ESA Radiation, Charging, Meteoroid and Debris Monitors

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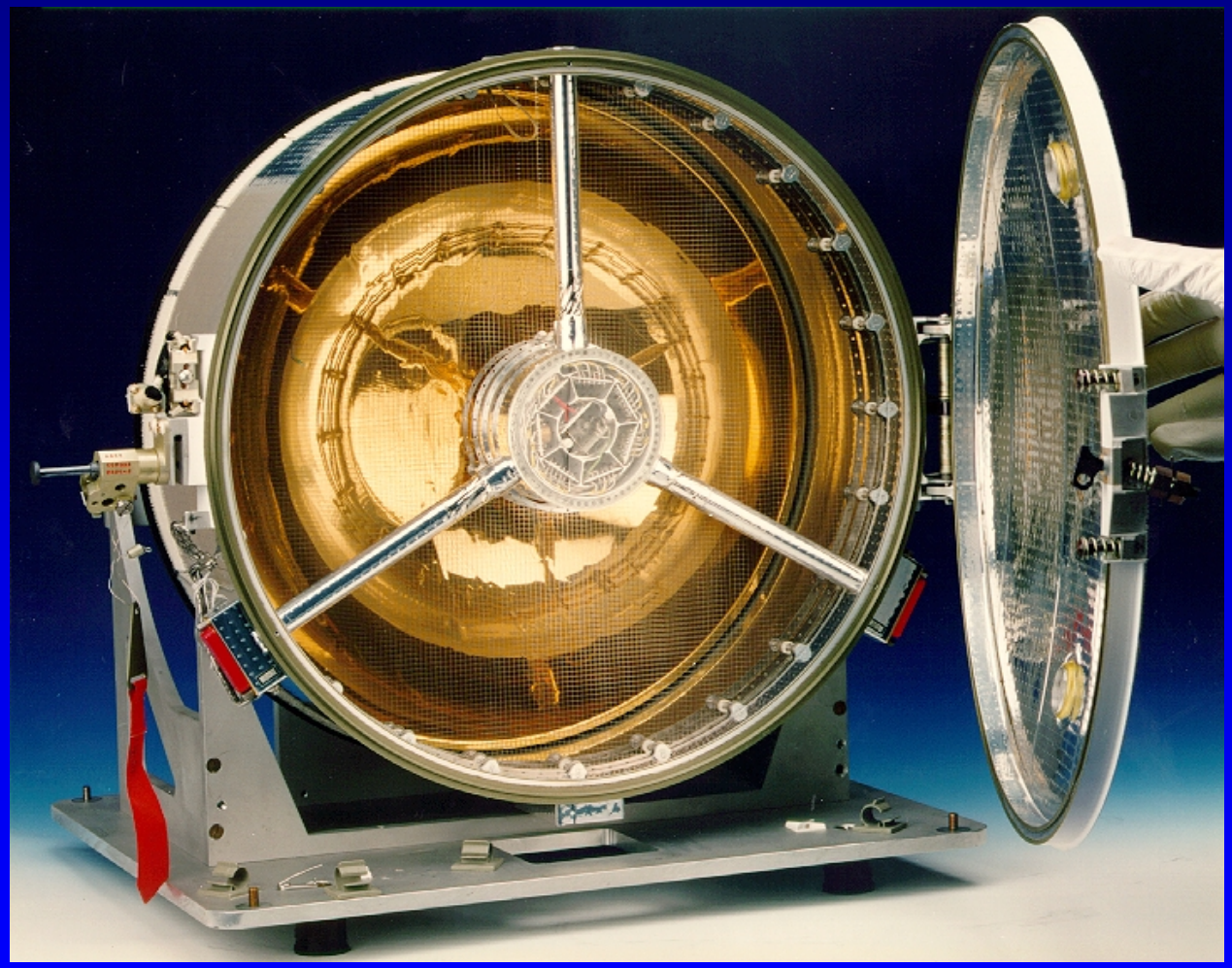
Geostationary Orbit Impact Detector (GORID)

NPO-PM (RUS)



GORID

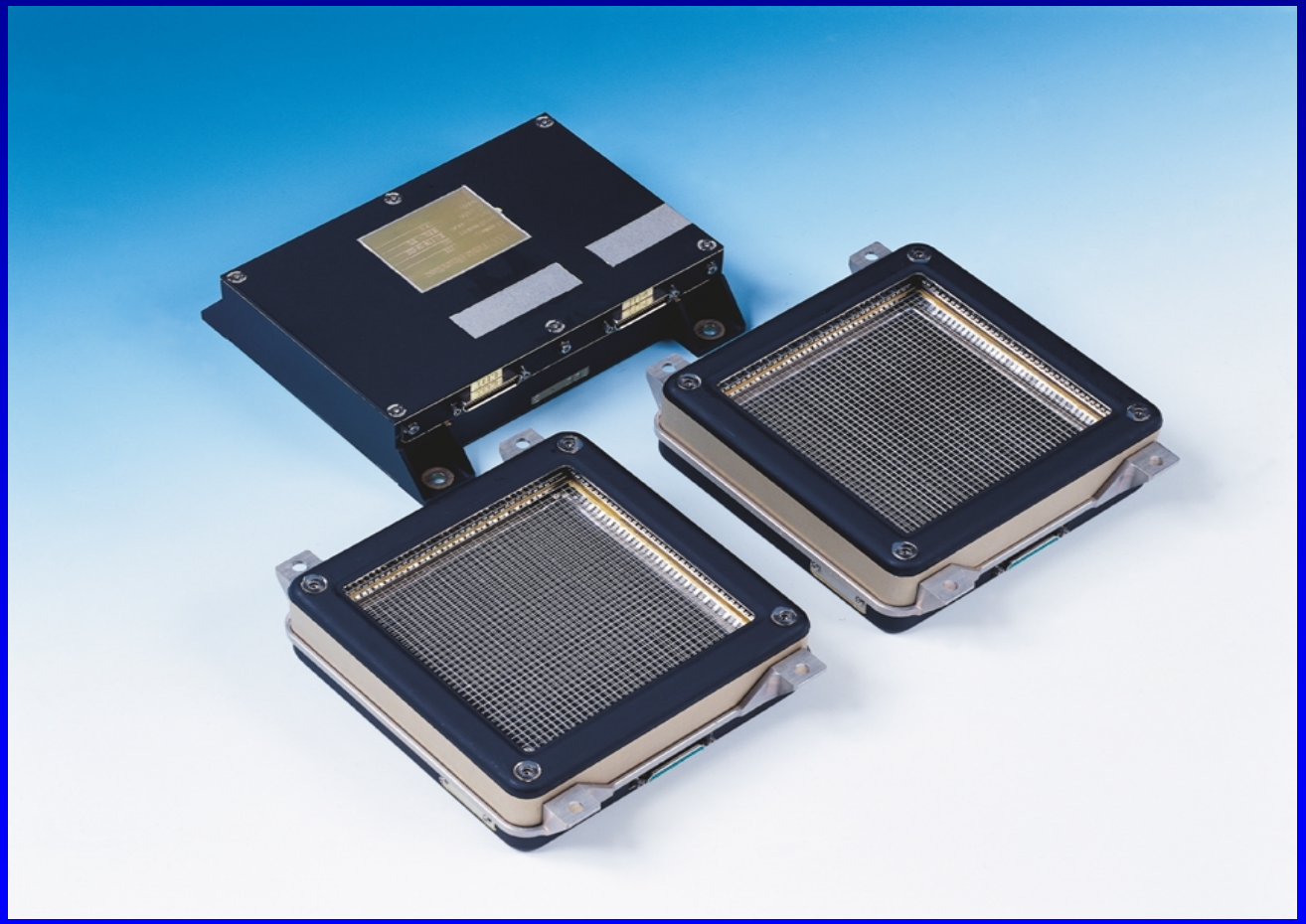
Overview

- Joint project of ESA (TOS-EM and SCI-SO), MPI f. Kernphys., NPO-PM
- Engineering model of Ulysses/Galileo dust impact detector
- Launched on 26 September 1996 on EXPRESS - 2 telecom. Satellite
- GORID/EXPRESS was stationed in GEO at 80° E, 103° E after July 2000
- Fixed pointing direction between ram and North, 140° FOV
- Normal operation since 22 April 1997
- Data are down-linked every 10 days and sent via e-mail to ESTEC
- Expected lifetime of GORID/EXPRESS is 5-7 years
- Present contract for operation ends September 2002
- Data analysis will be continued

DEBris In orbit Evaluator (DEBIE)

Patria Finavitec, SSF, Metorex (FIN), Unispace Kent (UK)

DEBIE DPU with 2 sensor units (opening 10 cm x 10 cm)

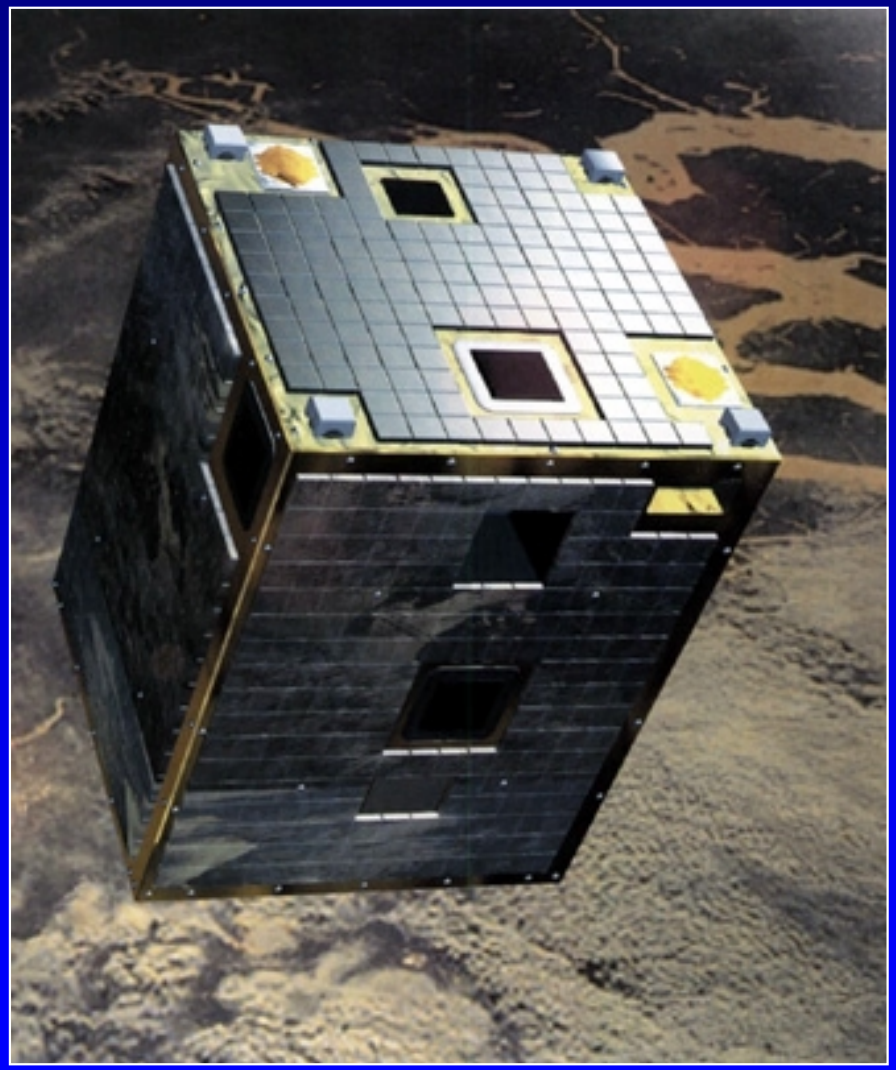


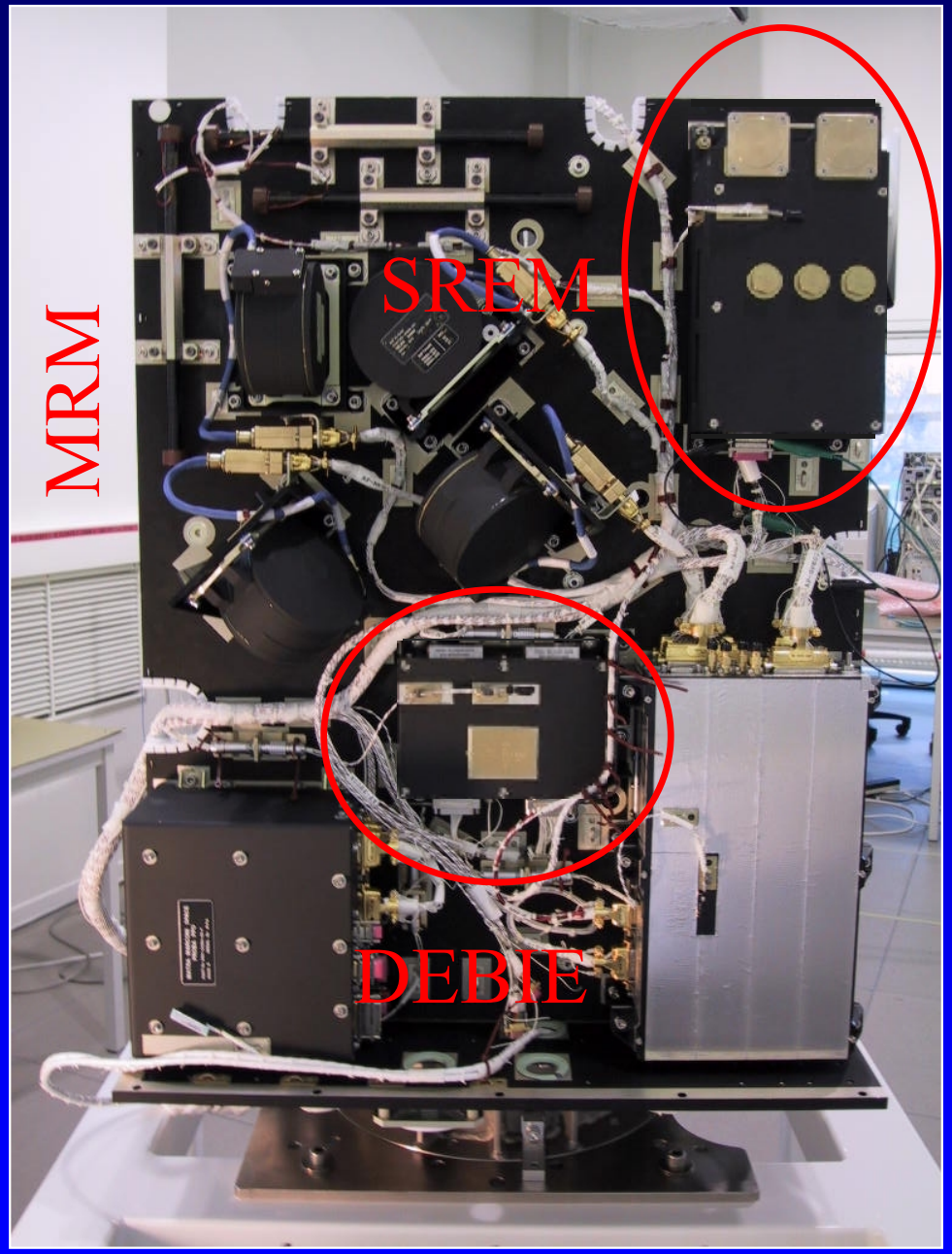
DEBIE

Main Properties

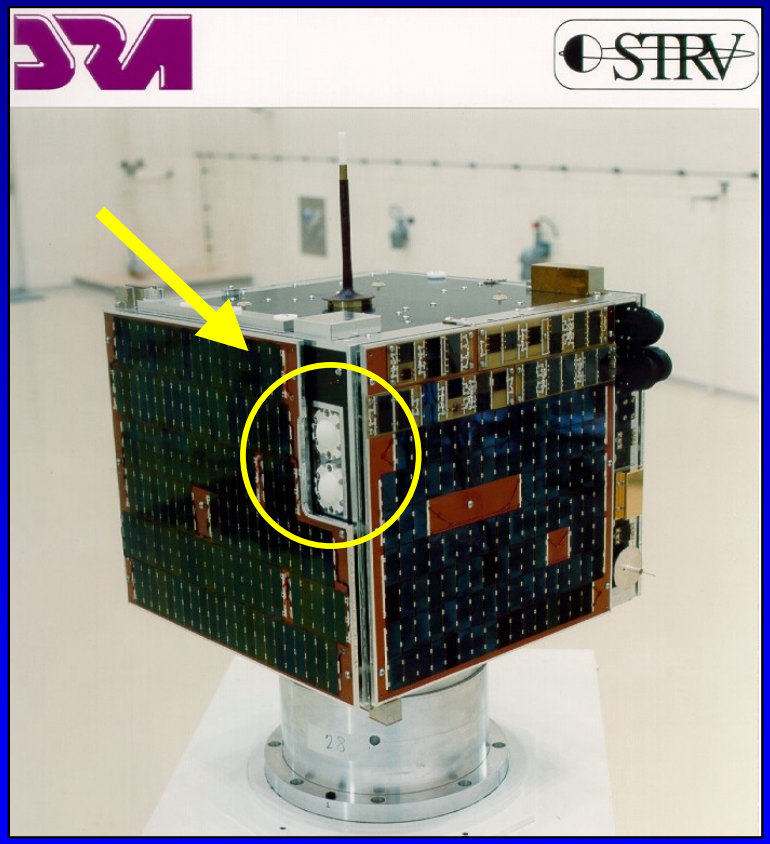
- Combination of impact ionisation, momentum and foil penetration detection
- Active sensor area: 10 cm x 10 cm per sensor
- Mass: ≈ 2.36 kg
- Power (for 2 sensors): 2.7 W; continuous operation
- Sensitivity: mass > 10^{-15} g (velocity dependent)
- On-board classification and storage of events
- ICD documents + DEBIE images available at: ftp://ftp.estec.esa.nl/pub/wm/incoming/debie/fin
- **DEBIE-1** launched on PROBA in October 2001
- **DEBIE-2** manufacturing ongoing; flight on ISS exposure facility (EuTEF) in 2005 (TBC)

PROBA





Radiation Environment Monitor (REM)



STRV-1b

Two units:

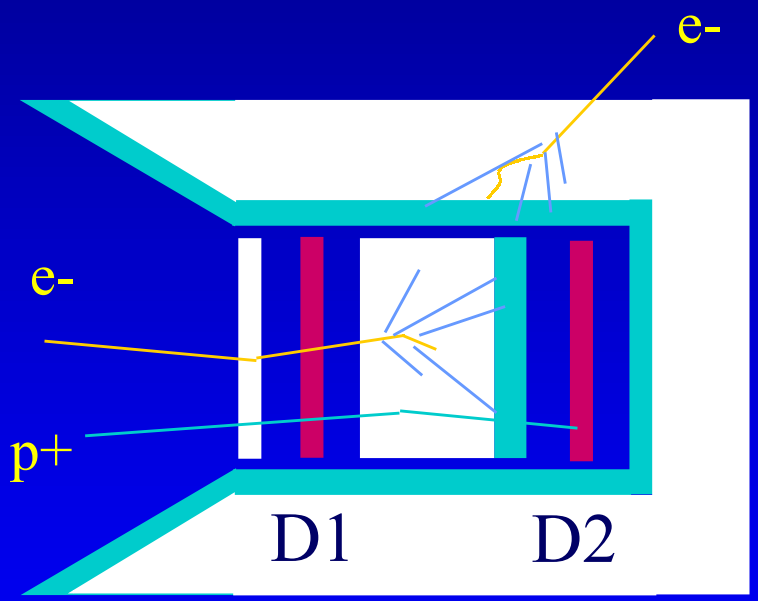
- STRV-1b microsatellite (1994 - 98)
- MIR space station (1994 - 96)

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

Standard Radiation Environment Monitor (SREM)

Contraves Space (CH)

Aluminum
Tantalum
Silicon (detectors)



Optimised Al-Ta "Sandwich structure".
Simulation outcome: modularity (D3).

Improved:

- Performance
- Cost
- Mass 2.5 kg
- Volume 2 l
- Power 2.5 W

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

SREM
energy binning

D1 protons/ electrons

D1 heavy ions

D1-D2 proton coincidence

D3 electrons/ protons

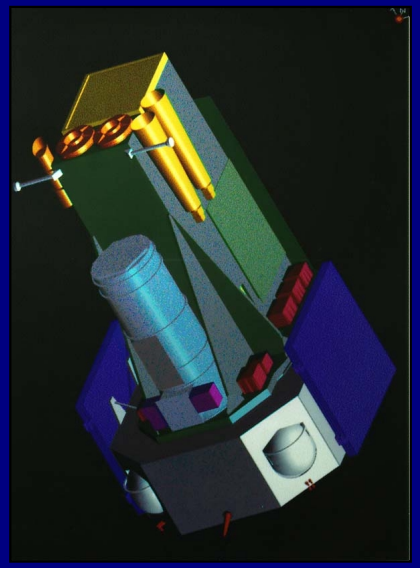
D3 protons

	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 on STRV-1c

Pictures courtesy of DERA Farnborough

PROBA 2001

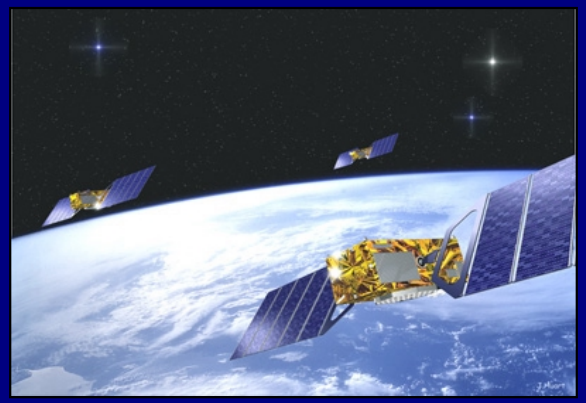


INTEGRAL 2002

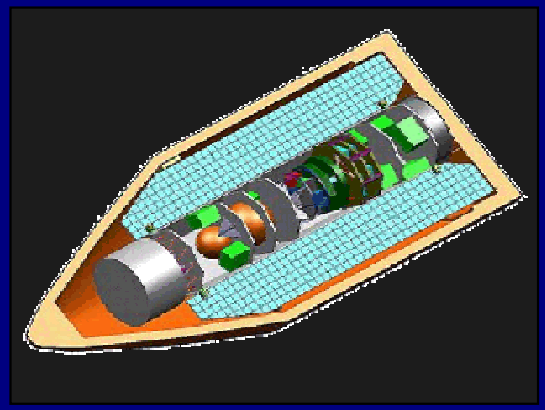
Rosetta 2003

Missions with SREM

ISS ????

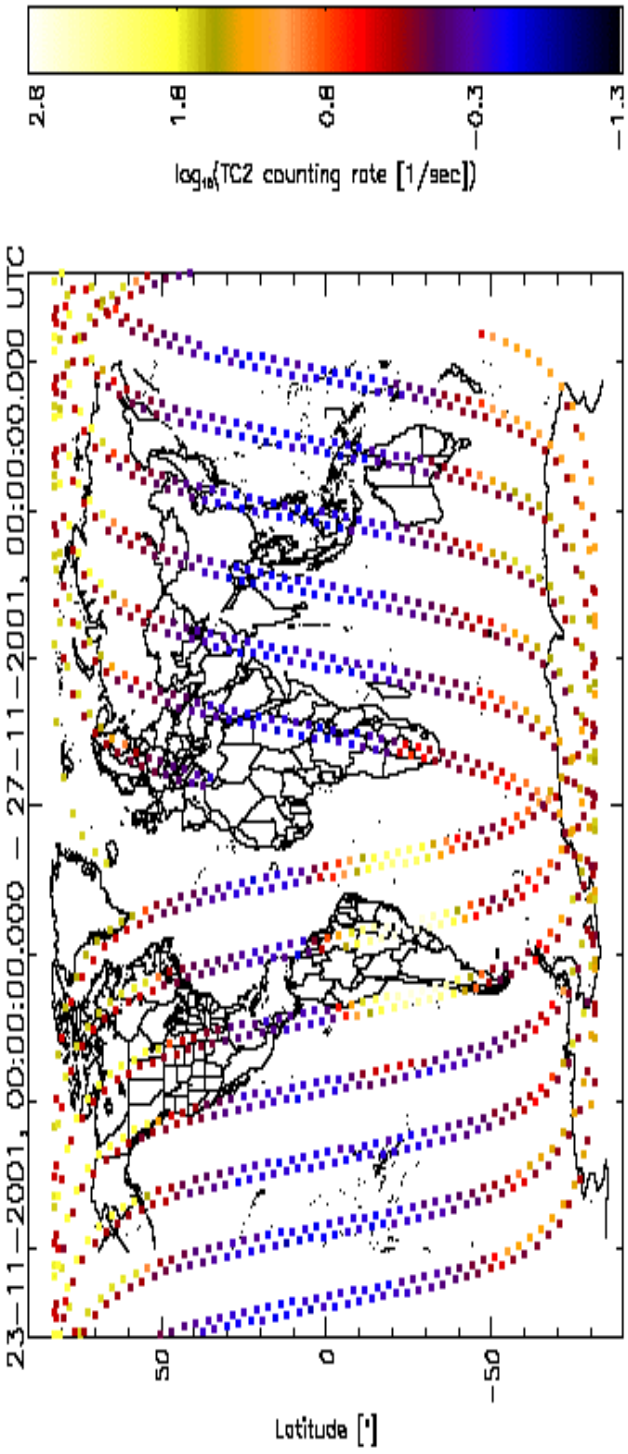


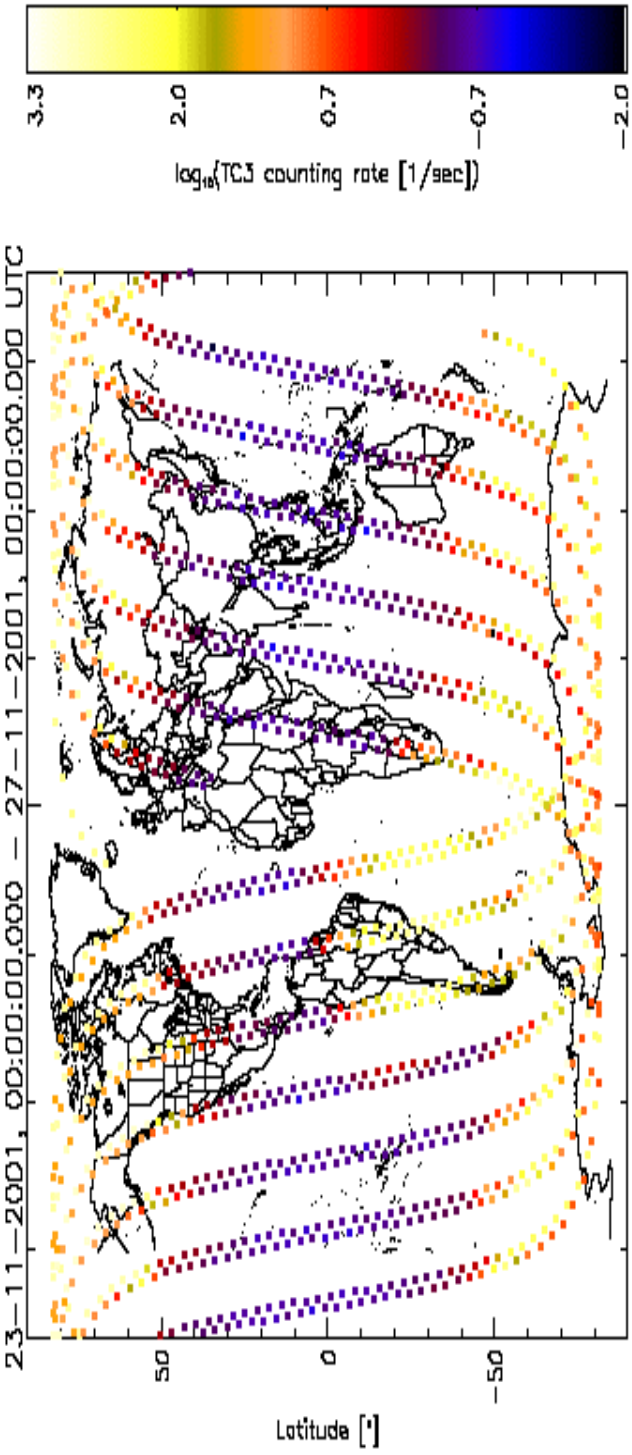
GSTB ????



GOCE 2005

PROBA SREM data





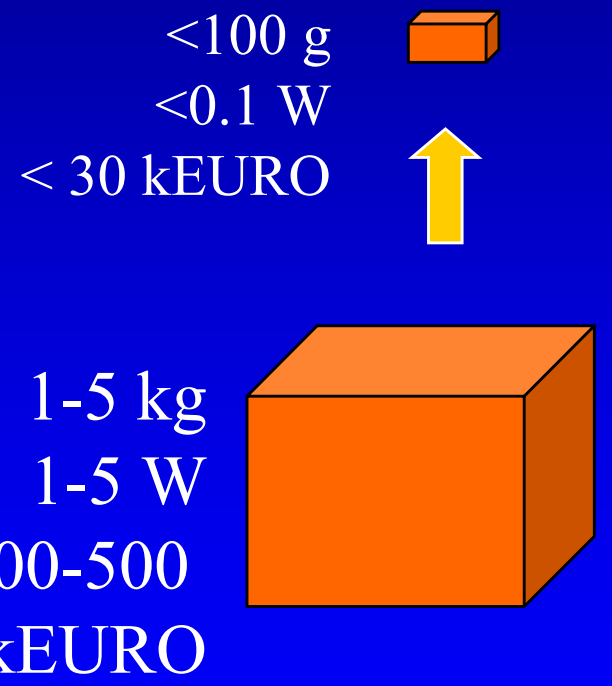
Miniaturised SREM (MSREM)

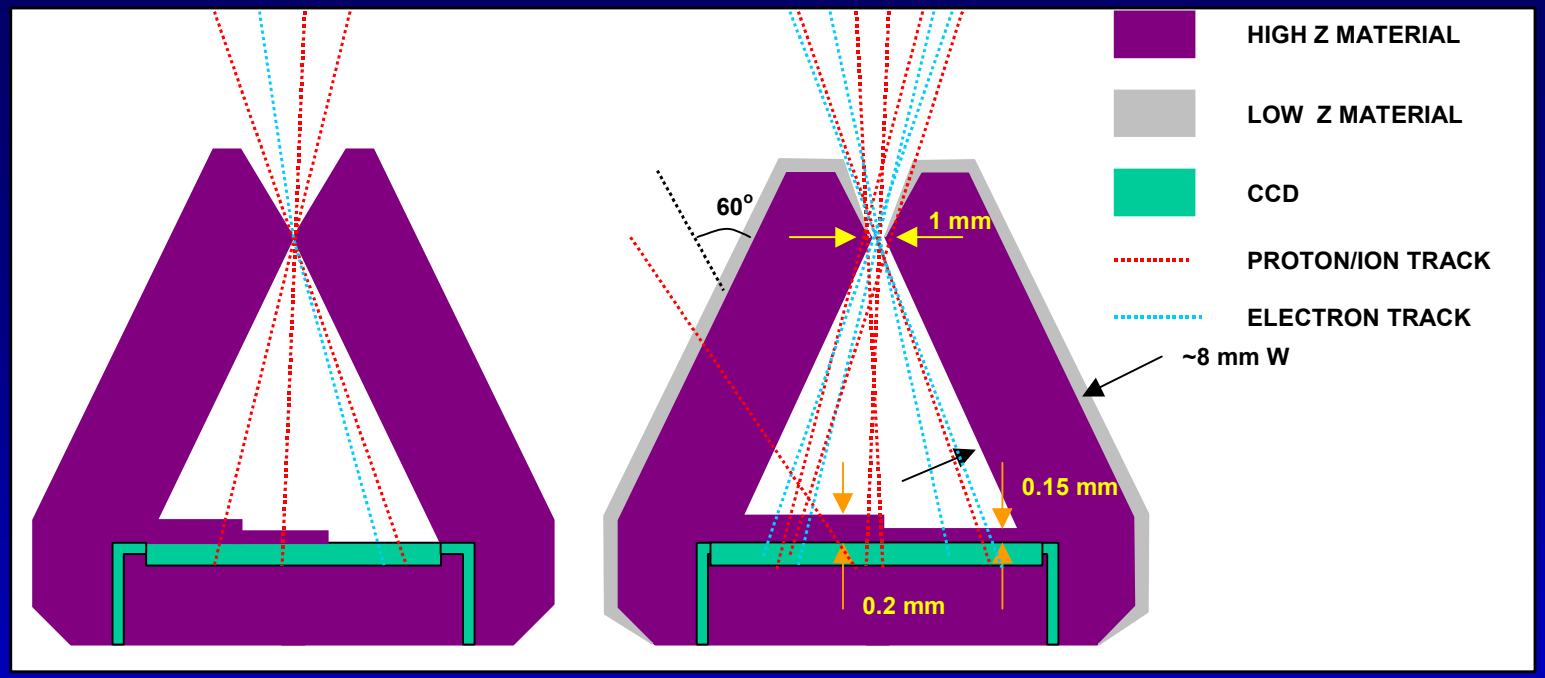
Contraves Space (CH)

- Multi-detector telescope; new detector diodes
- Volume 12 x 12 x 12 cm^3
- Improved scientific performance
- Mass ~1.8 kg
- Power < 2 W
- Breadboarding underway: finished by end of 2001
- First PFM MSREMs available by first half of 2003

Miniature Radiation Monitor (MRM)

- ESA General Studies Programme activity
- A degree of e-/p+, energy and directional resolution required
- Order of magnitude reduction in mass, volume, power and cost budgets
- Applications in medical, physics, environmental fields
- Two parallel activities:
  - Scintillating fibre (Sensys, NL)
  - CCD pinhole (Matra Bae, UK)





CCD pinhole
(*Matra BAe*, UK)

Scintillating fibre
(*Sensys*, NL)

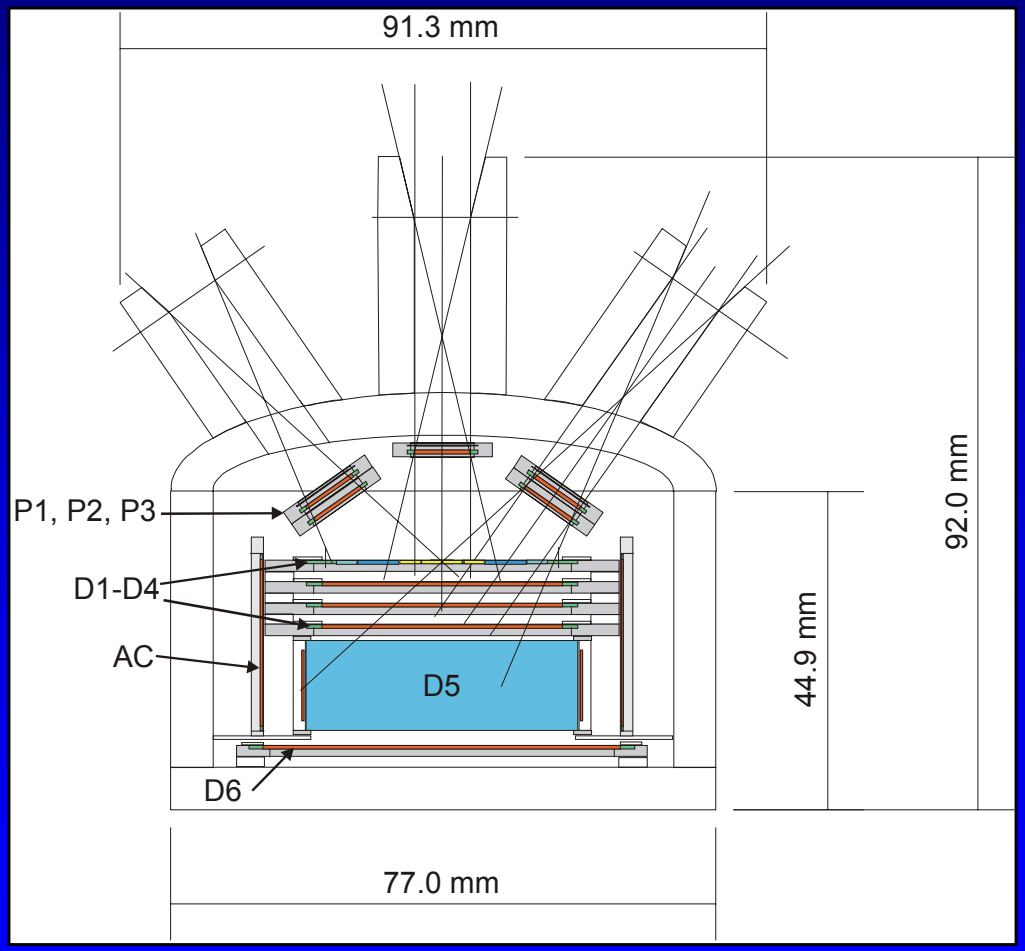
MRM rationale & experience:

Ubiquitous presence in space will require miniaturisation and low costs.

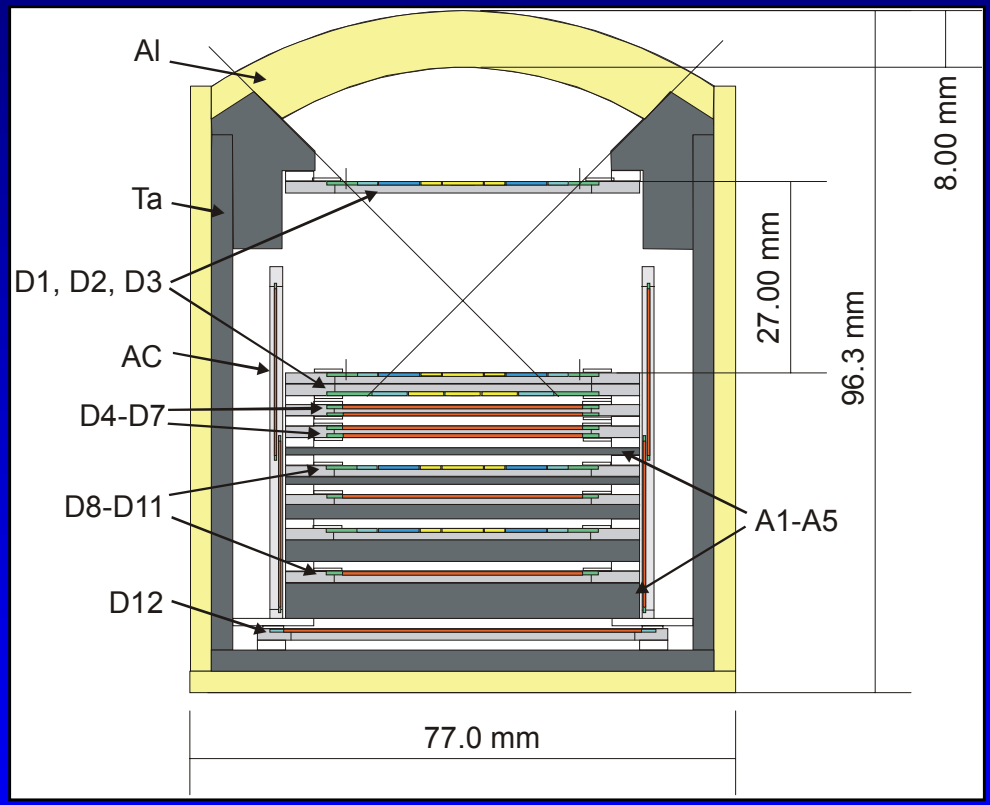
Highly relevant developments are possible with restricted budget.

Charged Particle Telescope (CPT)

Aboa Space Research ASRO (FIN)



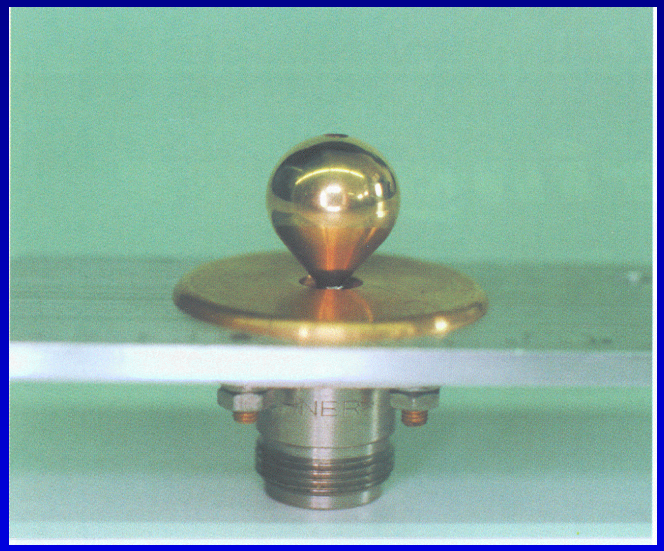
Low-Energy Telescope



High-Energy Telescope

Discharge Detector Experiment (DDE)

EMC-Baden (CH)



DDE Electric field probe

- First flight: Russian Express, launched March 2000 in GEO
- Dielectric sample (Mylar foil) : in case of discharge, voltage drop detected
- Two probe boxes outside and an electronics box inside the spacecraft
- Continuous, successful operation for more than a year with COTS hardware
- No discharge events recorded so far ⇒ internal discharge unlikely cause for unexpected failures in GEO

Low Energy Electron Density Experiment (LEEDEX-1)

UAM (E), MSSL (UK)

- Measurement of free electron densities and other charged particles arriving at the spacecraft
- Correlation of with data measured inside the spacecraft
- Cold Electron Detector (CED): 0.1-256 eV, FOV 7°. One unit outside and two inside the spacecraft
- Electron Plasma Sensor (EPS): 0.1-14 eV, FOV 5 x 360°. Mounted outside the spacecraft.
- Filter Wheel Assembly (FWA): 8 different materials/windows
- Launch possibly onboard Russian GTO satellite in 2002.