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RADCUBE-RADMAG instrument: technology demonstration & measurements

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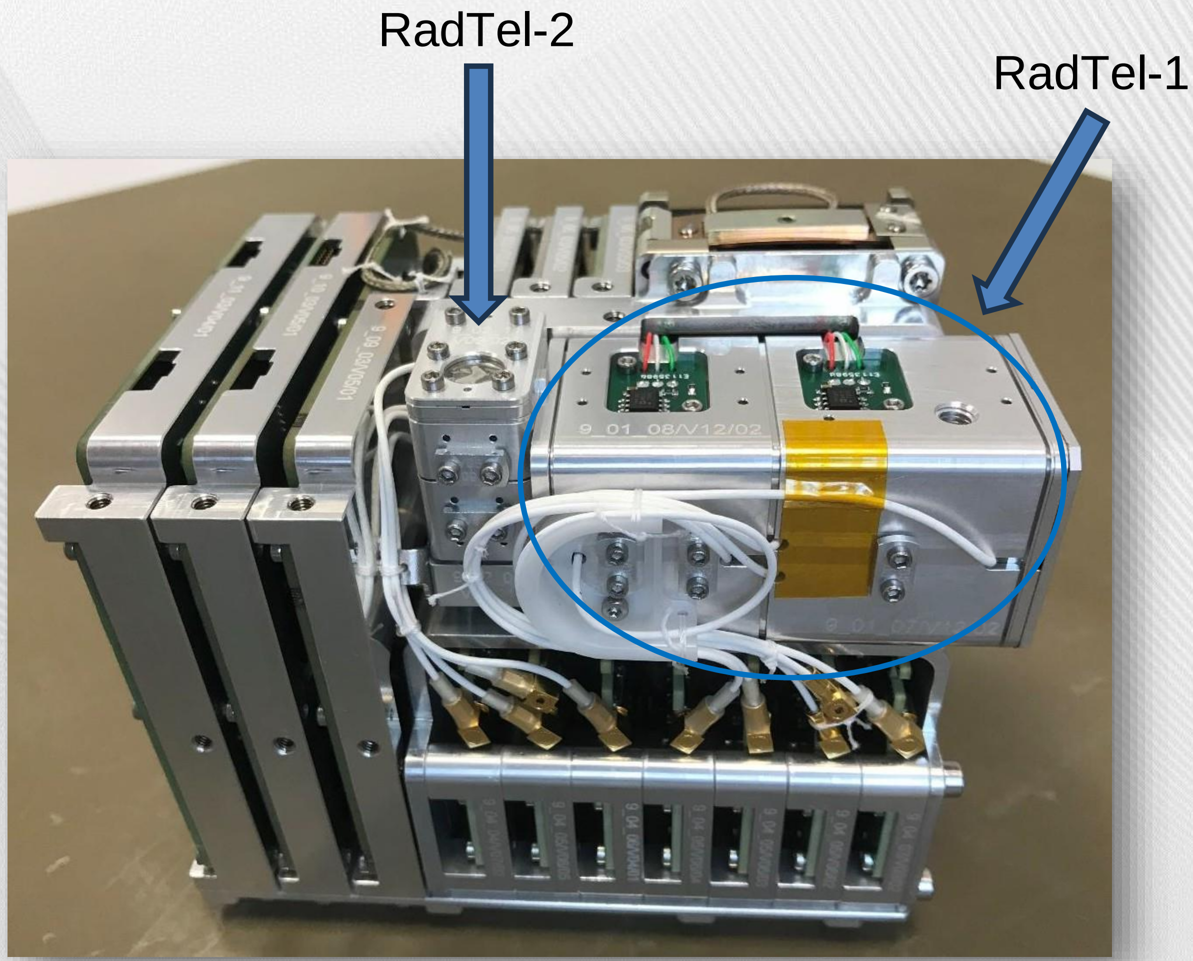
Outline

- Introduction – RADCUBE mission & RADMAG package
- RadTel-1 data – count & dose rates, energy spectra
- RadTel-1 & Eu:CROPIS RAMIS comparison
- Future plans

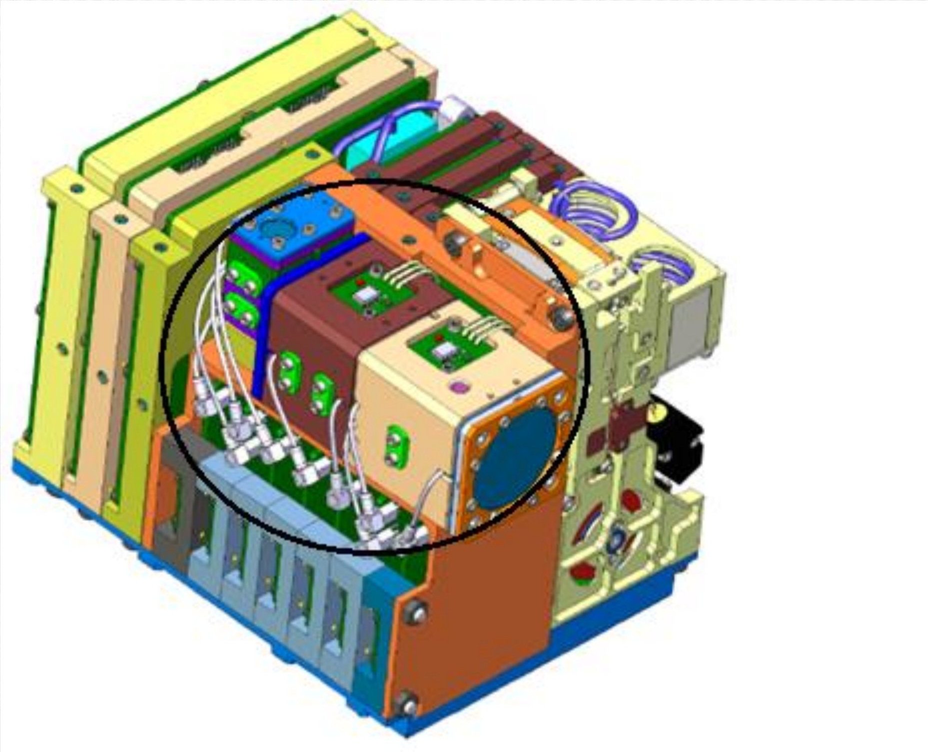


Introduction

Introduction

- RADCUBE: ESA demonstration 3U cubesat
- RADMAG: RADiation monitor and MAGnetometer

  1.3U of 3
- 2 radiation monitors: RadTel-1 & RadTel-2
- RadTel-1:
  - 4 Si detectors
  - 20 mm diameter each
- RadTel-2:
  - 3 Si based detectors
  - 3 mm diameter each



Introduction

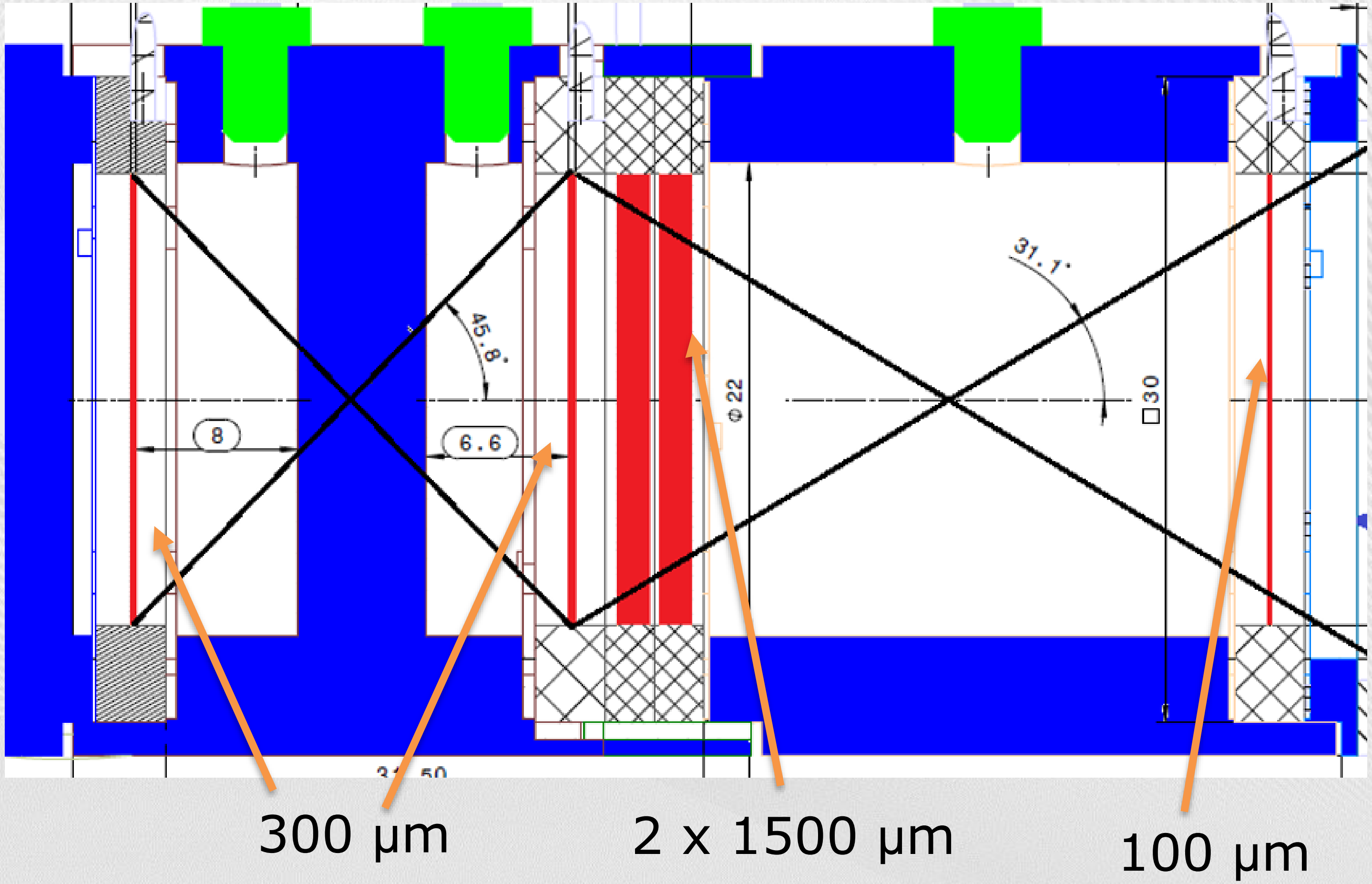
- RadTel-1 specifications:
  - 4 fully depleted Si detectors
  - 20 mm diameter each
  - 10 µm Ti foil in front
- detector thickness:

  D1 - 100 µm

  D2 - 2 x 1500 µm

  D3 - 300 µm → 0.6 cm Al after D3

  D4 - 300 µm



Introduction

- Orbit: h = 554 ± 40 km, i = 97.56°
- Operation: 2021/11/05 - 2022/05/02

  switched back in 2024 May for SPE → h ~ 400 km

  off when magnetometer is on → data gaps
- 68529 count rate measurements (each 1 min)
- Multiple energy spectra with 10 min resolution

  → coincidence, anti-coinc. → particle energy, type

RadTel-1 data

RadTel-1
Count rates

- Detector comparison

  D1 – low energy p, e

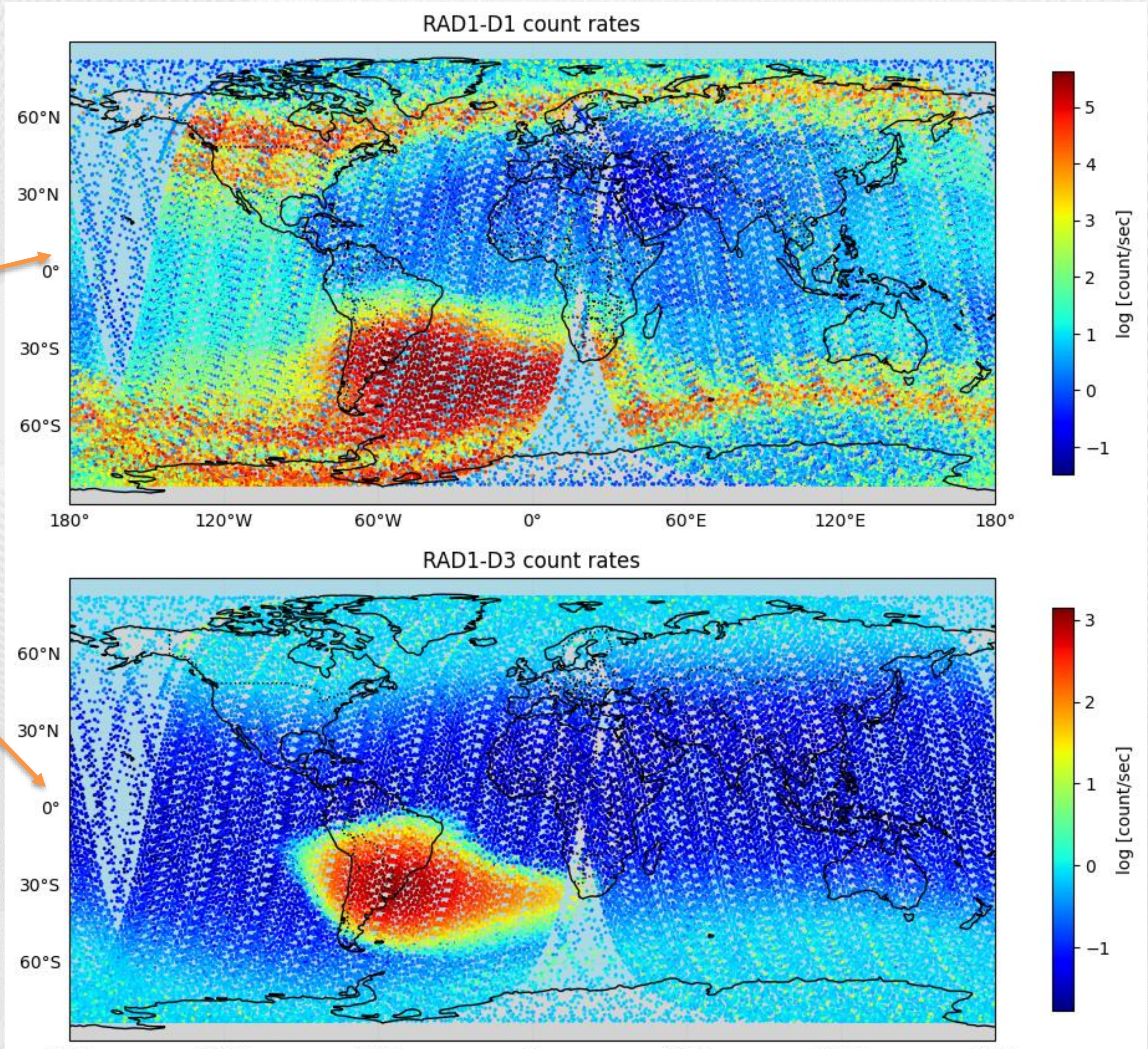
  polar + SAA

  D3 – SAA mostly

  D2 – in between

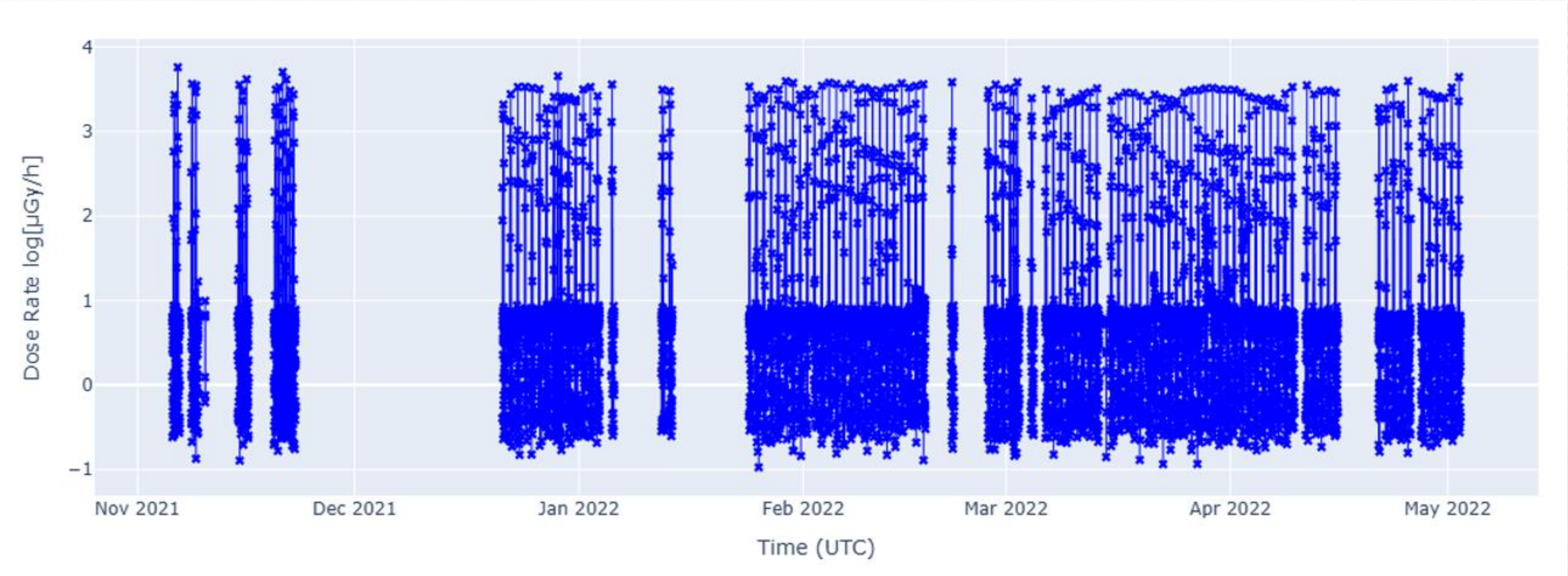
- Integration time:

  60 sec



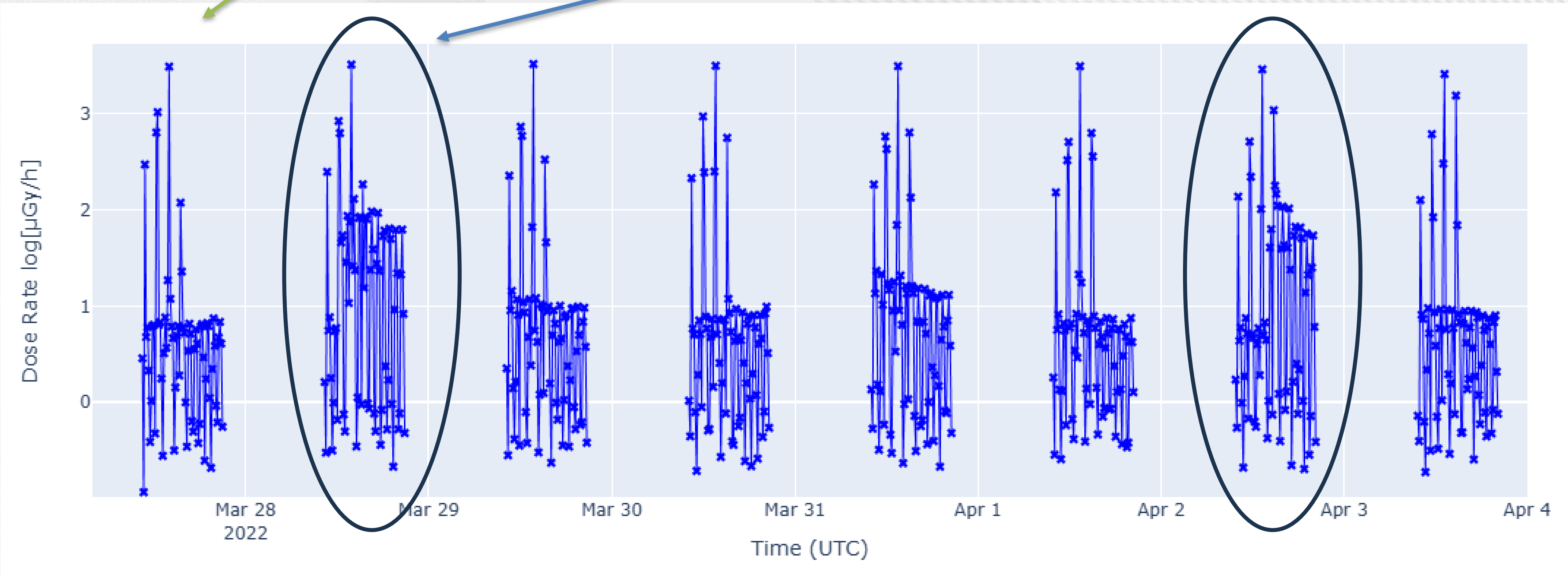
RadTel-1 dose rates from D3

- Proton energy resolution: 0.1 – 300 MeV
- Dose rate from energy deposition 1-150 MeV particles, **D3**



RadTel-1 Dose rates

- 2022/03/28-04/02 → series of SPE (M1-X1 flare)
- Marc. 27: *D=84.6 μGy/h*; marc. 28: *D=105 μGy/h*



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RadTel-RAMIS comparison

Comparison

- Eu:CROPIS RAMIS → launched in 2018, Si radiation detector

  Guo et al, 2023, https://doi.org/10.1029/2023GL103069;

  Hauslage et al, 2018, https://doi.org/10.1007/s12217-018-9654-1

- Orbit: RAMIS 600 km, RADCUBE 550 km

- Shielding:

  - RadTel-1: **D3** → 3.1 mm Si

  - RAMIS: **D1** → 3 mm Al

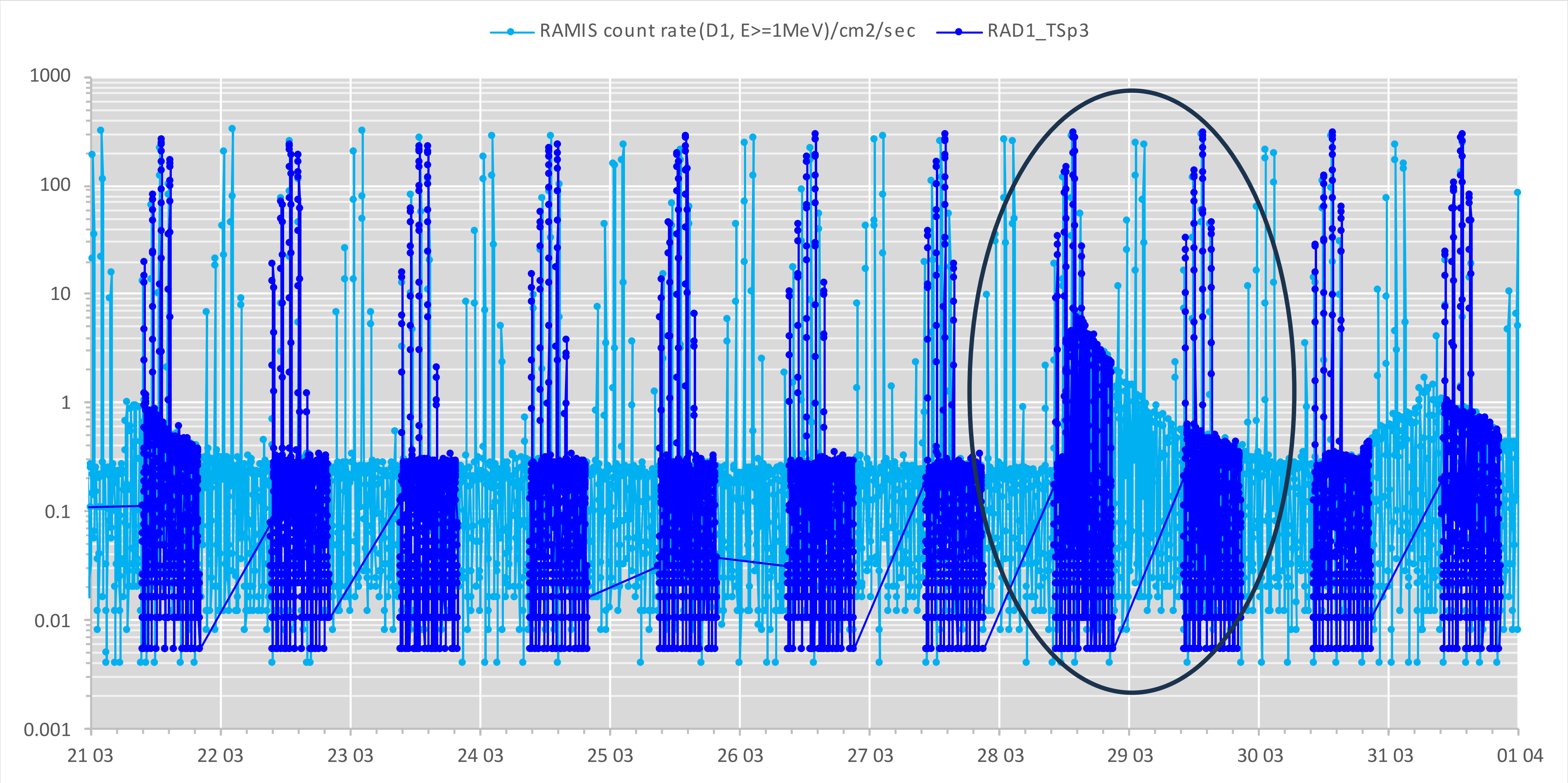
  → with similar orbit & shielding, good for comparison

- Energy deposition: RADCUBE **D3** > 1 Mev; RAMIS **D1** > 80 keV

  → 1-150 MeV particles compared

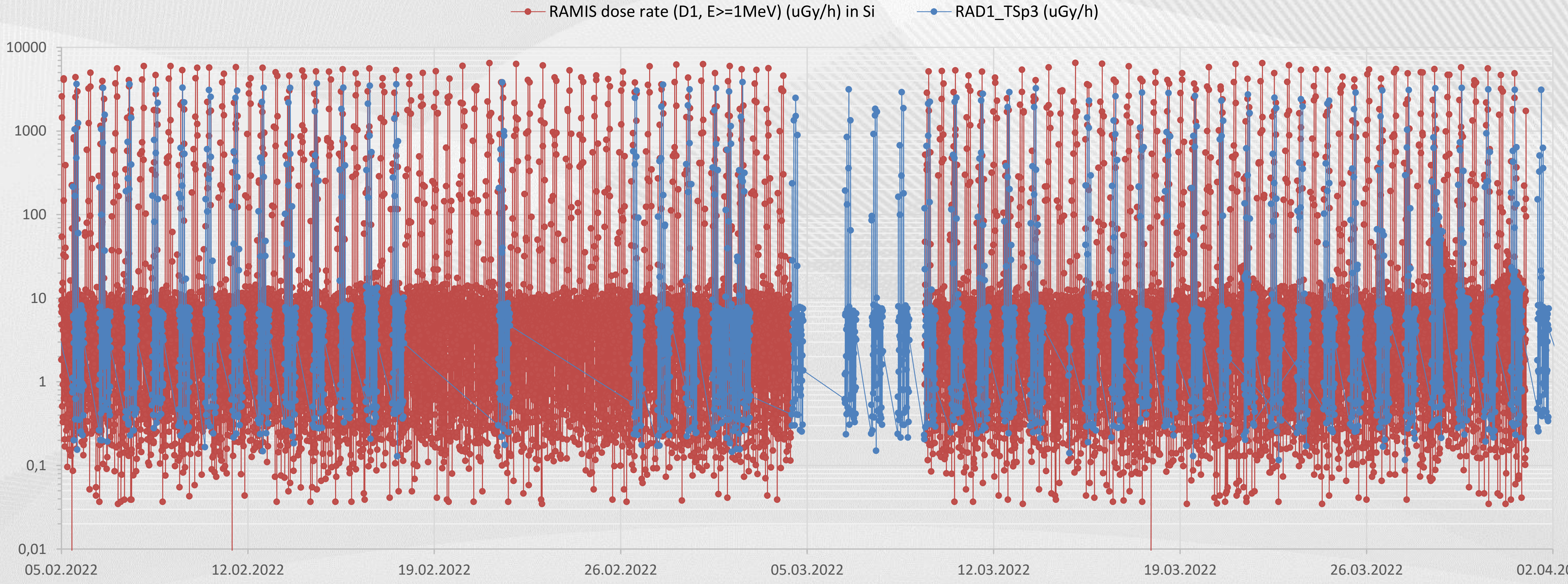
Comparison

- Count rates: SPE on 2022/03/28, similar profile



Comparison

- Dose rates, 2022 feb-apr

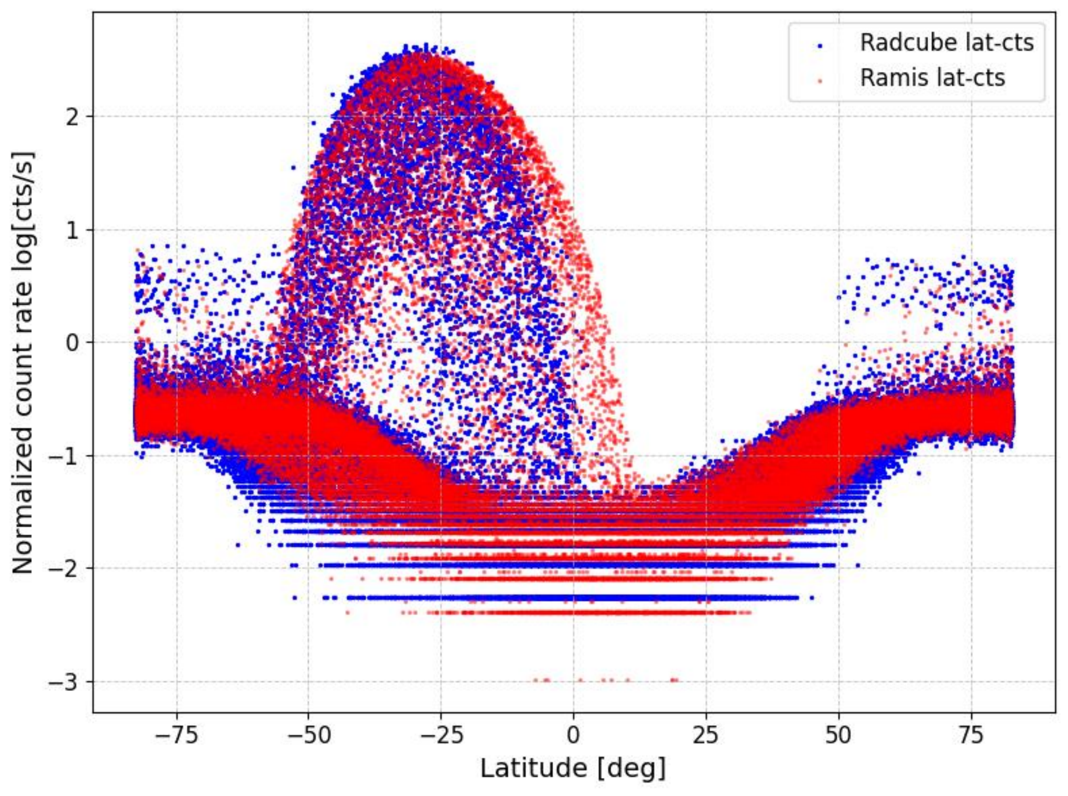


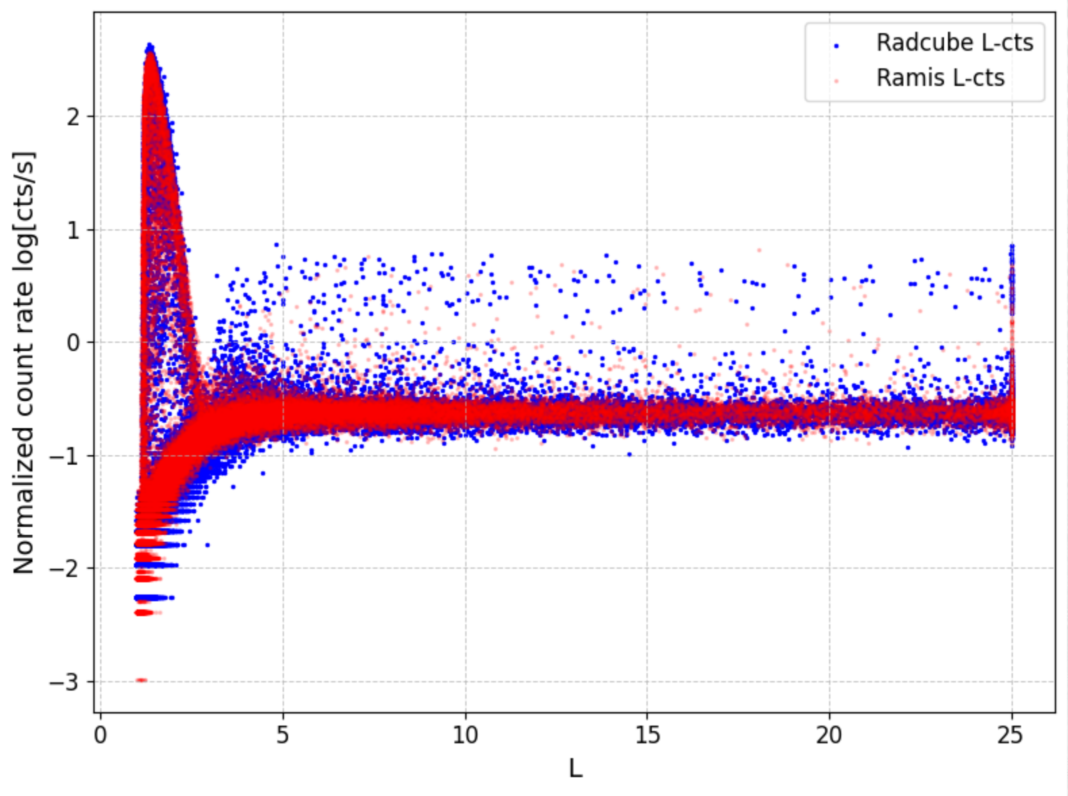
Comparison

- Coordinate comparison for 2021-2022

  other parameters match too

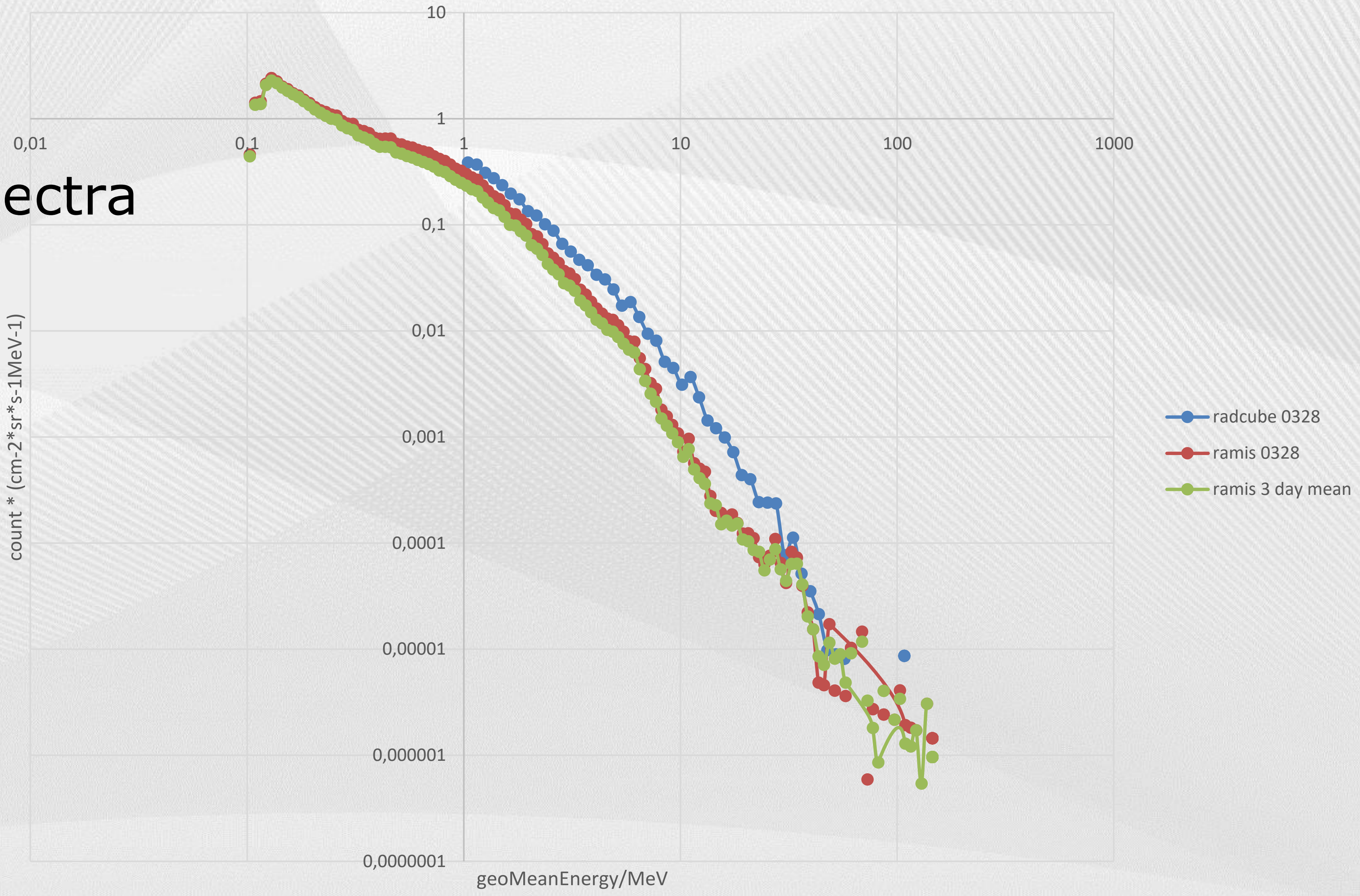
  (lon, lat, R_c, dose & count rate similar too)





Comparison

- SPE of 2022/03/28
- Energy deposition spectra
- Only when L>8
- 2024 May SPE similar spectra



Future plans

Future

- Successful demonstration mission → publication soon
- RadTel present on future ESA missions:
  - MSR-ERO (SDS)
  - Aurora-D (D3S)
  - MoonRad ?
- Improving:
  - detector logic
  - calibration for mission environment
- Goal: space weather fore- and nowcast as an integrated multi-instrument system

New Pille EVA data

Ref: RADCUBE-EK-ENG-HO-480_01_00
Template: UKL2020-EK-PQA-HO-002_00_02

New Pille-ISS EVA data

- 2004-2022 Pille EVA paper:

  → SAA, ISS altitude, solar cycle, suit type analysis

  Pinczés et al, 2025, https://doi.org/10.1016/j.lssr.2024.12.005

- Worst case EVA → 2.7 mGy ~8 days of inside stay
- SAA crossed EVA: ~ 30% increase in dose
- Suit type:

Suit type	Amount	Mean of specific $d_{EVA,mean}$ (μGy/h)	Max $d_{EVA,mean}$	Median $d_{EVA,mean}$	Dose for an 8 h EVA (μGy)
All EMU	148	31.9 ± 23.0	in SAA	31.1	255 ± 188
All Orlan	74	129.9 ± 71.3	in SAA	104.7	1039 ± 570

- 2022-2025 no systematic changes

  (reference location now fix)

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Thank you for your attention!

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