

Space Dosimetry with Tritel 3D Silicon Detector Telescope

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Outline

- **Main objectives of the development**
- **Instrumentation (Tritel)**
- **Results**
 - **Mechanical construction**
 - **Measurements, vibration tests**
- **Conclusion and the future**

Tritel

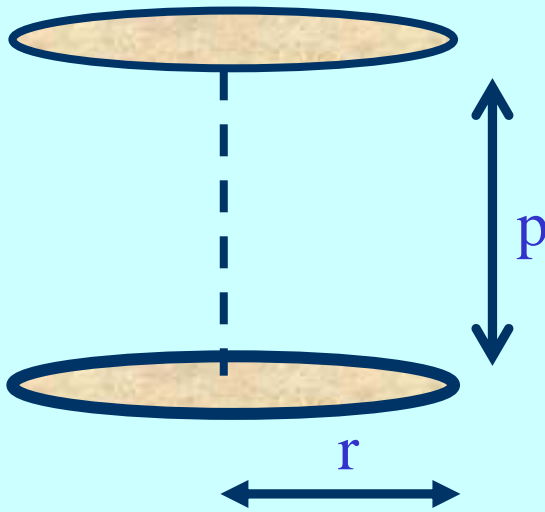
3D silicon detector telescope for space dosimetry

- Main goals:
 - determination of the absorbed dose
 - determination of the radiation weighting factor
 - evaluation of the equivalent dose
 - Assessment of angular asymmetry

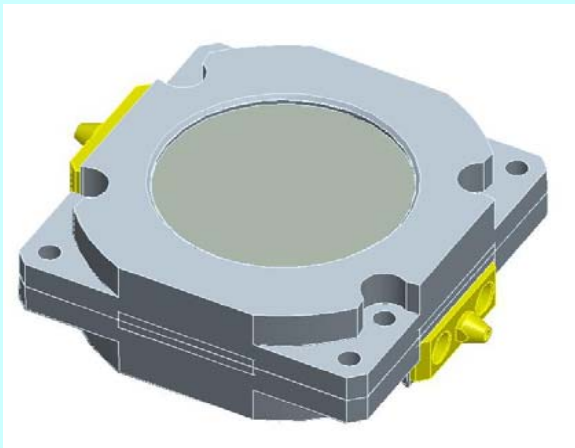
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- efficiency corrections of the TL measurements

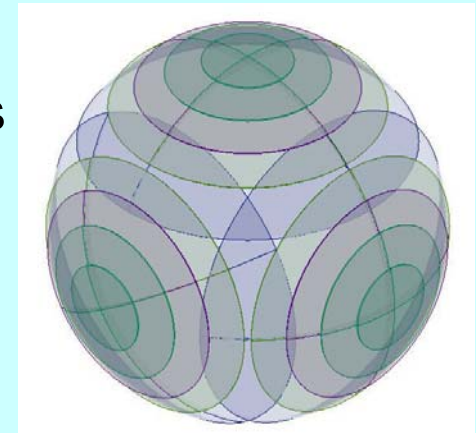
Geometry



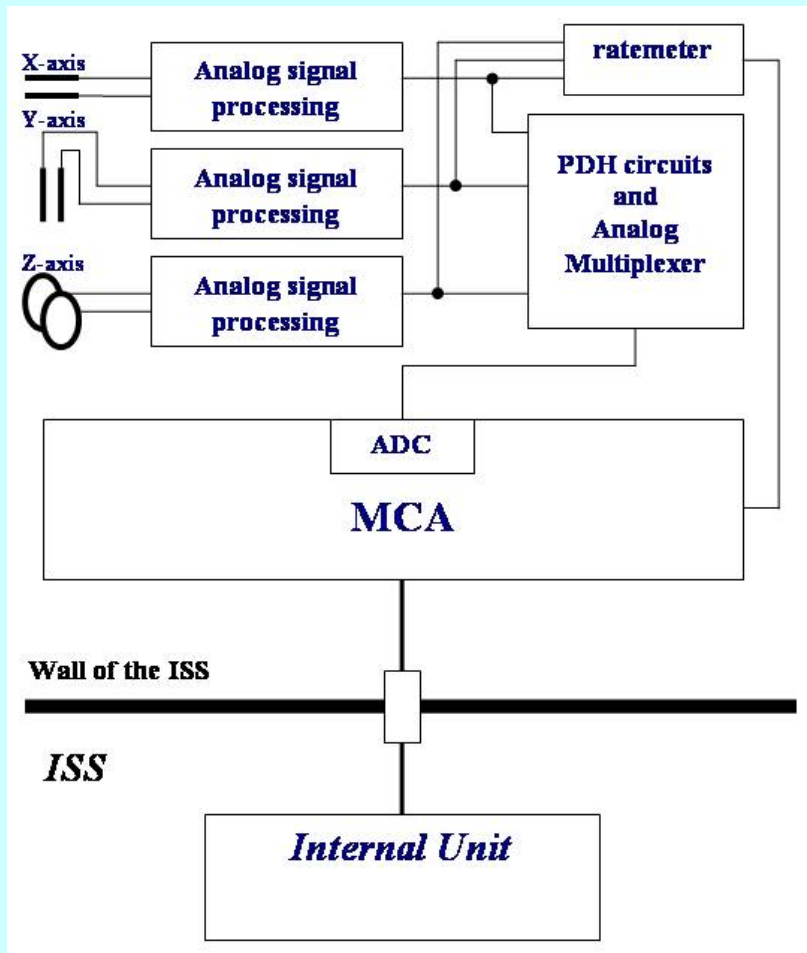
- Thickness of the silicon crystal: $\sim 300 \mu\text{m}$
- $r = 12 \text{ mm}$ (450 mm^2)
- $q = p/r = 1.23 \rightarrow p = 14.8 \text{ mm}$



- Detector chips of the telescope are connected as AND gate in coincidence
- 3D sensitivity

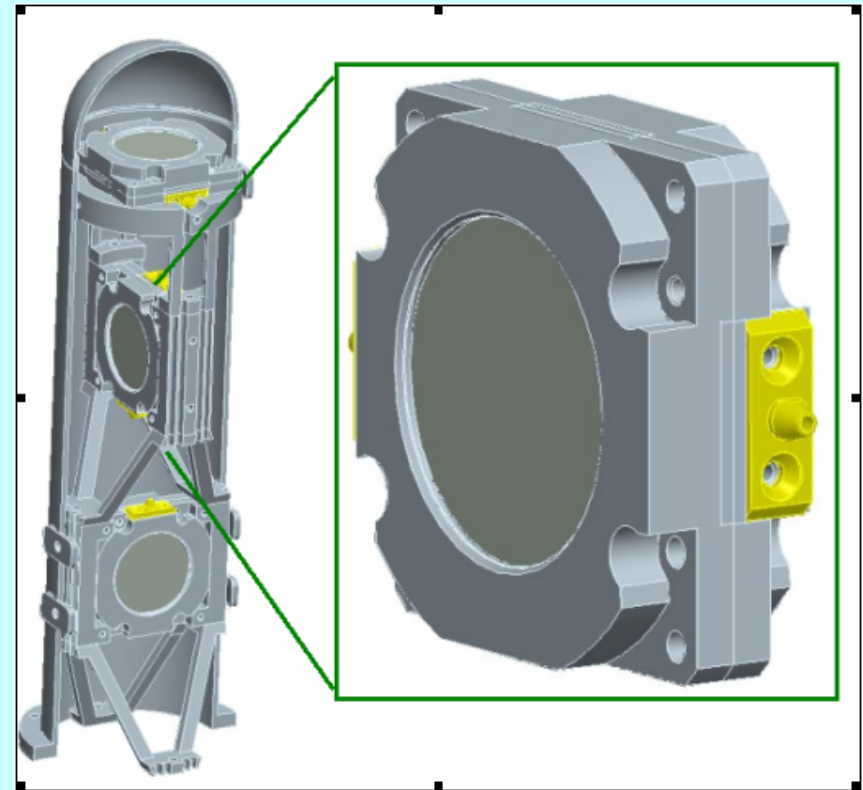
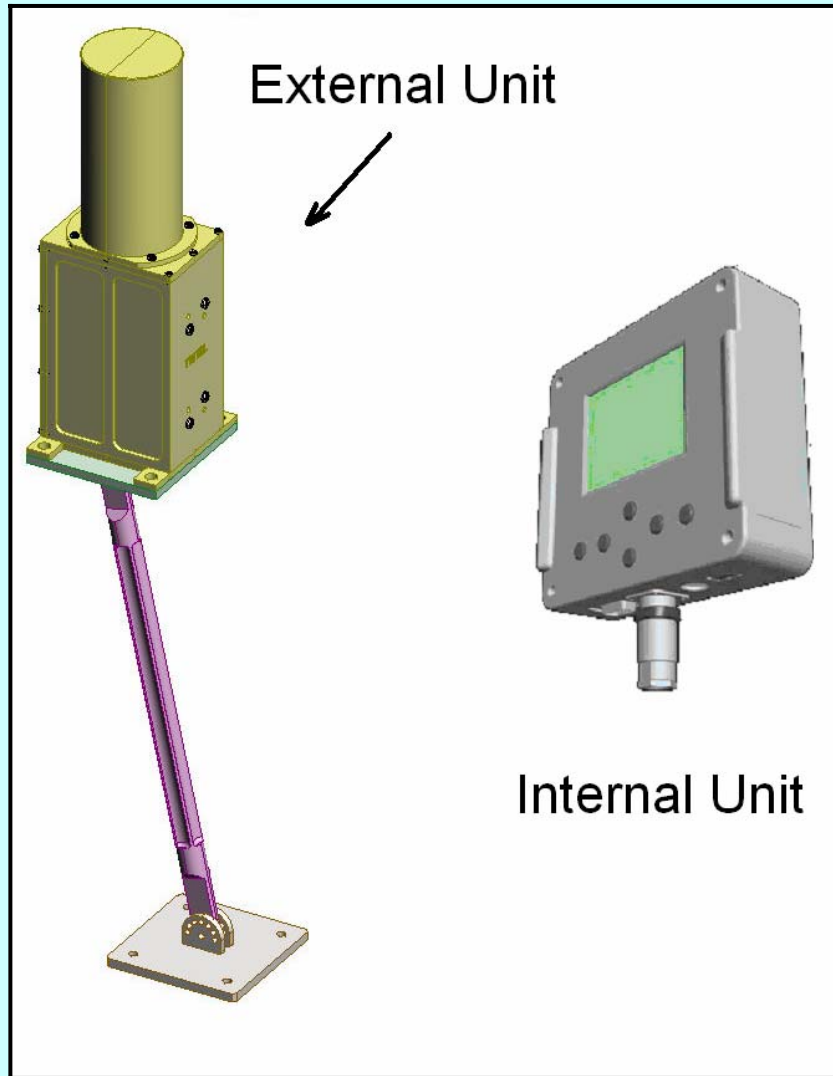


Instrumentation



- Ungated spectra
→ absorbed dose (D)
- Gated (coincidence) spectra
→ LET spectrum and equivalent dose (H)
- D and H
→ average radiation weighting factor
- Ratemeter + time analyser
→ SAA crossing

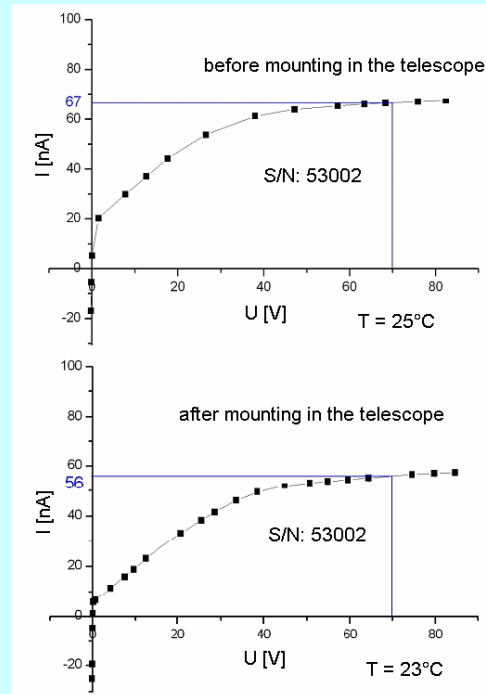
Mechanical construction



Measurements

Vibration tests (control: reverse current measurements)

→ telescope designed in our Institute complies with the vibration requirements



Detector (S/N: 53002) mounting	Specification (datasheets)			T [°C]	Measured	Calculated
	U [V]	U _{max} [V]	I _{reverse} (20°C) [nA]		I _{reverse} [nA]	I _{reverse} [nA]
original:	70	90	36	(25 ± 1)	67 ± 1	72 ± 10
telescope:				(23 ± 1)	56 ± 1	55 ± 8

Possible flight opportunities – the future

- **ISS Tritel**
- **SSETI Tritel (Tritel-S)**
- **ESA Tritel (SURE) (?)**



ISS Tritel

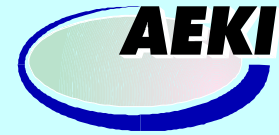


A Tritel installed outside ISS in cooperation with the Institute of Biomedical Problems (IBMP, Moscow).
(later aboard a Mars probe ?)

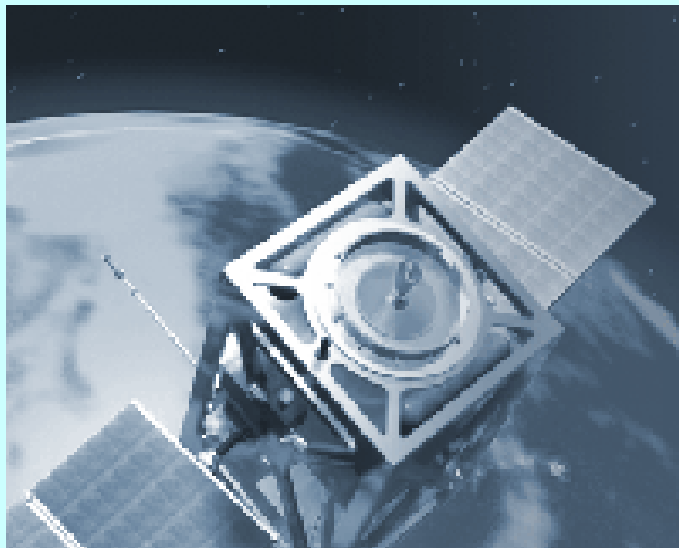
- Internal and external units
- Separate SAA spectra
- On board data processing
- 200 kB/d = 72 MB/yr:
 - On memory stick (change every 6 months)
 - Data transfer via ISS (data reduction needed: ~ 4kB/d)



ESA SSETI Program



SSETI (Student Space Exploration and Technology Initiative): designing and building of subsystems of student micro-satellites



- SSETI Express, Oct. 2005.
- SSETI ESEO (2008.)
- SSETI ESMO

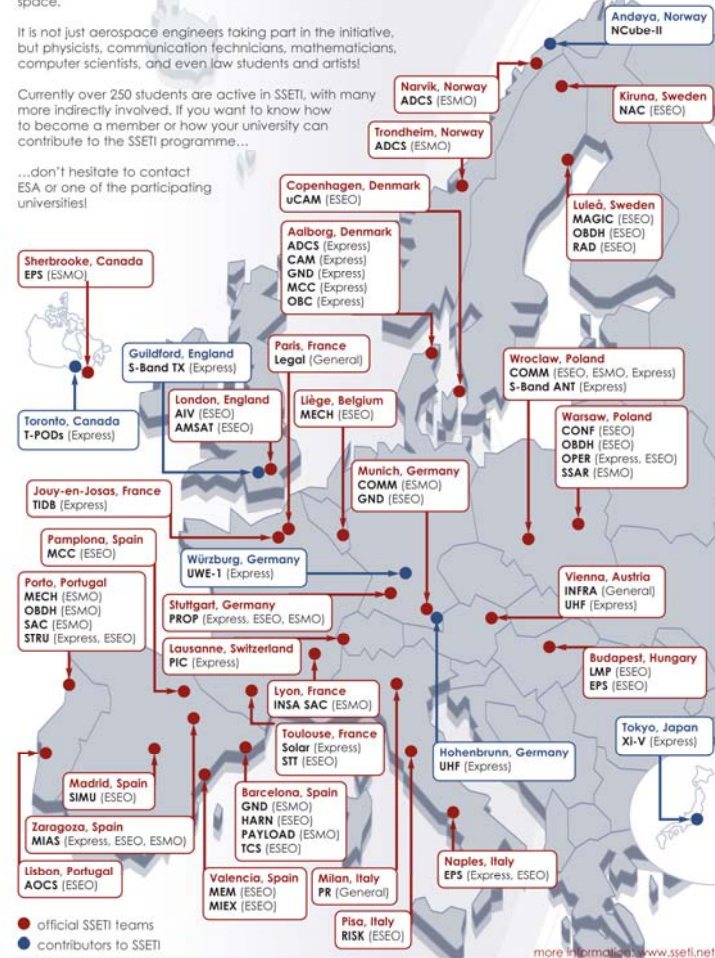
TEAMS OVERVIEW 2006

SSETI is open to all European students that are interested in space.

It is not just aerospace engineers taking part in the initiative, but physicists, communication technicians, mathematicians, computer scientists, and even law students and artists!

Currently over 250 students are active in SSETI, with many more indirectly involved. If you want to know how to become a member or how your university can contribute to the SSETI programme...

...don't hesitate to contact ESA or one of the participating universities!

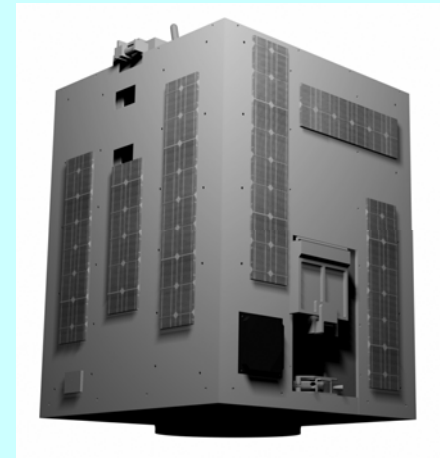


Tritel-S

- GTO: 250 km – 35950 km, $i = 7^\circ$, $t = 10.6$ h
- multiple crossings of the Van Allen belts
- may be a precursor of a Tritel aboard a Mars probe
- recruitment: students from the technical university will be involved in the development

LMP team

- Langmuir-probe (plasma measurements)
- **Tritel 3D silicon detector telescope**
(space dosimetry)

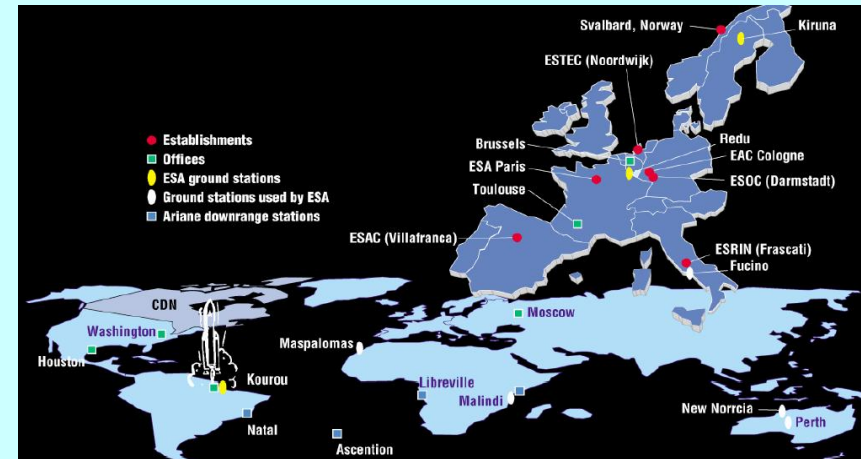


ESA Tritel (SURE)



- SURE = International Space Station:
a **U**nique **R**esearch Infrastructure
- Proposal evaluation and selection: September 2006 (?)
- 4-year ESA project for the 10 new EU members + Romania and Bulgaria funded by the European Commission under FP6
- Onboard the European Columbus module

Tritel + intercomparison with the results of three solid state nuclear track detector (SSNTD) + TL stacks



Summary

- testing of the detectors for space requirements
- development of the prototype of the telescope (mechanics)
- the construction of the first model of the analogue signal processing chain has been finished
- the final optimization of the parameters of the system is under way

Information for the

- absorbed dose
- LET spectrum
- radiation weighting factor
- equivalent dose
- effective dose (if completed with phantom measurements)

Thank you for your attention!

