



# TL dose measurements on board the Russian segment of the ISS during Expedition-11 and -12

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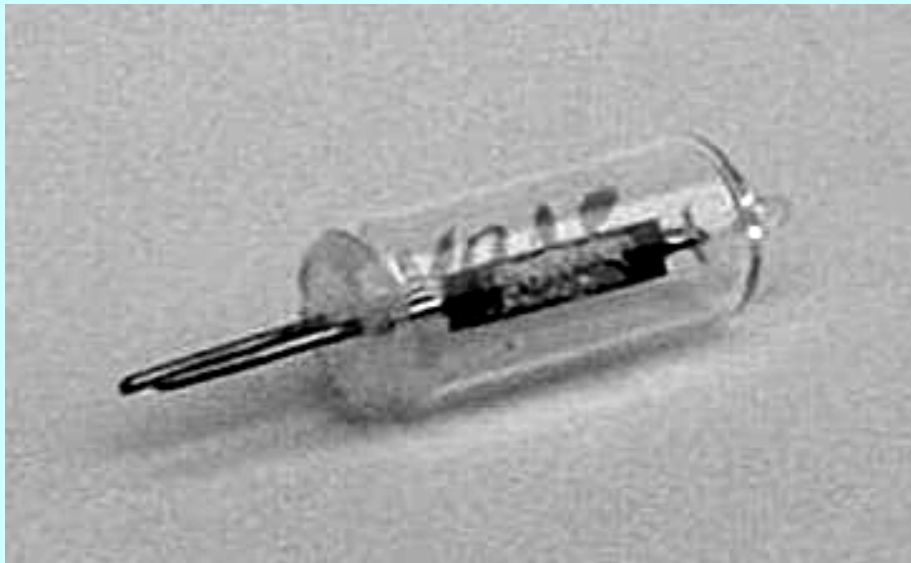
# The Pille TLD system

- **small, portable**
  - **space-qualified**
  - **suitable for reading out the TLDs on board, so**
  - **a solution for EVA dosimetry as well**
- used on board the**
- **Salyut-6 (from 1980) and -7 space stations by Hungarian and Soviet cosmonauts**
  - **Mir space station by ESA and NASA astronauts**
  - **ISS by NASA astronauts and Russian cosmonauts ⇒ service instrument**

# Main Specifications of the Pille TLD System

## Dosimeters

**Type:** bulb  
**Material:**  $\text{CaSO}_4:\text{Dy}$   
**Dimensions:**  $\phi$  20 mm \* 60 mm  
**Mass:** 70 g (with carrying case)



# Reader

<b>Measuring range (s&lt;10%):</b>	<b>10 <math>\mu</math>Gy <math>\div</math> 10 Gy (CaSO<sub>4</sub>:Dy)</b>
<b>TLD Efficiency <math>\varepsilon=1\pm 10\%</math></b>	<b>LET<sub><math>\infty</math></sub>H<sub>2</sub>O &lt; 10 keV/<math>\mu</math>m</b>
<b>Read-out precision:</b>	<b>3 digits + exp.</b>
<b>Accuracy (above 10 <math>\mu</math>Gy):</b>	<b><math>\delta &lt; 5\%</math></b>
<b>Measuring modes:</b>	<b>manual / automatic read-out</b>
<b>Display:</b>	<b>8-digit alphanumeric. LED</b>
<b>Storage of information:</b>	<b>PCMCIA mem. card (&gt; 4000 data)</b>
<b>Computer connection:</b>	<b>RS-232</b>
<b>Dimensions:</b>	<b>70 mm (H)*190 mm (W)*120 mm (D)</b>
<b>Mass:</b>	<b>1,400 g</b>
<b>Power consumption:</b>	<b>0.1 / 1 / 7 W (standby/ready/readout)</b>



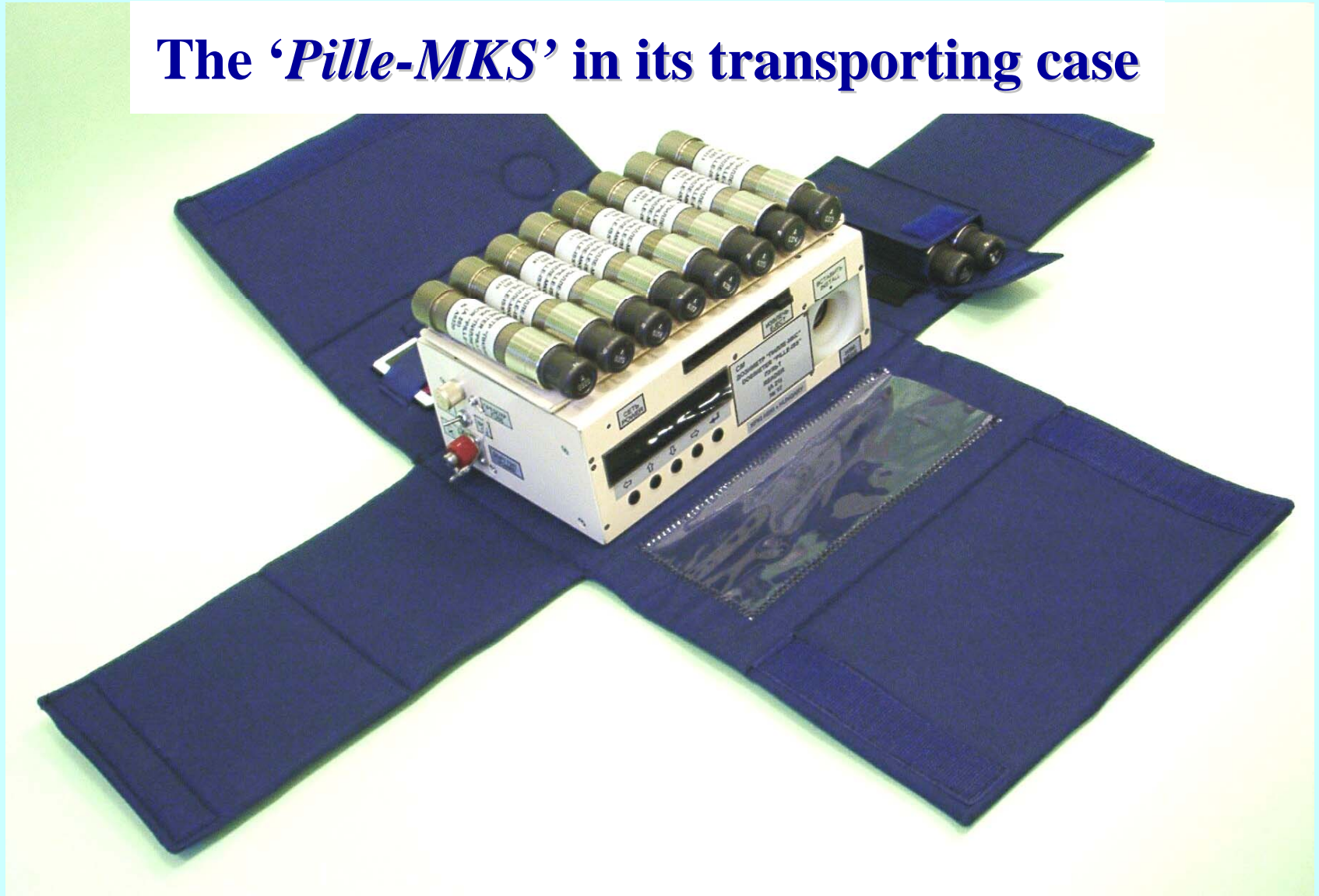
## Pille TLD System

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# ***'Pille-MKS'* on the Russian Service Module (Zvezda) of the ISS**

- **Consisting of**
  - **10 Dosimeters (№ A0301-A0310)**
  - **Reader**
- **Part of the service system**
- **Applied for**
  - **routine and EVA individual dosimetry and**
  - **onboard experiments**
- **Developed and manufactured by KFKI AEKI, Hungary**
- **Maintained by IBMP, Russia**
- **Launched on Progress-12 cargo S/C on 2003.08.29**

## The '*Pille-MKS*' in its transporting case



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# *Pille* TLD measurements during Expedition-11 and -12

- The *Pille-MKS* system was operated by
  - Sergei Krikalev (Exp.11, Commander)  
2005.05.13 – 2005.09.16



- Valery Tokarev (Exp.12, Flight Engineer)  
2005.10.18 – 2006.02.02

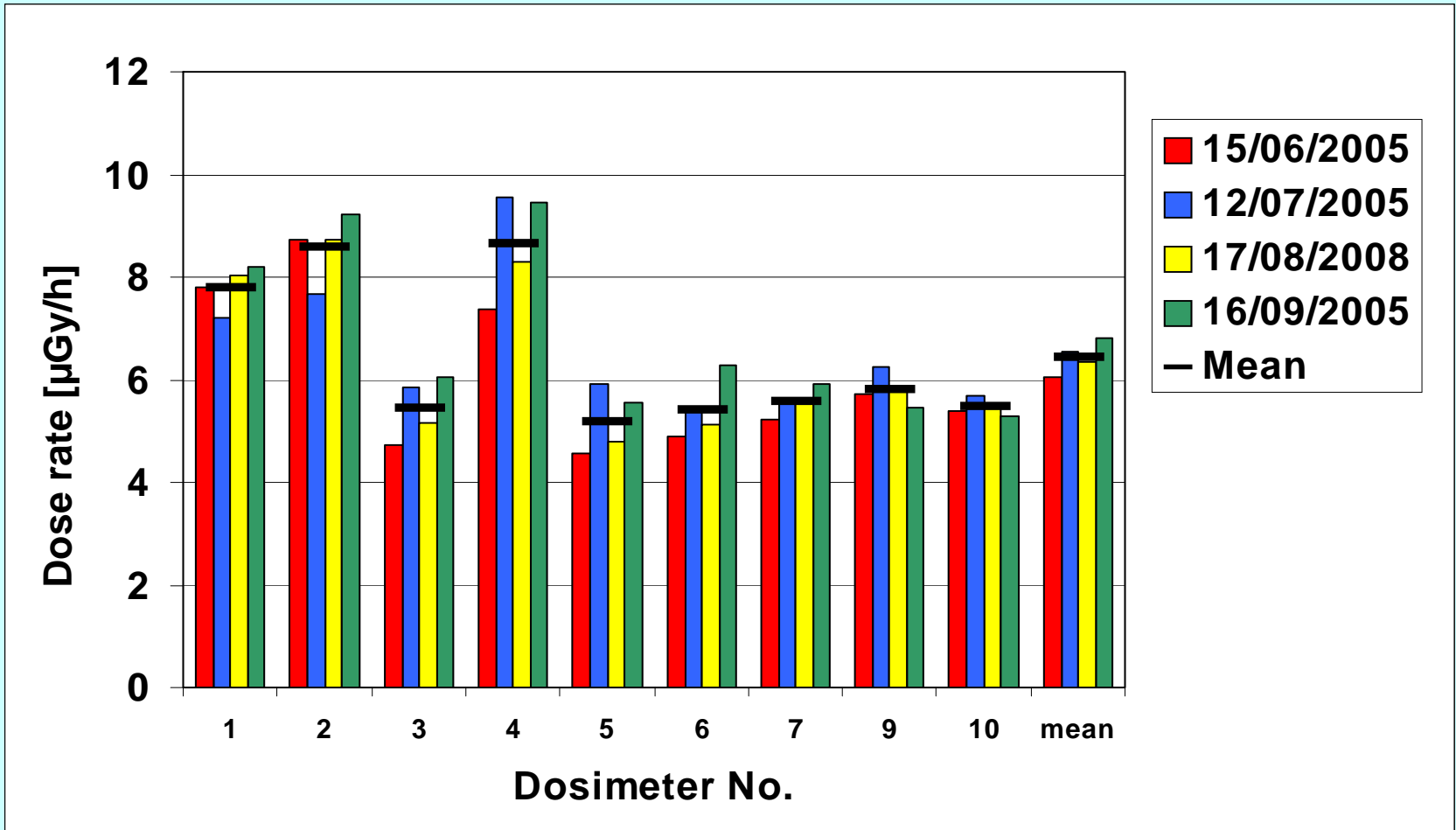
- 4691 measurements from 2005.05.13 until 2006.02.02
- Results of the measurements were transferred on memory card by to the Earth



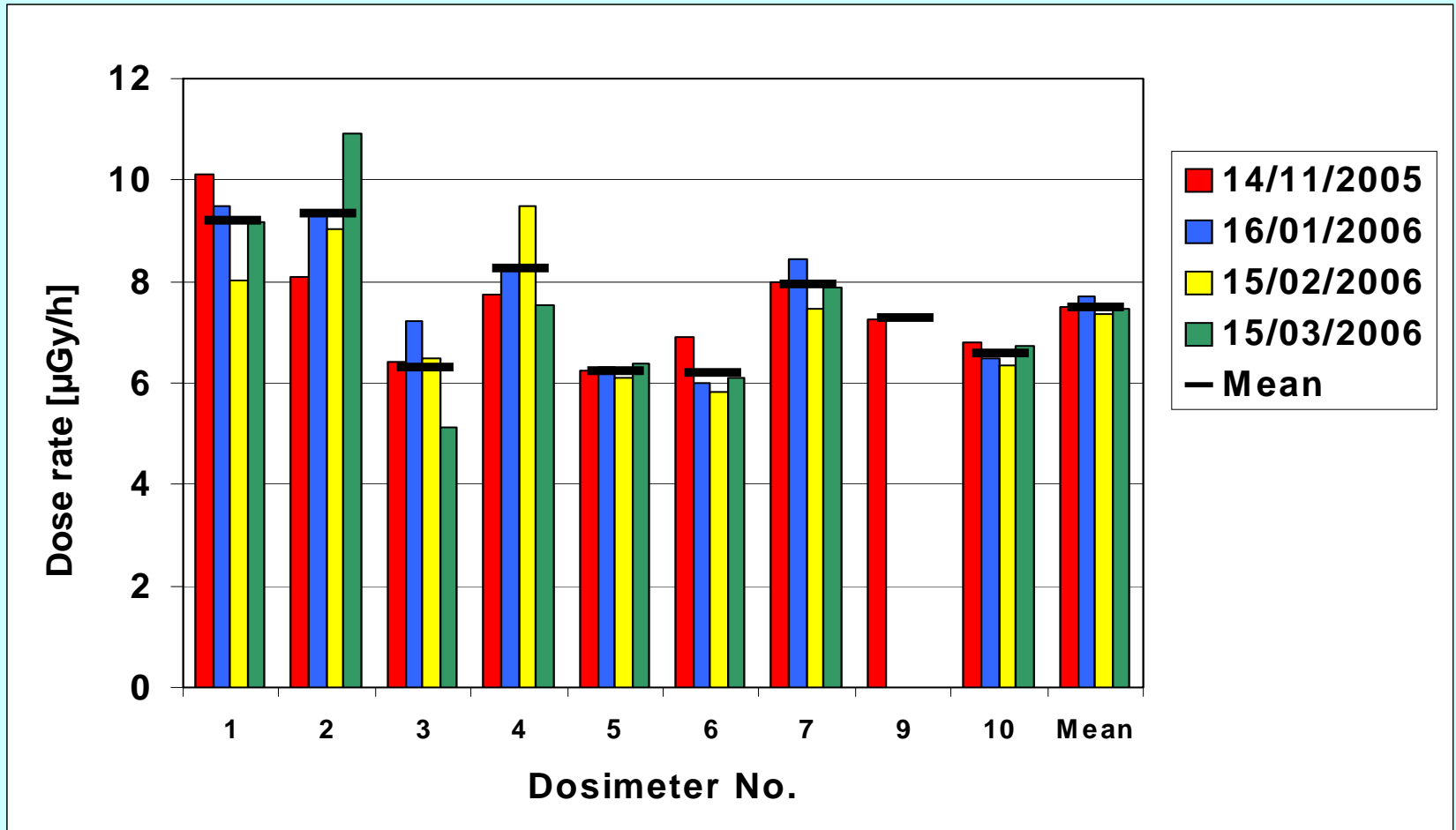
# General location and designation of the dosimeters

Dosimeter N <sup>o</sup>	Location in <i>Zvezda</i> module
A0301, A0302	Cabin of the right board, on both sides of the illuminator
A0303, A0304	Cabin of the left board, on both sides of the illuminator
A0305, A0306	Ceiling, on the system radiometer R-16
<b>A0307</b>	Right board, beside of the cabin, on ceiling of the lavatory <i>Dedicated for EVA reference measurement inside ISS</i>
<b>A0308/A0309</b> 05.11.06/ 05.11.18	Inserted in the Reader, which is fixed on the floor, right to illuminator N <sup>o</sup> 9 <i>Dedicated for automatic measurements</i>
<b>A0309, A0310</b>	In the transporting case of the Reader, left to illuminator N <sup>o</sup> 9 <i>Dedicated for EVA personal measurements</i>

# Dose rates of the single dosimeters (Exp. 11)



# Dose rates of the single dosimeters (Exp. 12)



# Dosimeter No. A0301

Cabin of the right board (Exp.9/10/11/12):  
7.8 / 10.3/ 7.8/ 9.2  $\mu\text{Gy/h}$



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# Dosimeter No. A0302

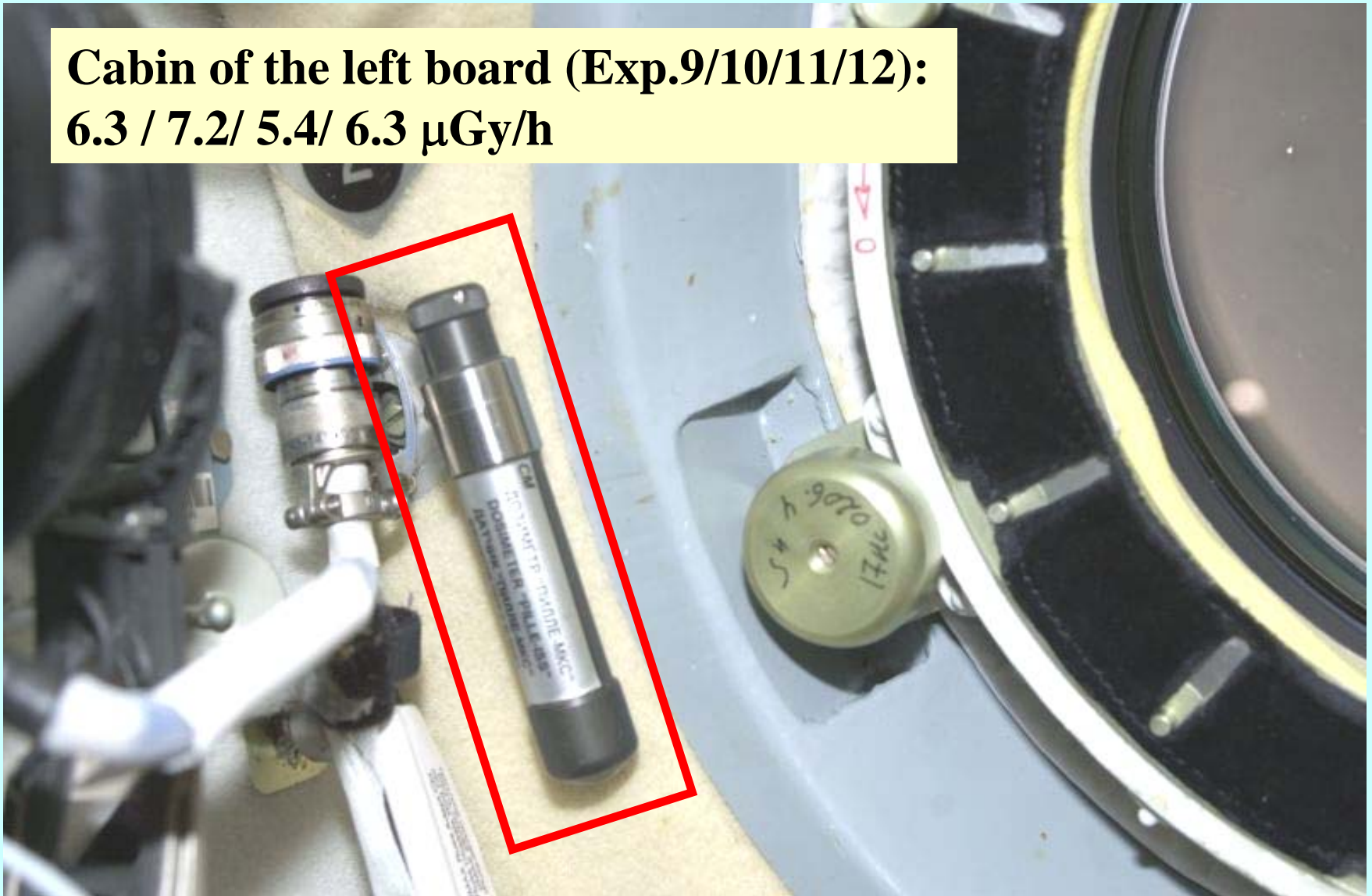
**Cabin of the right board (Exp.9/10/11/12):  
8.4 / 10.6/ 8.6/ 9.3  $\mu\text{Gy/h}$**



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# Dosimeter No. A0303

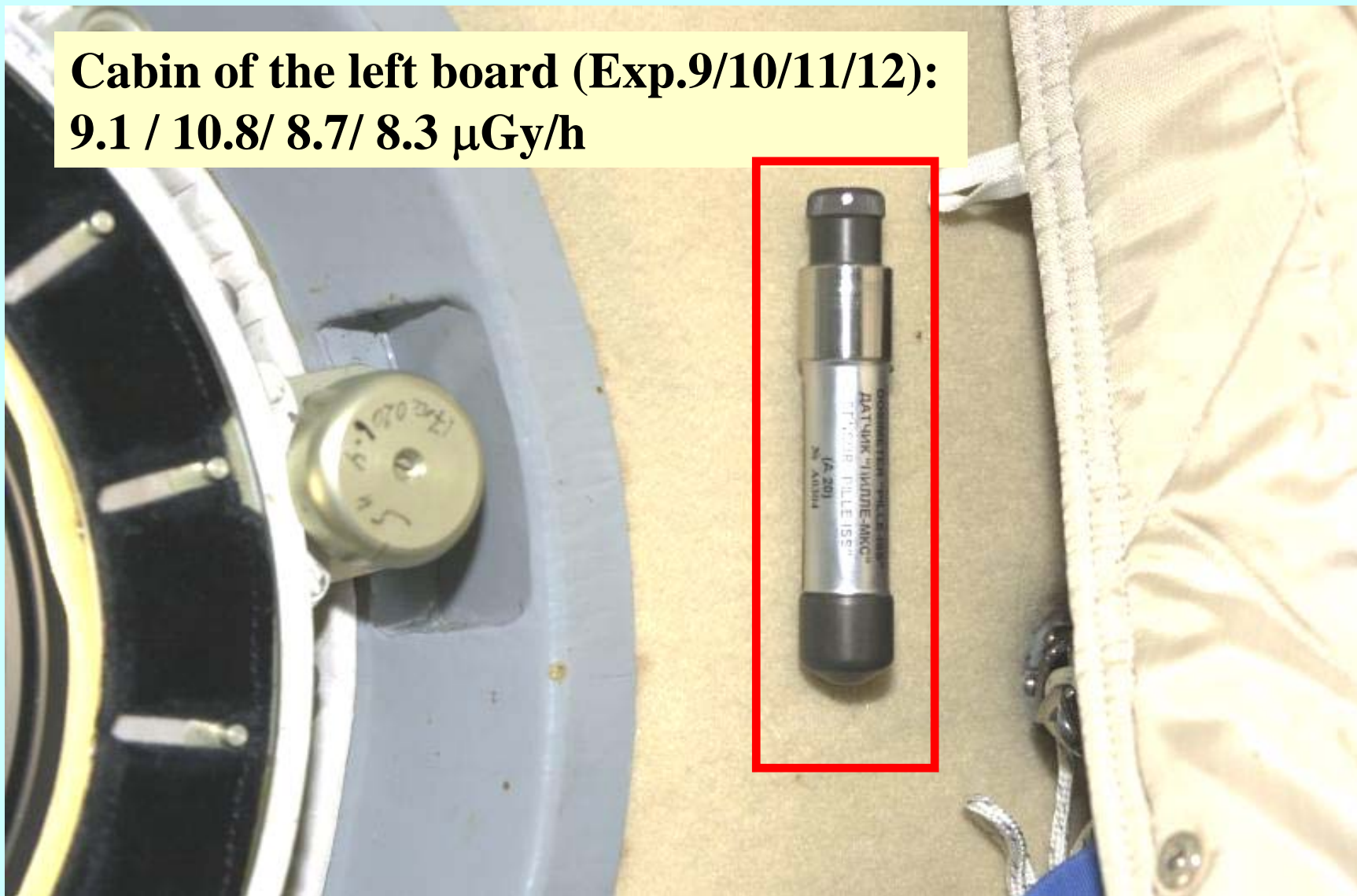
**Cabin of the left board (Exp.9/10/11/12):  
6.3 / 7.2/ 5.4/ 6.3  $\mu\text{Gy/h}$**



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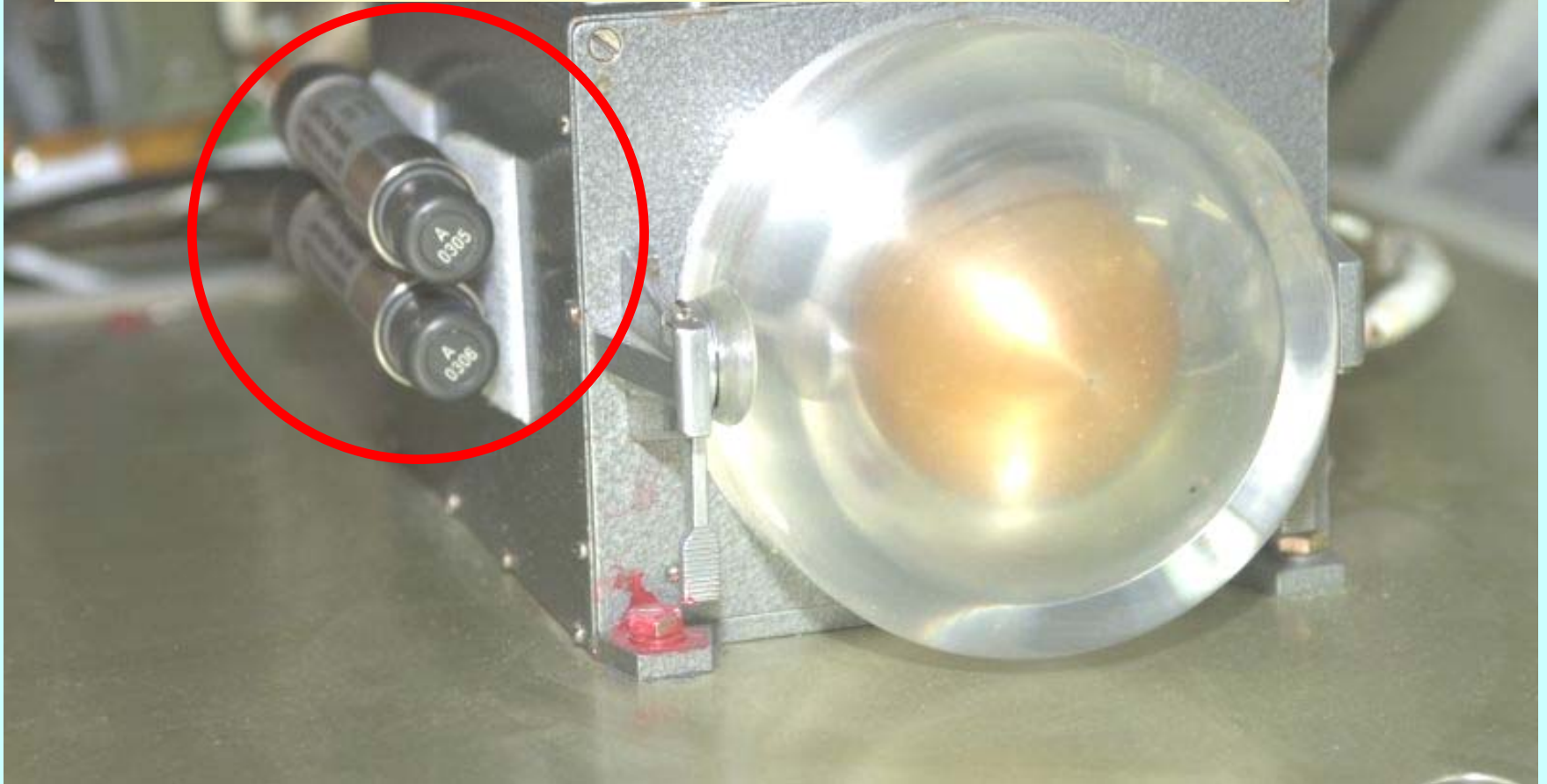
# Dosimeter No. A0304

**Cabin of the left board (Exp.9/10/11/12):  
9.1 / 10.8/ 8.7/ 8.3  $\mu\text{Gy/h}$**



# Dosimeters No. A0305 – A0306

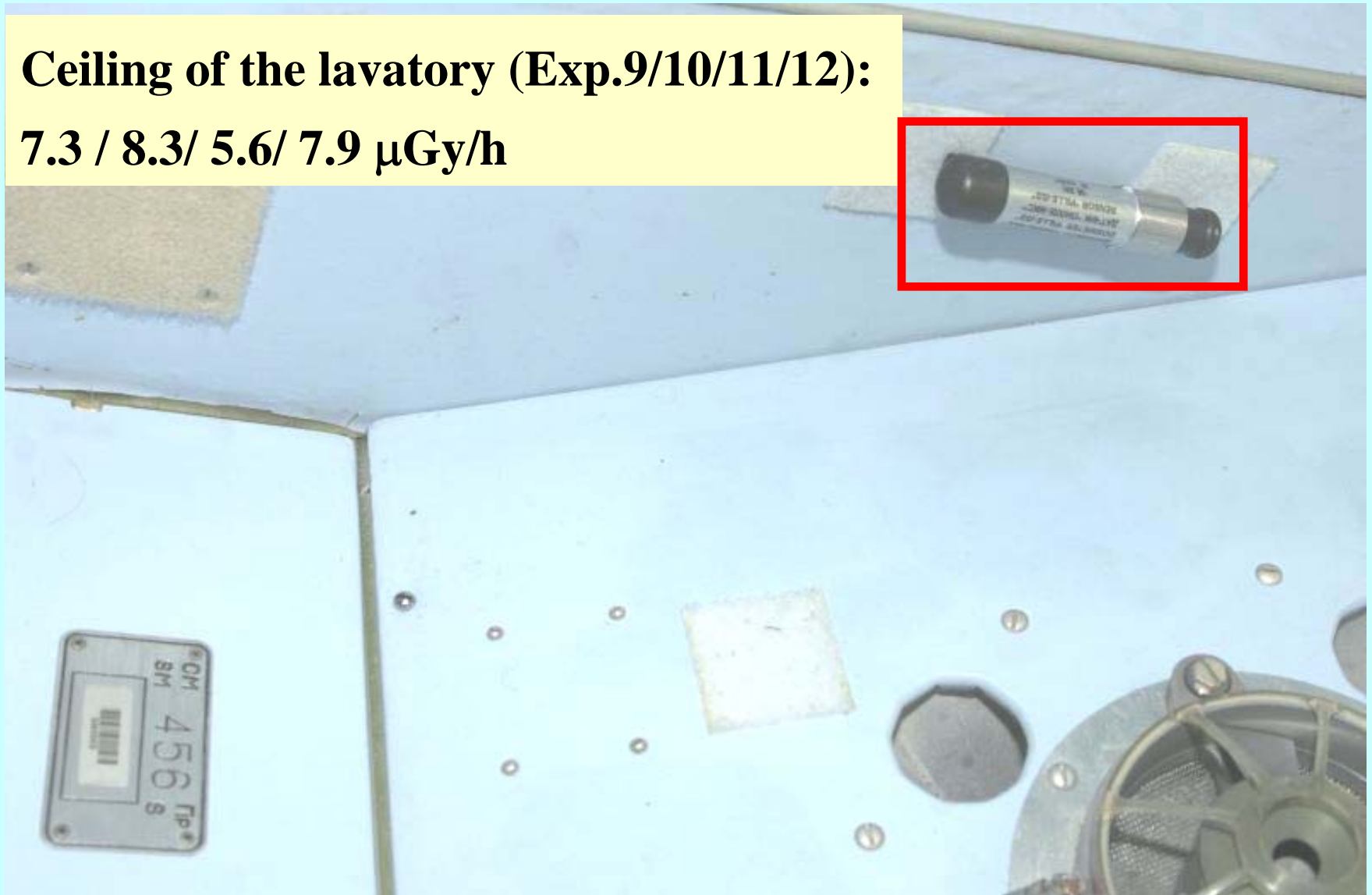
**Ceiling, on the radiometer R-16 (Exp.9/10/11/12):  
6.0 / 6.6/ 5.2, 5.4/ 6.3, 6.2  $\mu\text{Gy/h}$**





# Dosimeter No. A0307

**Ceiling of the lavatory (Exp.9/10/11/12):  
7.3 / 8.3/ 5.6/ 7.9  $\mu\text{Gy/h}$**



# Dosimeter No. A0308 in the Reader

Right to illuminator N° 9 (Exp.9/10/11/12):  
4.7 / 5.2 / 4.0/ 4.0?  $\mu\text{Gy/h}$

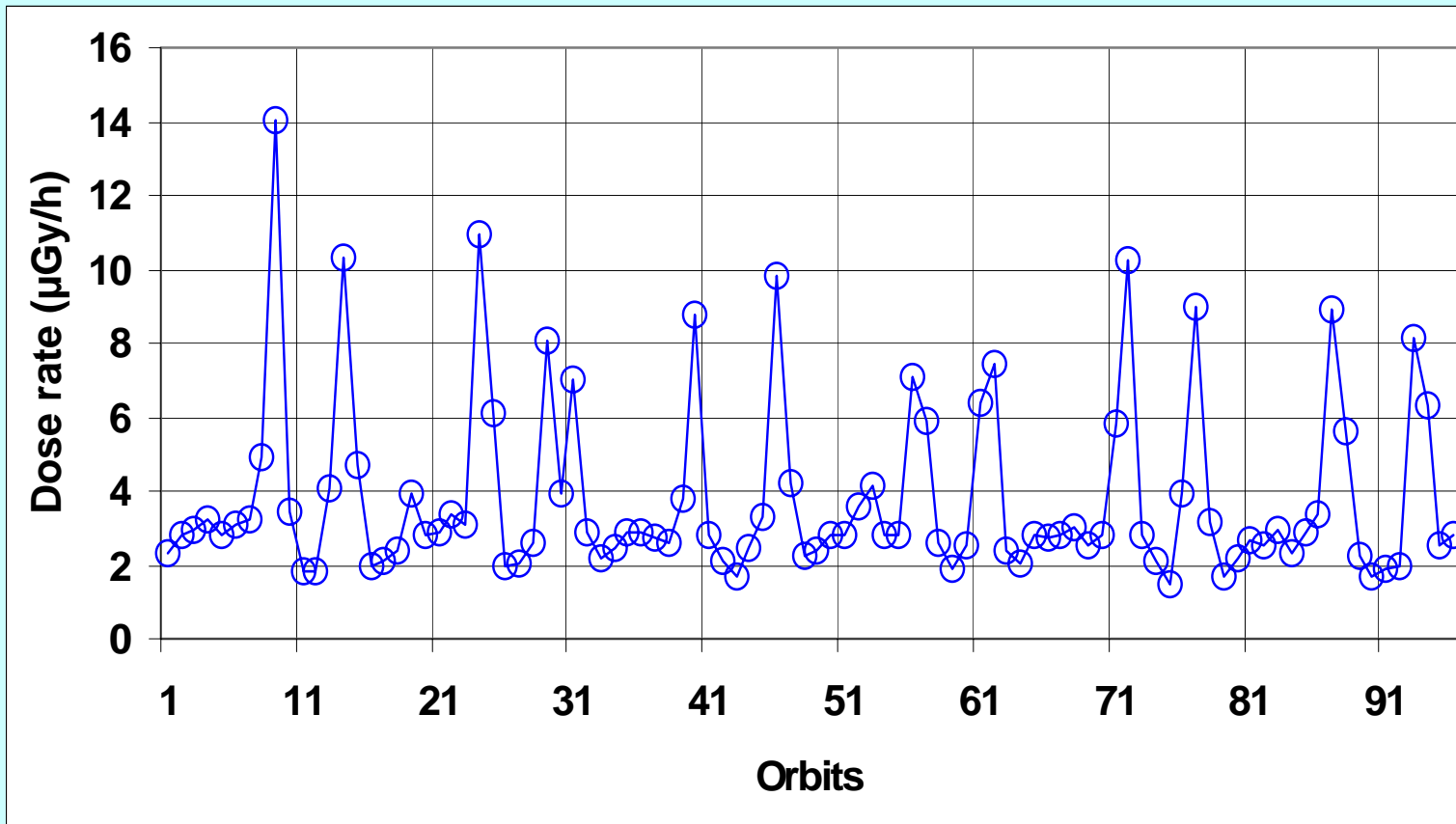


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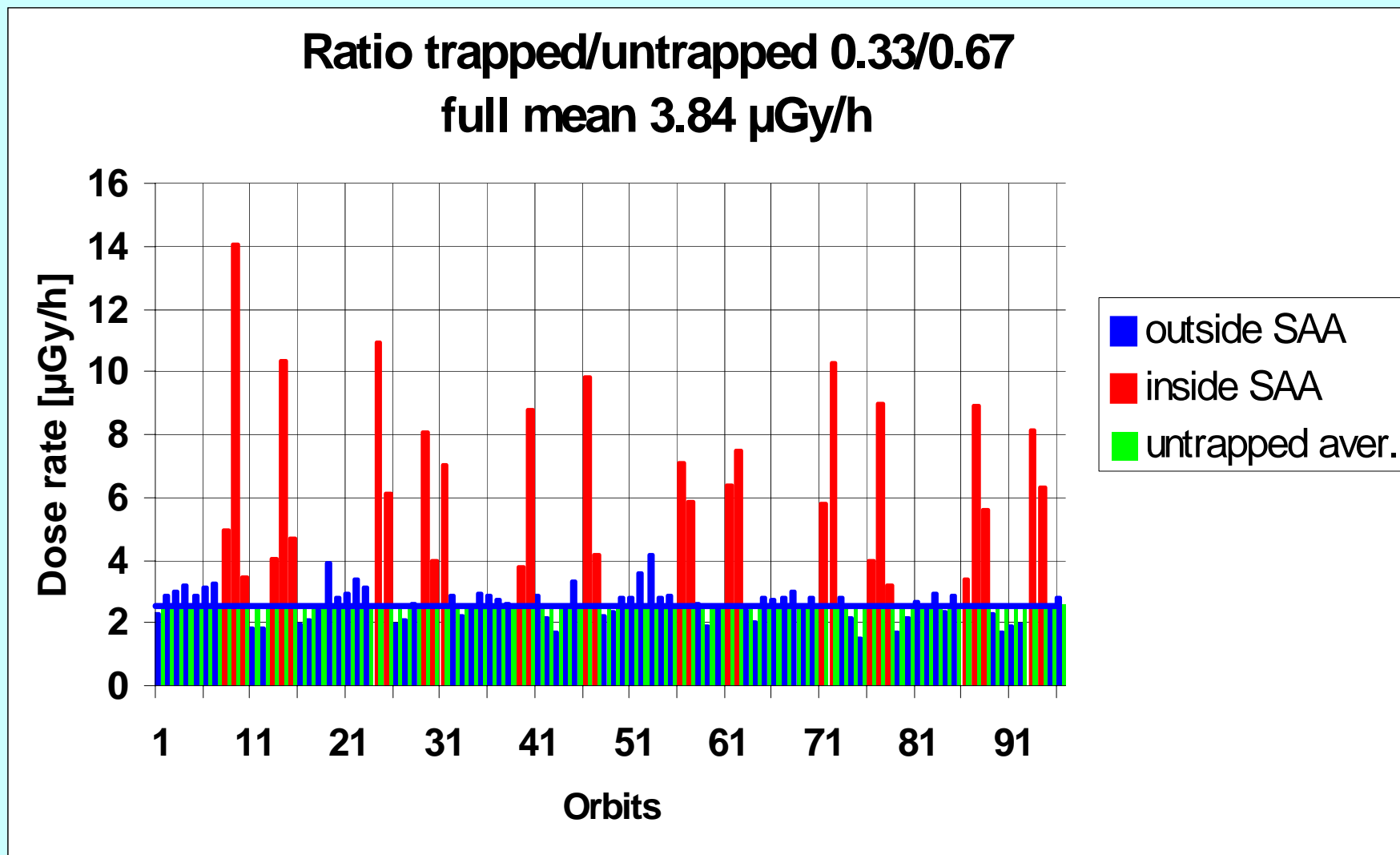
# 6-days sample of automatic measurements (No. A0308)

Starting of readouts: 2005.05.13 19:15    Range of time: 6 days

Orbit: 90 minutes  $\cong$  orbital time



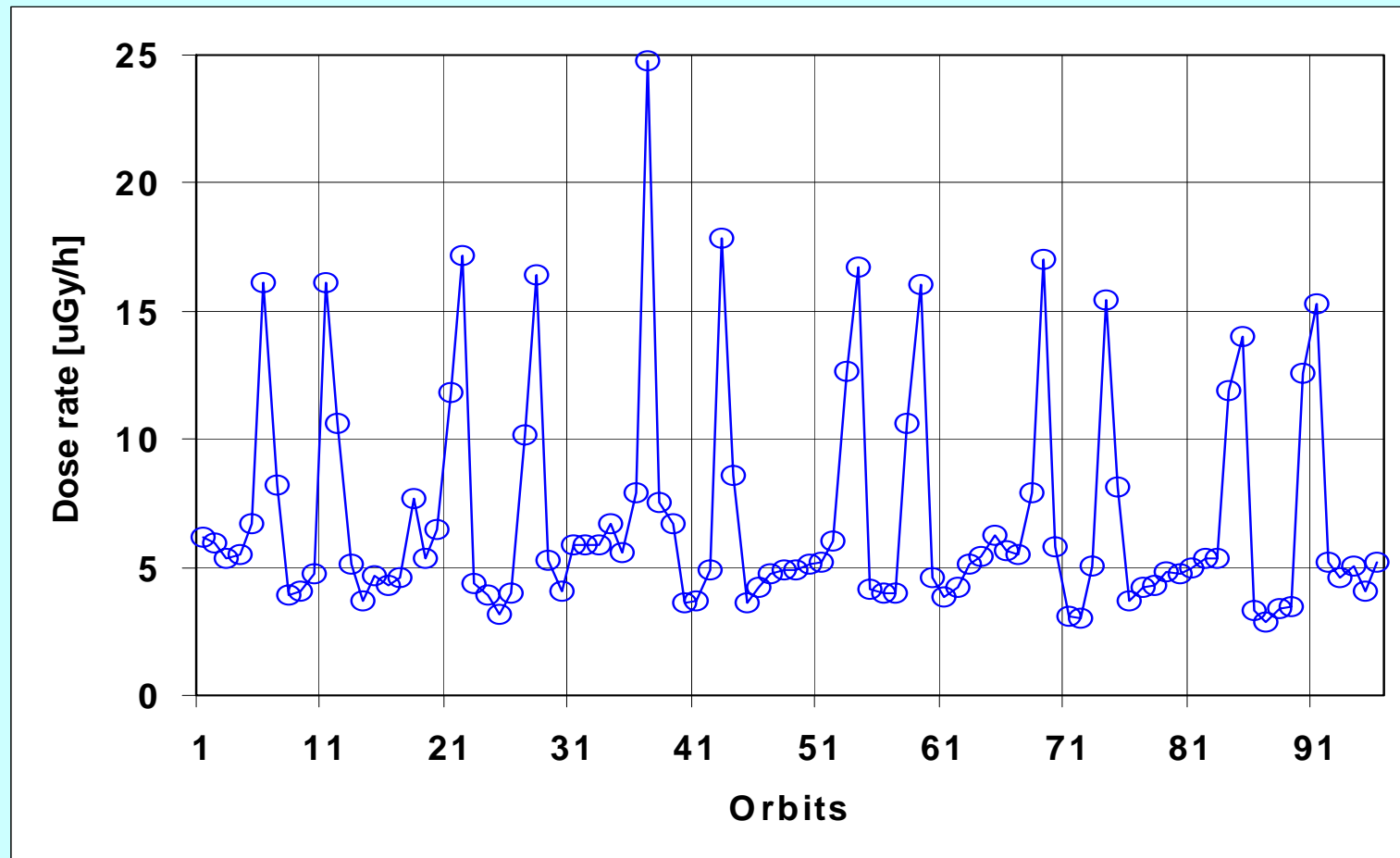
# 6-days sample of automatic measurements (No. A0308)



# 6-days sample of automatic measurements (No. A0309)

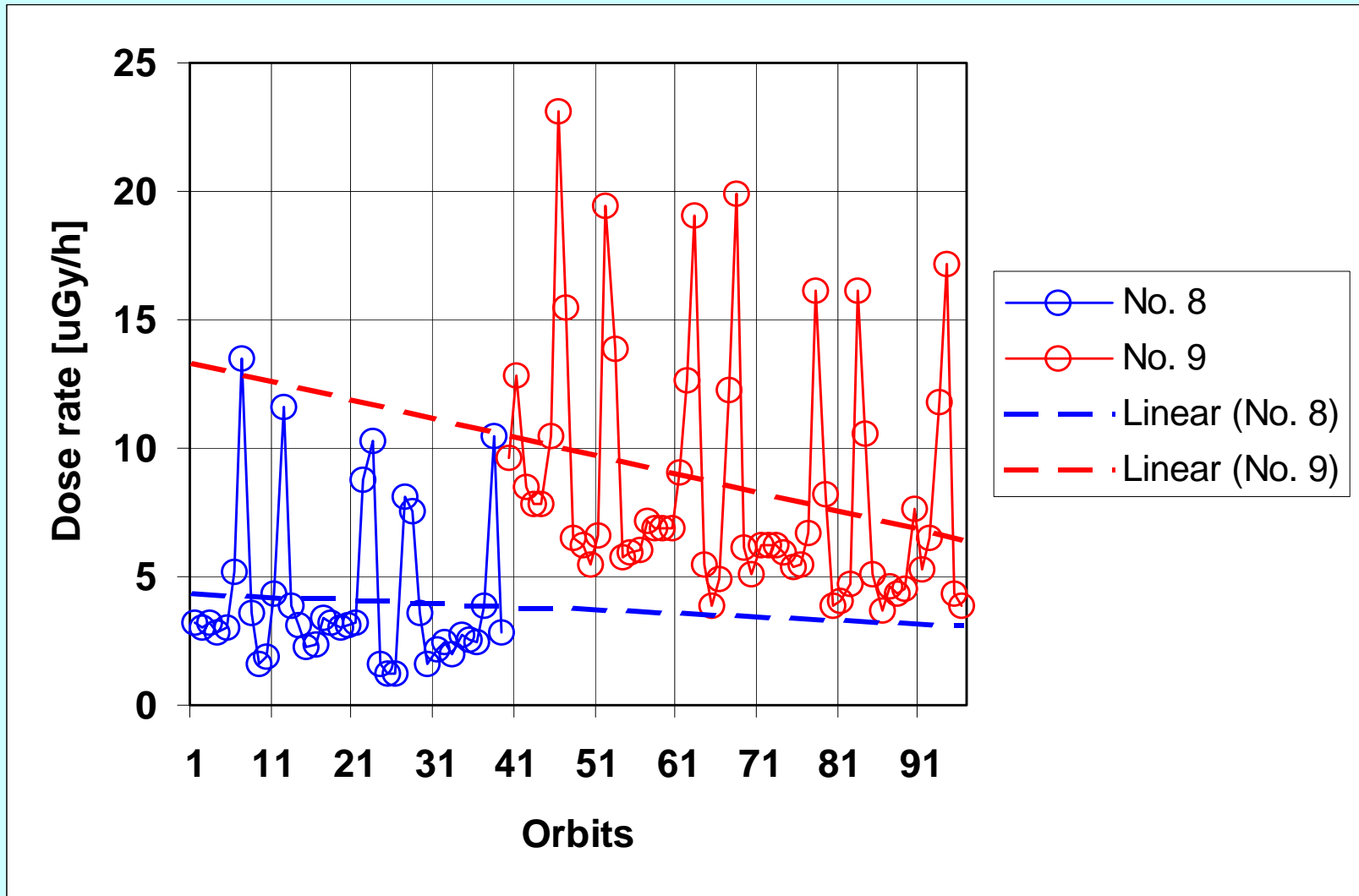
Starting of readouts: 2005.11.20 17:45 Range of time: 6 days

Orbit: 90 minutes  $\cong$  orbital time

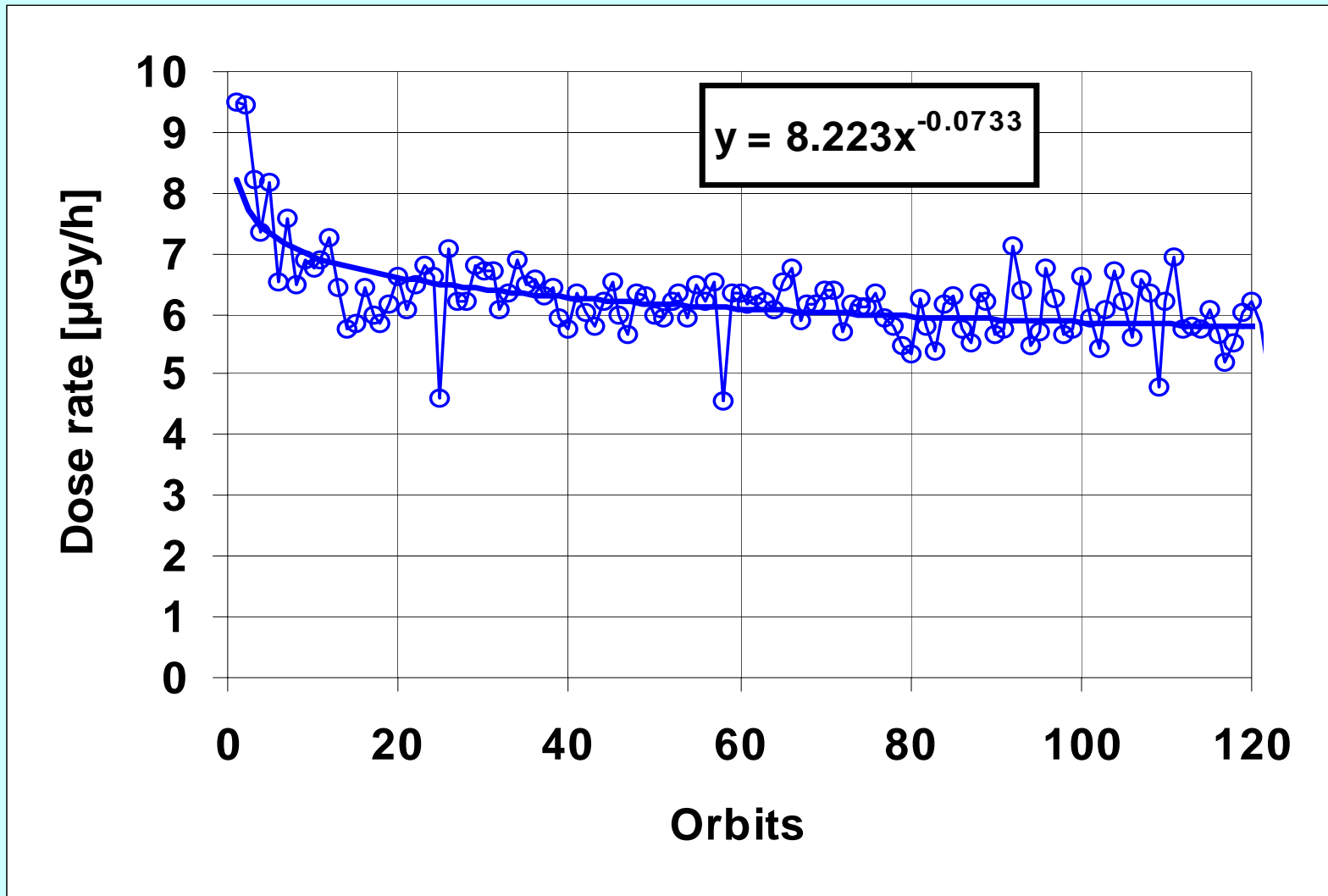


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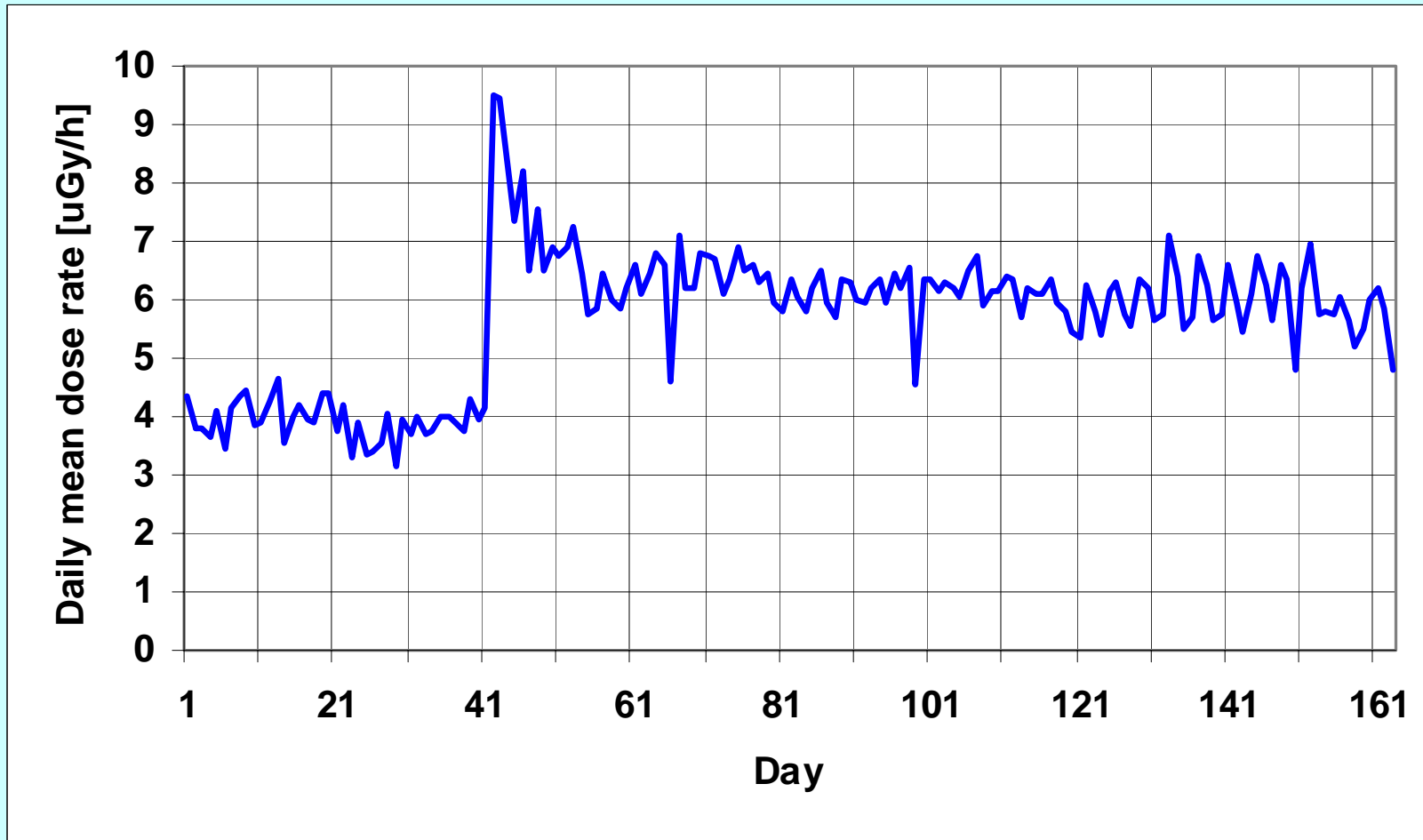
# Automatic measurements (No. A0308 -12 days - A0309)



# Automatic measurements (No. A0309)

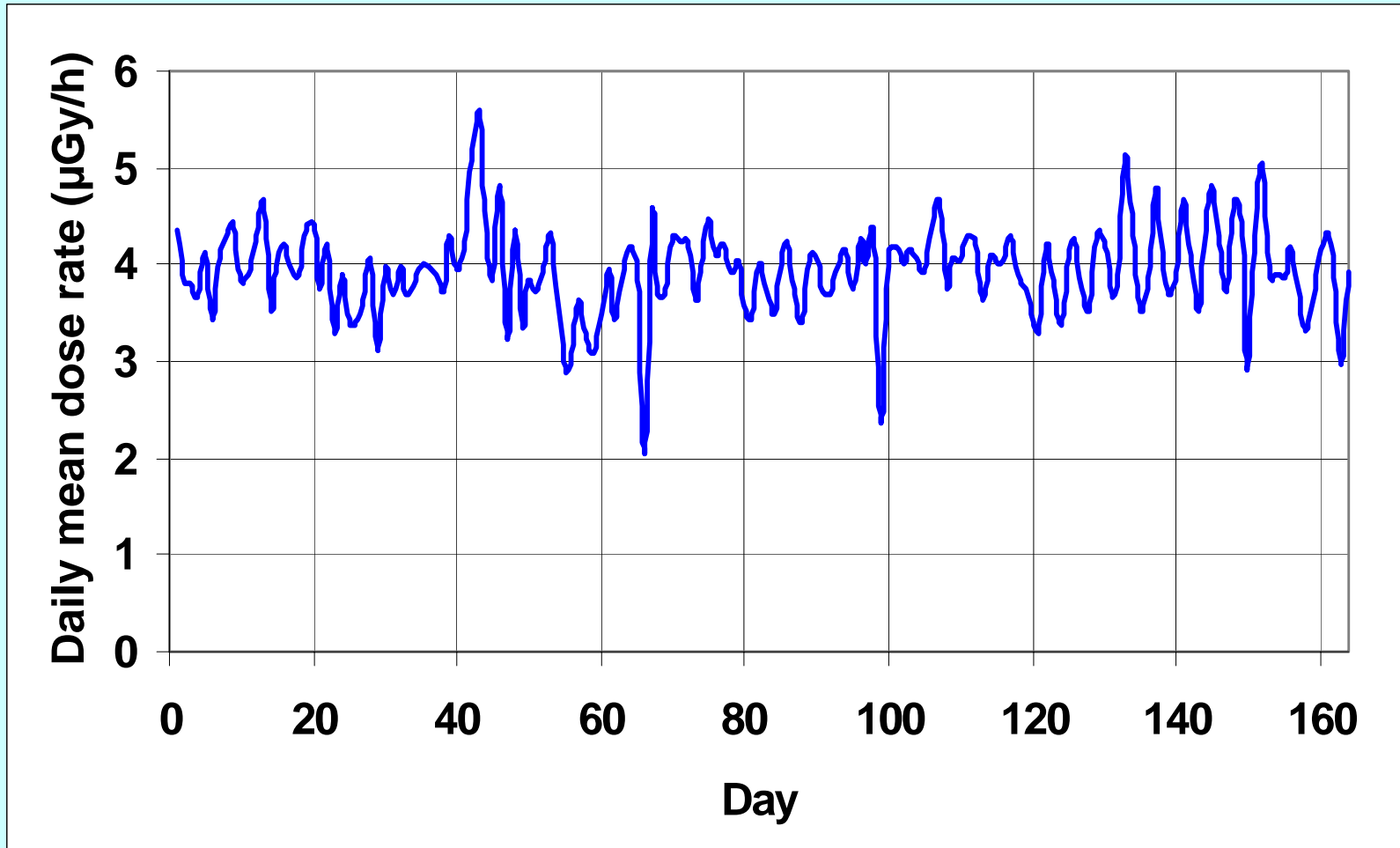


# Daily dose rates (dosimeter No. A0308 and No. A0309 without correction)



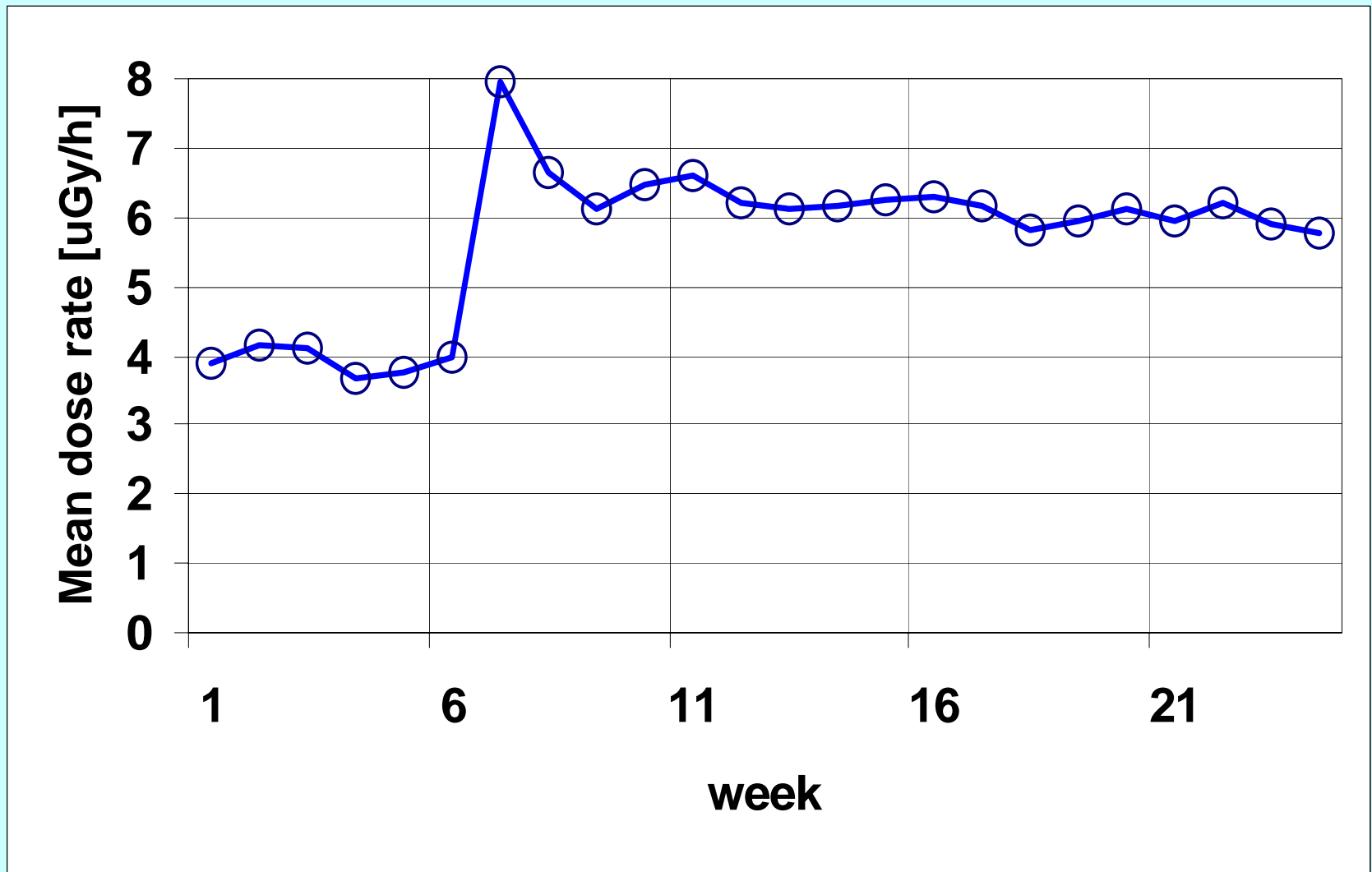


# Daily dose rates (dosimeter No.8 and No. 9, with correction)



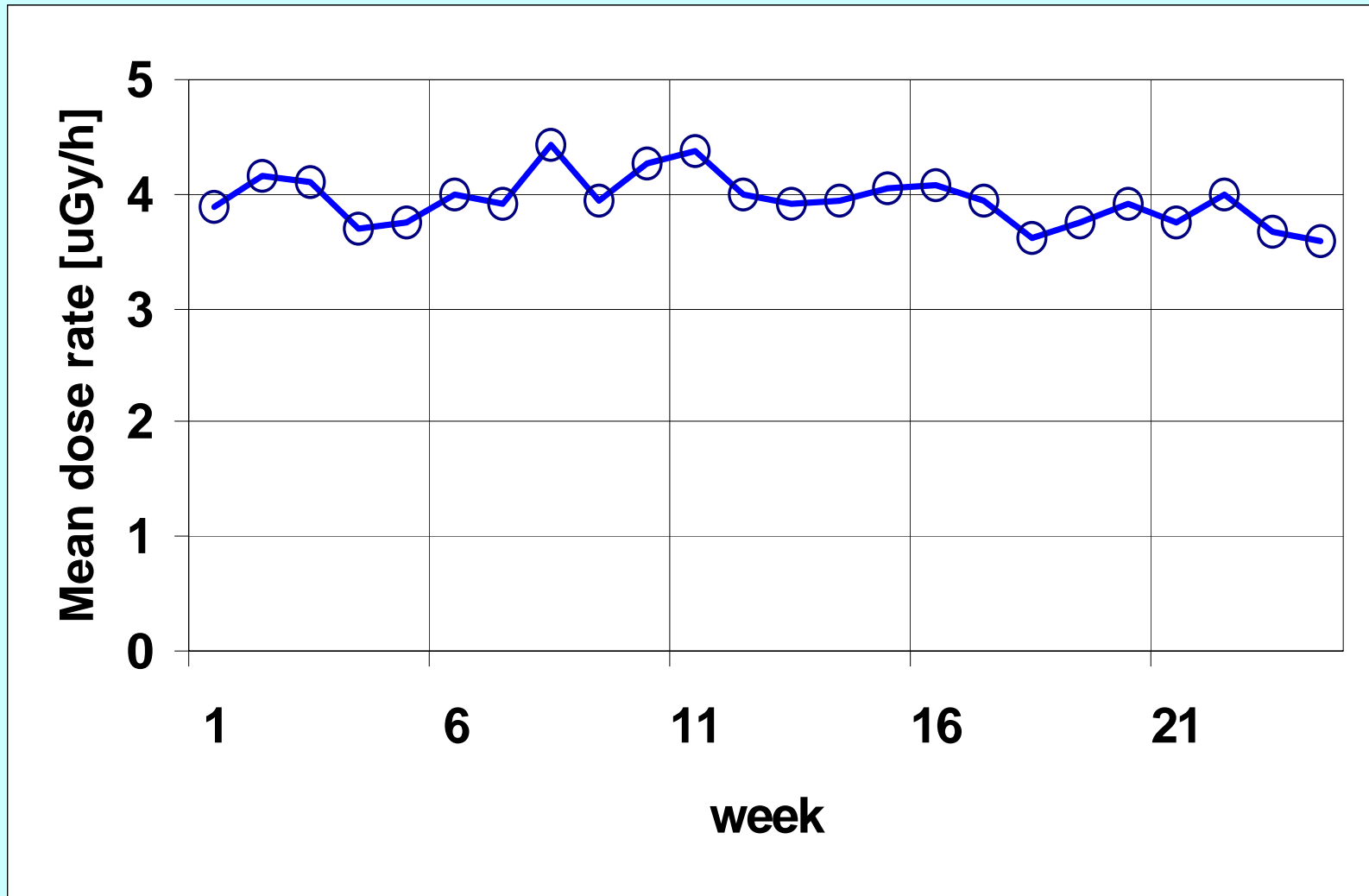
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# Weekly dose rates without correction



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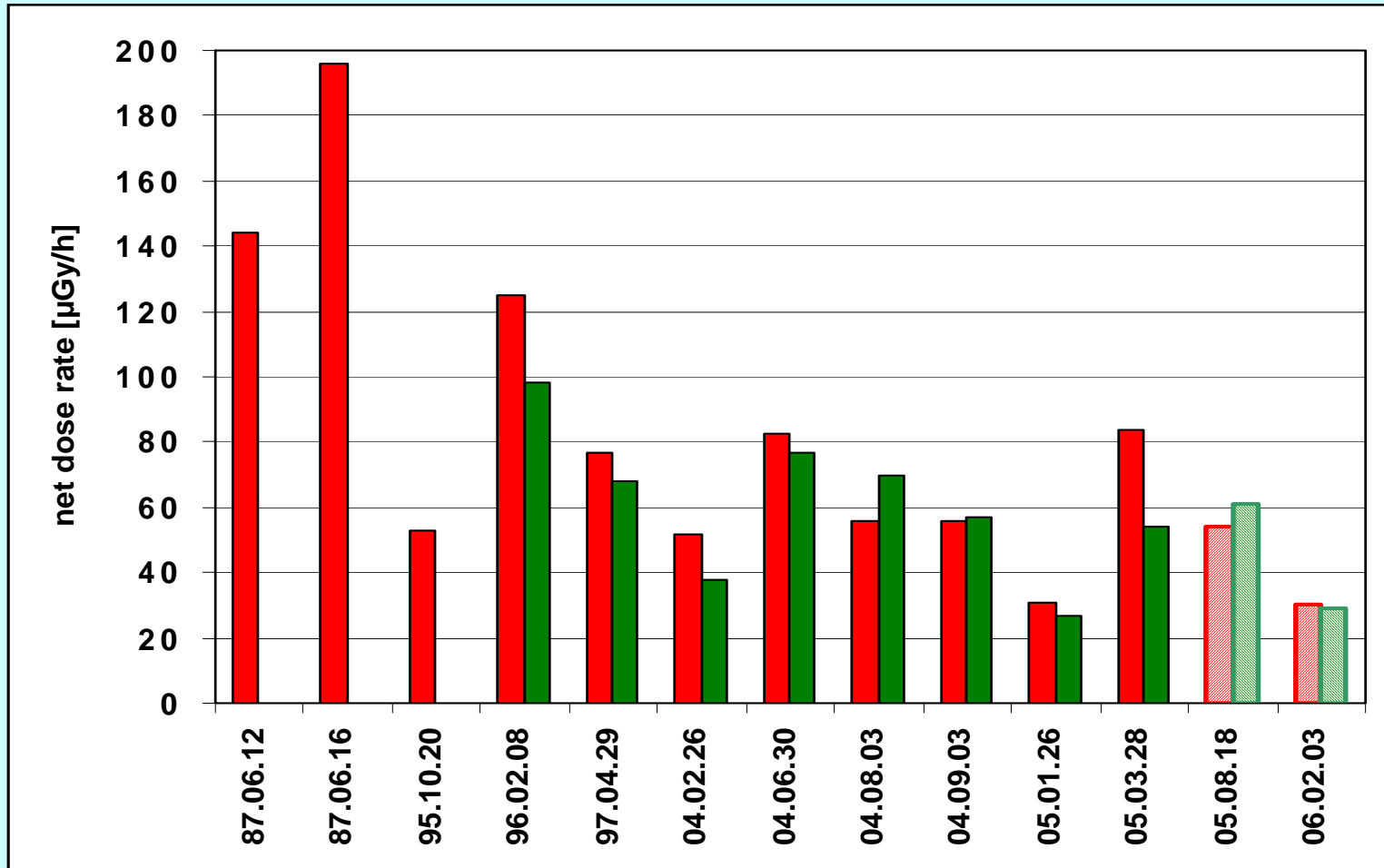
# Weekly dose rates with correction



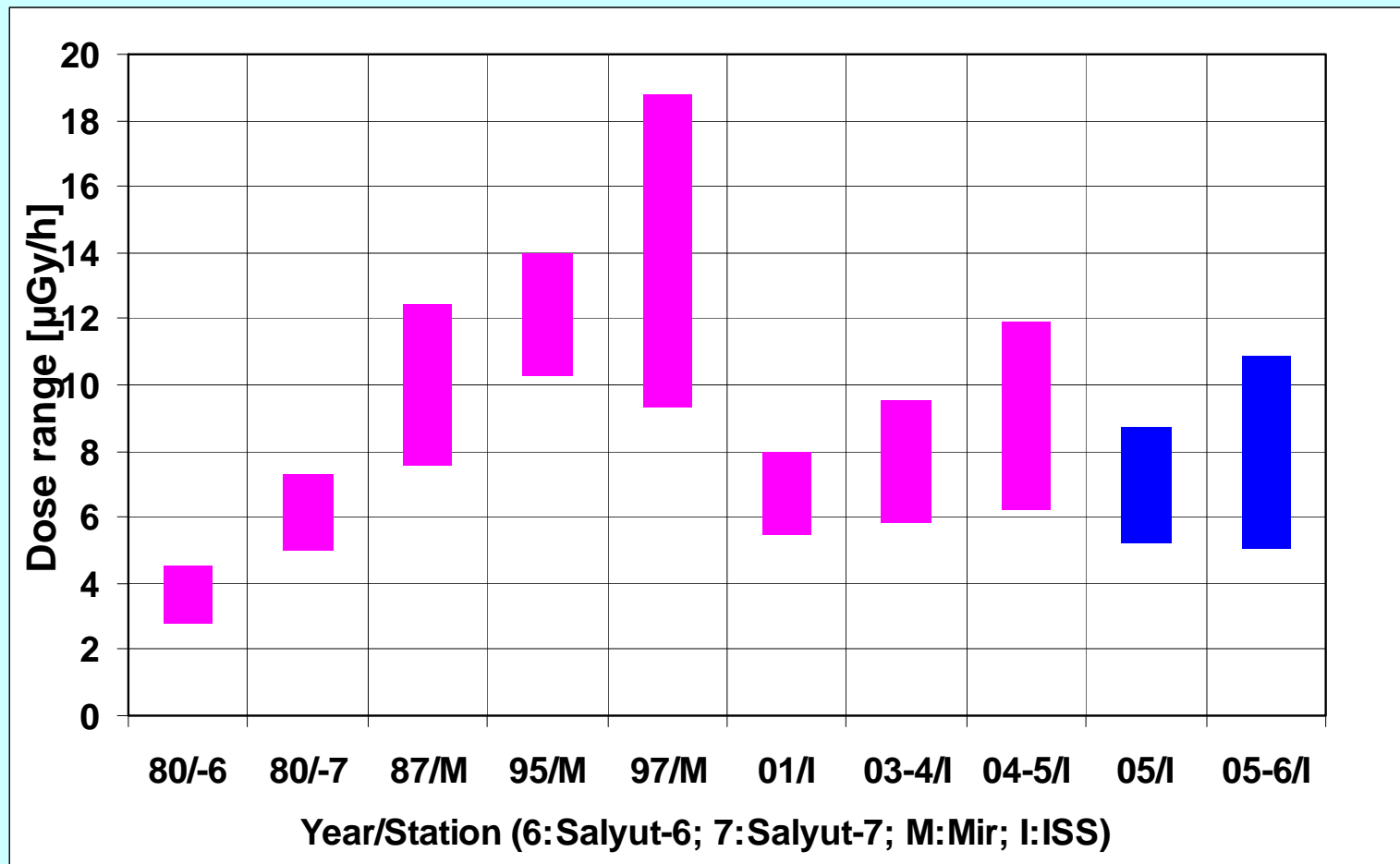
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# EVA excess dose rates

## Duration of EVAs 4.3...5.5 hours



# Dose rate ranges measured by Pille's on different Space Stations (1980-2006)



*Thank you for your attention!*

