Dosimetry Activities in the European Columbus Module onboard the ISS

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Outline

- **Radiation measurement devices onboard the space station**

- **Activities of DLR : The MATROSHKA FACILITY**

EuCPD

- **The DOSIS proposal and dosimetric activities on Columbus**

Radiation measurement devices onboard the ISS

- Operational

- Scientific

Radiation measurement devices onboard the ISS – Operational

Dosemeter		Heritage
TEPC **Tissue equivalent proportional counter**		**NASA, USA**
IV – CPDS **Charged particle detector system**		**NASA, USA**
EV – CPDS (#1-#3) **Charged particle detector system**		**NASA, USA**
R-16 **Ionisation Chamber**		**IBMP, Russia**
DB8 (#1 - #4) **Silicon detector**		**IBMP, Russia in cooperation with STIL, Bulgaria**
PILLE – TL system		**KFKI, Hungary**

Radiation measurement devices onboard the ISS – Scientific I

Dosemeter		Experiment	Heritage
DOSTEL – Silicon Telescope SSD – Silicon Szintillator Devices Passive Detectors		MATROSHKA	DLR in cooperation with University Kiel, Germany
Passive Detectors (Liulin-5)		MATROSHKA-R	IBMP, Russia (STIL, Bulgaria)
ALTEA – Silicon Strip Detector		ALTEA	INFN and University of Rome, Italy
SILEYE-3/ALTEINO – Silicon Strip Detector		ALTCRISS	INFN and University of Rome, Italy

Radiation measurement devices onboard the ISS – Scientific I

Guenther Reitz and Thomas Berger, *THE MATROSHKA FACILITY—DOSE DETERMINATION DURING AN EVA*, Radiation Protection Dosimetry (2006), Vol. 120, No. 1–4, pp. 442–445

J. Dettmann, G. Reitz, G. Gianfiglio, *MATROSHKA—The first ESA external payload on the International Space Station*, Acta Astronautica 60 (2007) 17 – 23

M. Casolino et al., *Relative nuclear abundances inside ISS with Sileye-3/Alteino experiment*, Advances in Space Research 37 (2006) 1685–1690

M. Casolino et al., *The Altcriss project on board the International Space Station*, Advances in Space Research (2007) in print.

L. Narici et al., *ALTEA: ANOMALOUS LONG TERM EFFECTS IN ASTRONAUTS. A PROBE ON THE INFLUENCE OF COSMIC RADIATION AND MICROGRAVITY ON THE CENTRAL NERVOUS SYSTEM DURINGLONG FLIGHTS*, *Adv. Space Res.* Vol. 31, No. 1, pp. 141-146, 2003

L. Narici et al., *The ALTEA/ALTEINO projects: studying functional effects of microgravity and cosmic radiation*, Advances in Space Research 33 (2004) 1352–1357

V.A. Shurshakov et al. *MATROSHKA-R experiment on board the ISS: Current status and preliminary results*, Ninth WRMISS Workshop, Vienna, September 8–10, http://www.oma.be/WRMISS/workshops/ninth/workshop.html, 2004.

Radiation measurement devices onboard the ISS – Scientific II

Dosemeter		Experiment	Heritage
DOSTEL – Silicon Telescope		**DOSMAP**	**DLR in cooperation with University Kiel, Germany**
Liulin (#1 - #4)		**DOSMAP**	**STIL, Bulgaria**

G. Reitz, R. Beaujean, E. Benton, S. Burmeister, Ts. Dachev, S. Deme,M. Luszik-Bhadra and P. Olko, *SPACE RADIATION MEASUREMENTS ON-BOARD ISS—THE DOSMAP EXPERIMENT*, Radiation Protection Dosimetry (2005), Vol. 116, No. 1–4, pp. 374–379

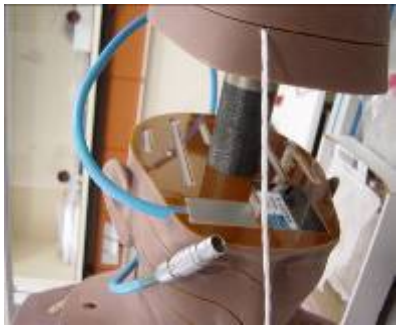
THE ESA FACILITY – MATROSHKA
PI: G. Reitz, DLR

The **MATROSHKA** experiments measures the radiation load on astronauts by using a human upper torso phantom

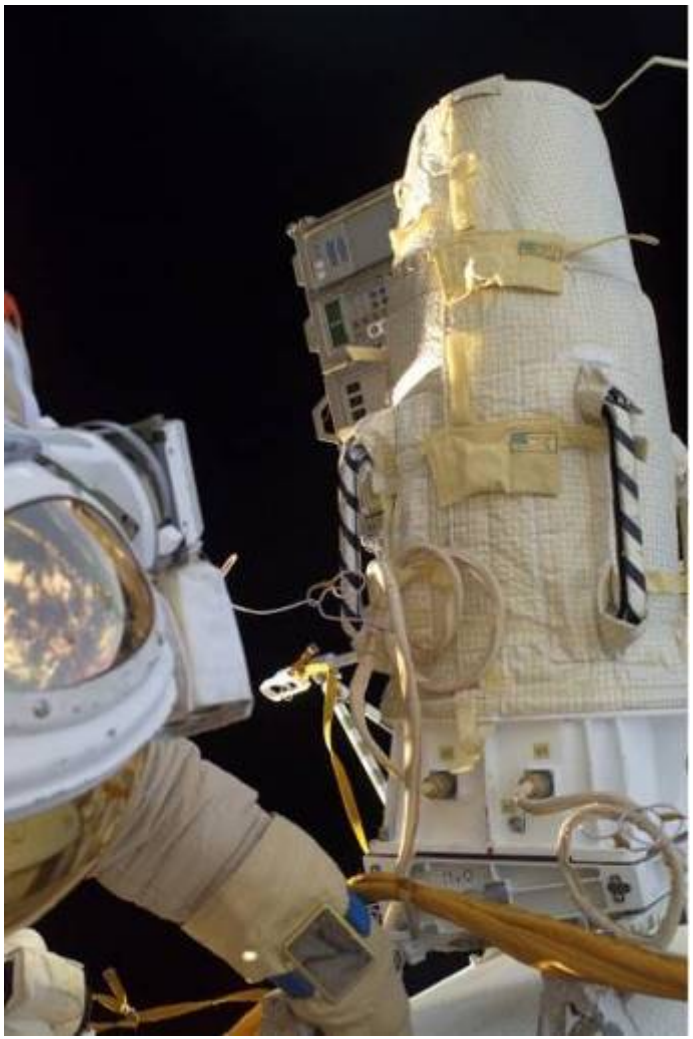
Over 6000 passive and 7 active radiation detectors are distributed in the phantom

MATROSHKA measures outside and inside the International Space Station

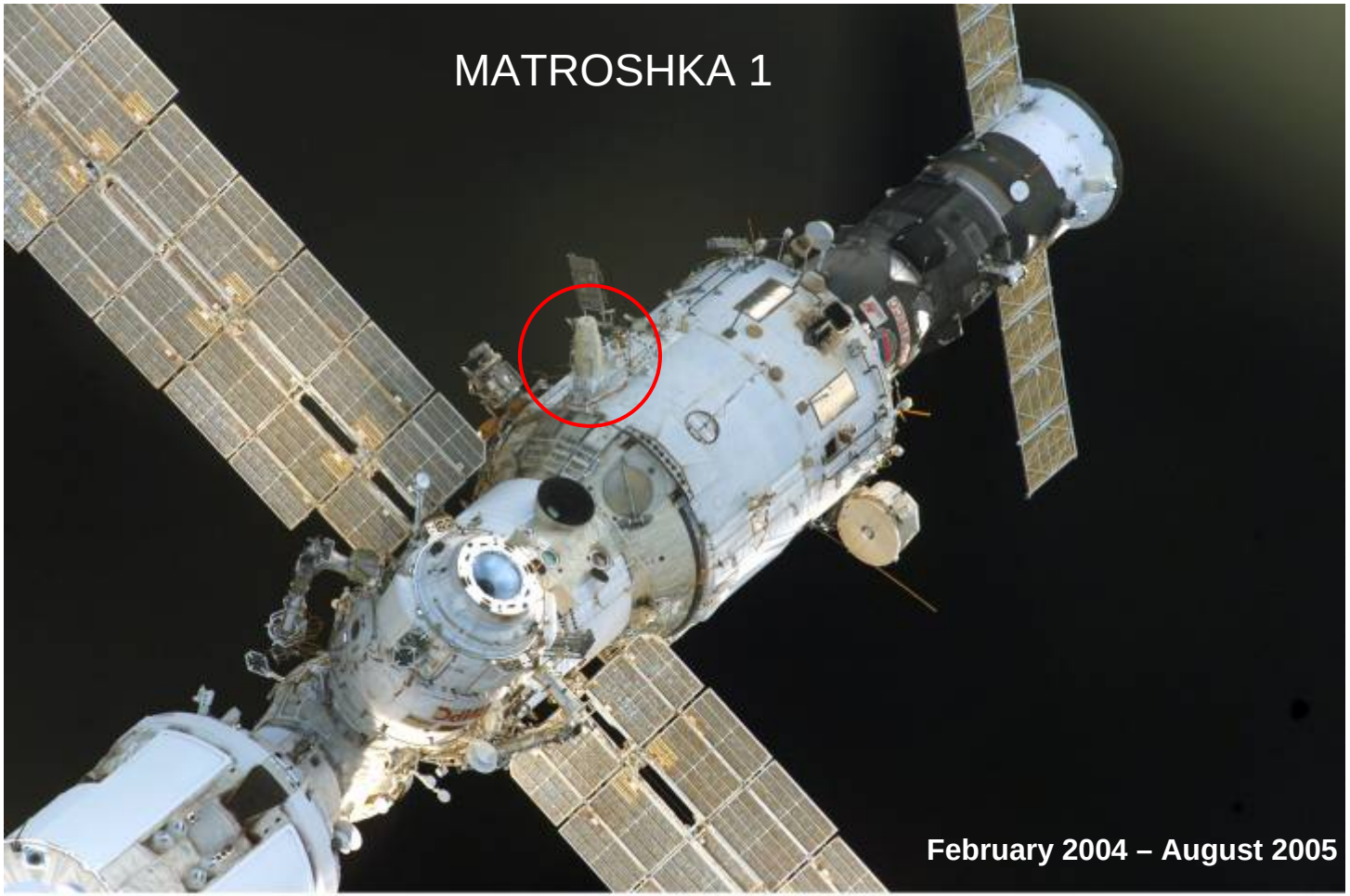
MATROSHKA measures the skin as well as the organ doses for a future better risk assessment for long duration space flight



THE ESA FACILITY - MATROSHKA



THE ESA FACILITY - MATROSHKA



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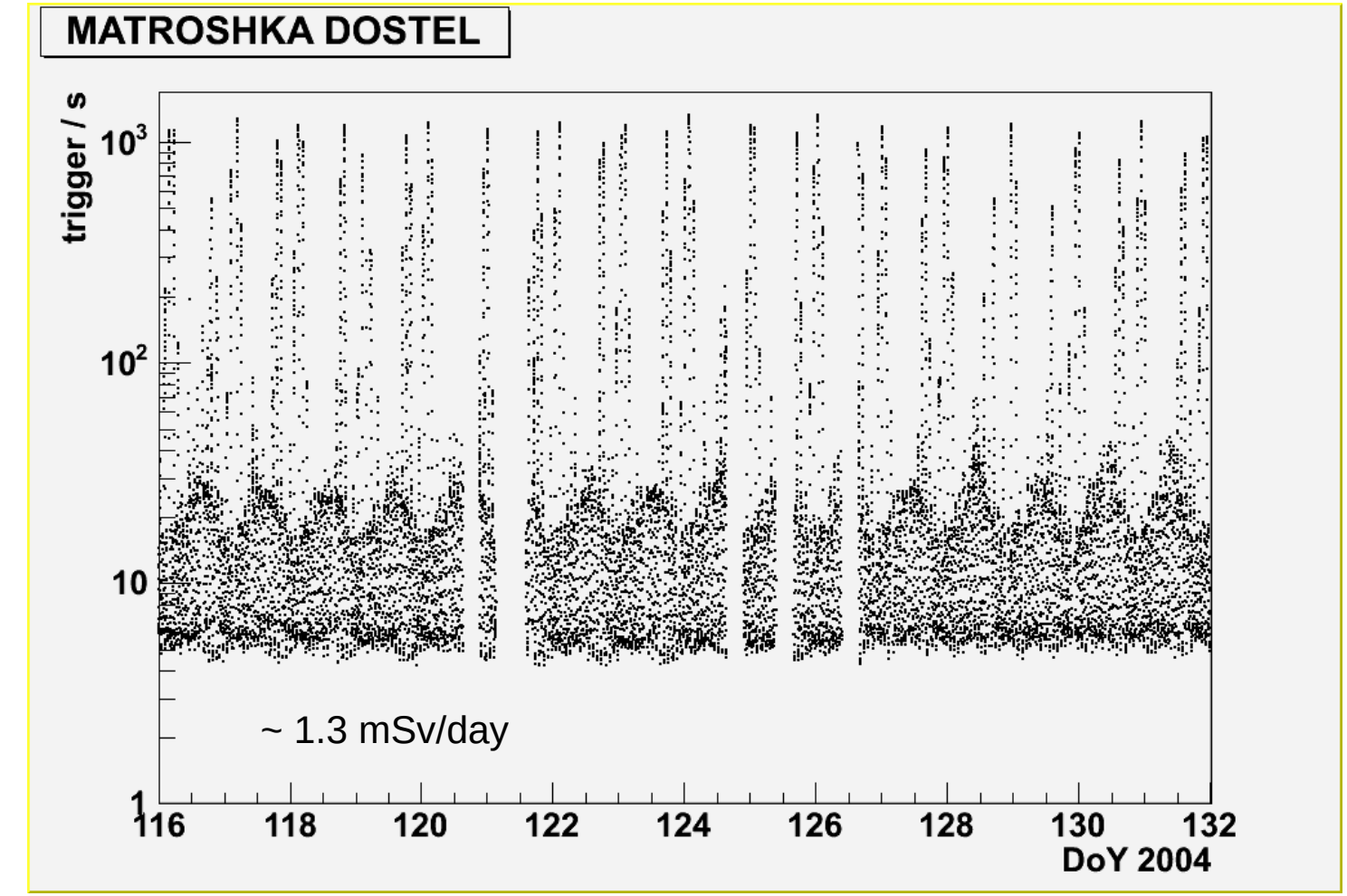
THE ESA FACILITY - MATROSHKA

THE ESA FACILITY - MATROSHKA

MATROSHKA 2B Detectors launched at the 10. October 2007
with SOYUZ-TMA 11

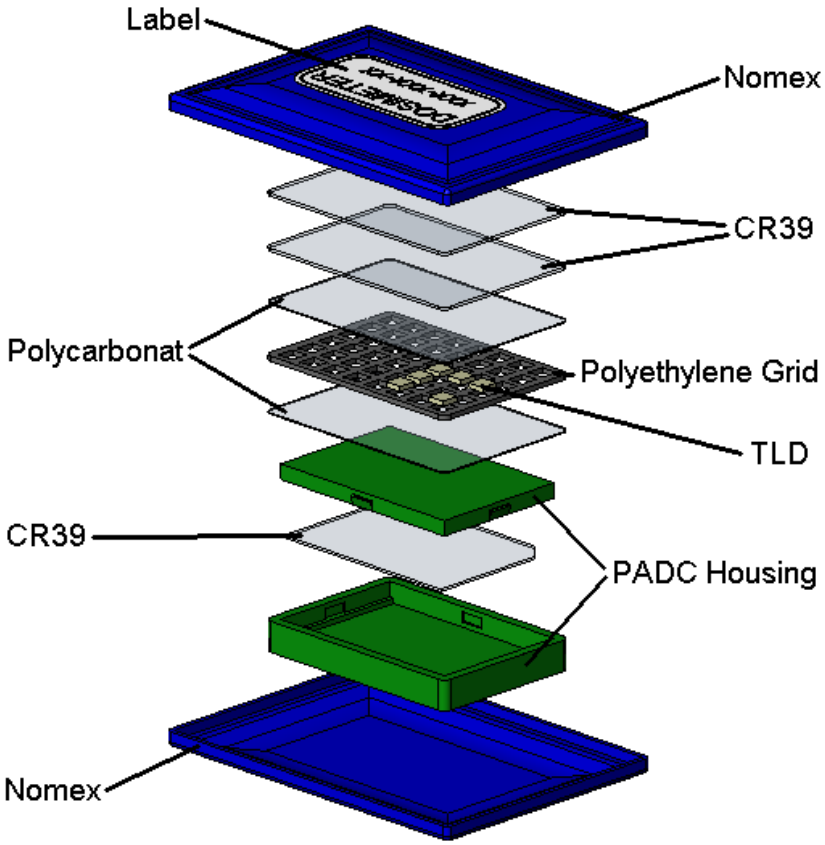
THE ESA FACILITY – MATROSHKA 1 – Preliminary Results



EuCPD - European Crew Personal Dosemeter

DLR contractor for the European Astronaut Center (EAC)

- 48 x TLD´s
- 2 x CR-39
- 1 x PADC



EuCPD - European Crew Personal Dosemeter

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ESA
IBMP
NASA
Personal
Dosemeters

EuCPD - European Crew Personal Dosemeter

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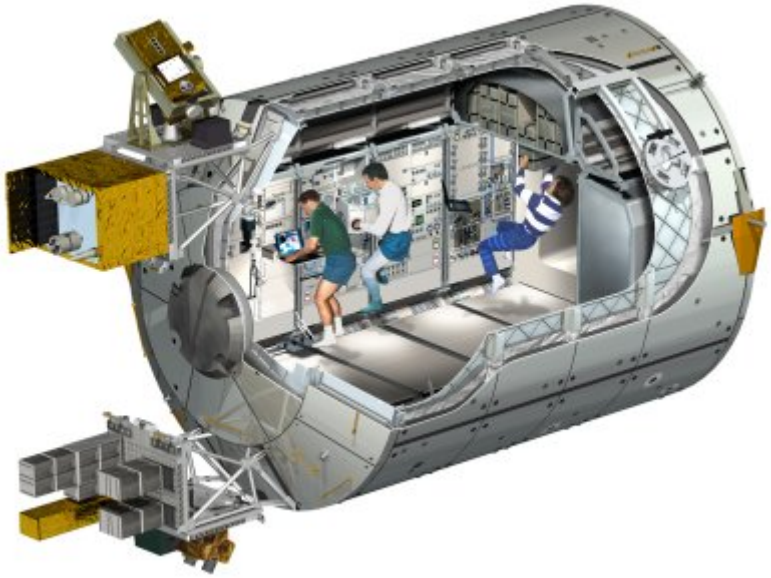
EuCPD - European Crew Personal Dosemeter

Upcoming missions:

- P. Nespoli STS-120/ISS
- H. Schlegel STS-122/ISS
- L. Eyhardts STS-122/ISS/STS-123

ILSRA-2004-167 Dose Distribution inside ISS (DOSIS)



DOSIS (International Contribution)
PI: G. Reitz, DLR

Günther Reitz, Thomas Berger	German Aerospace Center, DLR, Cologne, **Germany**
Rudolf Beaujean	Christian-Albrechts-Universität Kiel, Kiel, **Germany**
M. Luszik-Bhadra	Physikalisch-Technische Bundesanstalt, PTB, Braunschweig, **Germany**
V. Petrov	Institute for Biomedical Problems, IMBP, Moscow, **Russia**
P. Olko, P. Bilski	Institute for Nuclear Physics, IJF, Krakow, **Poland**
I. Aphaty, S. Deme, J. Palfalvi	Atomic Energy Research Institute, AERI, Budapest, **Hungary**
D. O´Sullivan	Dublin Institute for Advanced Studies, DIAS, Dublin, **Ireland**
D. Bartlett, L. Hager	National Radiological Protection Board, NRPB, Chilton, **United Kingdom**
M. Casolino	National Institute of Nuclear Physics, INFN, Rome, **Italy**
M. Hajek	Atomic Institute of the Austrian Universities, ATI, Vienna, **Austria**
Y. Uchihori, N. Yasuda	National Institute for Radiological Sciences, NIRS, Chiba, **Japan**
A. Nagamatsu	Japan Aerospace Exploration Agency, JAXA, **Japan**
N. Zapp, E.Semones	NASA JSC, Houston, TX, **USA**
E. Benton	Eril Research Inc., Stillwater, **USA**
S. McKeever, E. Yukihara	Oklahoma State University, Stillwater, **USA**
J. Miller and C. Zeitlin	Lawrence Berkeley Laboratory, Berkeley, CA, **USA**

cooperation with DOBIES

ILSRA-2004-248 Dosimetry for Biological Experiments in Space (DOBIES)

DOBIES (International Contribution)
PI: F. Vanhavere, SCK CEN

F. Vanhavere	Belgian Nuclear Research Centre (SCK·CEN), Mol, **Belgium**
D. O´Sullivan	Dublin Institute for Advanced Studies, DIAS, Dublin, **Ireland**
F. Spurny	Nuclear Physics Institute, NFJ, Prague, **Czech Republic**
E. Yukihara	Oklahoma State University, Stillwater, **USA**

DOSIS – Scientific Goal

- **Dosimetry inside Columbus**
  - Dosimetric mapping inside Columbus using passive radiation detectors
  - Dosimetric mapping inside Columbus using active radiation monitors
  - Dosimetric measurements by use of passive and active devices mounted on the European Physiology Module (EPM)
- **Dosimetry outside Columbus**
  - Dosimetric mapping inside EXPOSE – EuTEF (EXPOSE – R) with passive systems only

DOSIS (Experiment Definition)

- 2 DOSTEL dosimeters powered by EPM
- NTDP (Passive detector packages) (3 in EPM) and up to 10 distributed at different locations inside the Columbus module (together with PILLE)
- TLD-PILLE reader with 10 dosimeter bulbs (already on ISS) powered by EPM or Columbus
- ALTEINO (already on ISS (RUS)), transfer to Columbus required
- Optional 1 TEPC (already on ISS) temporally in Columbus, data to be provided by NASA
- *1-2 personal neutron dosimeters, powered by rechargeable battery (commercially available)*

DOSIS (Main detector systems)

Passive Detector
Boxes - NTDP

Detector Telescope
DOSTEL

DOSIS (Additional detector systems)

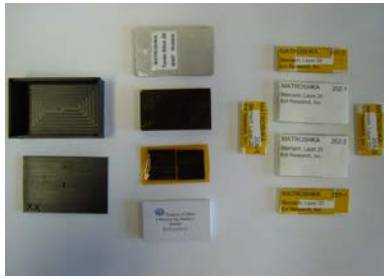
Alteino

TLD Reader
PILLE

DOSIS (Additional detector systems)

Tissue Equivalent Proportional Counter (TEPC)

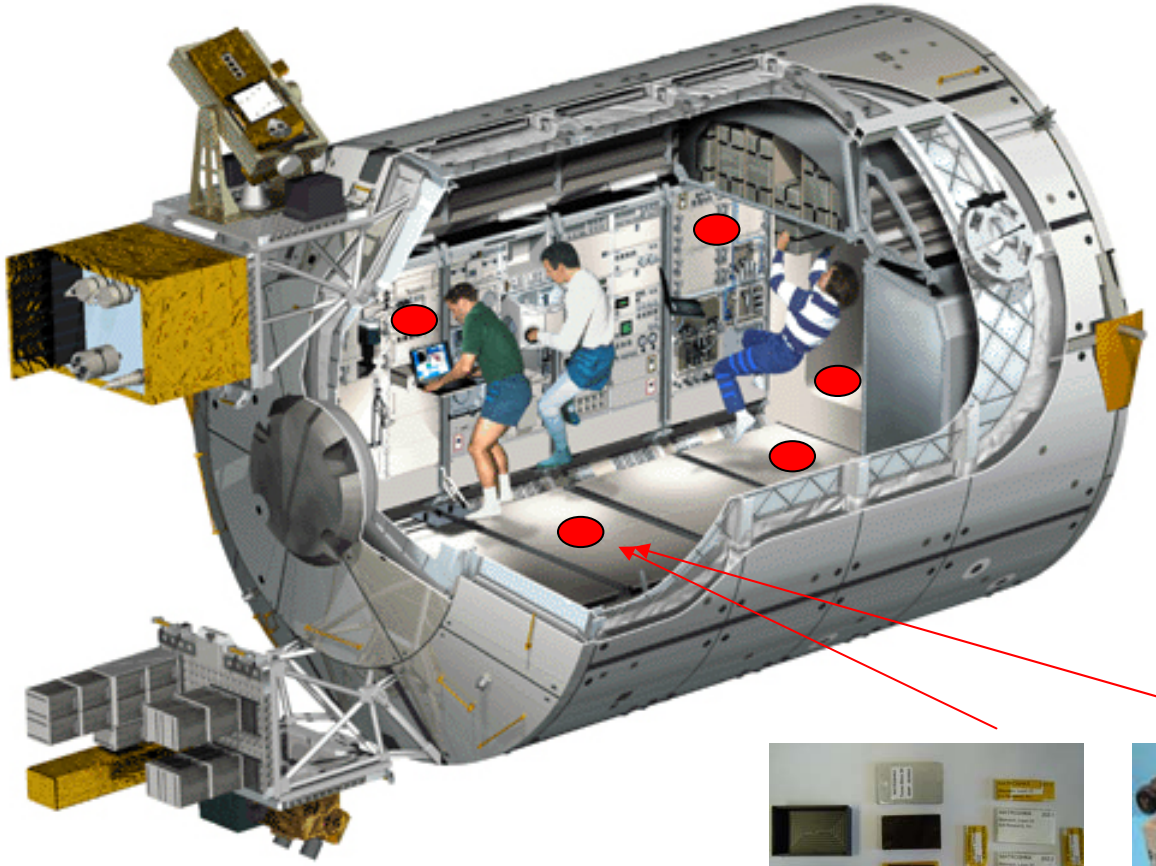
DOSIS (EPM)



2 Dostels and up to three NTDP packages mounted outside the EPM

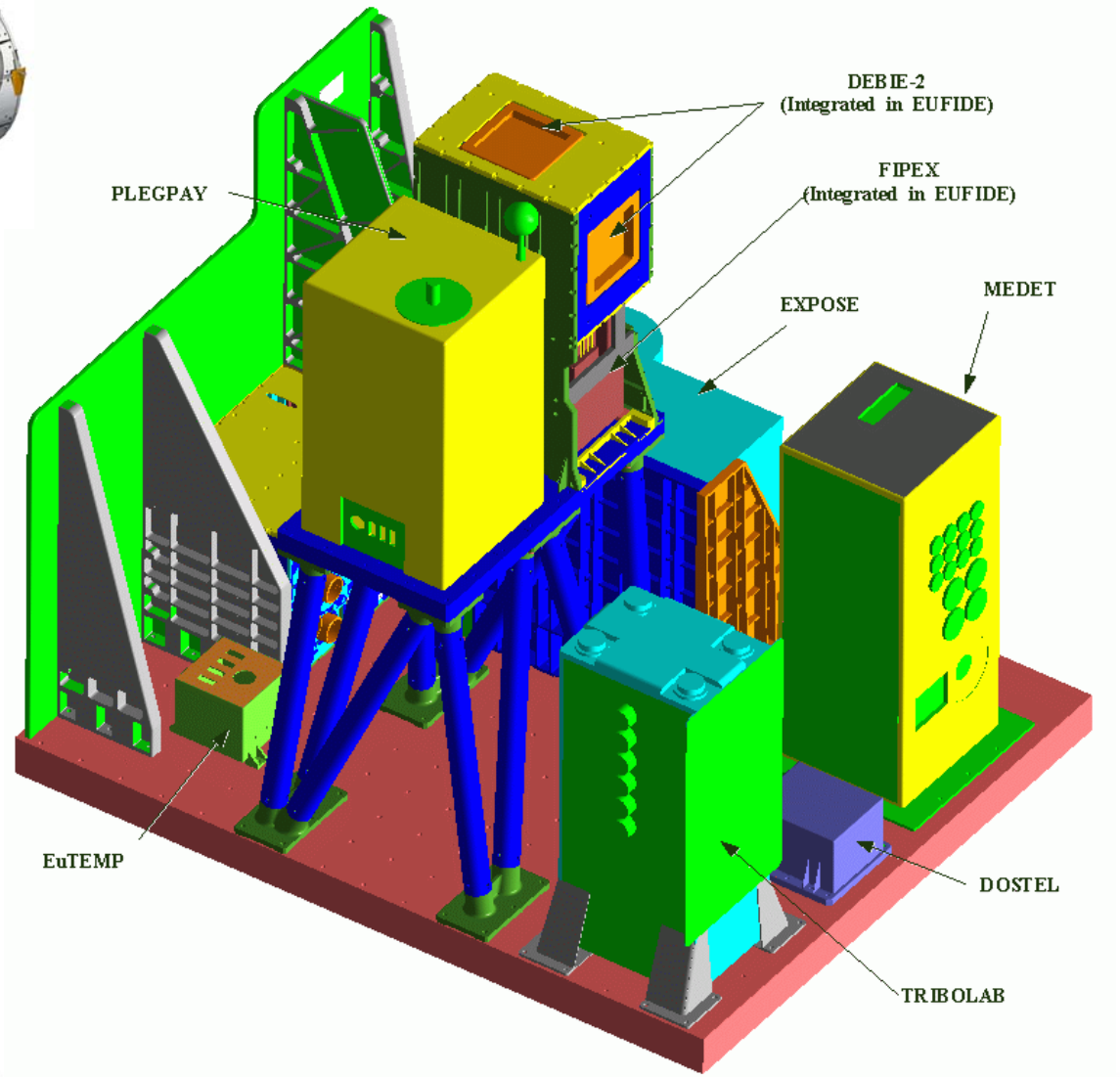
→ DOSTEL data transfer and download (TBD)
→ Exchange of NTDP packages every 6 month

DOSIS (passive detector locations)

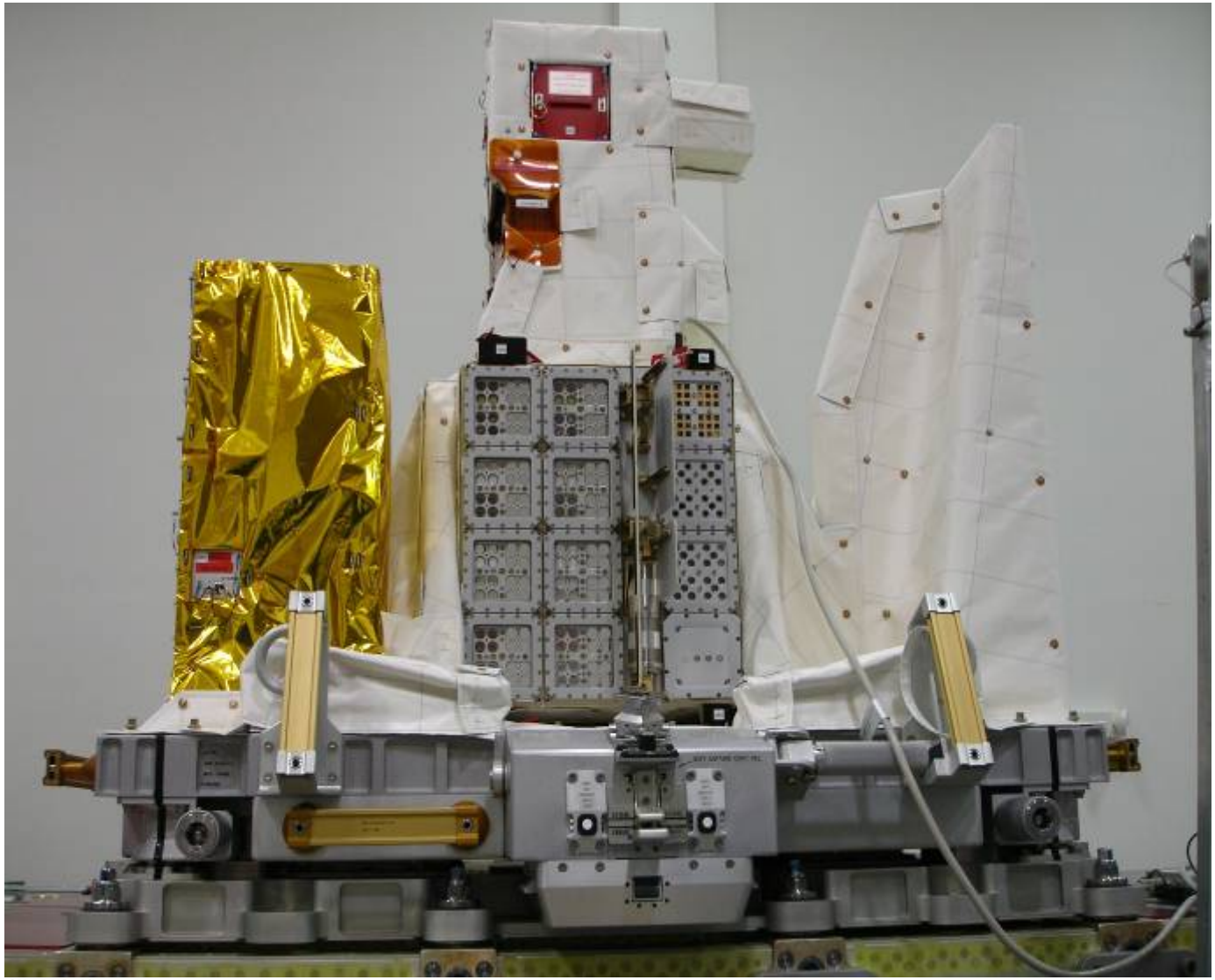


10 NTDP packages / PILLE detectors inside Columbus
→ Exchange of NTDP packages every 6 months
→ Read out of PILLE detectors every 10 days

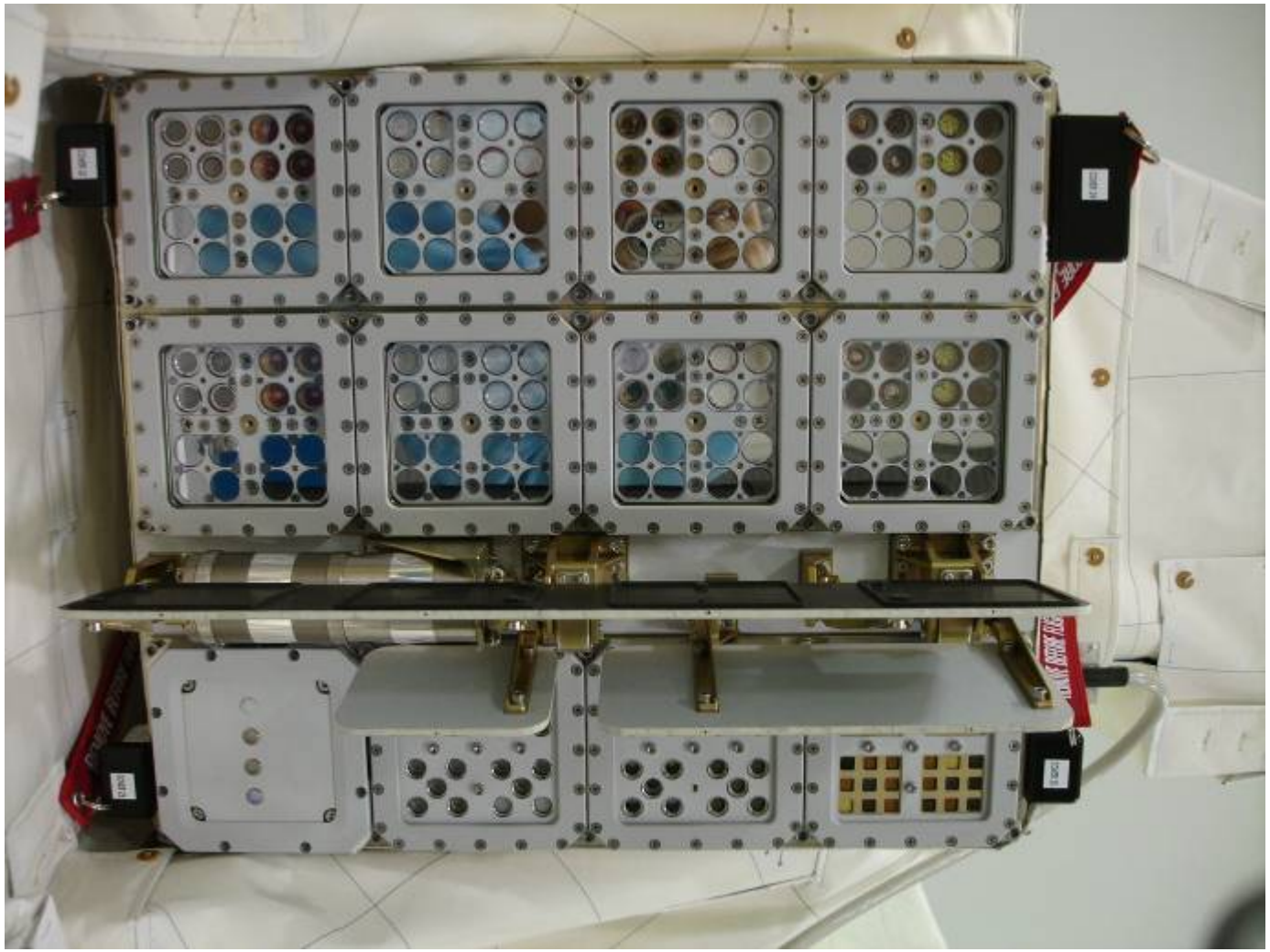
DOSIS inside Expose on EuTEF



EuTEF Facility



DOSIS / Expose-EuTEF

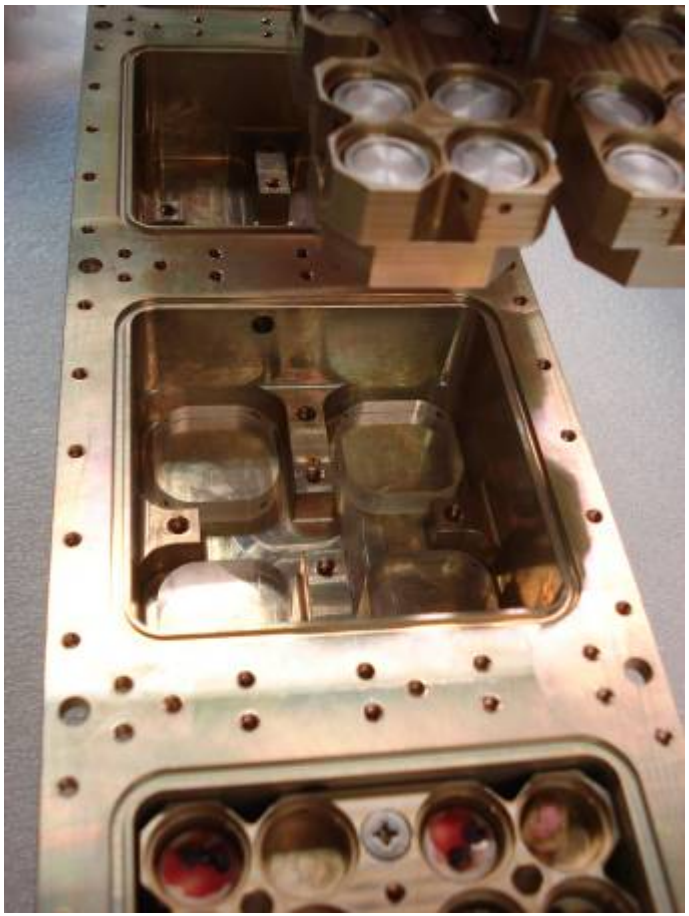


DOSIS / Expose-EuTEF

- Passive Dosimetry in the Expose-EuTEF facility for the determination of the radiation environment at the location of the biological samples
- 32 TLD / OSL – CR-39 packages as “Dark Control”
- 32 “Depth Dose Stacks” for the depth dose measurements

cooperation with : DOBIES

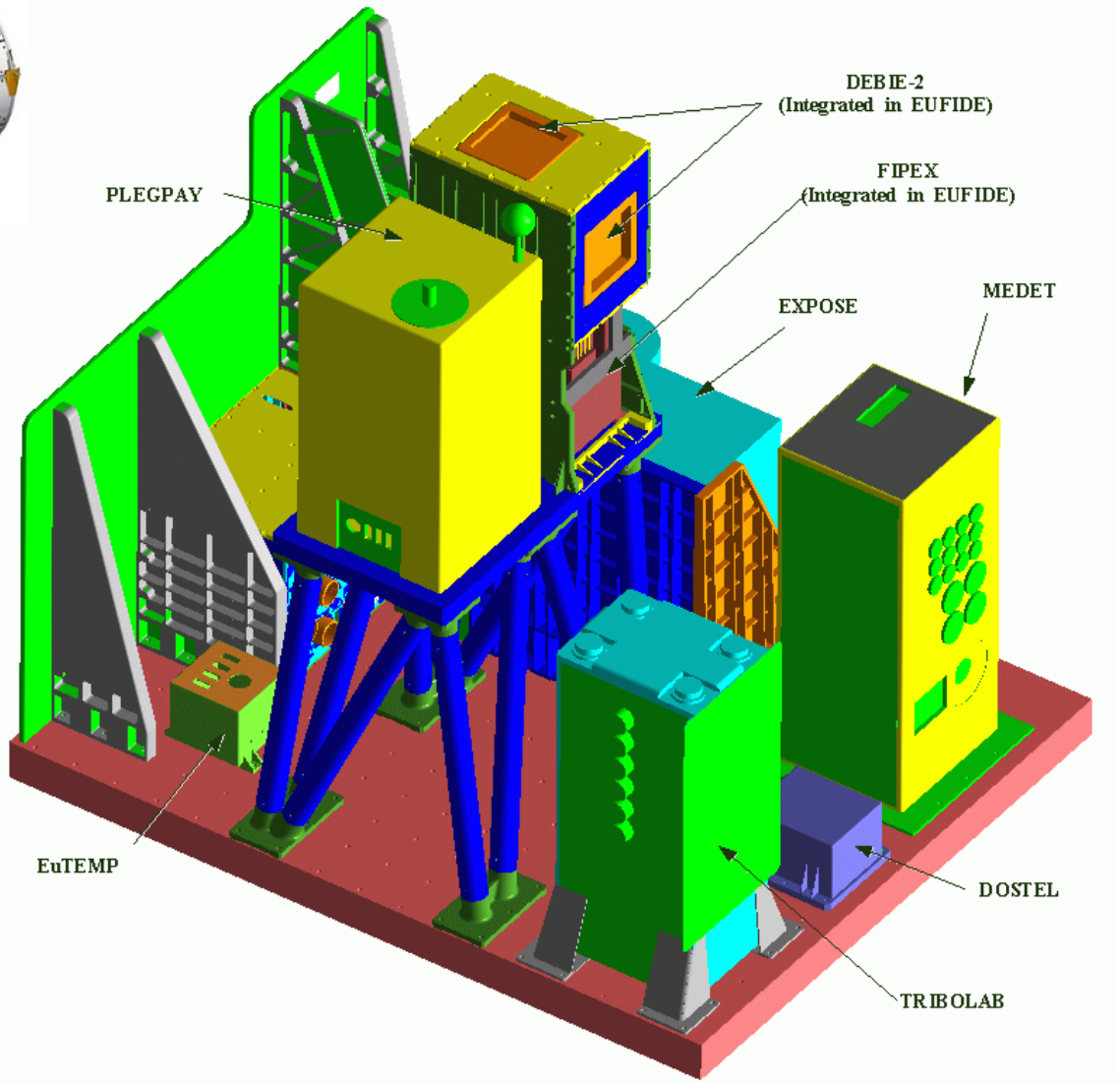
DOSIS (ISLRA-2004-167) / Expose-EuTEF



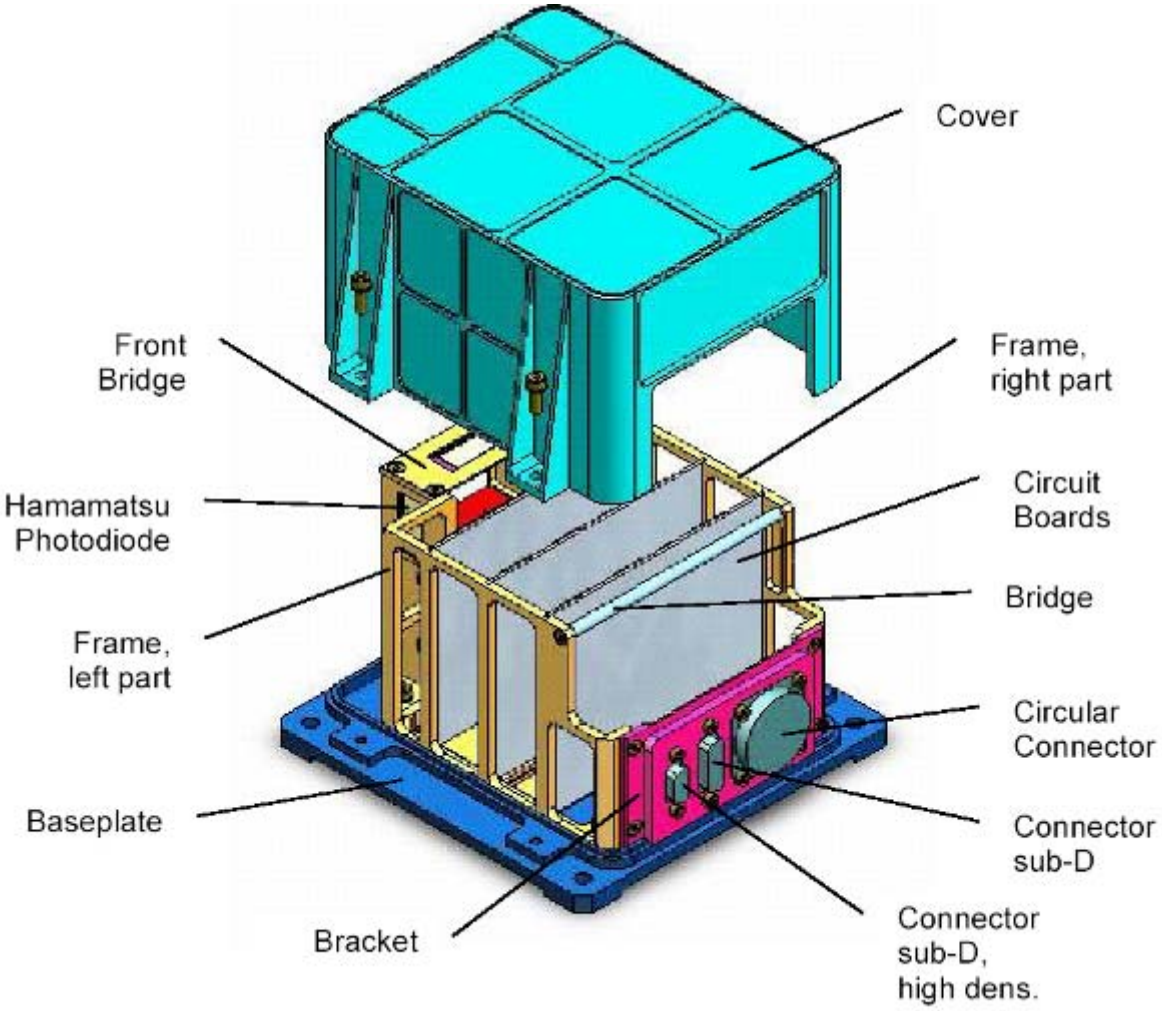
DOSIS (ISLRA-2004-167) / Expose-EuTEF

Depth dose TLD stack

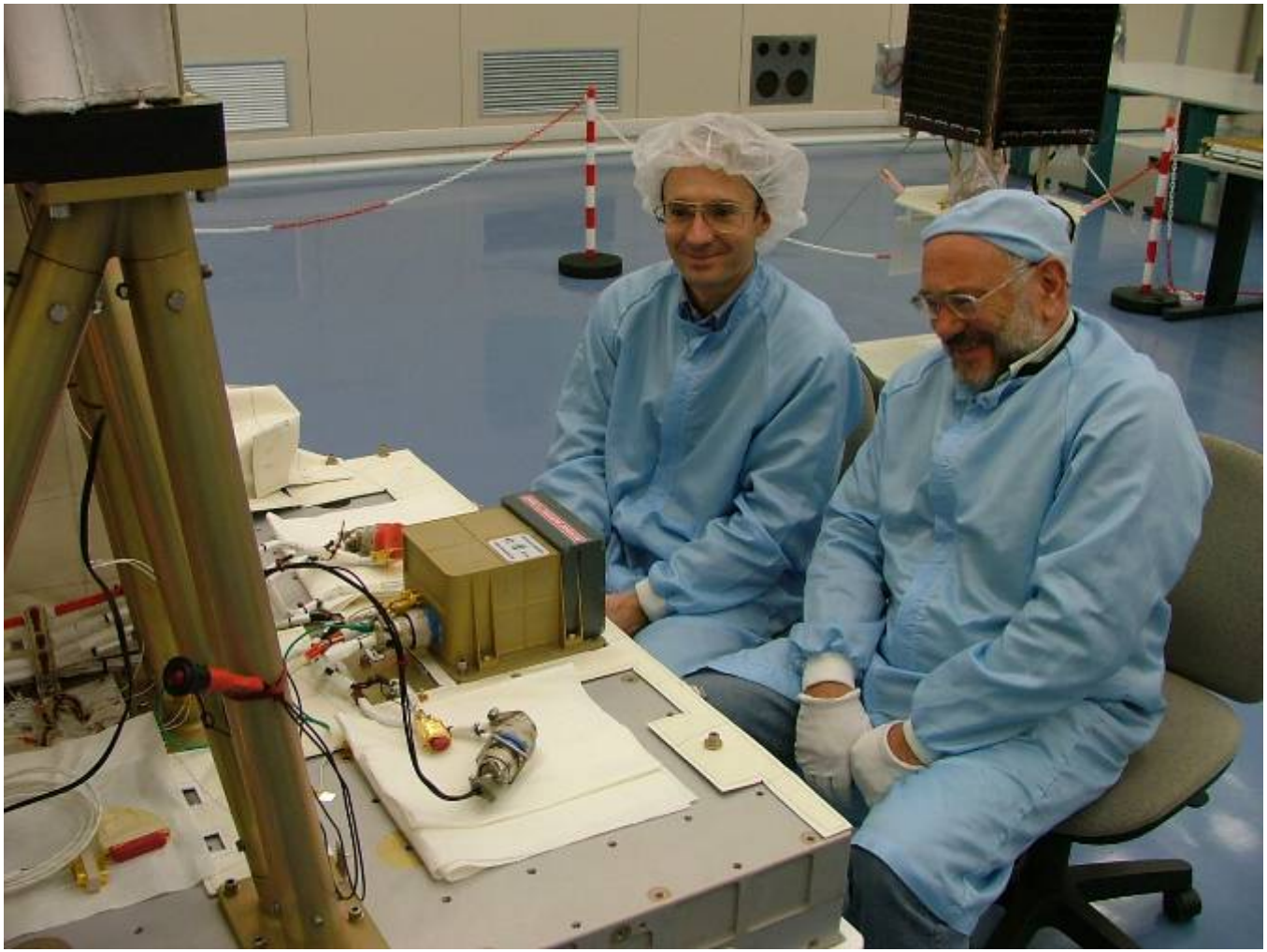
Advanced DOSTEL on EuTEF



Advanced DOSTEL on EuTEF



Advanced DOSTEL during Interface Test



Thank you very much
for your attention !