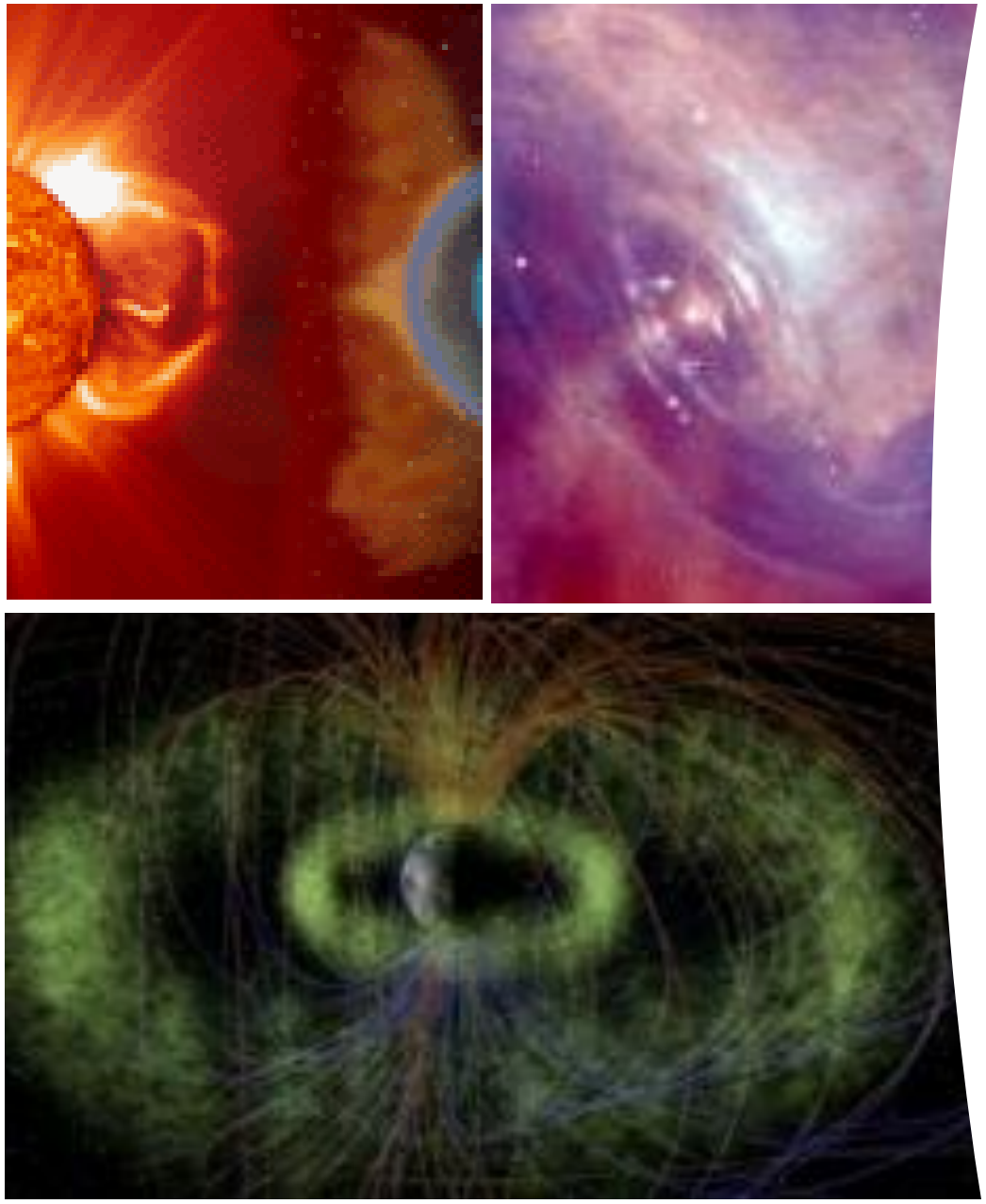


News from SpaceRAD

Space Radiation Environment and Effects

People

Patrícia Gonçalves
Luísa Arruda
António Gomes (PhD) – BERM (M.Pinto)
Francisca Santos (MsC) – RADEM (M. Pinto)
Pedro Assis (10%)
Bernardo Tomé (10%)

<u>New members joining the group</u>
António Amorim (instrumentation for ESO)
André Moitinho (GAIA)
José Figueiredo (Optoelectronics)
Paulo Gordo
+ Students and Technicians

SpaceRad Ongoing Projects

Space Radiation Environment and Effects

BARD **– Expert support to BERM and RADEM Radiation Monitors** (archiving & operation)
SpaceRAD - **An integrated Model for planetary radiation environment prediction for human space flight**

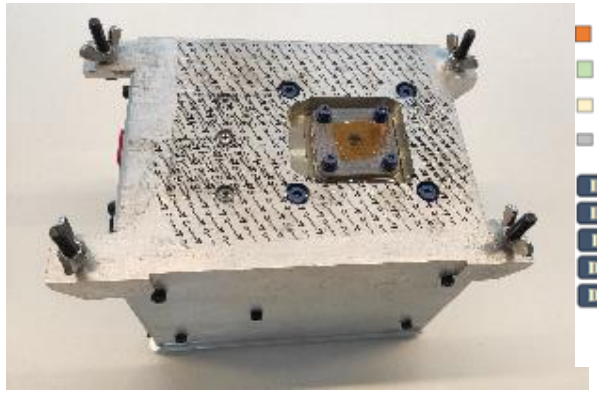
Average funding (k€)	**Period**	**Entity**	**2022**	**2023**	**2024**	**2026**	**2026**
ESA JUICE radiation monitor - RADEM (300 k€)	2014-2022	ESA	33.3				
Expert Support to BERM and RADEM (75 k€)	2022-2024	ESA	25	25	50		
SpaceRAD	2024-2026	ESA			46	46	46
Total			**58.3**	**25**	**96**	**46**	**46**

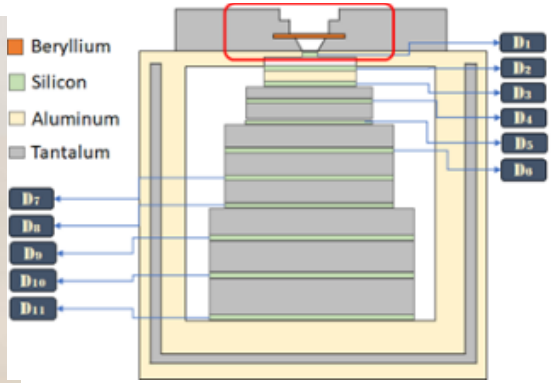
The radiation environment in the solar system: from Mercury to Jupiter

To Mercury – BepiColombo Mission (2018)
BERM – BEpiColombo Radiation Monitor

Measurement
- electron, proton and ion spectra

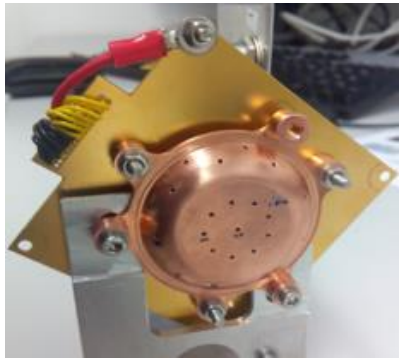
Earth radiation belts measurements in 2021
Now near Mercury

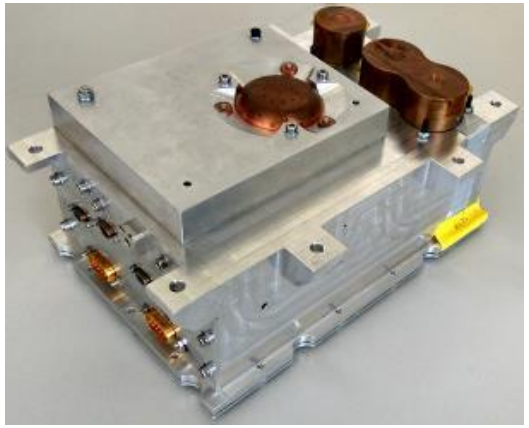


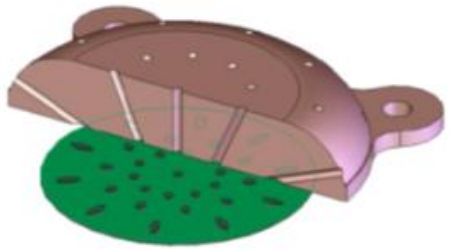


To Jupiter – ESA JUICE Mission (2023)
RADEM – RADiation hard Electron Monitor

Measurement
- electron and proton spectra
- ion LET
- electron directionality
- **JUICE launched in April 23**

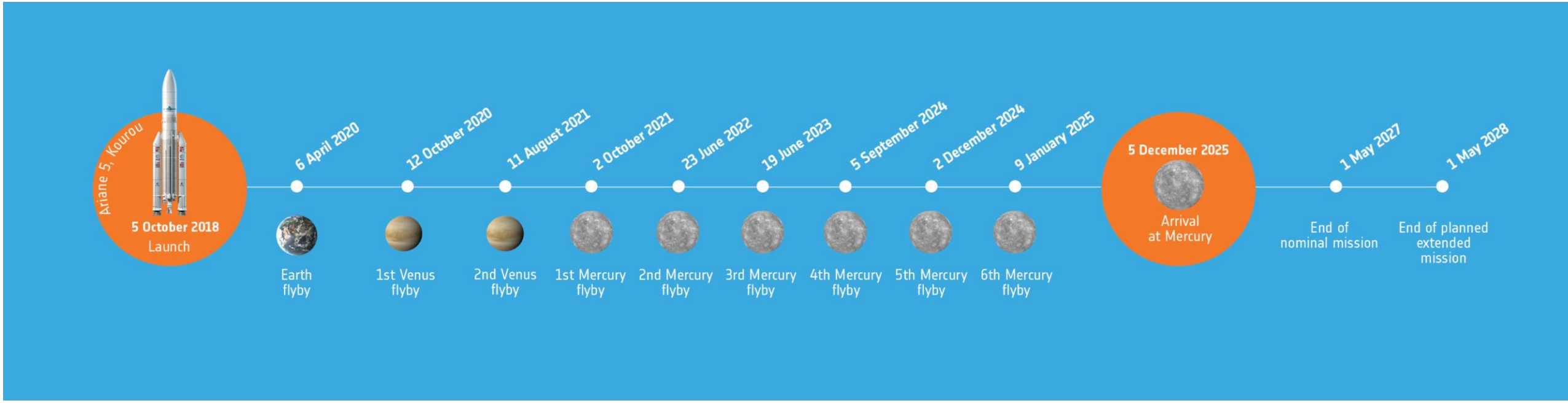




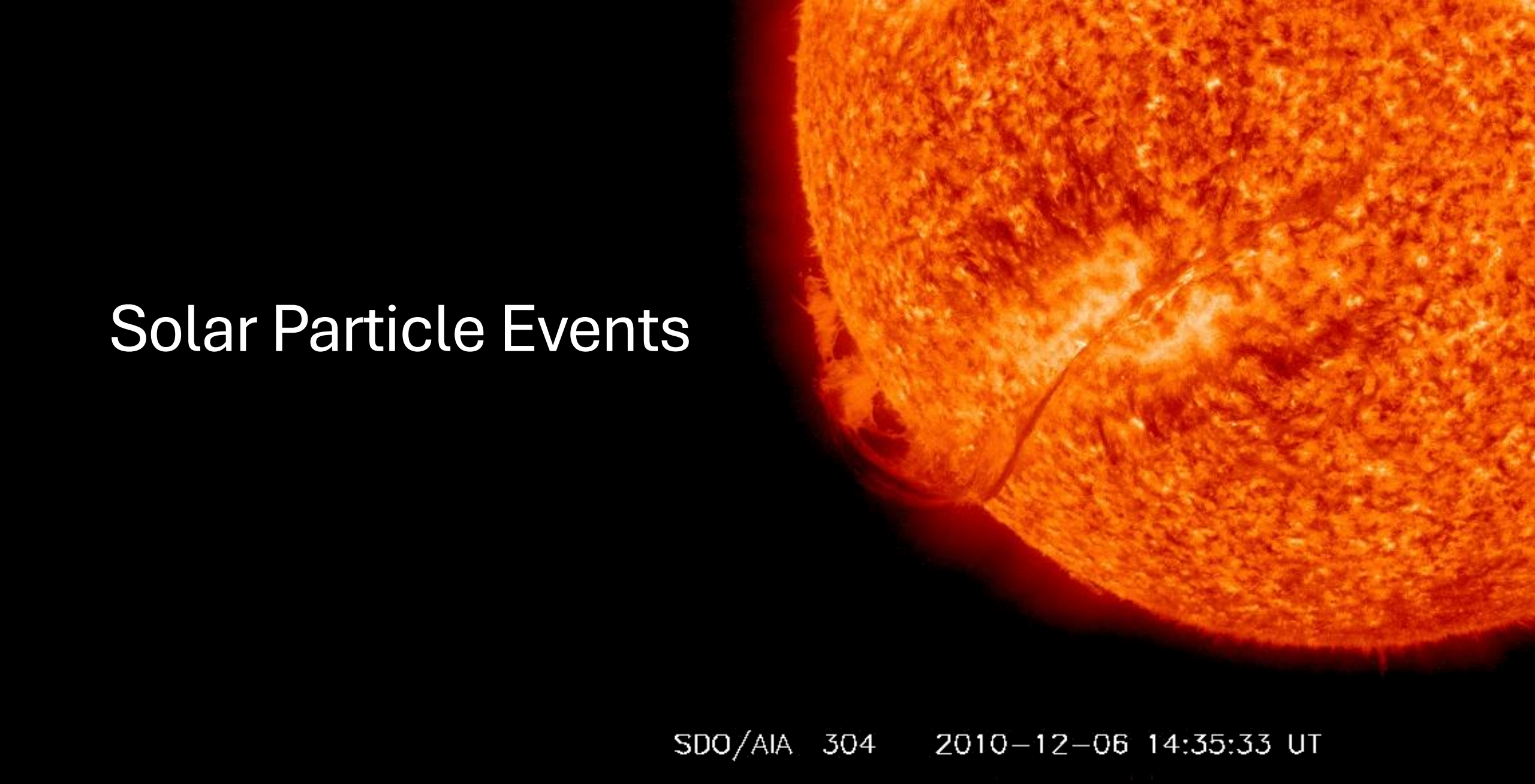


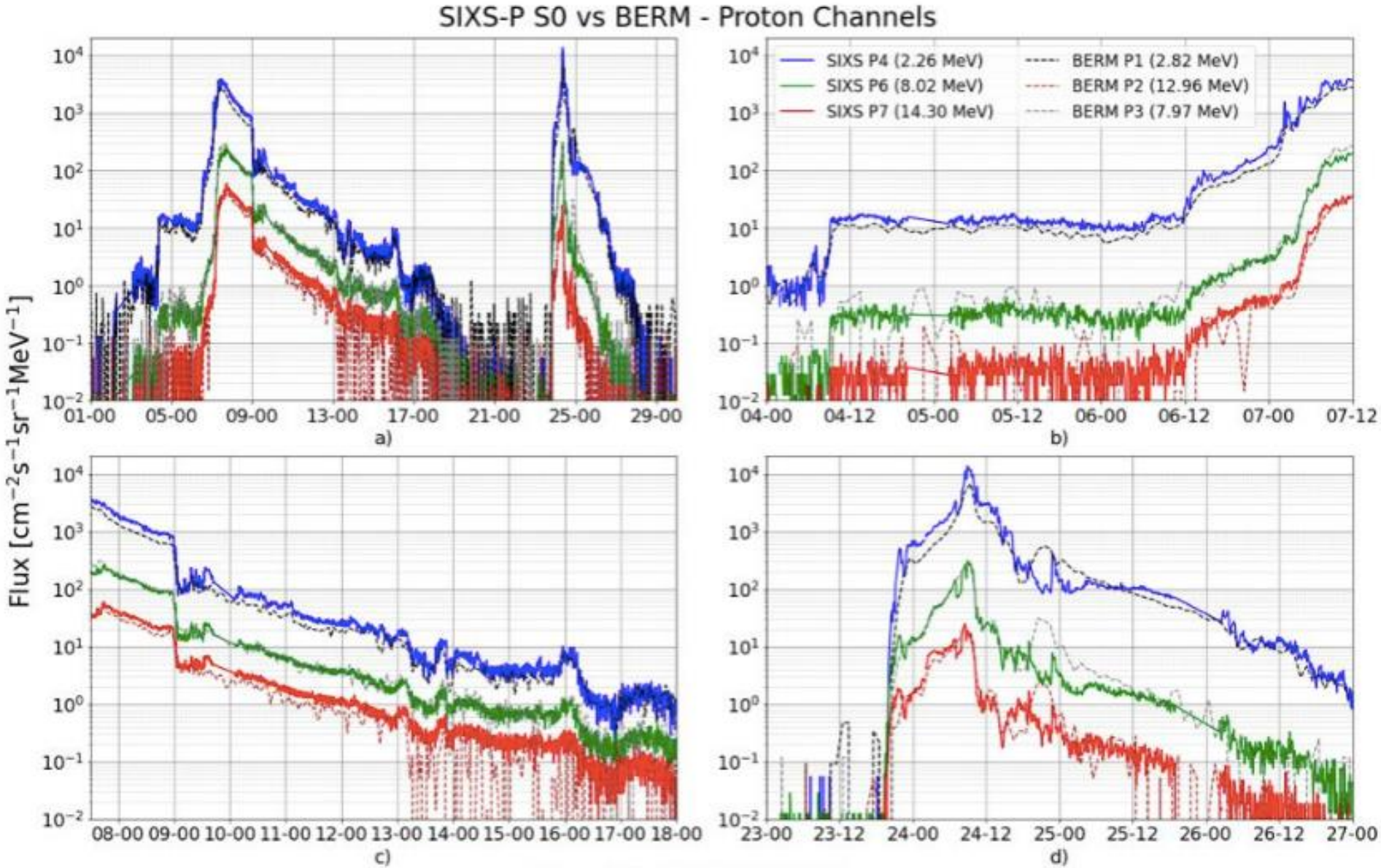
ESA Contract No. 4000137865/22/ES/JD - Expert support to BERM (BepiColombo Environment Radiation Monitor) & RADEM units on board BepiColombo and JUICE spacecraft (LIP,SE2S)
ESA Contact No. 4000110643/13/NL/HB - RADEM Proto-Flight Model (EFACEC, PSI, IDEAS, LIP)

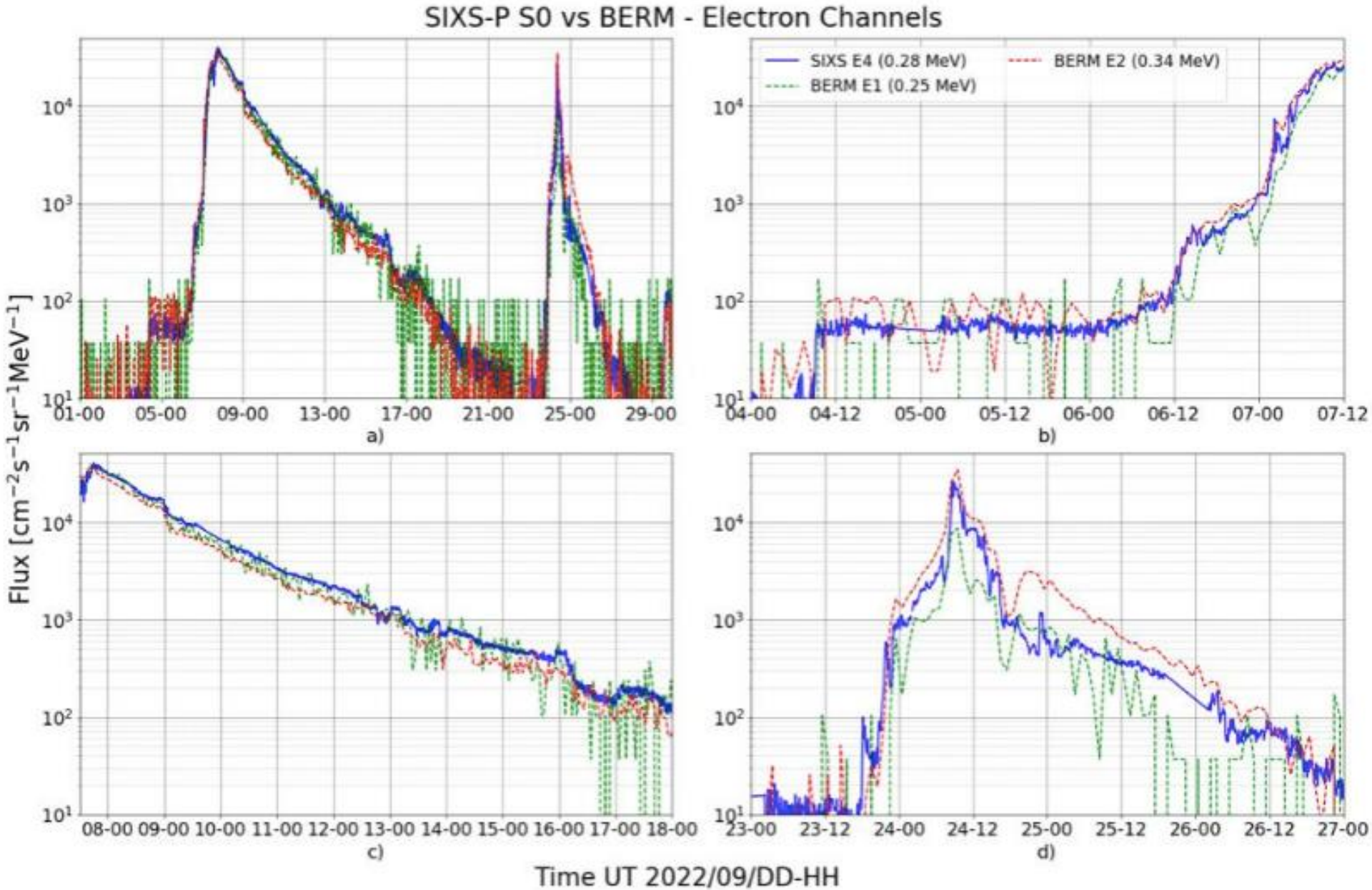
BepiColombo mission timeline



Solar Particle Events

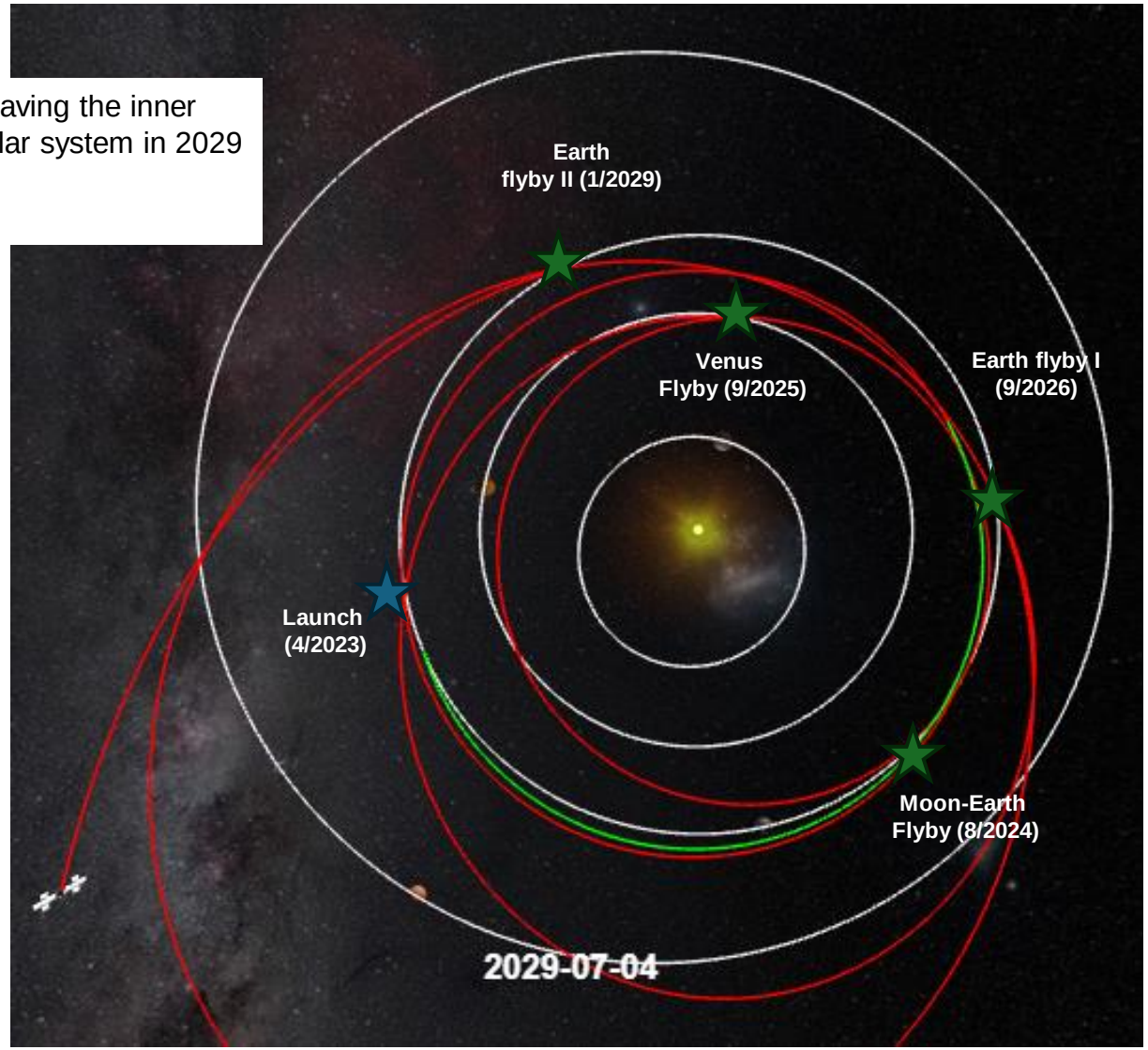



SIXS-P S0 vs BERM - Proton Channels
SIXS P4 (2.26 MeV)
SIXS P6 (8.02 MeV)
SIXS P7 (14.30 MeV)
BERM P1 (2.82 MeV)
BERM P2 (12.96 MeV)
BERM P3 (7.97 MeV)
Flux [cm⁻²s⁻¹sr⁻¹MeV⁻¹]
a)
b)
c)
d)
Time UT 2022/09/DD-HH

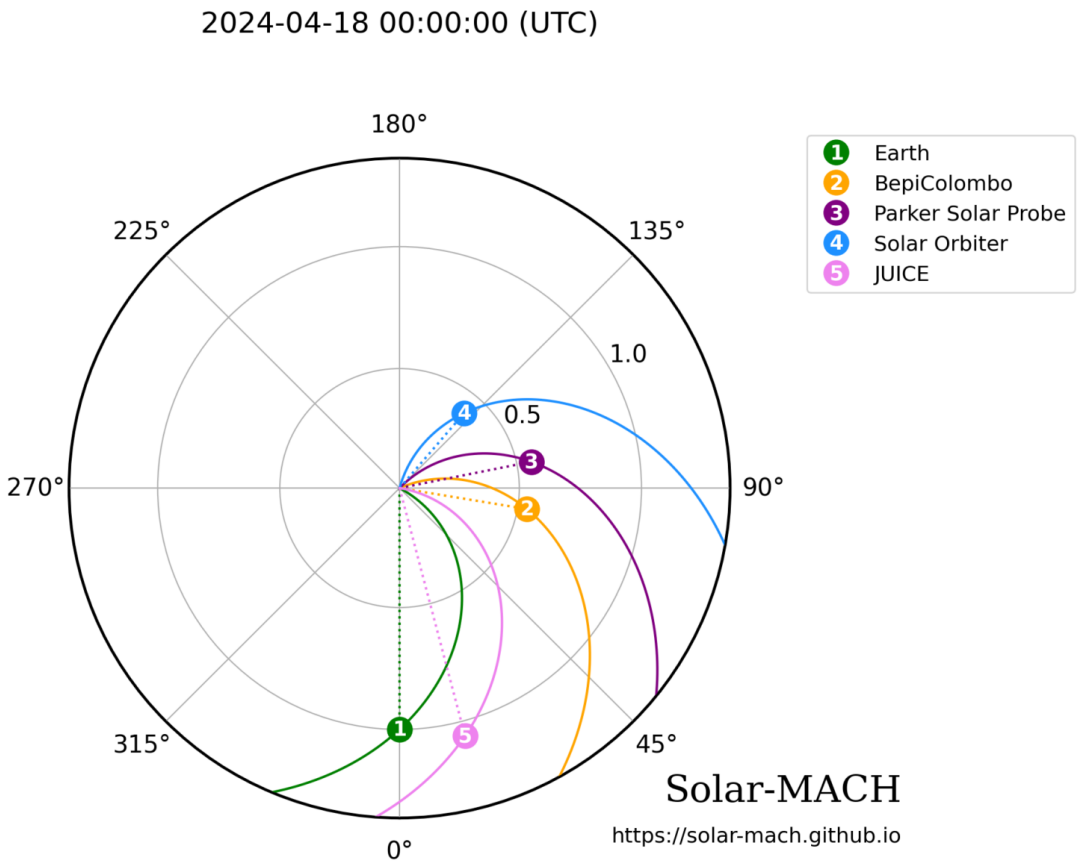

SIXS-P S0 vs BERM - Electron Channels
SIXS E4 (0.28 MeV)
BERM E1 (0.25 MeV)
BERM E2 (0.34 MeV)
Flux [cm⁻²s⁻¹sr⁻¹MeV⁻¹]
a)
b)
c)
d)
Time UT 2022/09/DD-HH

JUICE Cruise Phase

Leaving the inner solar system in 2029

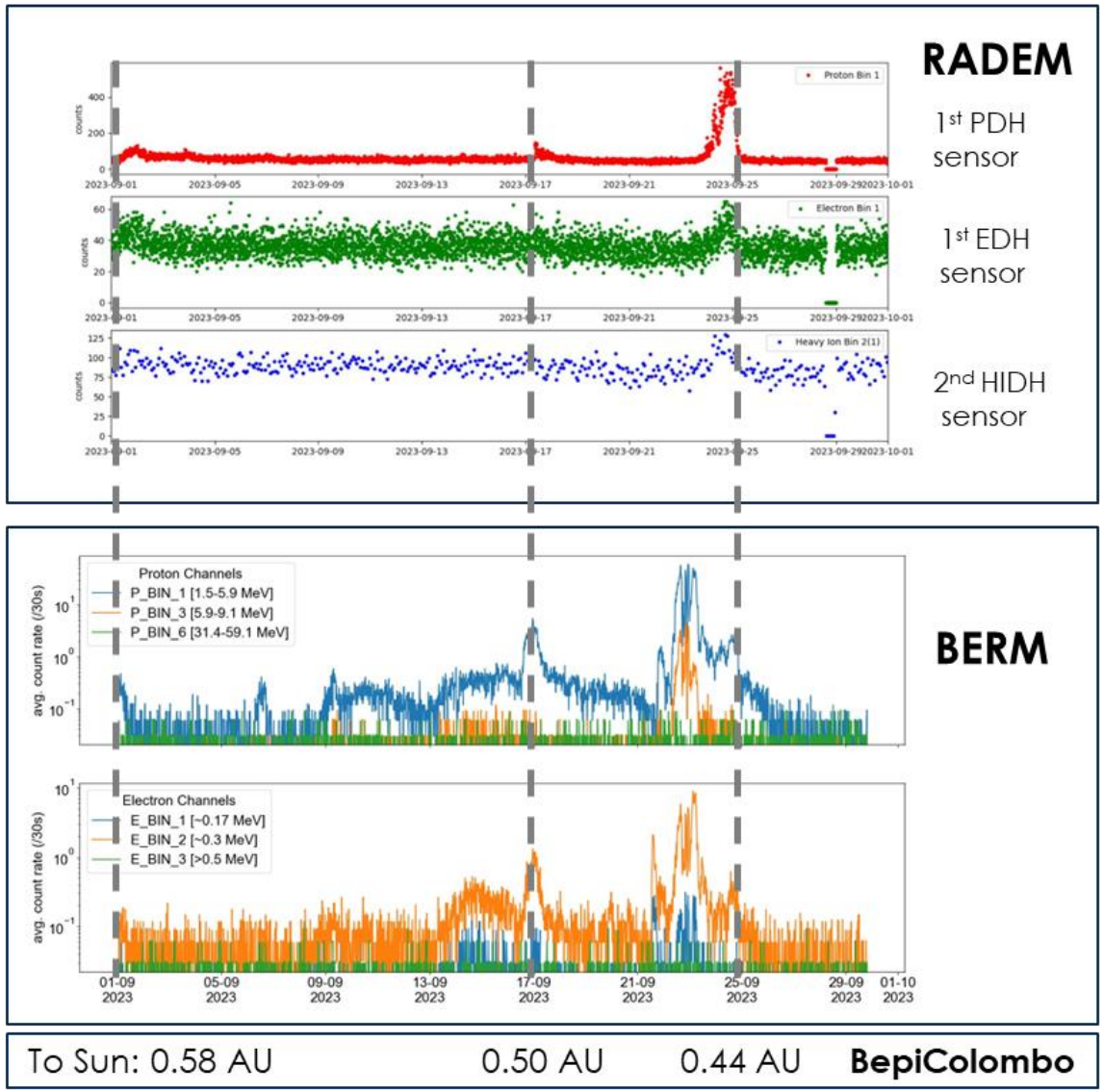


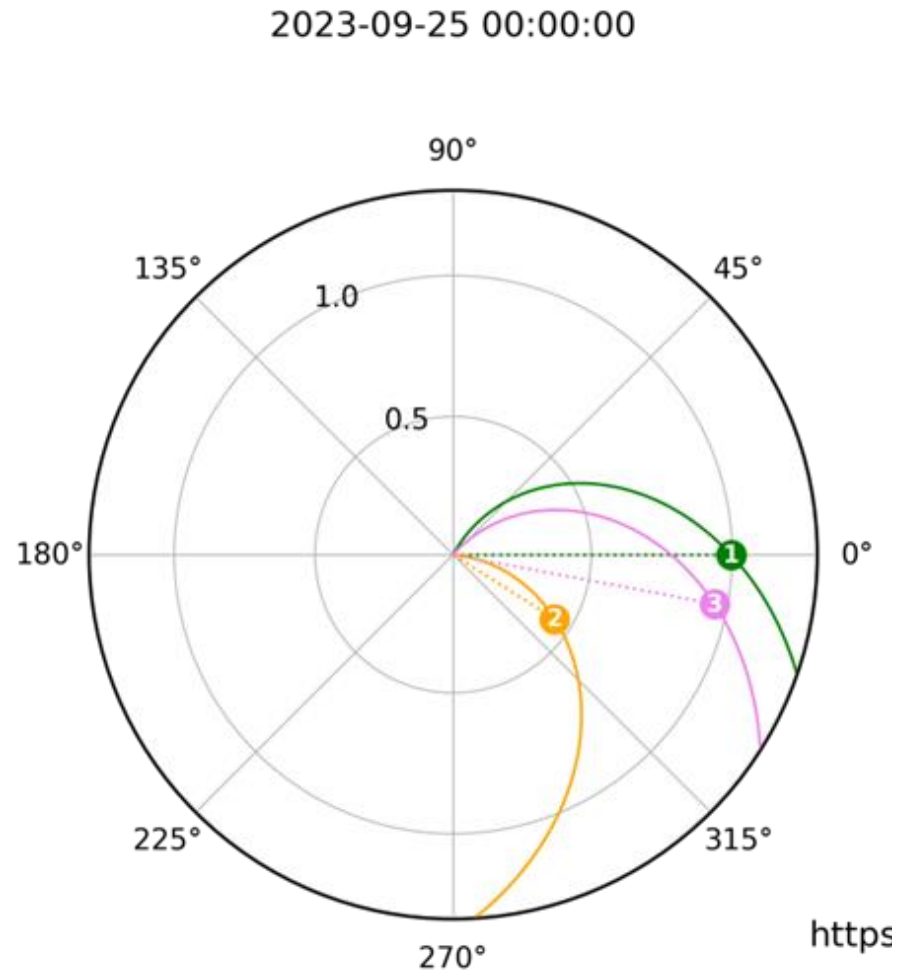
2023 – 2029 Inner solar system



2031 - Arrival at the Jovian System

Proton, Electron & Heavy Ion Detectors count rates





To Sun: 0.58 AU 0.50 AU 0.44 AU **BepiColombo**

Strengths

- Expertise in Geant4 for Space Applications and Radiation Analyses
- **17 years of activity with several contracts completed:**
  - Environment analysis & Modelling
  - Radiation Effects Analysis tools
  - Radiation measurement technologies.
  - Radiation Hardness Assurance

Weaknesses

- **No straightforward undergraduate training in Portuguese Universities**
- Slow Learning curve for students - larger than duration of contracts
- Low nr of Senior Researchers in Group
- RH Profile is not easy to find…

Opportunities

- **Participation on BERM and RADEM data analysis**
- **(inner and outer solar system data!!)**
- Participation in consortia for H2020 calls and other international funding programmes
- Networking with Portuguese Space Exploration community and in University
- Collaboration with industry, Contracts with ESA
- Involvement in a possible creation of a Post-Graduation in Space Technologies at IST

Threats

- Timing and duration of typical projects/contracts
- PI is heavily involved in LIP management
- **Career Prospects for post-docs and young researchers**
  - **Competition from industry**
  - **International opportunities**
- Group is low on RH