DOSIS and DOSIS 3D on-board the ISS

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Workshop on the anniversary of 10 Years of the Czech Republic in ESA, 12th November 2018, Prague, Czech Republic
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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¹⁶ESA-ESTEC (European Space Agency), Noordwijk, The Netherlands
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 (CaSO$_4$:Dy; Al$_2$O$_3$:C / MTS-6 and MTS-7) + CR-39 (Harzlas TD-1; Baryotrak/Tastrak)
DOSIS & DOSIS 3D: PDP

- [https://twitter.com/esaspaceflight/status/1024685877635817473](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

<table>
<thead>
<tr>
<th>PDP Nr</th>
<th>Columbus Location</th>
<th>Related Rack</th>
<th>Position</th>
<th>Columbus coordinate system [cm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>1</td>
<td>Star Cone</td>
<td>-</td>
<td>Behind bend in right cone structure</td>
<td>Aft</td>
</tr>
<tr>
<td>2</td>
<td>A4 UIP</td>
<td>HRF 2</td>
<td>Left side on UIP next to Vacuum connector</td>
<td>Aft</td>
</tr>
<tr>
<td>3</td>
<td>F4 UIP</td>
<td>HRF 1</td>
<td>Left side on UIP next to Vacuum connector</td>
<td>Forward</td>
</tr>
<tr>
<td>4</td>
<td>B1 HRF 1</td>
<td>HRF 1</td>
<td>Front panel of Cooling Stowage Drawer</td>
<td>Forward</td>
</tr>
<tr>
<td>5</td>
<td>A3 EPM</td>
<td>EPM</td>
<td>410 mm left from upper right edge</td>
<td>Aft</td>
</tr>
<tr>
<td>6</td>
<td>A2 UIP</td>
<td>BLB</td>
<td>Left side on UIP next to Vacuum connector</td>
<td>Aft</td>
</tr>
<tr>
<td>7</td>
<td>O2 UIP</td>
<td>-</td>
<td>Left side on UIP next to Vacuum connector</td>
<td>Aft</td>
</tr>
<tr>
<td>8</td>
<td>F1 UIP</td>
<td>EDR</td>
<td>Left side on UIP next to Vacuum connector</td>
<td>Forward</td>
</tr>
<tr>
<td>9</td>
<td>F1 EDR</td>
<td>EDR</td>
<td>77 mm left from upper right edge</td>
<td>Forward</td>
</tr>
<tr>
<td>10</td>
<td>End Cone</td>
<td>-</td>
<td>On PBA Cover</td>
<td>Forward</td>
</tr>
<tr>
<td></td>
<td>DOSIS-MAIN-BOX</td>
<td>EPM</td>
<td>On the left side of the DOSIS-MAIN-BOX</td>
<td>Aft</td>
</tr>
</tbody>
</table>

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## DOSIS & DOSIS 3D: PDP

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

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DOSIS & DOSIS 3D:
Timeline / ISS Altitude / $S_n$ / Oulu NM

Workshop on the anniversary of 10 Years of the Czech Republic in ESA, 12th November 2018, Prague, Czech Republic
DOSIS & DOSIS 3D: PDP results
DOSIS & DOSIS 3D: DOSTEL results
DOSIS & DOSIS 3D: long-term dose monitoring onboard the Columbus Laboratory of the International Space Station (ISS)

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Received 20 July 2016 / Accepted 19 September 2016

https://www.swsc-journal.org/articles/swsc/full_html/2016/01/swsc160033/swsc160033.html

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

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Received 2 November 2016 / Accepted 30 January 2017


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DOSIS & DOSIS 3D: Data viewer

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

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DOSIS & DOSIS 3D: Data viewer
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DOSIS & DOSIS 3D: Acknowledgements

We gratefully acknowledge the support of the European Space Agency (ESA) especially Jason Hatton, Rene Demets, Chiara Lombardi and Liesbeth De Smet as well as colleagues from CADMOS, Toulouse, France and DLR-MUSC, Cologne, Germany.

All of this experiments would not be possible without the help of all the astronauts working on the DOSIS and DOSIS 3D experiment:
Frank de Winne, Tracy Caldwell-Dyson, Shannon Walker, Ron Garan, Mike Fossum, Andre Kuipers, Joe Acaba, Sunita Williams, Chris Hadfield, Chris Cassidy, Luca Parmitano, Michael Hopkins, Rick Mastracchio, Koichi Wakata, Alexander Gerst, Samantha Cristoforetti, Scott Kelly, Timothy Peake, Jeffrey Williams, Takuya Onishi, Thomas Pesquet, Jack Fischer, Mark Vande Hei, Norishige Kanai, Andrew Feustel

At DLR, Cologne, DOSIS 3D was supported by the DLR grant FuE-Projekt “ISS LIFE” (Programm RF-FuW, Teilprogramm 475).

The participation of the Technische Universität Wien, Atominsitut (ATI), Vienna, Austria in the DOSIS-1 and -2 experiments was supported by the Austrian Space Applications Programme (ASAP) under contract no. 819643.

The Polish contribution for the Institute of Nuclear Physics (IFJ), Krakow, Poland was supported by the National Science Center (project No DEC-2012/06/M/ST9/00423).

MTA EK greatly acknowledges the possibility to participate in the project to the DLR and to the ESA PECS for the financial grant No. PECS4000108464.

The participation of the Nuclear Physics Institute of the Czech Academy of Sciences (NPI) has been supported by the grant of Czech Science Foundation (GACR) No. 15-16622Y.

CAU, Kiel was supported by DLR under grants 50WB0826, 50WB1026, 50WB1232 and 50WB1533.

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