SPACE DOSIMETRY

Hungarian Innovations

Balazs Zabori
Centre for Energy Research, Lead Aerospace Engineer
REMRED Space Technologies Ltd., Chief Technical Officer
HUNOR Research and Outreach Program Manager
Advisor of Hungarian ESA Delegation
Member of ESA Moon Strategy Team
Sustainable long-term human space presence requires monitoring and protection solutions. Hungary has one of the longest heritage and knowledge in the domain...
The Beginning – PILLE, more than a success story...
PILLE: the Hungarian word for “butterfly”

Space dosimetry developments from 1970’s
System is composed from Reader Unit + Dosimeters
First time flown onboard Salyut-6 in 1980-1983
PILLE: more than a success story…

- The 2nd-gen PILLE was flown on Salyut-7 and transferred to Mir to be used until the deorbit of Mir in 2001.
- From 2001 the 3rd-gen PILLE is used on ISS and space vehicles (space shuttle).
- Nowadays the 3rd-gen & 4th-gen PILLE is used on ISS together (Zvezda) as part of the service system.
- During its more than 20 years of service lifetime, the PILLE system never malfunctioned.
- Note that until now PILLE is the only instrument used for routinely EVA dosimetry.
- Making this system one of the longest used piece of spaceflight hardware in the history of human spaceflight…
Nowadays – TRITEL, the story continues…
TRITEL: acronym for a “triaxial telescope”

System developments from 2000’s
System is composed from Central Unit + Detector Unit
First time flown on ISS Columbus in 2012-2013
TRITEL: the story continues...

- The full 1st-gen TRITEL system was flown on ISS Zvezda from 2017 until nowadays
- A 1st-gen TRITEL Detector Unit is operated on the ESEO SmallSat launched in 2020
- The system is using passive control detector packages
- The system is integrating the long-term heritage and experiences of PILLE
- Making this system appropriate for future Moon and Mars missions...
Hungarian Service Dosimeters on ISS

- Zvezda
- Rassvet
- Columbus
- Unity
- Kibo
- Poisk & Pirs
- Destiny
- Unity
- Destiny
- Columbus
- Kibo
- Poisk & Pirs
- Unity
Future strategy – Beyond LEO to Moon and Mars...
STEP I.
International Space Station
Low Earth Orbit
New technology demonstrations

STEP II.
STEP II-a.
Lunar Gateway & Artemis
Moon Orbit & Landing
Service operation demonstration in Moon missions

STEP II-b.
Earth Return Orbiter mission
Earth-Mars Travel
Martian Orbit
Critical science data collection for Mars mission preparations

STEP III.
Future Mars mission
Martian Orbit & Landing
Mars mission service operation

Critical science data collection for Mars mission preparations
STEP I. – NEW TECHNOLOGY DEMONSTRATIONS

- New technology developments are planned to be demonstrated on ISS as part of HUNOR program in 2024

NEW DEVELOPMENTS

- 2nd-gen TRITEL Detector Unit
- TRIPIL Complex Space Dosimetry System
- PSDS Personal Space Dosimetry System
STEP II-a. – SERVICE OPERATION DEMONSTRATIONS IN MOON MISSIONS

- IDA (Internal Dosimeter Array) Payload Development to be hosted in Lunar Gateway US HALO module during early utilization phase (launched in 2024) in Moon orbit

- Passive detector packages for ORION EM-1 demonstration mission

- Discussions for dosimetry monitoring provision in Artemis landing missions...
STEP II-b. – CRITICAL SCIENCE DATA COLLECTION FOR MARS MISSION PREPARATIONS

- SDT (Space Dosimetry Telescope) Payload Development to be hosted on Earth Return Orbiter (launched in 2026) during the travel between Earth and Mars and in Moon orbit

- Discussions to support the dosimetrical preparations of future human Mars mission based on the science output of SDT payload...
In 2026...

2nd TRITEL #1
ISS in LEO

2nd TRITEL #2 & #3
Gateway in Moon orbit
Moon Surface

2nd TRITEL #4
ERO in Martian orbit
STEP III. – TO SUPPORT HUMAN MARS MISSION

- Proven space dosimetry systems
  - PILLE
  - TRITEL
  - TRIPIL
  - PSDS

- Complex space dosimetry service
  - Environmental dosimetry
  - Personal dosimetry
  - EVA dosimetry

- To become one of the world leader in the field of space dosimetry…
“The Human Adventure is Just Beginning!”

Gene Roddenberry