Pille Measurements on ISS

I. Apáthy¹, S. Deme¹, P. Szántó¹, T. Pázmándi¹
Y. A. Akatov², V. V. Arkhangelsky²,
Igor Nikolaev³

¹HAS Centre for Energy Research, Budapest, Hungary
²Institute for Biomedical Problems, Russia
³RSC Energia, (Russia)

szanto@energia.mta.hu

18th WRMISS – Budapest, Hungary
Outline

The Pille TLD System

Pille on ISS

Results of Exp. 31-34

Summary
The Pille thermoluminescent dosimeter system

Space qualified, on-board TLD system

Dosimeters and the reader device

<table>
<thead>
<tr>
<th>Dosimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
</tr>
<tr>
<td>Material:</td>
</tr>
<tr>
<td>Dimensions:</td>
</tr>
<tr>
<td>Mass:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range (s&lt;10%):</td>
</tr>
<tr>
<td>TLD Efficiency (( \varepsilon = 1 \pm 10% )):</td>
</tr>
<tr>
<td>Accuracy (above 10 ( \mu \text{Gy} )):</td>
</tr>
</tbody>
</table>

High sensitivity

Even hourly read-outs are possible

On board of every space station since Salyut-6

More than 36 000 comparable read-outs from different space stations
Pille on ISS

DOSMAP project

Service dosimetry system on Zvezda since 2003. (Exp. 8.)
- Dose mapping
- Personal dosimetry during CME-s
- Personal dosimetry during EVA-s
- Automatic read-out on every orbit

New dosimeters carried to ISS
- Currently 12 dosimeters onboard
Monthly manual read-outs, Exp. 31-32.
Monthly manual read-outs, Exp. 33-34.
Sample from the automatic measurements, Exp. 33-34.


One third of the dose of the astronauts are caused by the South Atlantic Anomaly.
Daily average dose rates, Exp. 27-34.

Daily mean dose rates
March 2011 – April 2013

Dose rate [μGy/h]

2011.03.08  2011.04.19  2011.05.31
2011.07.12  2011.08.23  2011.10.04
2011.11.15  2011.12.27  2012.02.07
2012.03.30  2012.05.01  2012.06.12
2012.07.24  2012.09.04  2012.11.27
2013.01.18  2013.02.19  2013.04.02

- Exp 29-30.
- Exp 31-32.
- Exp 33-34.
Weekly average dose rates, Exp. 27-34.

Weekly mean dose rates
March 2011–April 2013

Dose rate [μGy/h]

Date


Exp 27-28,
Exp 29-30,
Exp 31-32,
Exp 33-34.
EVA measurements

EXP. 31-32.
4 EVAs were measured

Aug. 20. 2012. 11:37 - 17:28 EDT
Reference dosimeter: A0306

<table>
<thead>
<tr>
<th>EVA date</th>
<th>Total EVA dose [μGy]</th>
<th>Extra EVA dose [μGy]</th>
<th>Total Dose rate [μGy/h]</th>
<th>Extra dose rate [μGy/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DosimeterA0309</td>
<td>887</td>
<td>852</td>
<td>152</td>
<td>146</td>
</tr>
<tr>
<td>DosimeterA0310</td>
<td>787</td>
<td>752</td>
<td>135</td>
<td>129</td>
</tr>
</tbody>
</table>

Aug. 30. 2012. 08:16 - 16:33 EDT
Reference dosimeter: A0306

<table>
<thead>
<tr>
<th>EVA date</th>
<th>Total EVA dose [μGy]</th>
<th>Extra EVA dose [μGy]</th>
<th>Total Dose rate [μGy/h]</th>
<th>Extra dose rate [μGy/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DosimeterA0307</td>
<td>268</td>
<td>218</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>DosimeterA0309</td>
<td>141</td>
<td>91</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>DosimeterA0310</td>
<td>153</td>
<td>103</td>
<td>18</td>
<td>12</td>
</tr>
</tbody>
</table>
EVA measurements

EXP. 31-32.

4 EVAs were measured (continued)

Sept. 4. 2012. 07:06 - 13:34 EDT

Reference dosimeter: A0301

<table>
<thead>
<tr>
<th>EVA date</th>
<th>Total EVA dose [μGy]</th>
<th>Extra EVA dose [μGy]</th>
<th>Total Dose rate [μGy/h]</th>
<th>Extra dose rate [μGy/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dosimeter A</td>
<td>193</td>
<td>150</td>
<td>29</td>
<td>23</td>
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<tr>
<td>Dosimeter B</td>
<td>135</td>
<td>92</td>
<td>21</td>
<td>14</td>
</tr>
</tbody>
</table>

Nov. 1. 2012. 08:29 - 15:07 EDT

Reference dosimeter: A0301

<table>
<thead>
<tr>
<th>EVA date</th>
<th>Total EVA dose [μGy]</th>
<th>Extra EVA dose [μGy]</th>
<th>Total Dose rate [μGy/h]</th>
<th>Extra dose rate [μGy/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dosimeter A0307</td>
<td>252</td>
<td>206</td>
<td>39</td>
<td>32</td>
</tr>
<tr>
<td>Dosimeter A0314</td>
<td>132</td>
<td>86</td>
<td>20</td>
<td>13</td>
</tr>
</tbody>
</table>
EVA measurements

EXP. 33-34.

1 EVA was measured (continued)

Apr. 19. 2013. 10:03– 16:41 EDT

Reference dosimeter: A0306 (A0307 ???)

<table>
<thead>
<tr>
<th>EVA date</th>
<th>Total EVA dose [μGy]</th>
<th>Extra EVA dose [μGy]</th>
<th>Total Dose rate [μGy/h]</th>
<th>Extra dose rate [μGy/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dosimeter A0307</td>
<td>389</td>
<td>344</td>
<td>59</td>
<td>52</td>
</tr>
<tr>
<td>Dosimeter A0309</td>
<td>826</td>
<td>781</td>
<td>124</td>
<td>117</td>
</tr>
<tr>
<td>Dosimeter A0310</td>
<td>816</td>
<td>771</td>
<td>123</td>
<td>116</td>
</tr>
</tbody>
</table>

- It is not recommended to use Dosimeter A0306 as EVA reference dosimeter
  - It’s properties (remanent dose) differ due to the continuous automatic read-outs
- EVA on Aug. 20. 2012 was probably during SAA crossing
- EVA on Apr. 19. 2013 was probably during SAA crossing
EVA excess dose rates

Excess dose rate [μGy/h]

EVA date

- Series 1
- Series 2
Dose ranges measured by Pille

Dose Rate Ranges Measured by Pille in Space
Further work and summary

Dose rates of Exp. 31-34. were similar to the previous measurements.

EVAs were performed during SAA crossing.

More information would be appreciated:
- on the exact positions of the dosimeters
- EVA activities and dosimeters used during EVAs
Thank you for your attention
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