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 $\rightarrow$ new problem areas

- Modelling: Need for continuous measurements with adequate spatial, energy and particle species coverage
Radiation Environment Monitor (REM)

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)

Optimised Al-Ta “Sandwich structure”.

Simulation outcome: modularity (D3).

Further electronics miniaturisation underway.

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

- Electrons > 0.5 MeV
- Protons > 10 MeV
- Heavy ions qualitatively
### SREM Energy Binning

<table>
<thead>
<tr>
<th></th>
<th>Logic</th>
<th>dE Discr. Level [MeV]</th>
<th>Particle</th>
<th>E min [MeV]</th>
<th>E max [MeV]</th>
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</table>

**D1-D2 Proton Coincidence**
SREM

First mission: STRV-1c

Pictures courtesy of DERA Farnborough
Missions with SREM...

...contd...
Missions with SREM...

*Rosetta*  
*Mercury Orbiter*
Columbus Radiation Environment and Effects Package (CREEP) in TEF
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: <100 g
  - <0.1 W

- **A degree of e-/p+ and energy resolution required**
  - < 30 kEURO

- **Applications in medical, physics, environmental fields**
  - 1-5 kg
  - 1-5 W

- **Contractor chosen; prototyping activity will be started soon**
  - 100-500 kEURO

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WRMISS Workshop
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