

DOSIS and DOSIS 3D on-board the ISS

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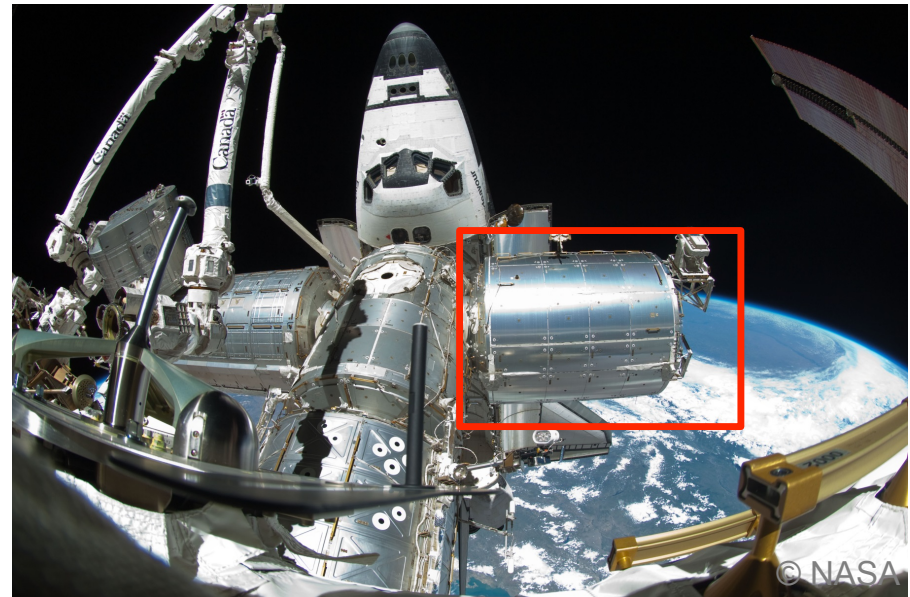
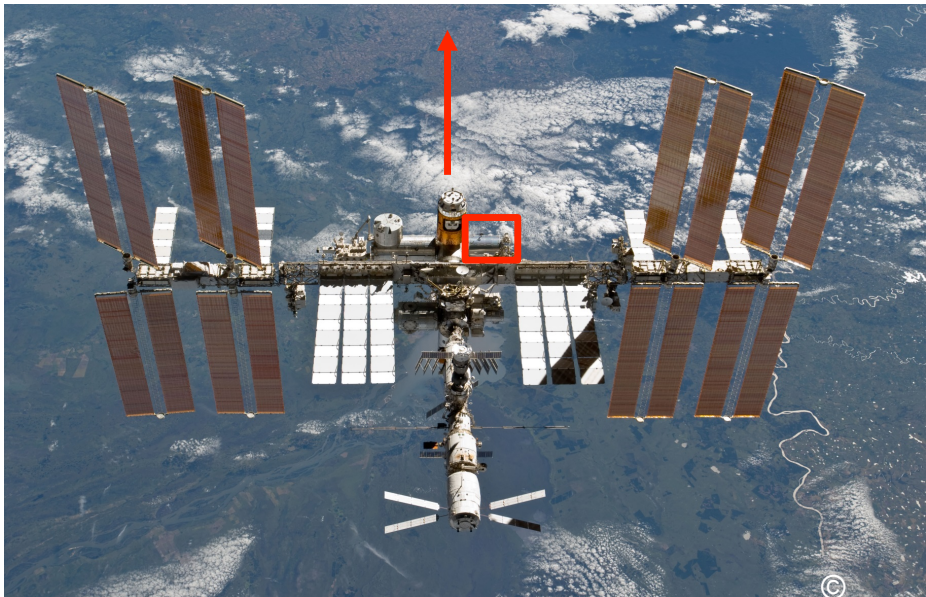
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Introduction

- environment in space
- cosmic radiation
- risk for astronauts
- dependence on the solar activity, orbital parameters, shielding configurations
- knowledge of the physical characteristics of the space radiation field

DOSIS & DOSIS 3D

- ESA projects
- Dose Distribution Inside the International Space Station – 3D
- DOSIS (2009 – 2011) and DOSIS 3D (2012 – ongoing)
- characterization of the radiation environment within the European Columbus Laboratory of the ISS



DOSIS & DOSIS 3D: Science Team

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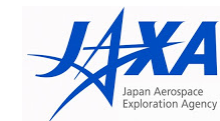
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¹⁵Leidos (Leidos Innovations Corporation), Houston, TX, United States

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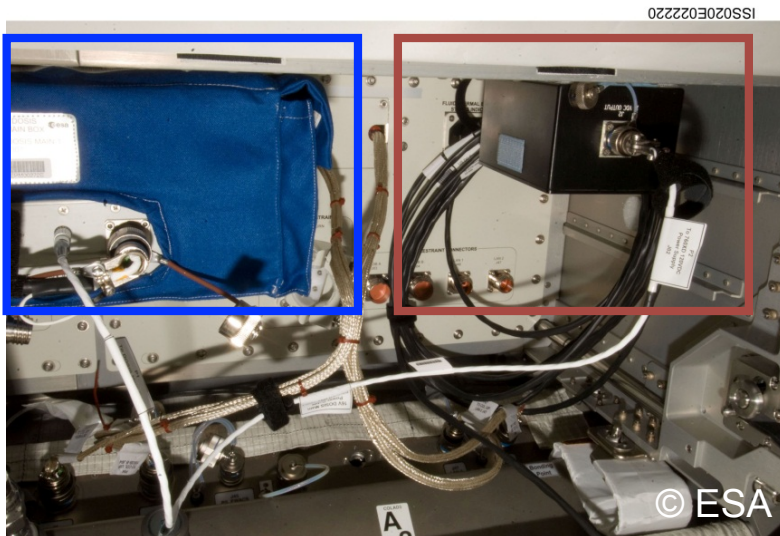
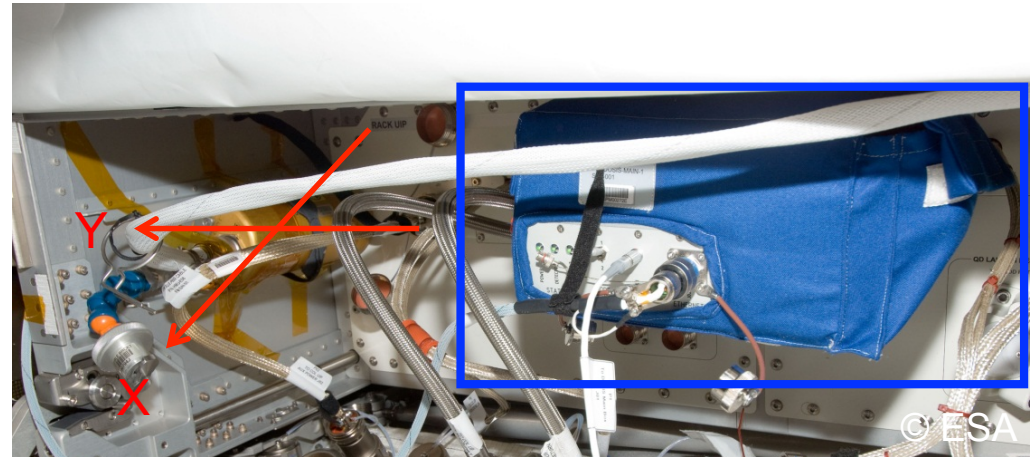
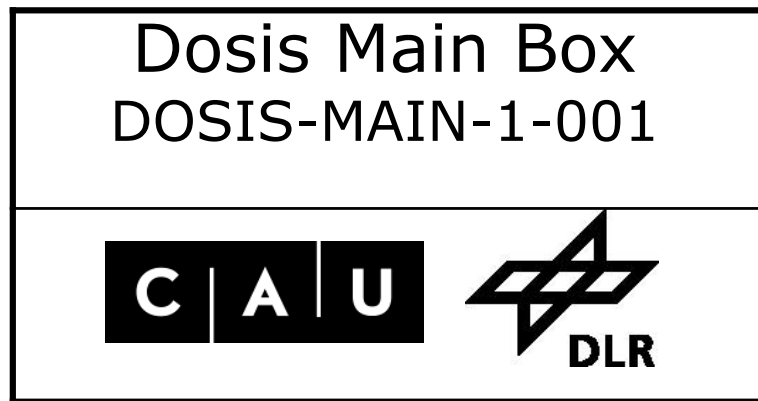


DOSIS & DOSIS 3D: Scientific Goals

- determination of the absorbed dose and dose equivalent using a variety of active and passive radiation detector devices distributed throughout the ISS
 - monitor the radiation environment inside Columbus with active and passive radiation detectors for the determination of the temporal and spatial dose distribution
 - combine data gathered by NASA, JAXA, IMBP into a 3D radiation map of the International Space Station

DOSIS & DOSIS 3D: Active detectors

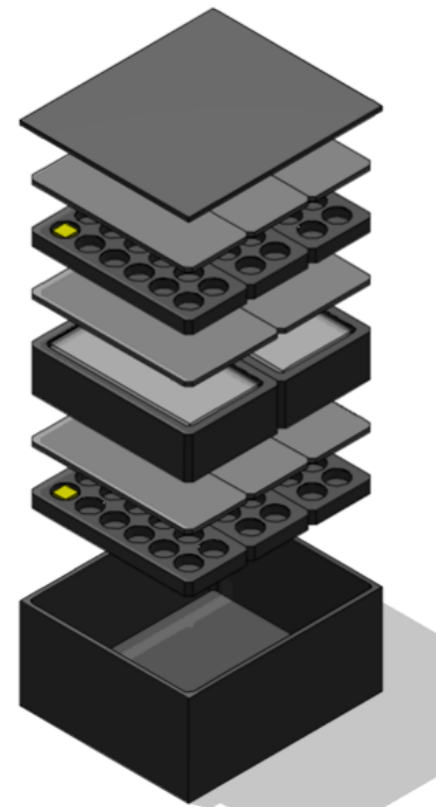
2 x DOSimetry TElescope



- ethernet connection to EPM rack "Right Utility Distribution Panel"
- DOSIS-MAIN-BOX connected to EPM LAN like an external EPM instrument
- data downlink is an EPM operation from ground performed once per month over CADMOS – COLCC – MUSC – Scientists
- up to July 2018: 71 data downlinks

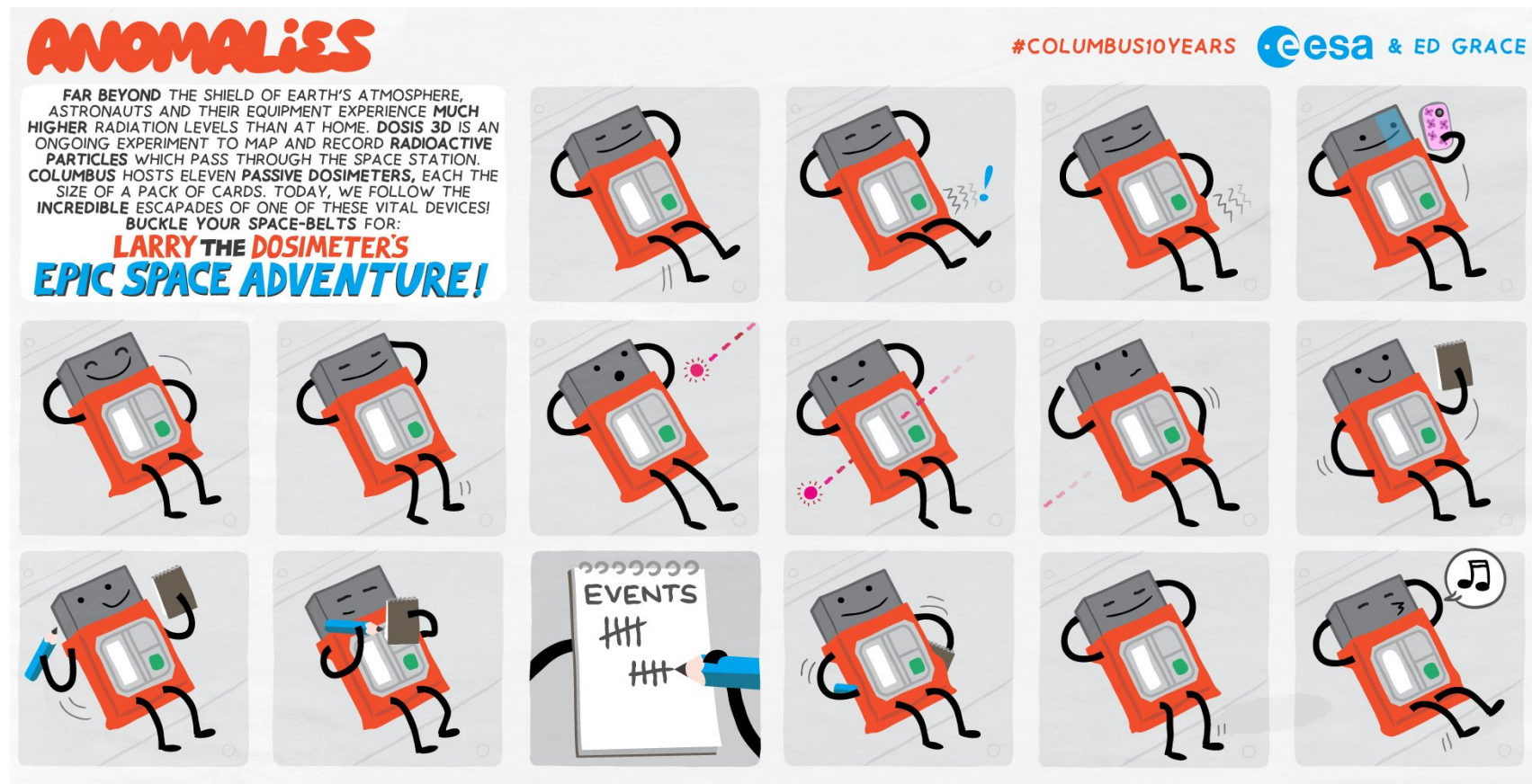
DOSIS & DOSIS 3D: Passive Detectors

- luminescence detectors (TLD / OSLD)
- nuclear track etch detectors (CR-39)
- TLD/OSLD + CR-39 → absorbed dose + dose equivalent
- passive detectors package (PDP)
- NPI: TLD ($\text{CaSO}_4:\text{Dy}$; $\text{Al}_2\text{O}_3:\text{C}$ / MTS-6 and MTS-7) + CR-39 (Harzlas TD-1; Baryotrak/Tastrak)

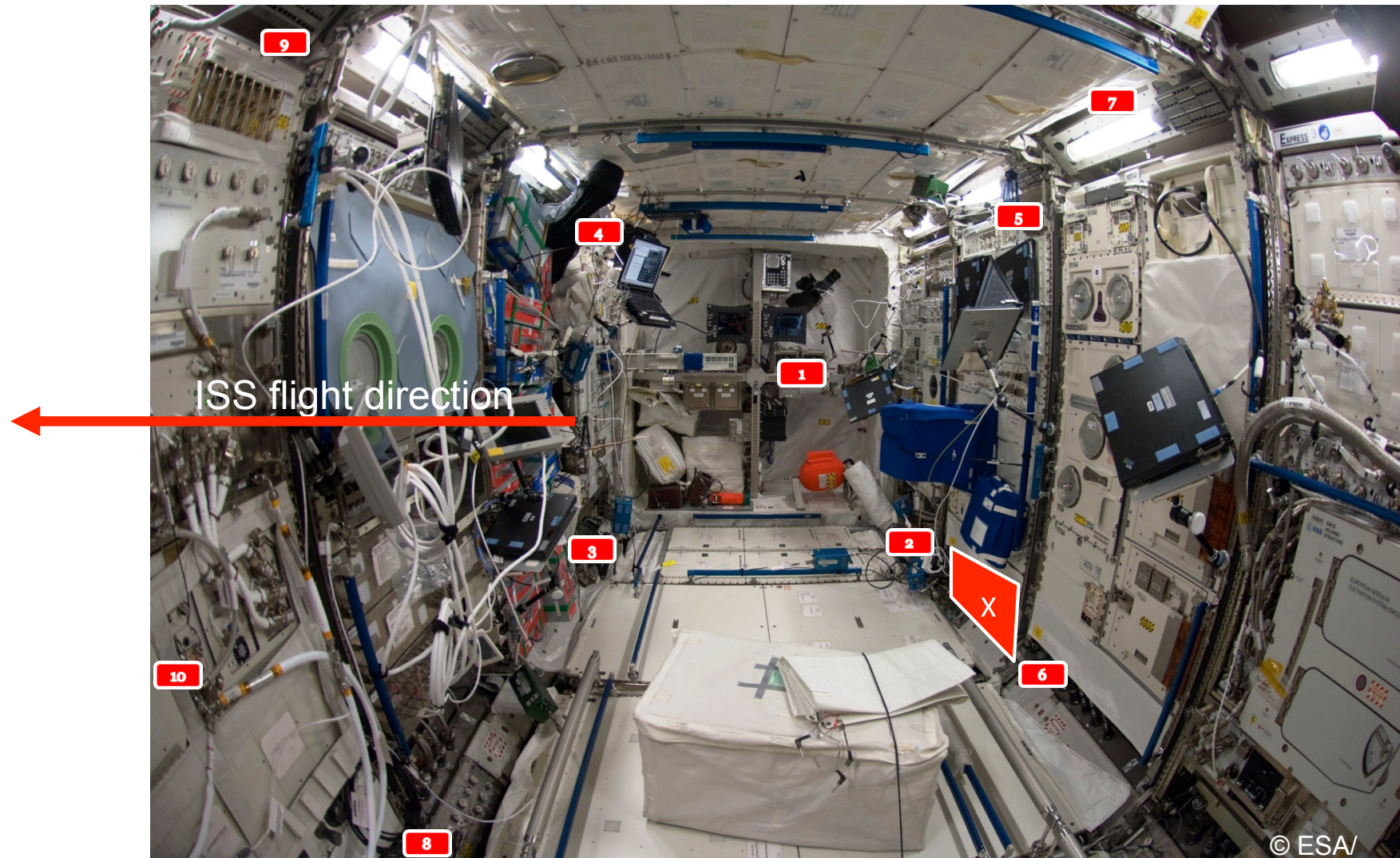


DOSIS & DOSIS 3D: PDP

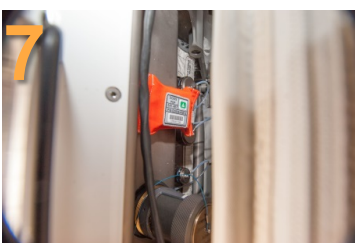
- <https://twitter.com/esaspaceflight/status/1024685877635817473>
- Meet the new face of radiation detection. Little orange pouches like Larry may look inactive, but they're actually recording radiation levels on the @space_station. It's all part of helping future astronauts stay well... #Columbus10Years #cartoon



DOSIS & DOSIS 3D: PDP Positions



DOSIS & DOSIS 3D: PDP Positions



PDP Nr	Columbus Location	Related Rack	Position		Columbus coordinate system [cm]		
					X	Y	Z
1	Star Cone	-	Behind bend in right cone structure	Aft	681	-57	0
2	A4 UIP	HRF 2	Left side on UIP next to Vacuum connector	Aft	665	-123	-93
3	F4 UIP	HRF 1	Left side on UIP next to Vacuum connector	Forward	570	123	-93
4	B1 HRF 1	HRF 1	Front panel of Cooling Stowage Drawer	Forward	600	104	60
5	A3 EPM	EPM	410 mm left from upper right edge	Aft	463	-104	93
6	A2 UIP	BLB	Left side on UIP next to Vacuum connector	Aft	436	-123	-93
7	O2 UIP	-	Left side on UIP next to Vacuum connector	Aft	436	-101	106
8	F1 UIP	EDR	Left side on UIP next to Vacuum connector	Forward	243	123	-93
9	F1 EDR	EDR	77 mm left from upper right edge	Forward	333	104	93
10	End Cone	-	On PBA Cover	Forward	221	95	85
X	DOSIS-MAIN-BOX	EPM	On the left side of the DOSIS-MAIN-BOX	Aft	516	-116	-60

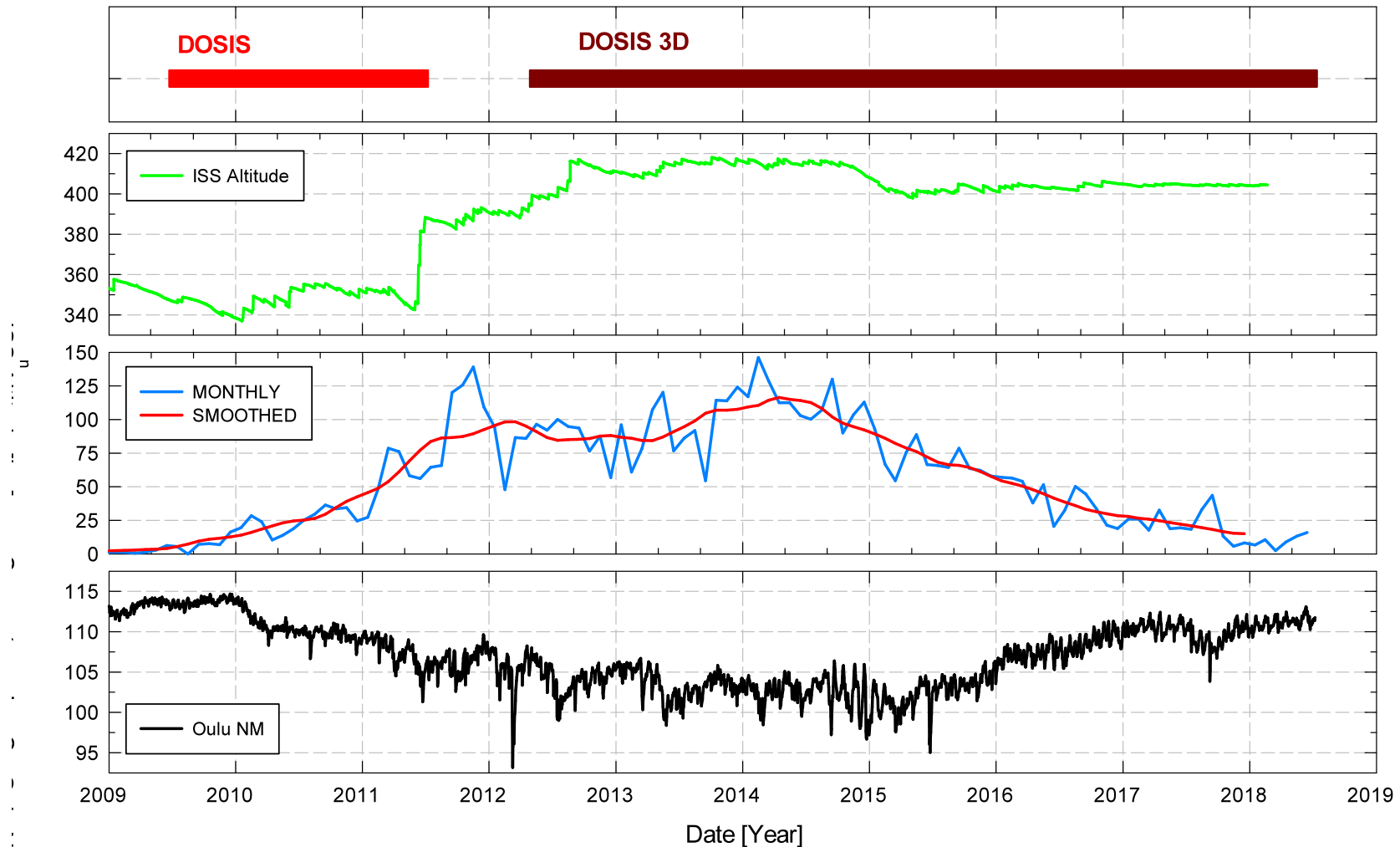


DOSIS & DOSIS 3D: PDP

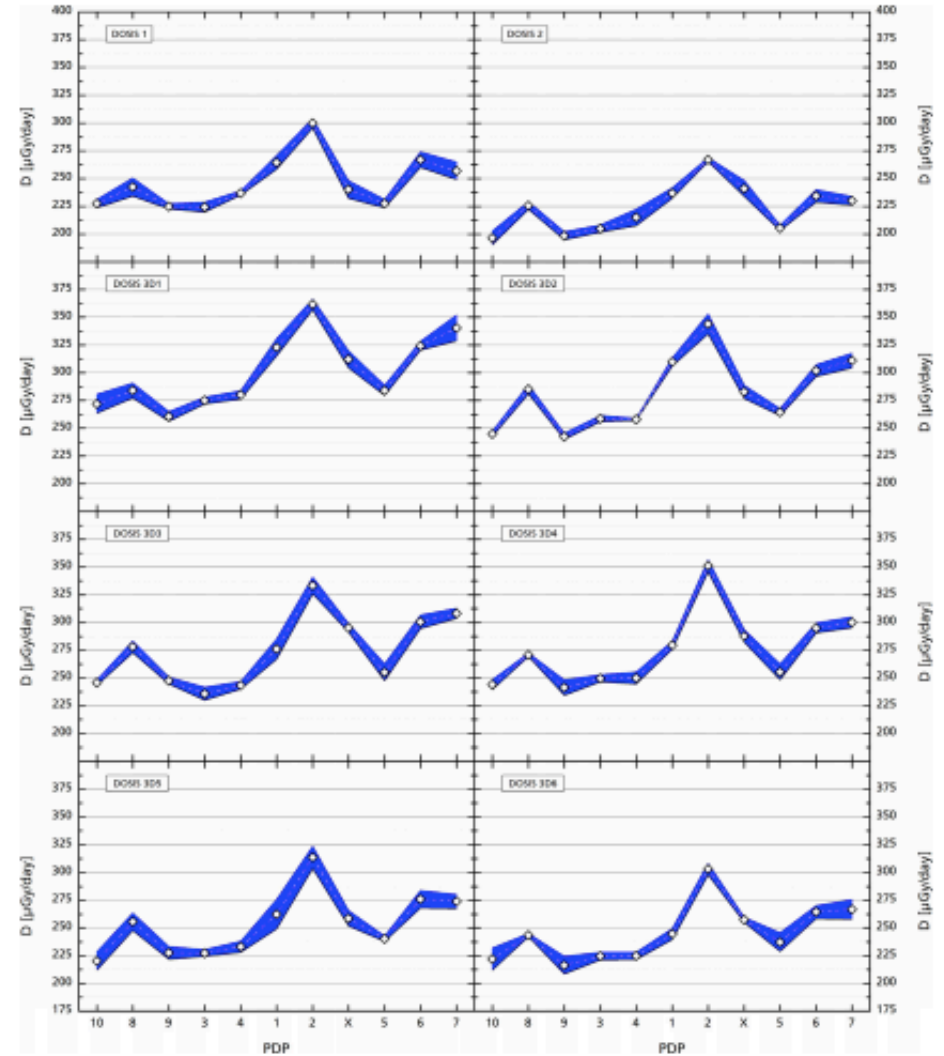
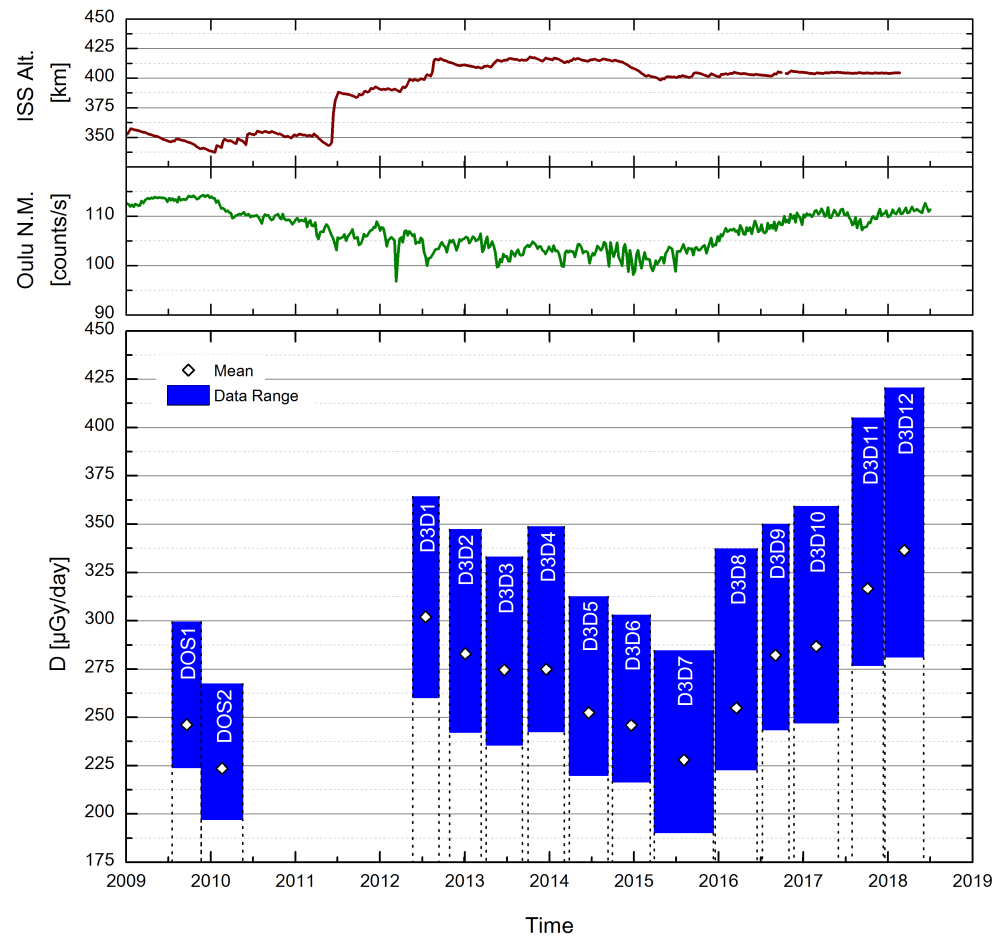
Experiment	Phase	Timeline	Duration [days]	Installed [days]	Installed [%]	ISS altitude [km]
DOSIS (Passive)	1	July 15, 2009 – November 27, 2009	136	127	93	339-348
	2	November 16, 2009 – May 26, 2010	191	178	93	337-349
DOSIS 3D (Passive)	1	May 15, 2012 – September 17, 2012	125	113	90	397-417
	2	October 23, 2012 – March 16, 2013	144	137	95	407-416
	3	March 28, 2013 – September 11, 2013	167	156	93	409-417
	4	September 25, 2013 – March 11, 2014	167	156	93	413-418
	5	March 25, 2014 – September 11, 2014	170	161	95	413-417
	6	September 26, 2014 – March 12, 2015	167	161	96	401-416
	7	March 27, 2015 – December 11, 2015	259	256	99	398-405
	8	December 15, 2015 – June 18, 2016	186	161	97	401-405
	9	July 07, 2016 – October 30, 2016	115	109	95	401-406
	10	November 17, 2016 – June 02, 2017	197	192	97	403-406
	11	July 28, 2017 – December 14, 2017	139	135	97	404-405
	12	December 17, 2017 – June 02, 2018	168	167	96	403-405

DOSIS & DOSIS 3D:

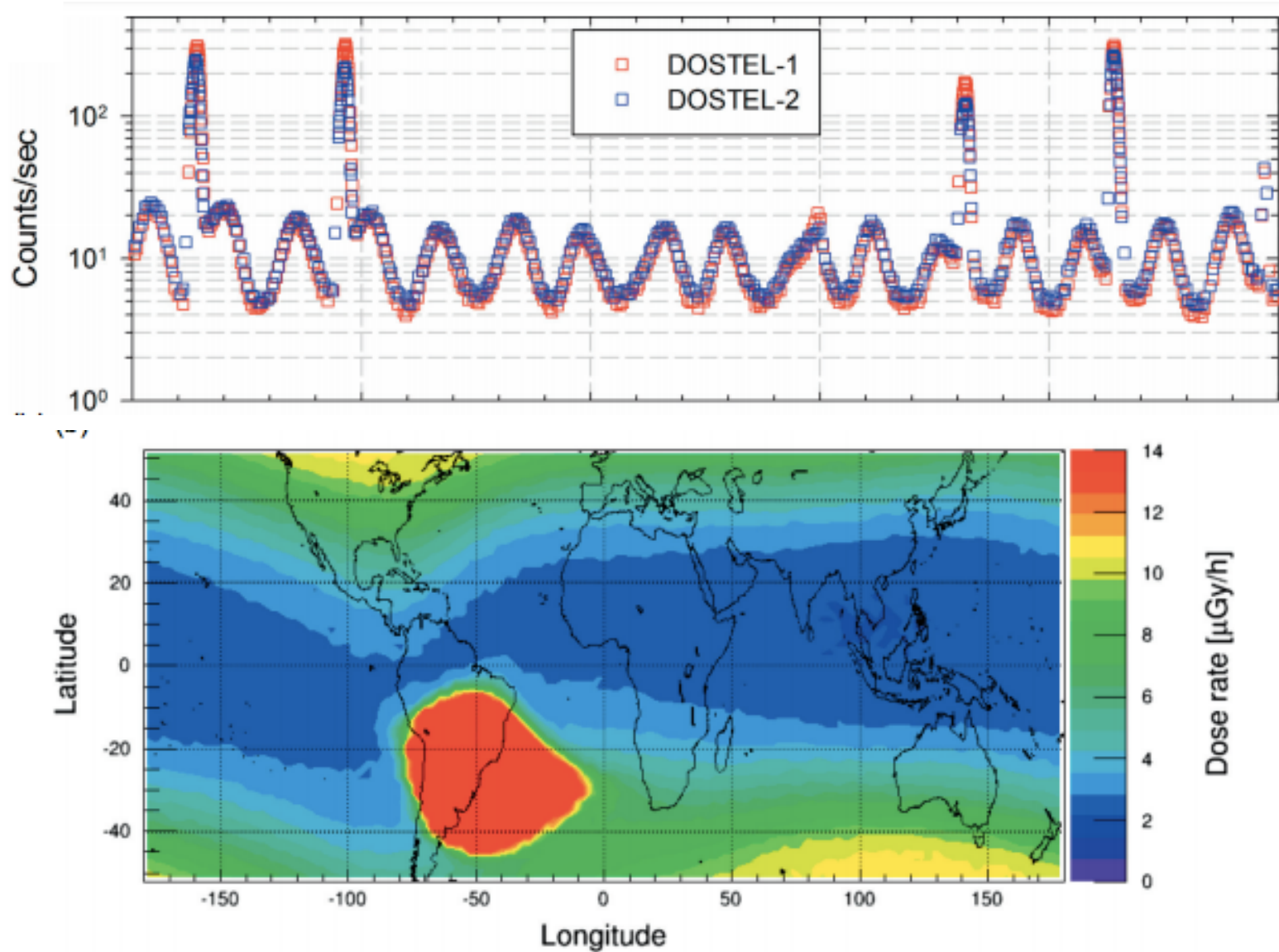
Timeline / ISS Altitude / S_n / Oulu NM



DOSIS & DOSIS 3D: PDP results



DOSIS & DOSIS 3D: DOSTEL results



DOSIS & DOSIS 3D: Results → Publications

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ACCESS

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RESEARCH ARTICLE

OPEN ACCESS

DOSIS & DOSIS 3D: long-term dose monitoring onboard the Columbus Laboratory of the International Space Station (ISS)

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RESEARCH ARTICLE

OPEN ACCESS

DOSIS & DOSIS 3D: radiation measurements with the DOSTEL instruments onboard the Columbus Laboratory of the ISS in the years 2009–2016

Thomas Berger^{1*}, Sönke Burmeister², Daniel Matthiä¹, Bartos Przybyla¹, Günther Reitz¹, Pawel Bilski³, Michael Hajek^{4,5}, Lembit Sihver^{5,6}, Julianna Szabo⁷, Iva Ambrozova⁸, Filip Vanhavere⁹, Ramona Gaza^{10,11}, Edward Semones¹⁰, Eduardo G. Yukihara¹², Eric R. Benton¹², Yukio Uchihori¹³, Satoshi Kodaira¹³, Hisashi Kitamura¹³, and Matthias Boehme¹⁴

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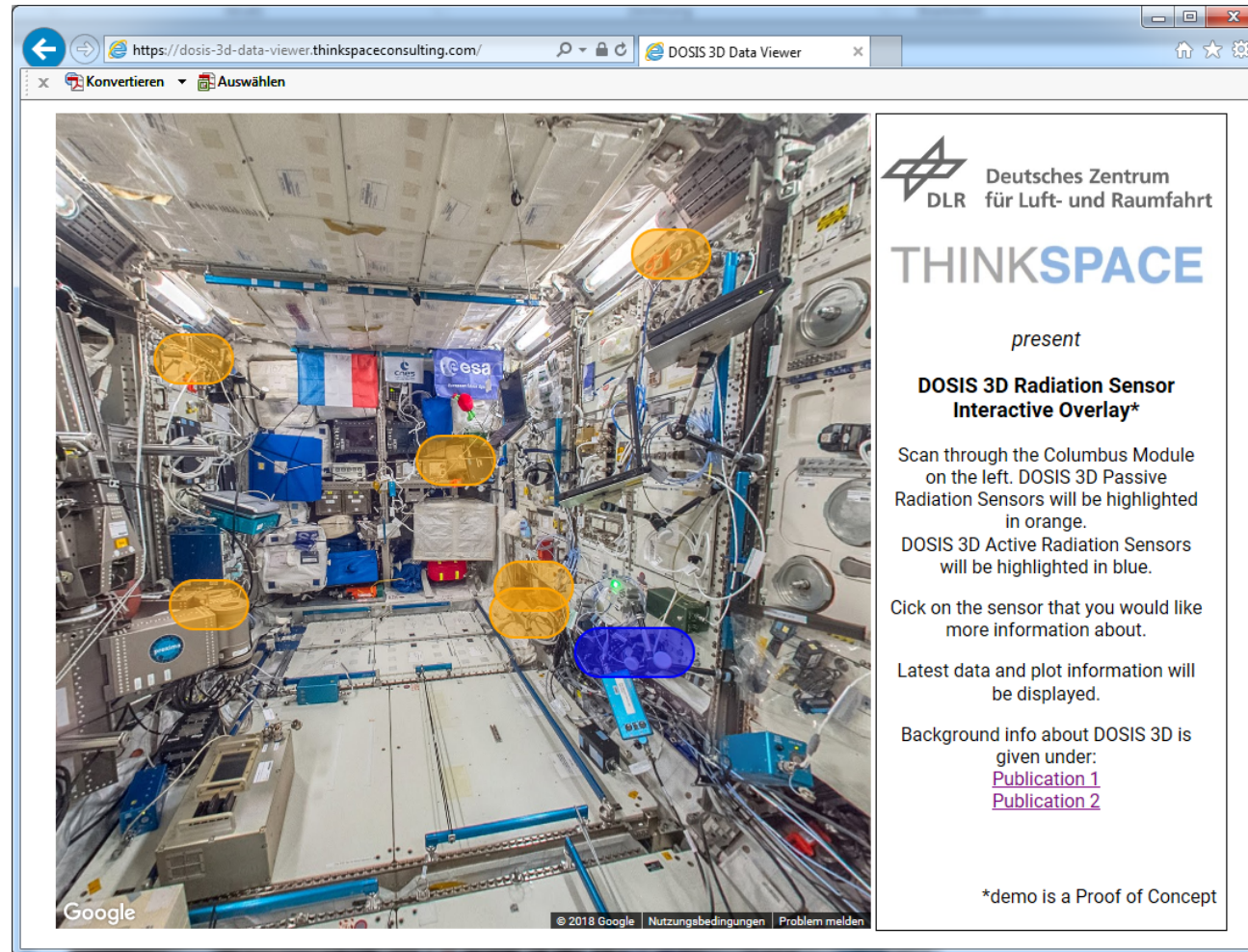
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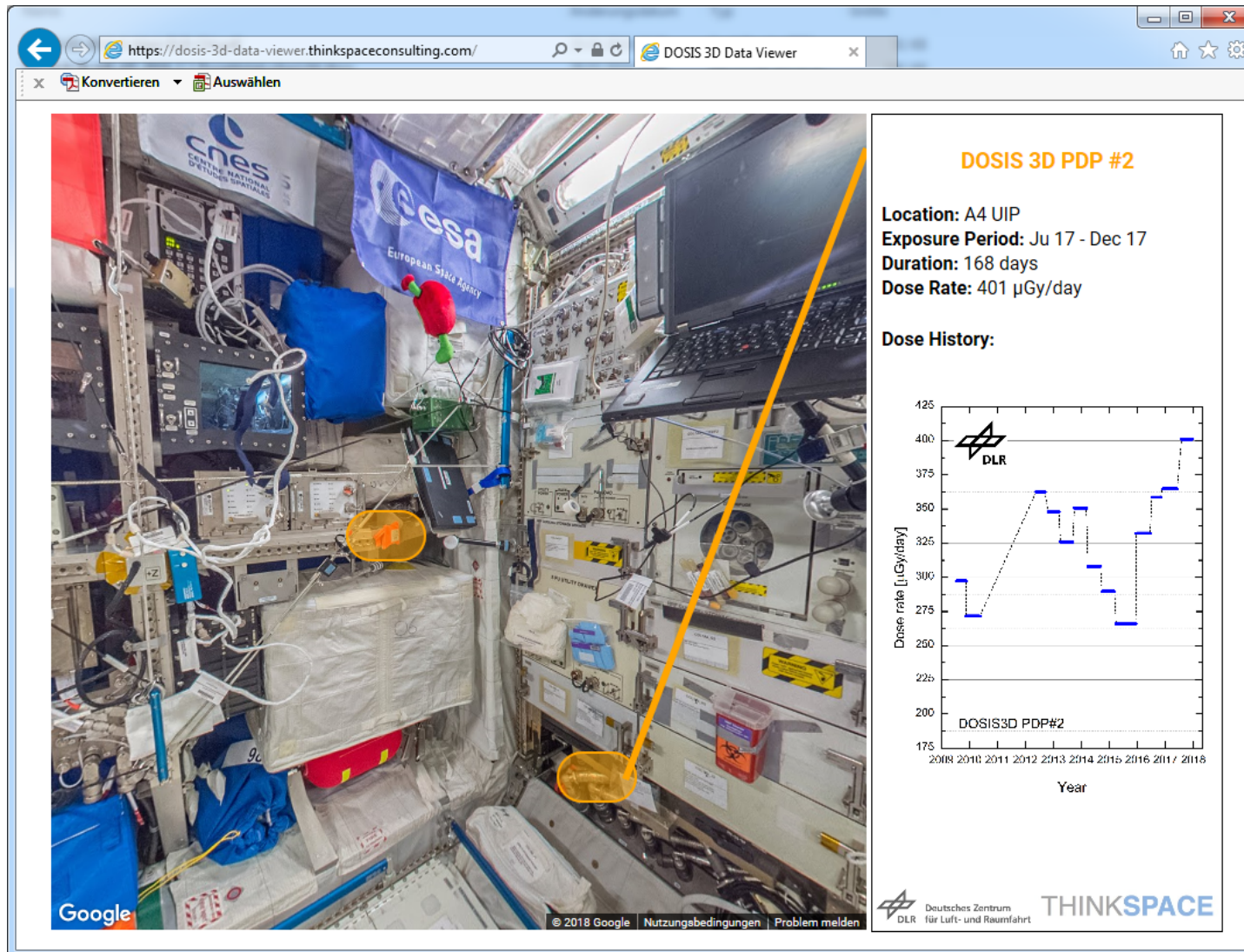
https://www.swsc-journal.org/articles/swsc/full_html/2017/01/swsc160046/swsc160046.html

DOSIS & DOSIS 3D: Data viewer

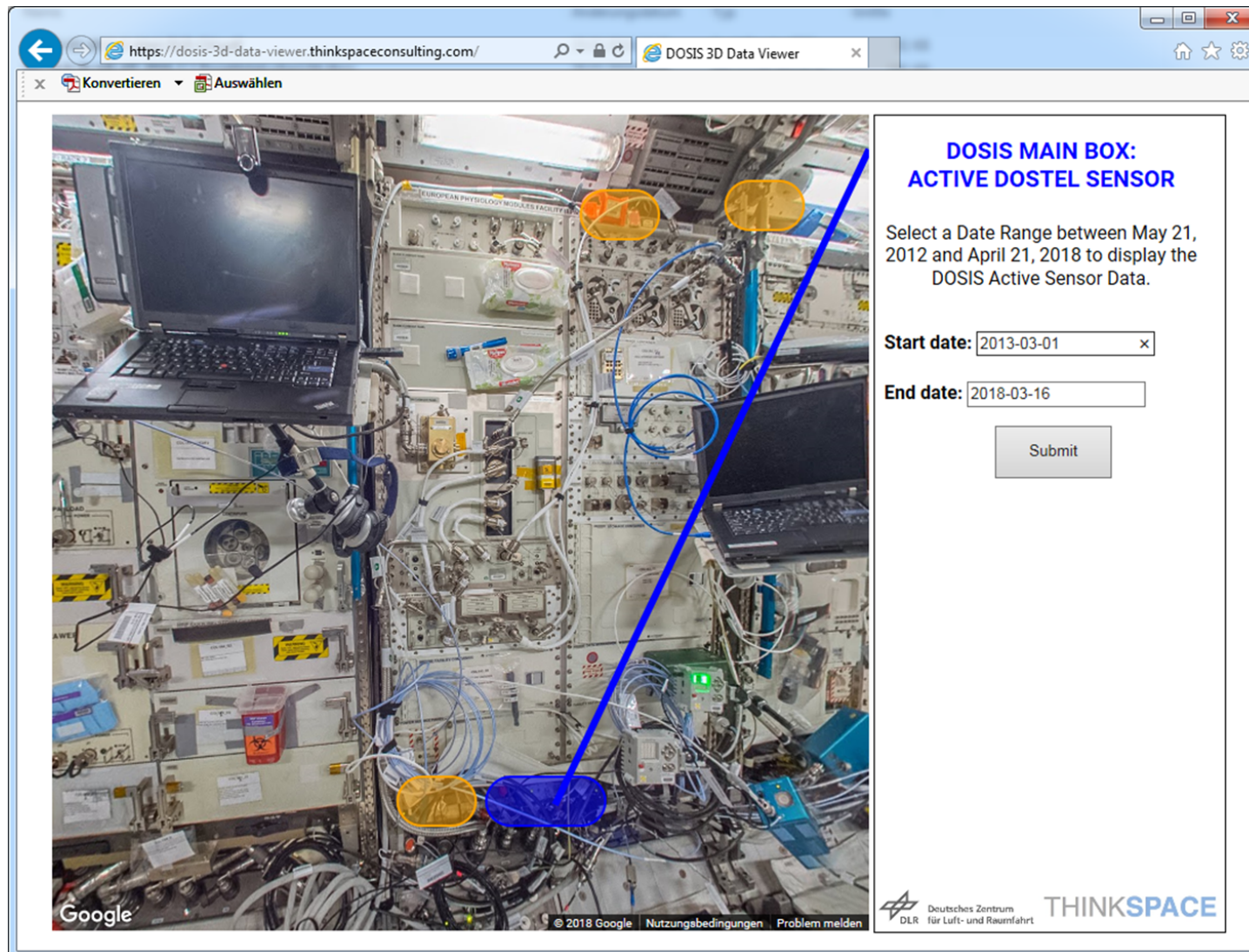


<https://dosis-3d-data-viewer.thinkspaceconsulting.com/>

DOSIS & DOSIS 3D: Data viewer



DOSIS & DOSIS 3D: Data viewer



<https://dosis-3d-data-viewer.thinkspaceconsulting.com/>

Konvertieren Auswählen

**DOSIS MAIN BOX:
ACTIVE DOSTEL SENSOR**

Select a Date Range between May 21, 2012 and April 21, 2018 to display the DOSIS Active Sensor Data.

Start date: x

End date:

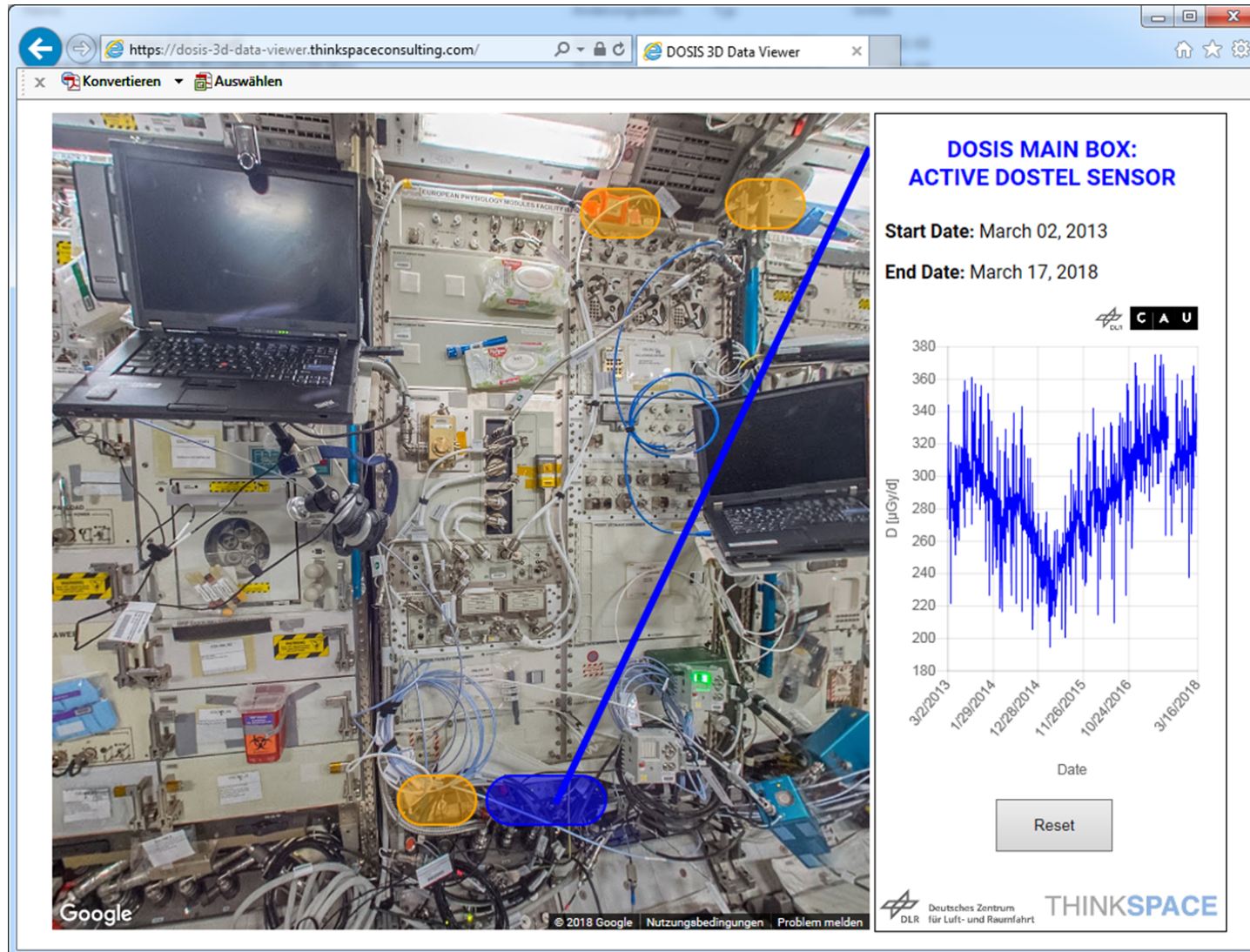
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THINKSPACE

DOSIS & DOSIS 3D: Data viewer



DOSIS & DOSIS 3D: Acknowledgements

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