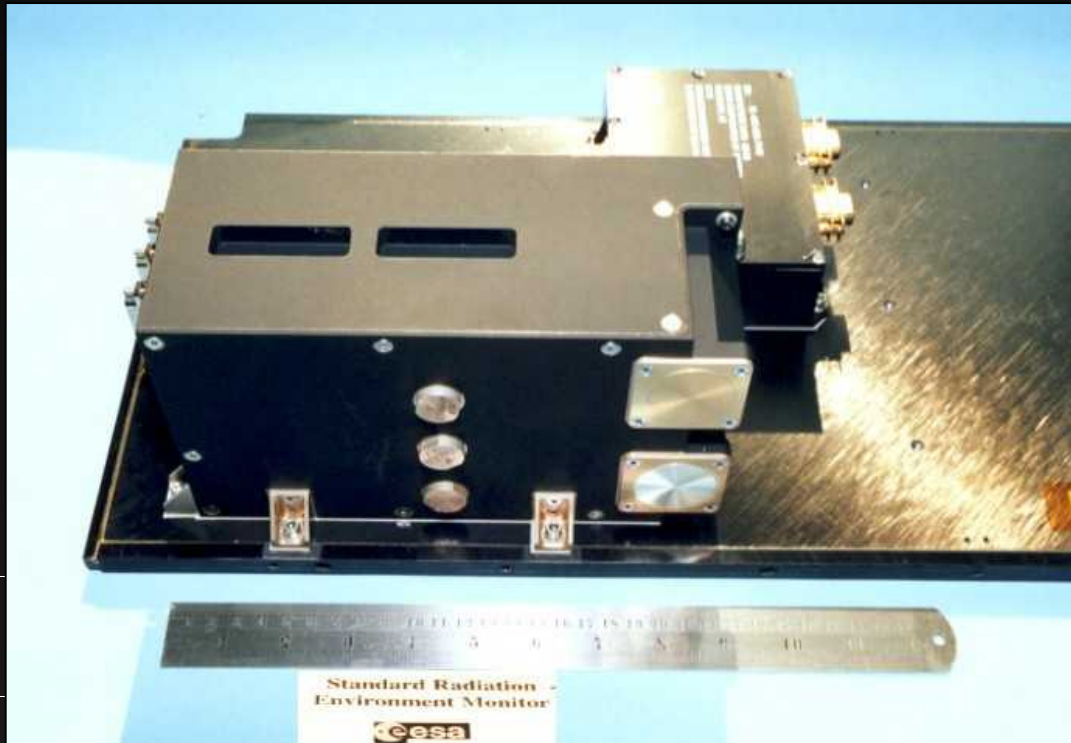
- Electrons > 0.5 MeV
- Protons > 10 MeV
- Heavy ions qualitatively

SREM energy binning

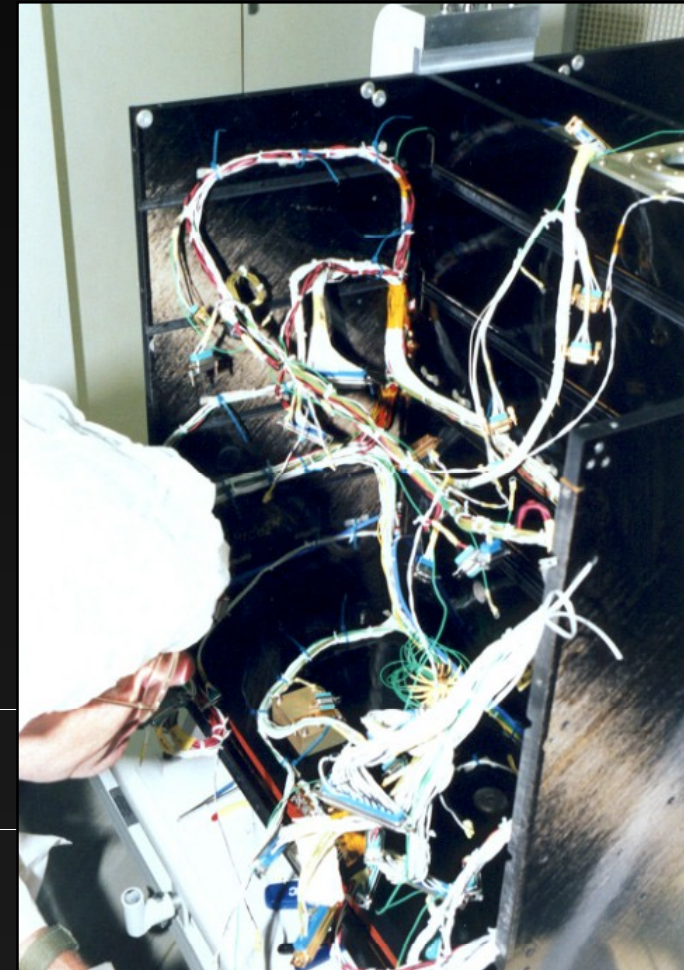
D1-D2 proton
coincidence

	Logic	dE discr. level [MeV]	Particle	E min [MeV]	E max [MeV]
1.	D1	0.085	Proton Electron	20 1.0	Inf.
2.	D1	0.25	Proton	20	550
3.	D1	0.6	Proton	20	120
4.	D1	2	Proton	20	27
5.	D1	30	Proton	20	34
6.	D2	0.085	Proton	39	Inf.
7.	D2	9	Ions	Depending on Z	Depending on Z
8.	D1*D2	0.6, 2	Proton coincidence	40	50
9.	D1*D2	0.6, 1.1-2.0	Proton coincidence	50	70
10.	D1*D2	0.6, 0.6-1.1	Proton coincidence	70	120
11.	D1*D2	0.085-0.6, 0.085- 0.6	Proton coincidence	130	Inf.
12.	D3	0.085	Electron Proton	0.5 10	Inf.
13.	D3	0.25	Electron	0.55	2.3
14.	D3	0.75	Proton	11	90
15.	D3	2	Proton	11	30

SREM



First mission: STRV-1c



Pictures courtesy of DERA Farnborough



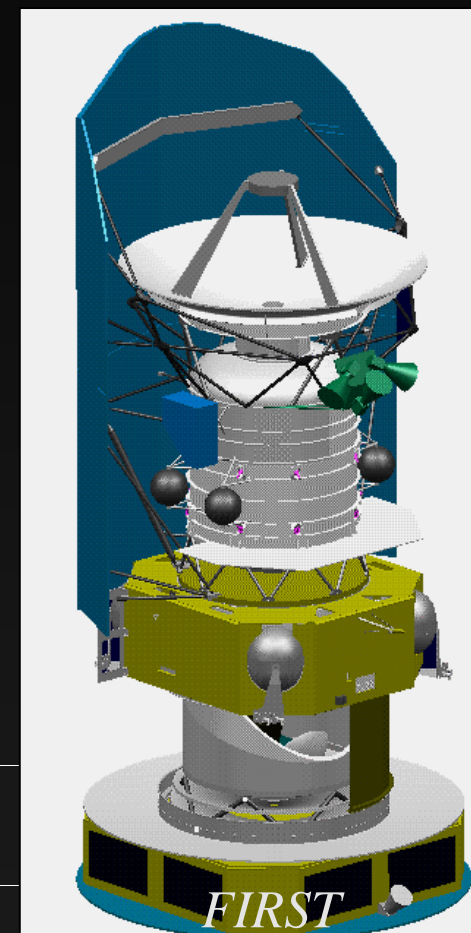
Missions with SREM...



4 November 1999

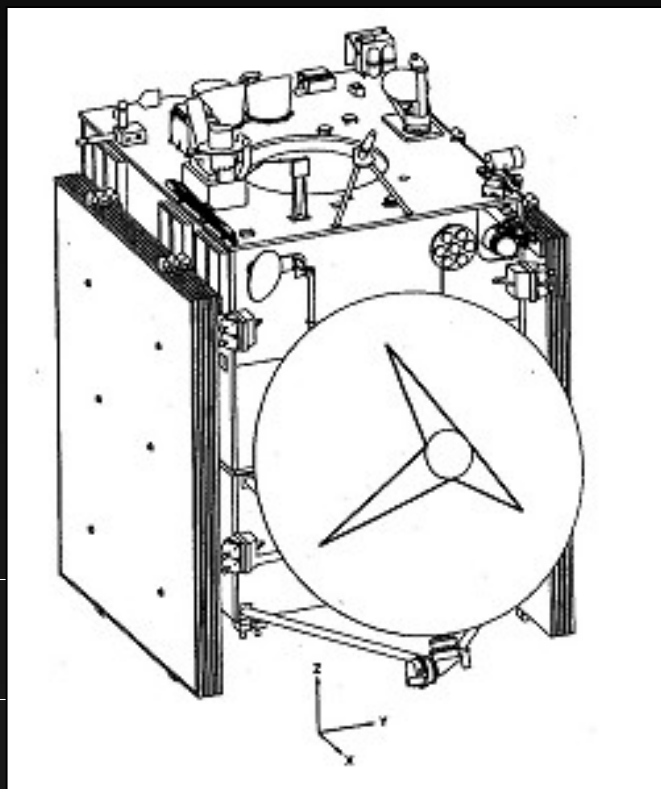


WRMISS Workshop

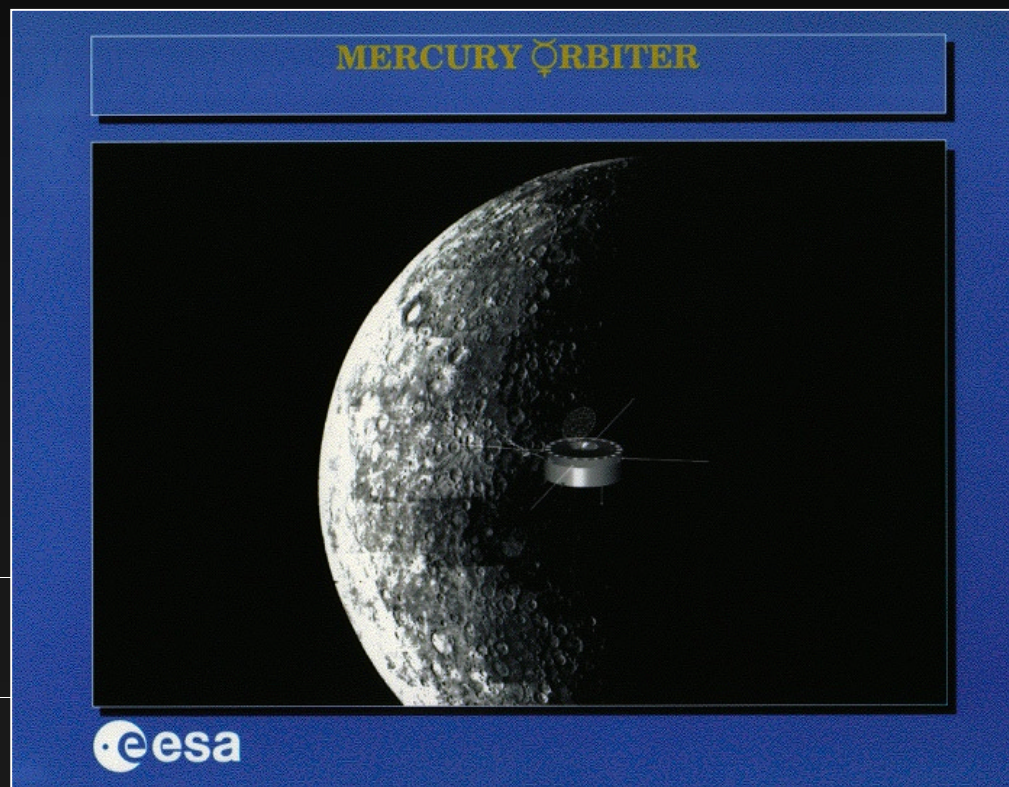


...contd...

Missions with SREM...

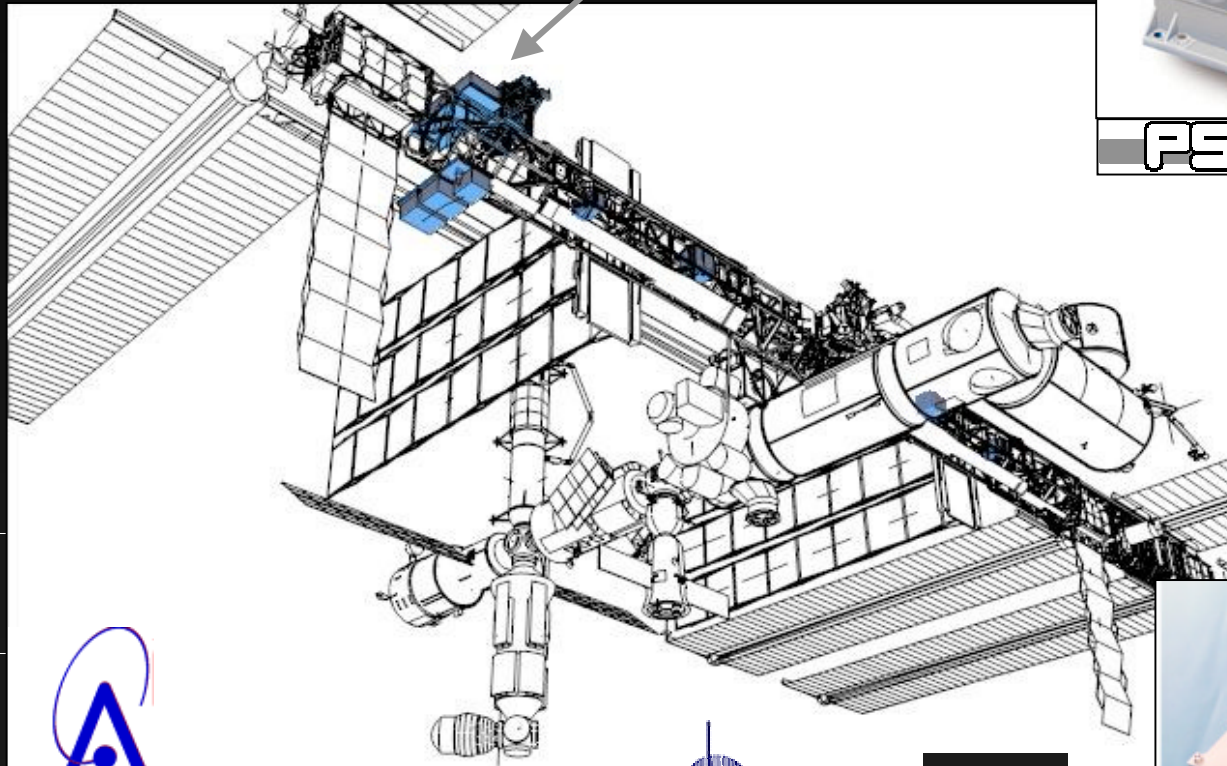


Rosetta



Mercury Orbiter

Columbus Radiation Environment and Effects Package (CREEP) in TEF



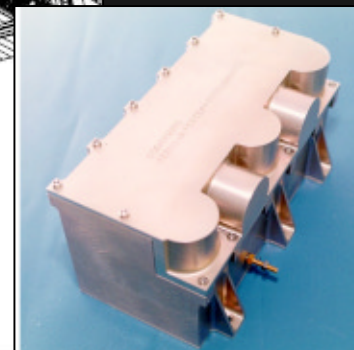
SREM

PSI

PAUL SCHERRER INSTITUT



Dose-Depth Monitor
Proton Monitor



CREAM

DERA



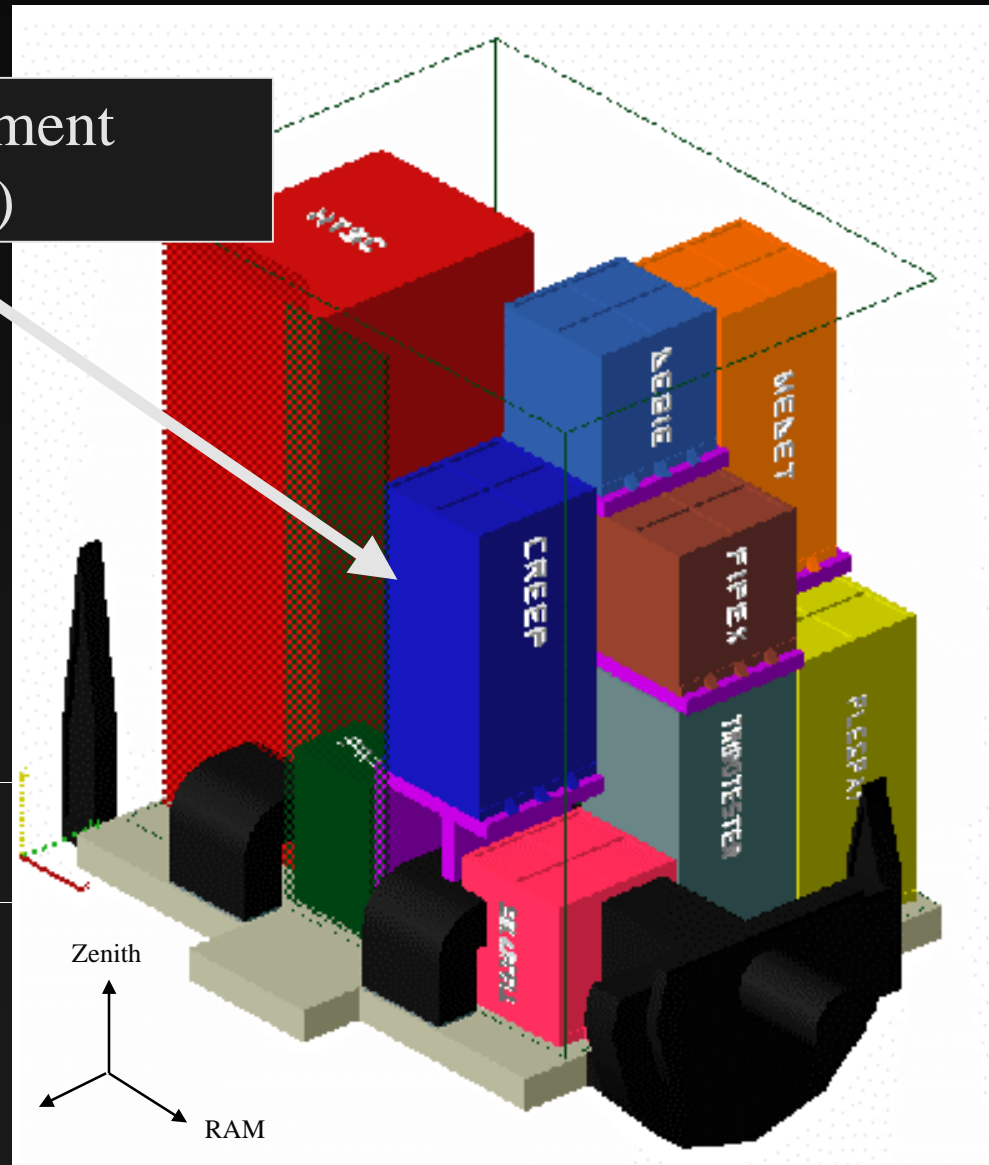
CENTRE NATIONAL D'ETUDES SPATIALES

SPICA

ONERA

Columbus Radiation Environment and Effects Package (CREEP)

- Unobstructed view to RAM, zenith and a direction perpendicular to these
- Component Technology Test-Bed (CTTB) for memory devices, opto-couplers, comparators,...
- Launch late 2002, mission duration ~3 years.
- Simulations; **Geant 4**



Under Study...

Charged Particle Telescope (CPT)

- High-fidelity “science” instrument
- Good spatial, temporal and energy resolution
- In-orbit co-ordination facility for SREMs and potentially other monitoring devices
- Phase-A Study by Aboa Space Research, Inc. (ERNE instrument onboard SOHO; AMS collaborators) due to start by end of -99.
- **Geant 4** to be used for simulations.

Under Study...

Plasma Environment Monitor (PEM)

- Low weight, low power plasma monitor
- Electrons, ions < 100 keV (spacecraft anomalies due to charging; instrumental background in X-ray detectors).
- This low-energy energy range is not covered by current monitor-type devices
- Space weather effects predictions, spacecraft anomaly analysis, plasma science instruments calibration

Under Study...

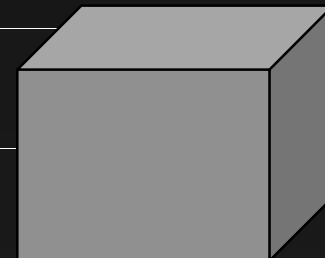
Miniature Radiation Monitor (MRM)

- ESA General Studies Programme activity
- A degree of e-/p+ and energy resolution required
- Applications in medical, physics, environmental fields
- Contractor chosen; prototyping activity will be started soon

<100 g
 <0.1 W
 < 30 kEURO



1-5 kg
 1-5 W
 100-500
 kEURO



Conclusions

- ESA has a wide range of on-going radiation and plasma monitoring activities
- Needs of the ISS, science missions, commercial satellites, technology demonstration payloads addressed
- Connection to data and modelling efforts important
- Potential applications in other fields
- Comments, requirements, feedback from space radiation community welcome
- Collaboration, data sharing