

Czech Personal Active Dosimeter (CZPAD): Dosimetric Support for the First Czech Astronaut Mission

martin.kakona@odz.ujf.cas.cz on behalf of CRREAT team

Vladimír Remek
1978



Aleš Svoboda
2027/2028

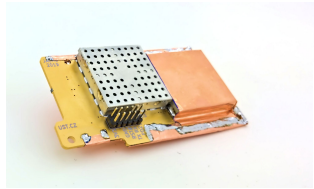
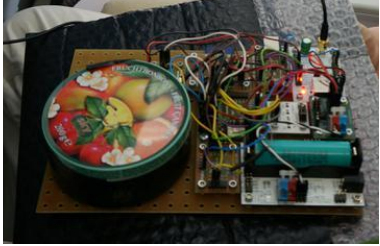


CANDY

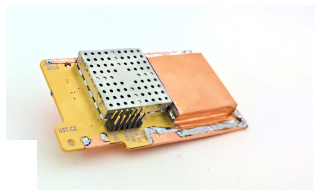
WRMISS 2015 in Cologne



AIRDOS - LABDOS - SPACEDOS

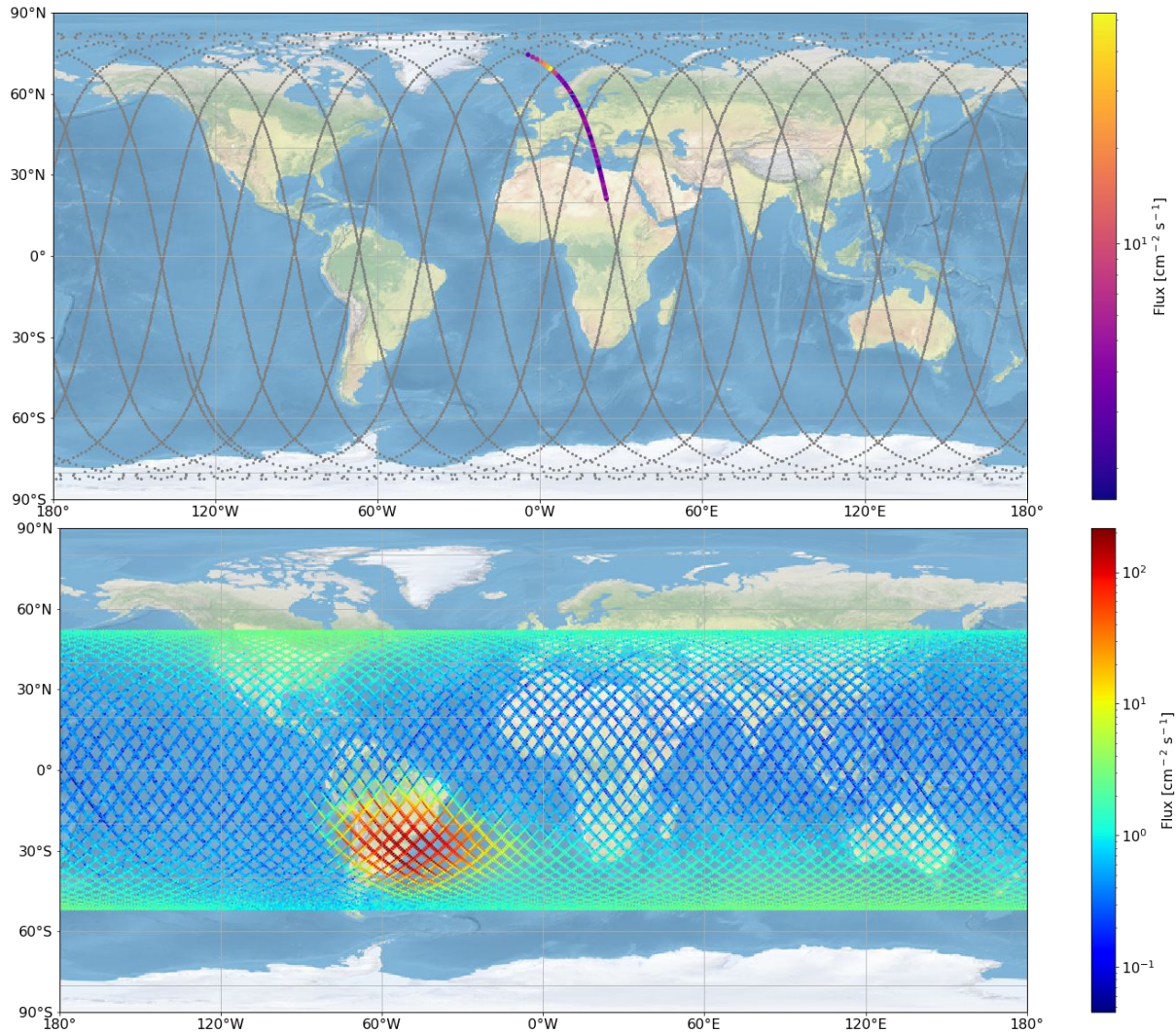


AIRDOS - LABDOS - SPACEDOS

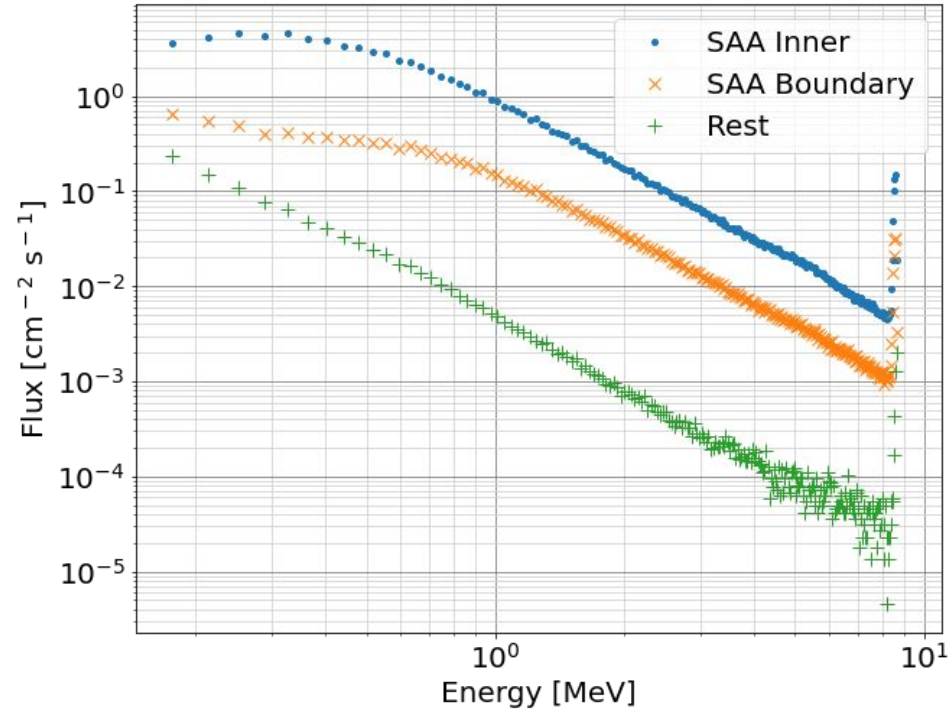
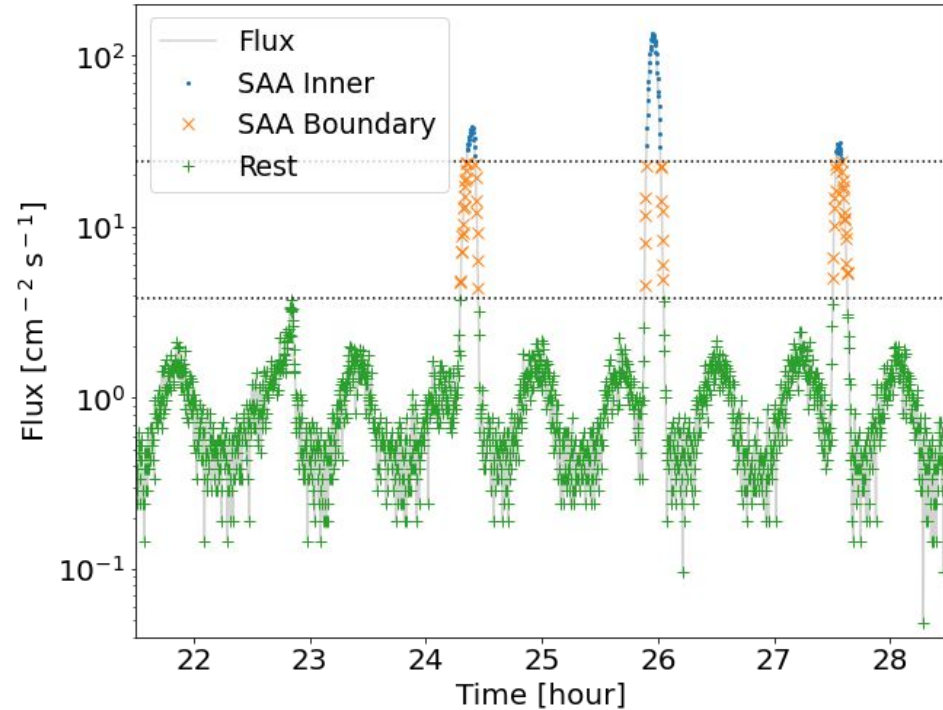


RESEARCH CENTRE OF COSMIC RAYS
AND RADIATION EVENTS IN THE ATMOSPHERE

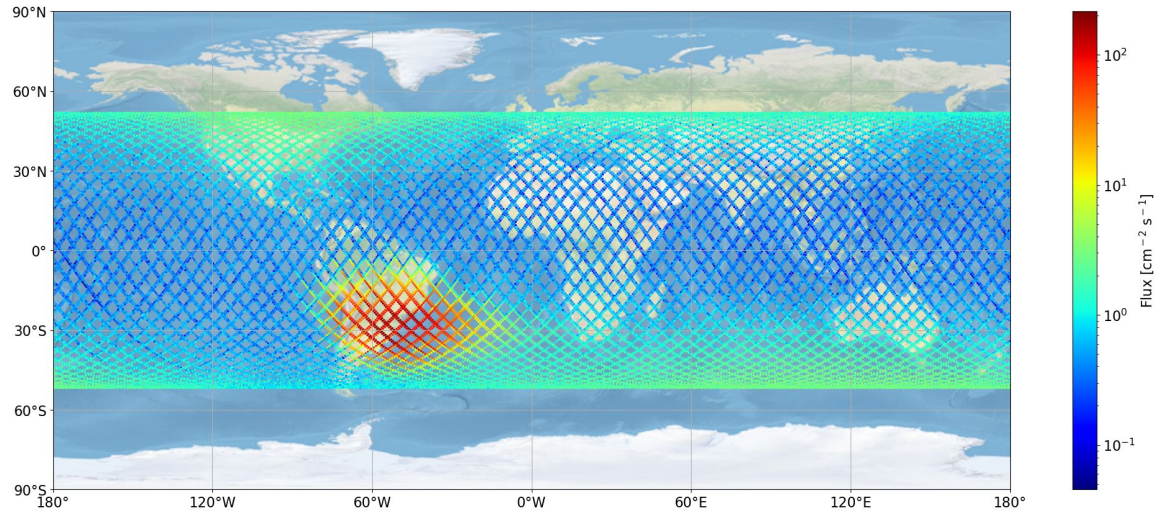
Missions



What have we learned?

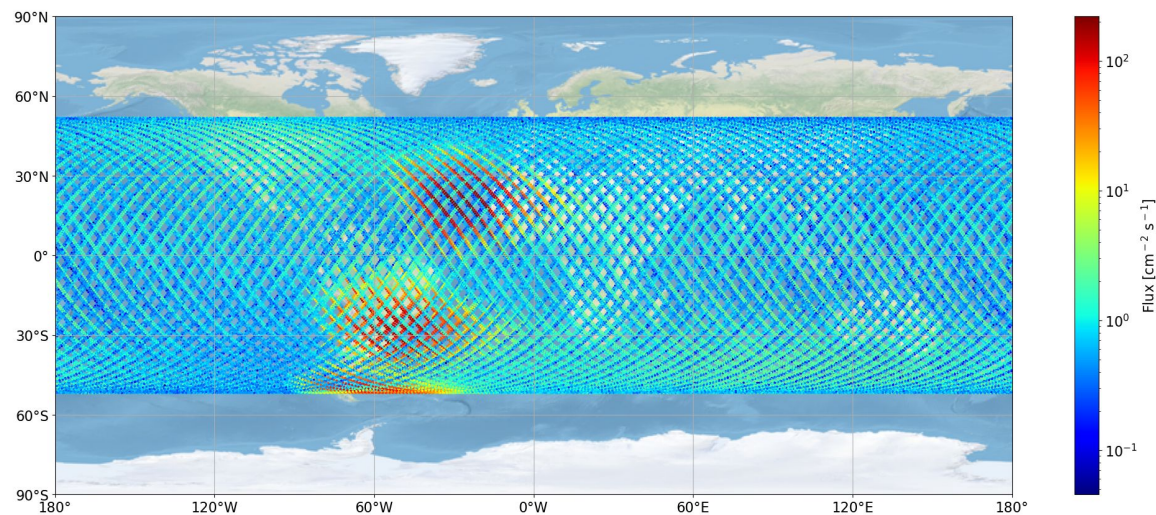
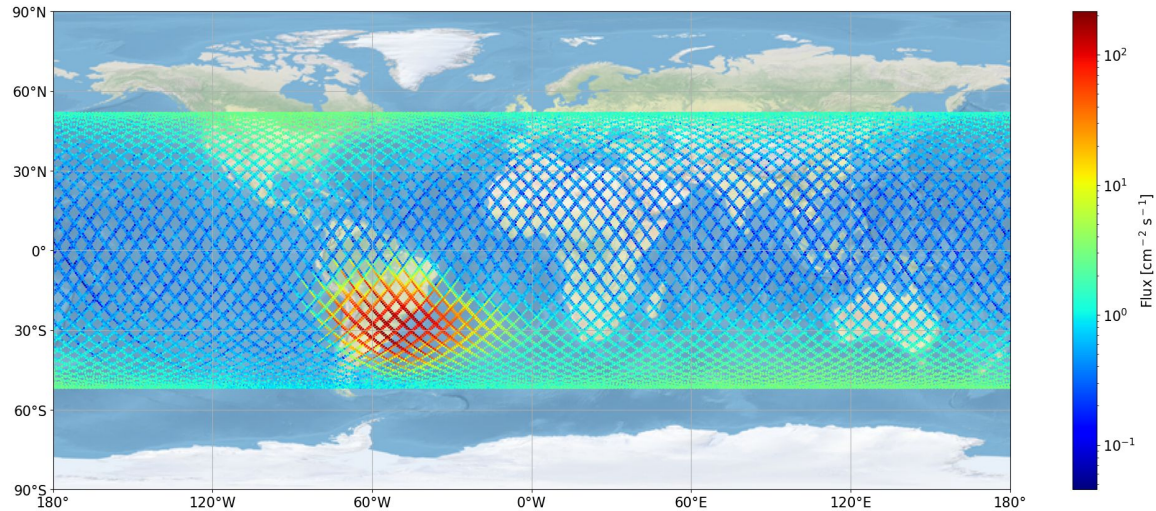


RadLab Data Integration



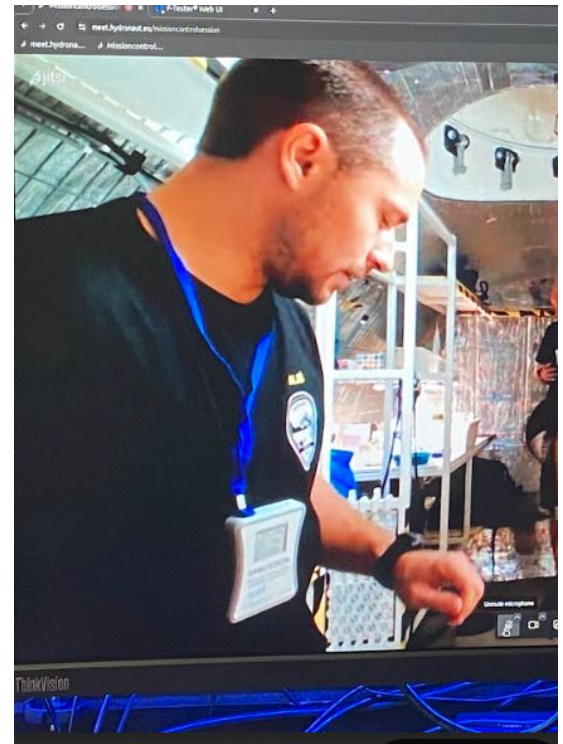
RadLab
Data Integration

RTC Crystal
20 PPM



Small slab of silicon

- Mixed radiation field detection efficiency
 - Charged particles ~100 %
 - Gammas < 1%
 - Neutrons < 10 %
 - HZE - low flux
- The astronaut moves within the station



CZPAD experiment

1. Distinguish thermal albedo neutrons
2. Identify the optimal placement
3. Technology demonstration of the Dosimeter Display Unit

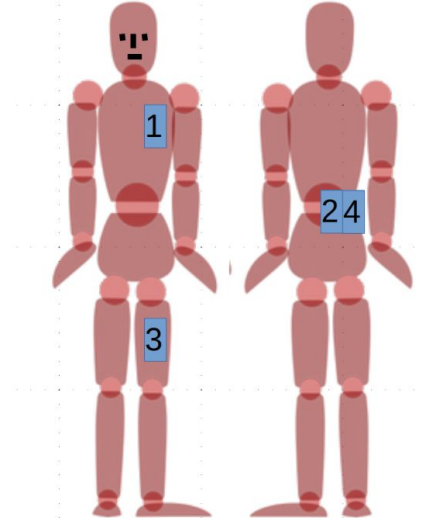
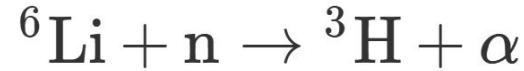
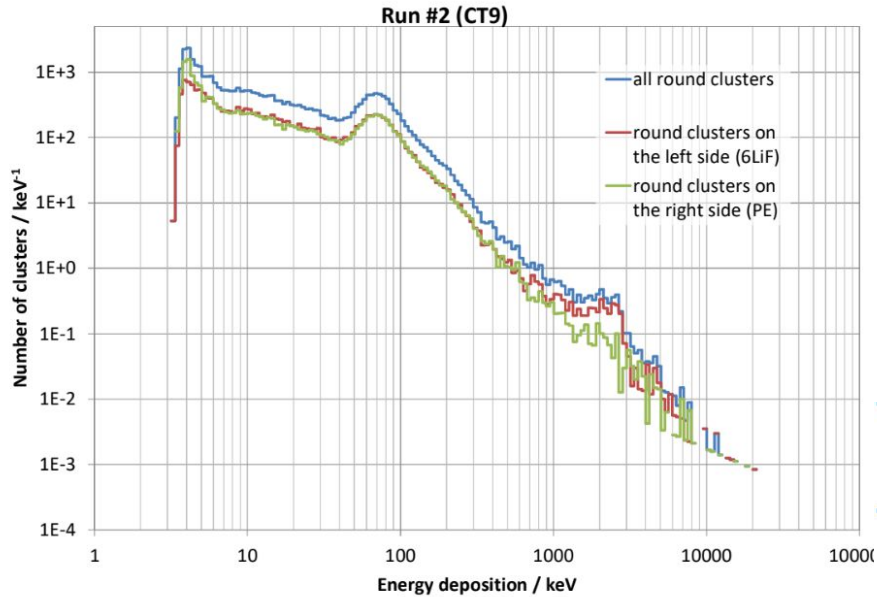
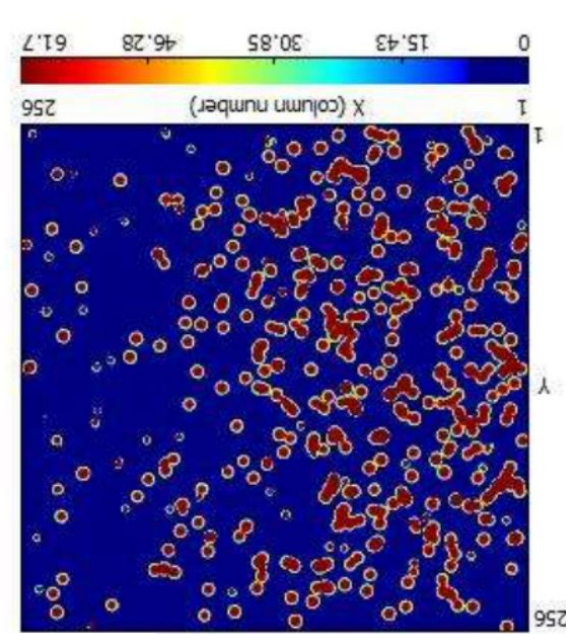
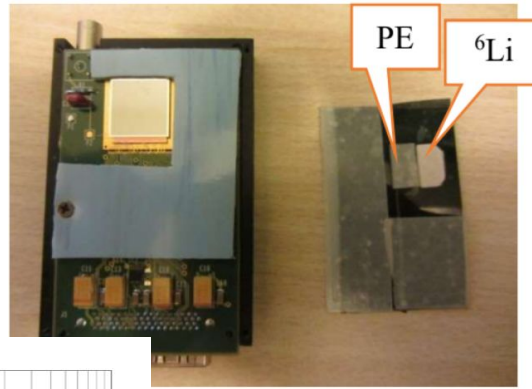


Fig. 1: Position of four dosimeters on the astronaut's body



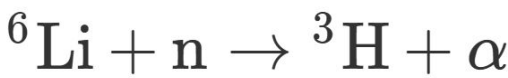
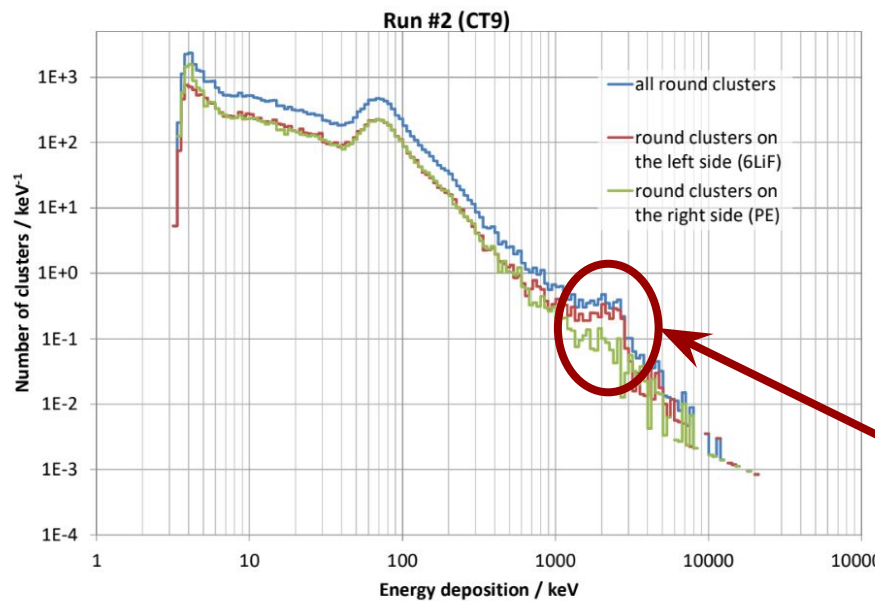
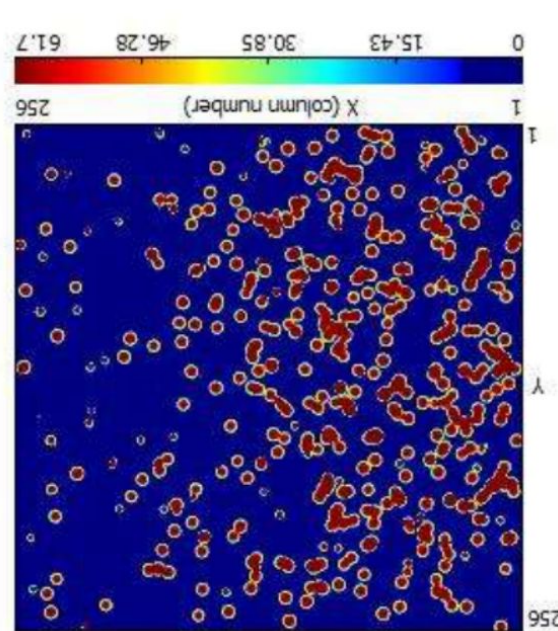
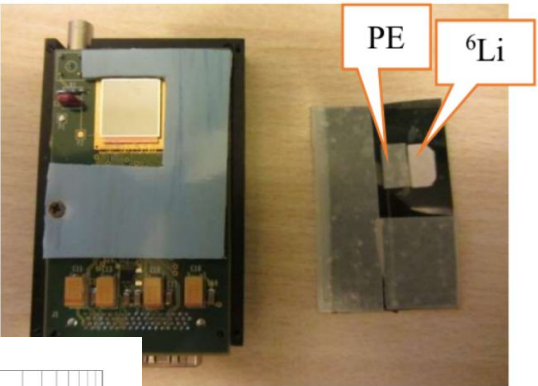
Fig. 2: TrM of SPACEDOS and DDU

Measurement principle



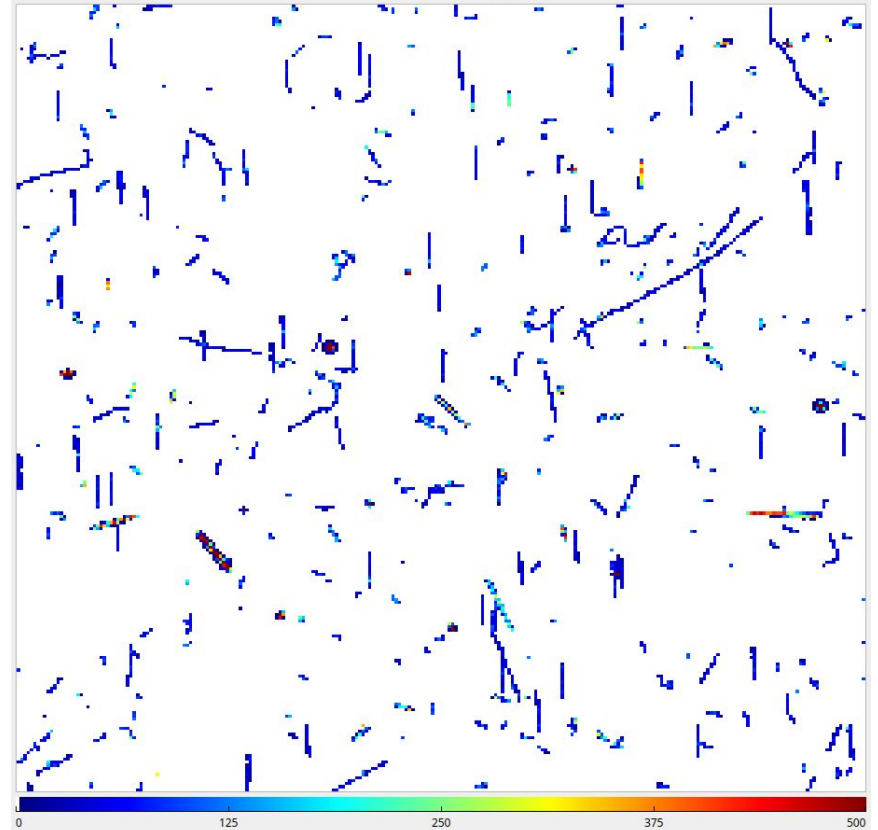
Ion	Energy / MeV	LET in Si / (keV/μm)	Projected range / μm
³ H	2.73	42.95	42.94
⁴ He	2.05	230.7	7.49

Measurement principle



Ion	Energy / MeV	LET in Si / (keV/μm)	Projected range / μm
³ H	2.73	42.95	42.94
⁴ He	2.05	230.7	7.49

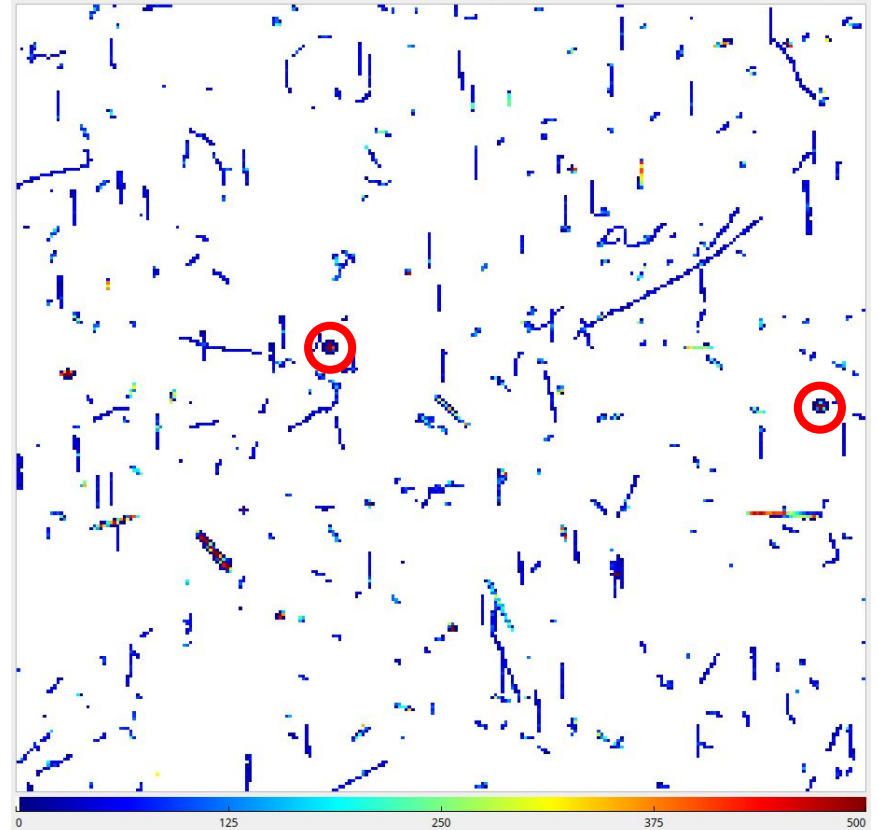
Measurement principle



Measurement principle

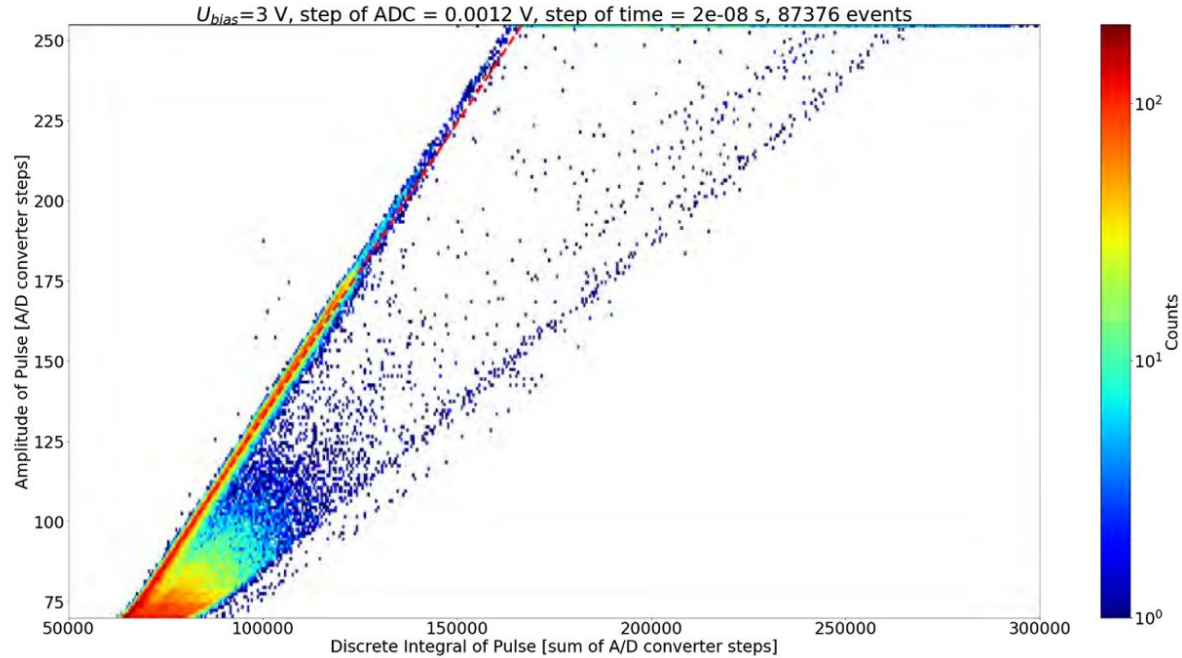
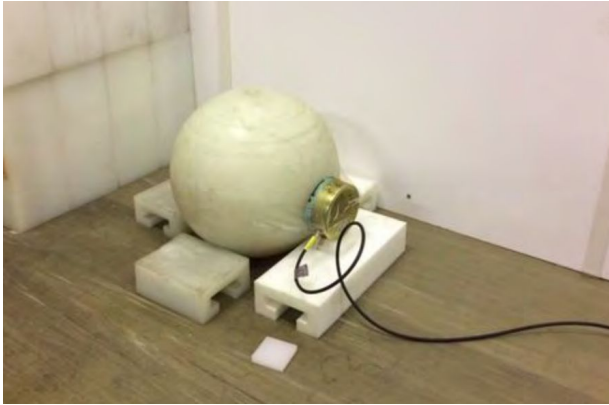


Si 100 %
 ^{10}B 125 %
 ^6Li 165 %



Measurement principle

AmBe source



Challenges

- Low efficiency for neutron conversion
 - Increasing the surface area
 - Increased capacitance - increased noise
 - HZE
- Electromagnetic interference
 - Wireless data transfer (DDU)



Parameters

Detection element: Silicon PIN diode, volume $10 \times 20 \times 0.23 \text{ mm}^3$ $\square$ $28 \times 28 \times 0.35 \text{ mm}^3$

Deposited energy range: 40 keV to 80 MeV (AIRDOS 04)

Energy measurement resolution: 5 keV (14 bit)

Radiation spectra integration time: 15 s (SPACEDOS 03)

Maintenance interval (data download, battery pack change): 1 month (AIRDOS 05)

6 months (SPACEDOS 03; $< 10 \text{ mW}$)

Collaboration and data sharing

- Comparison of data with other onboard devices during the Czech astronaut mission
- 2 or 3 units will remain on board of ISS

