



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

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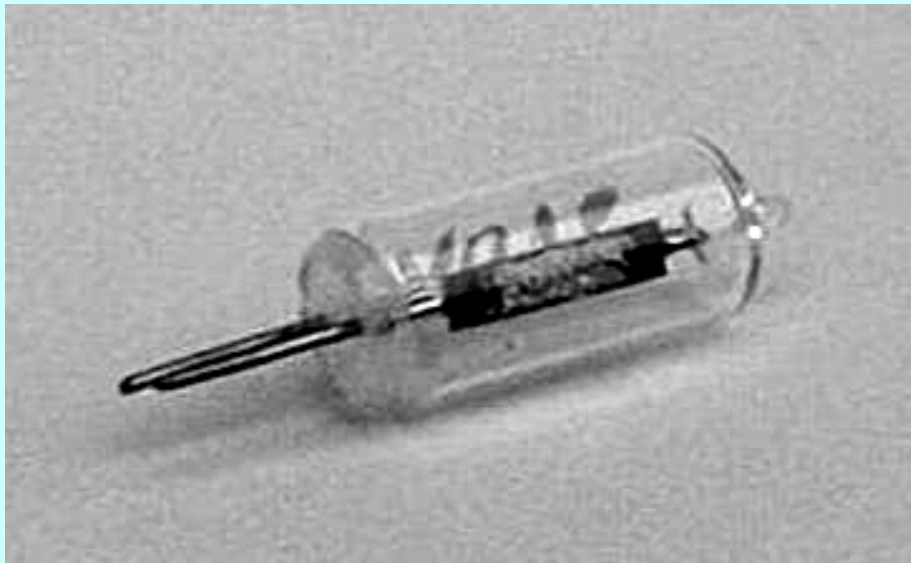
The Pille TLD system

- **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: ϕ 20 mm * 60 mm
Mass: 70 g (with carrying case)



Reader

| | |
|--|--|
| Measuring range (s<10%): | 10 μGy ÷ 10 Gy (CaSO₄:Dy) |
| TLD Efficiency $\varepsilon=1\pm 10\%$ | LET_{∞}H₂O < 10 keV/μm |
| Read-out precision: | 3 digits + exp. |
| Accuracy (above 10 μGy): | $\delta < 5\%$ |
| Measuring modes: | manual / automatic read-out |
| Display: | 8-digit alphanumeric. LED |
| Storage of information: | PCMCIA mem. card (> 4000 data) |
| Computer connection: | RS-232 |
| Dimensions: | 70 mm (H)*190 mm (W)*120 mm (D) |
| Mass: | 1,400 g |
| Power consumption: | 0.1 / 1 / 7 W (standby/ready/readout) |



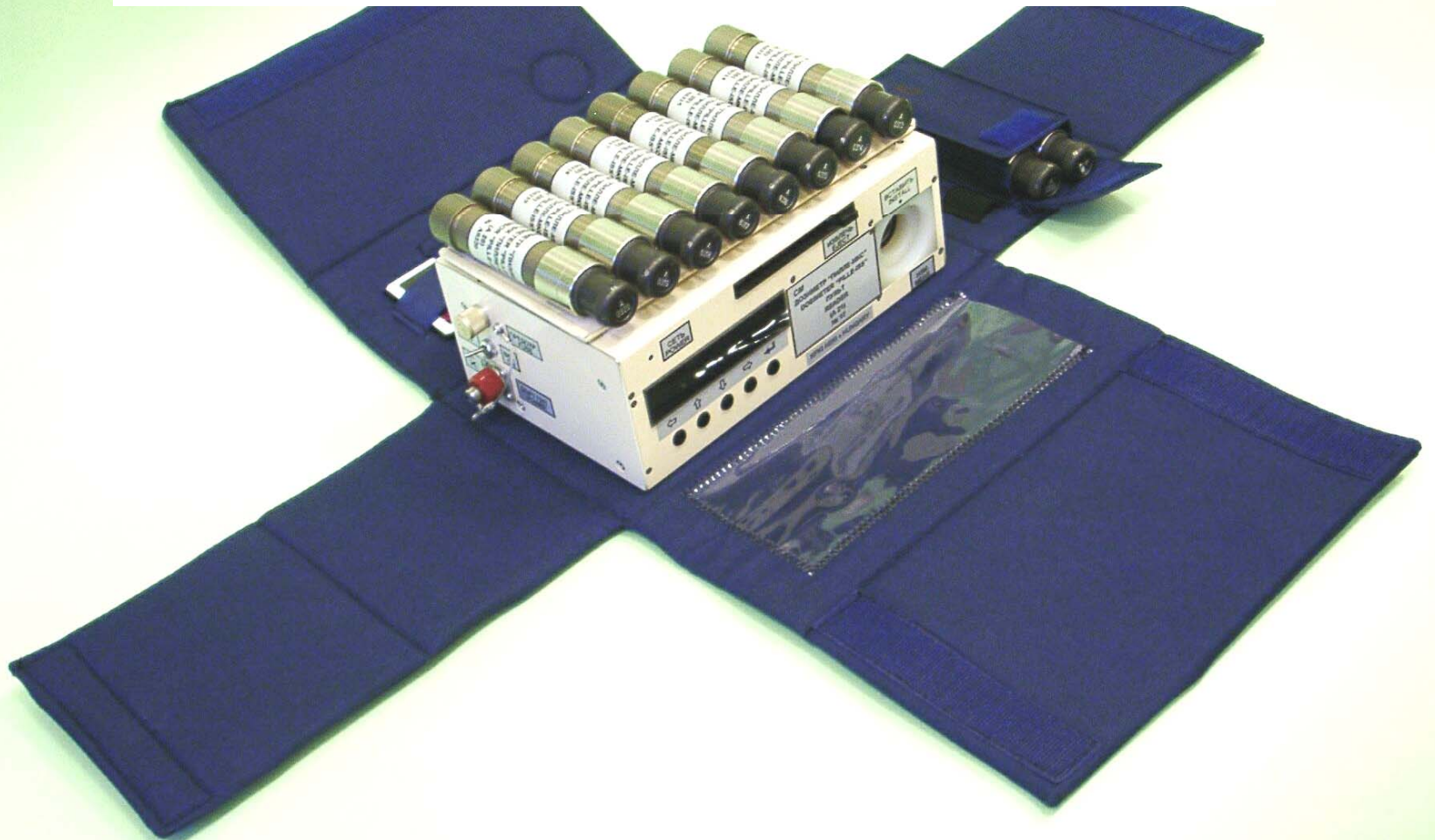
Pille TLD System

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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

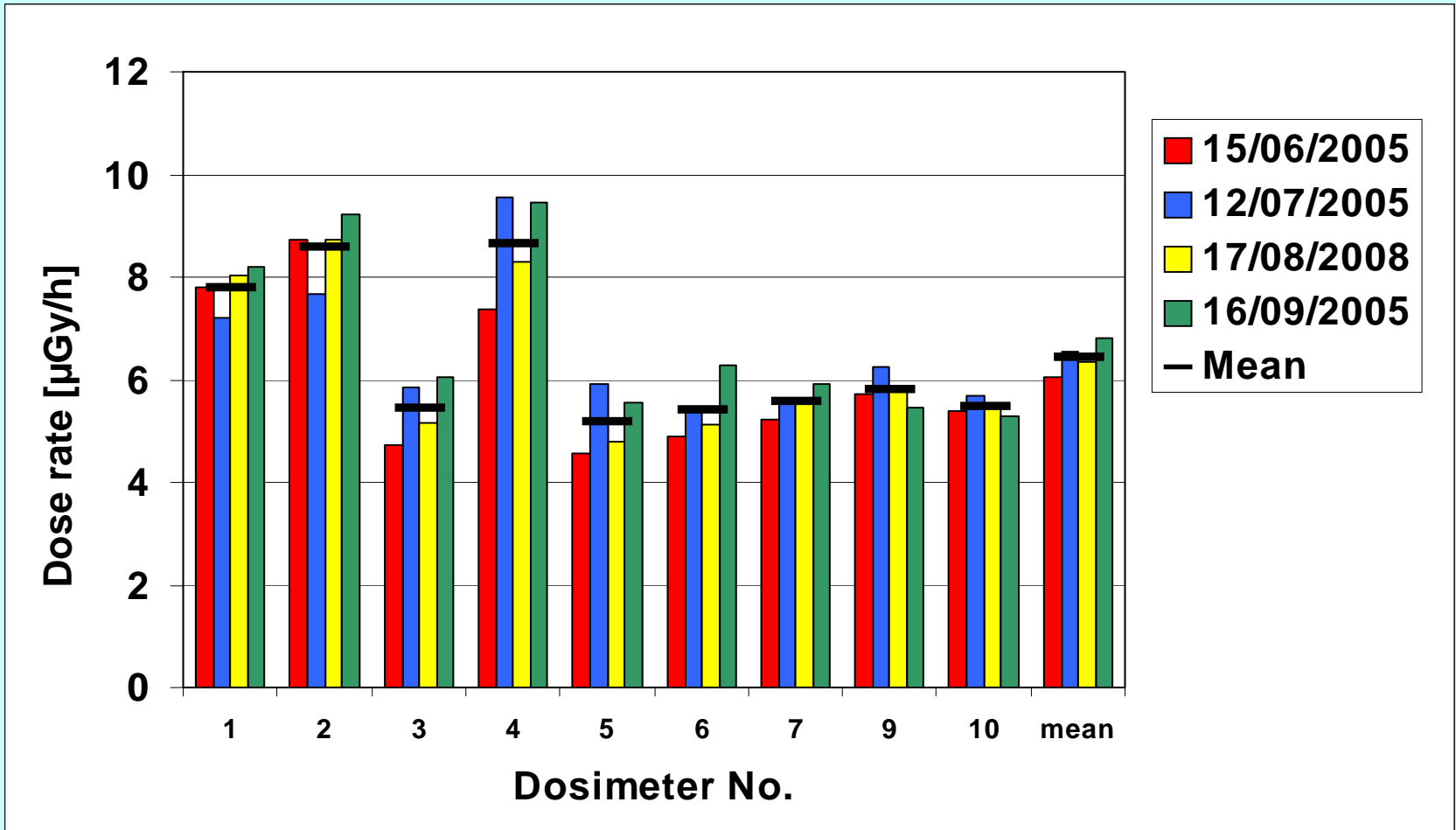
– 4691 measurements from 2005.05.13 until 2006.02.02

- Results of the measurements were transferred on memory card by to the Earth

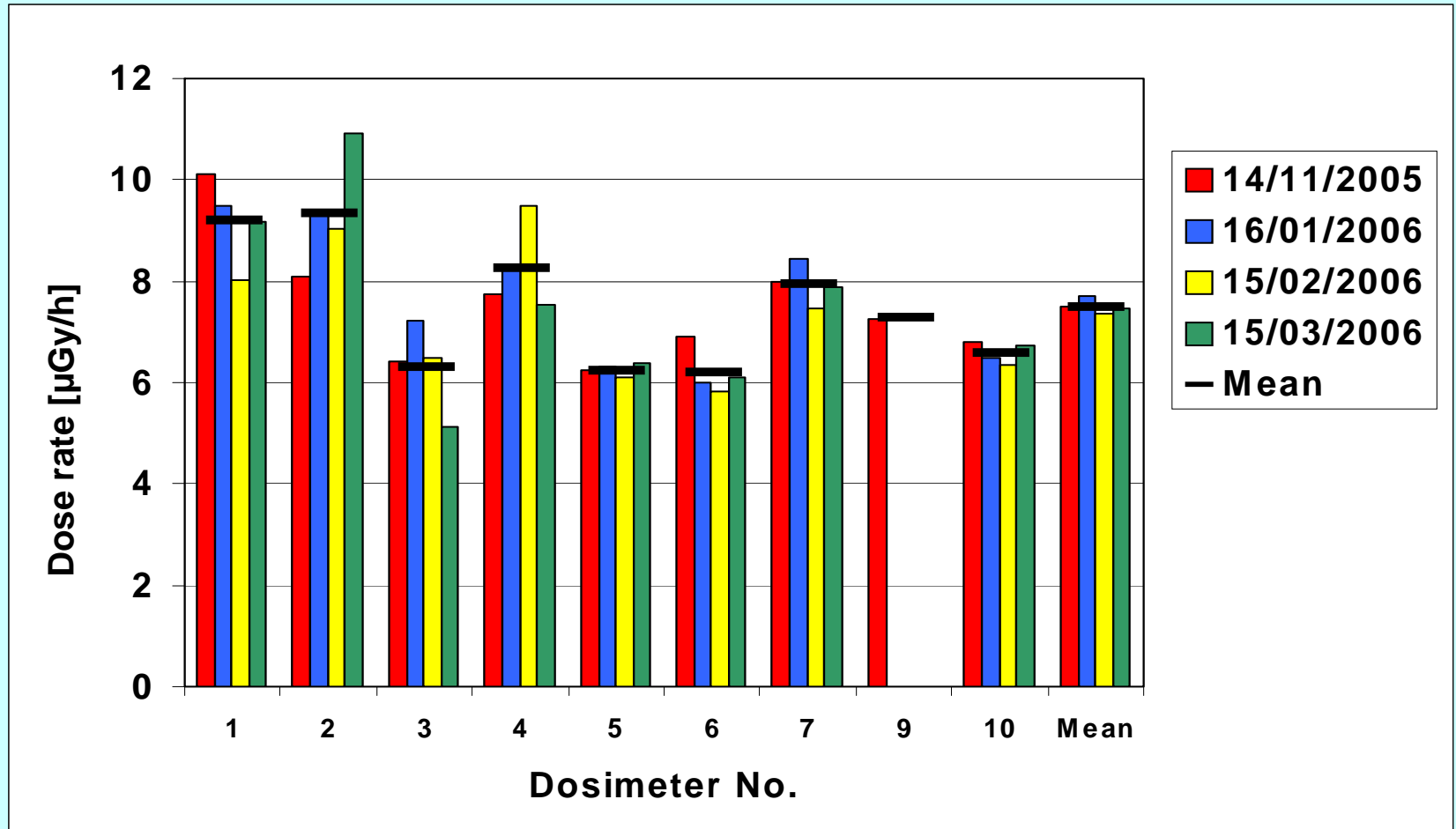
General location and designation of the dosimeters

| Dosimeter N ^o | 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 |
| A0307 | Right board, beside of the cabin, on ceiling of the lavatory <i>Dedicated for EVA reference measurement inside ISS</i> |
| A0308/A0309 05.11.06/ 05.11.18 | Inserted in the Reader, which is fixed on the floor, right to illuminator N ^o 9 <i>Dedicated for automatic measurements</i> |
| A0309, A0310 | In the transporting case of the Reader, left to illuminator N ^o 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

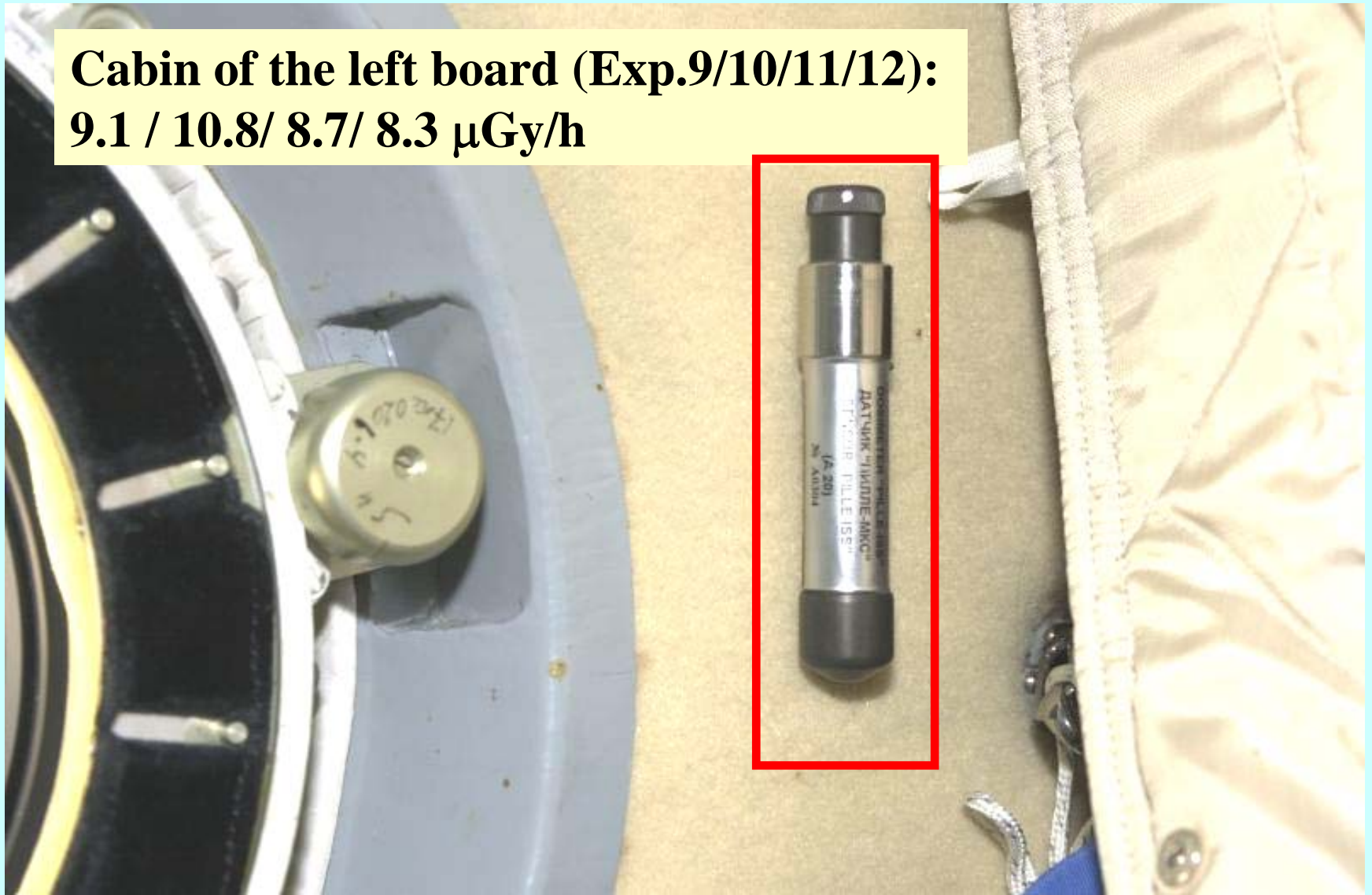
**Cabin of the left board (Exp.9/10/11/12):
6.3 / 7.2/ 5.4/ 6.3 $\mu\text{Gy/h}$**



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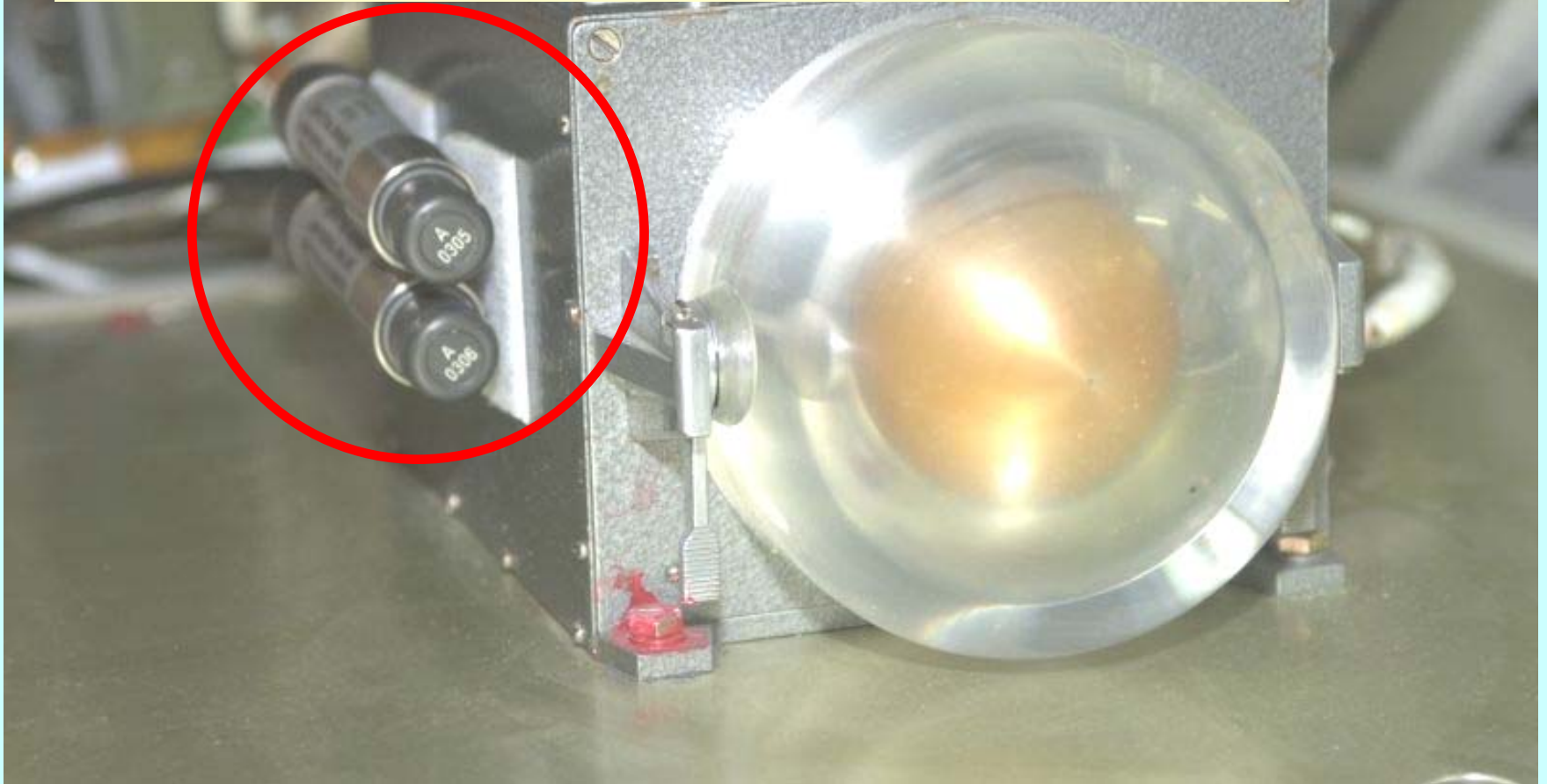
Dosimeter No. A0304

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



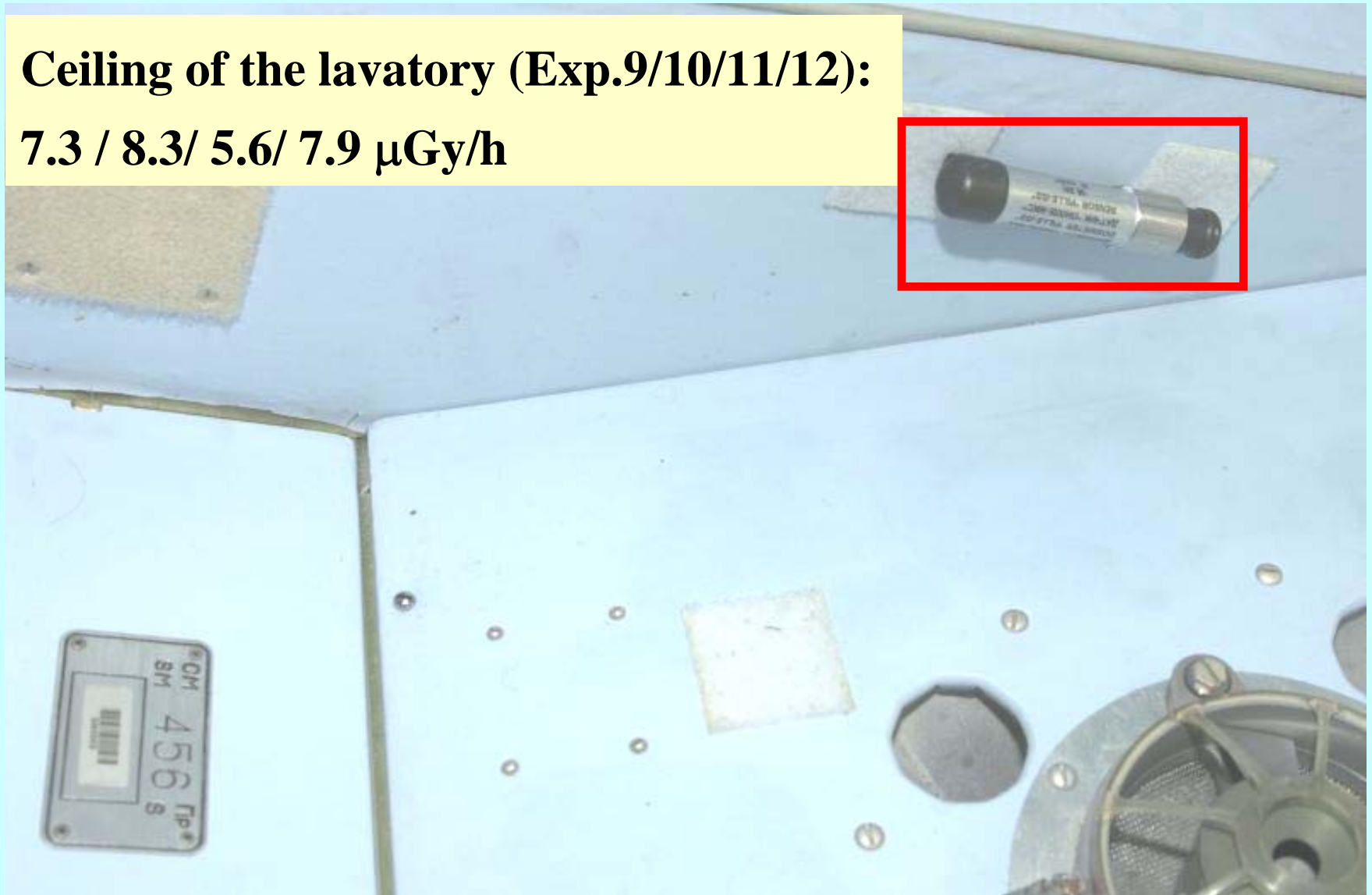
Dosimeters No. A0305 – A0306

**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? $\mu\text{Gy/h}$

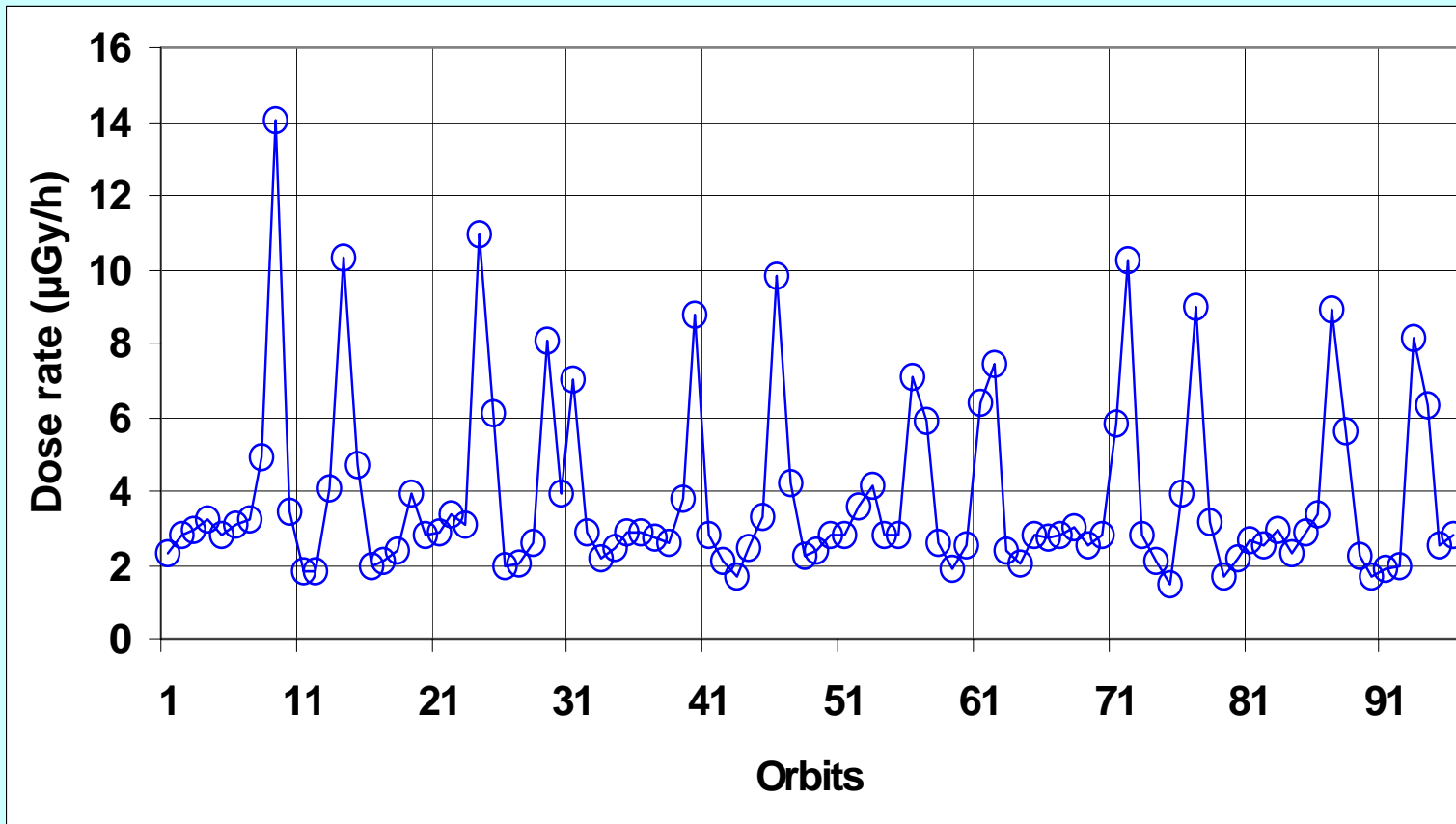


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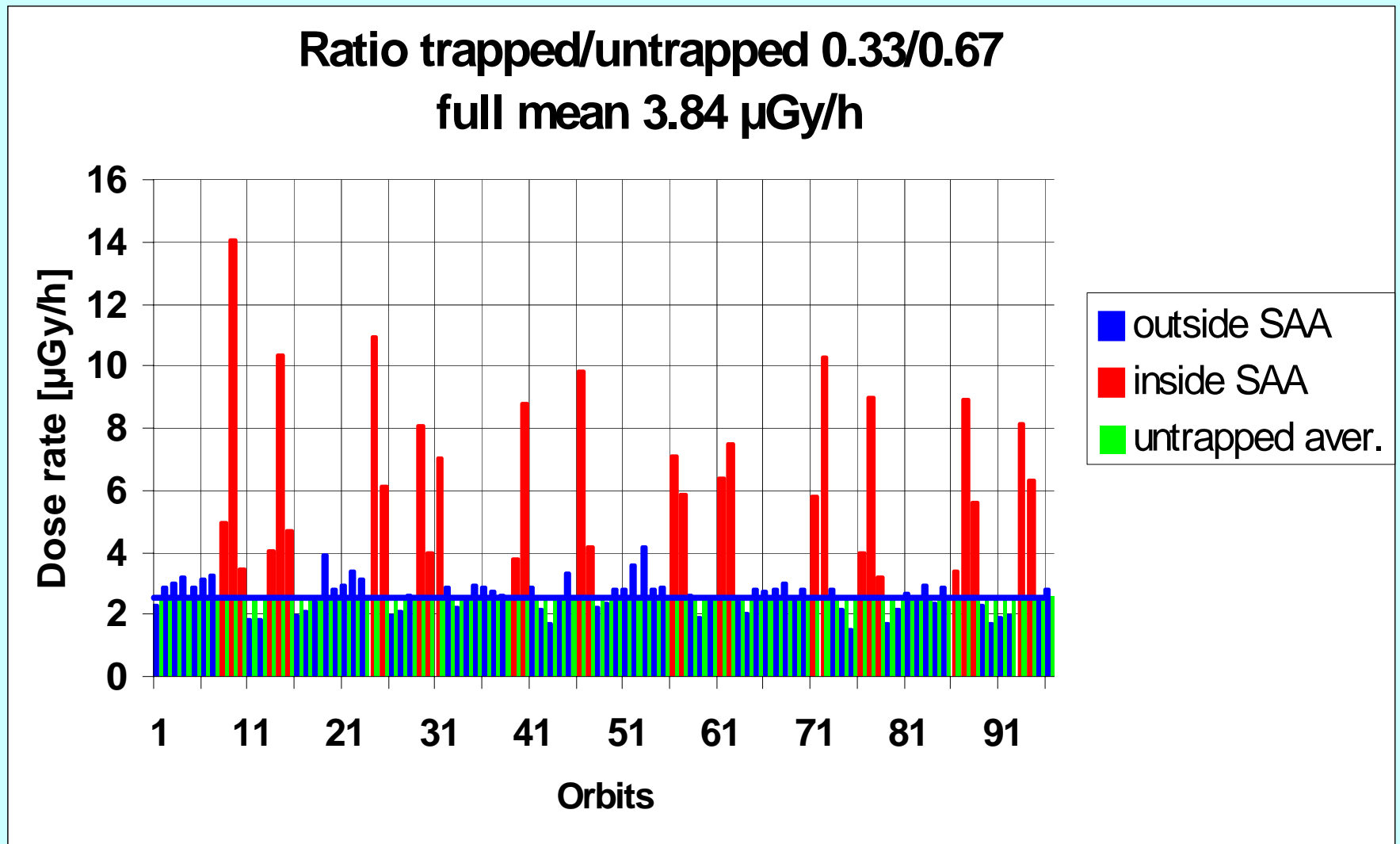
6-days sample of automatic measurements (No. A0308)

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

Orbit: 90 minutes \cong orbital time



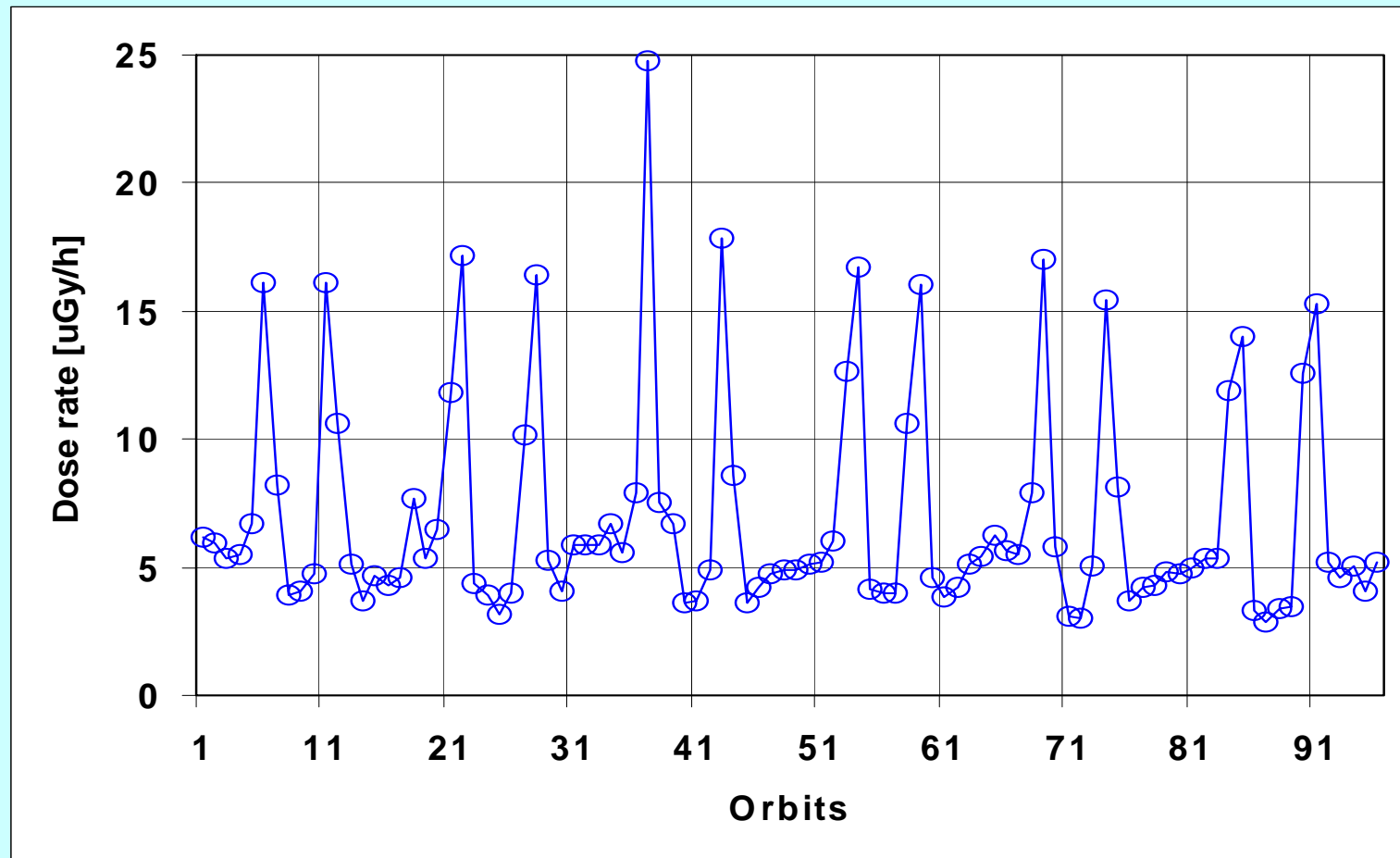
6-days sample of automatic measurements (No. A0308)



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

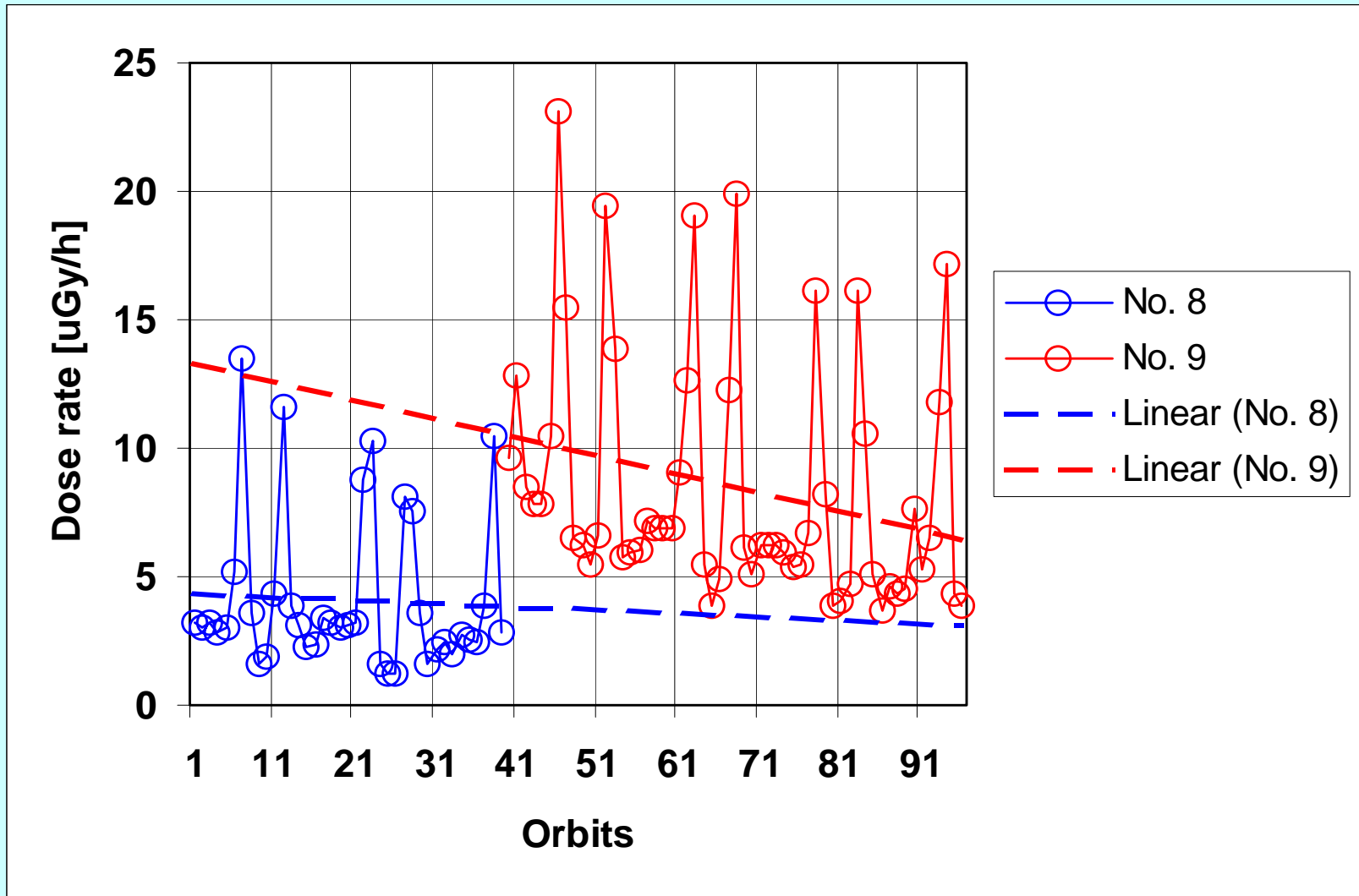
Starting of readouts: 2005.11.20 17:45 Range of time: 6 days

Orbit: 90 minutes \cong orbital time

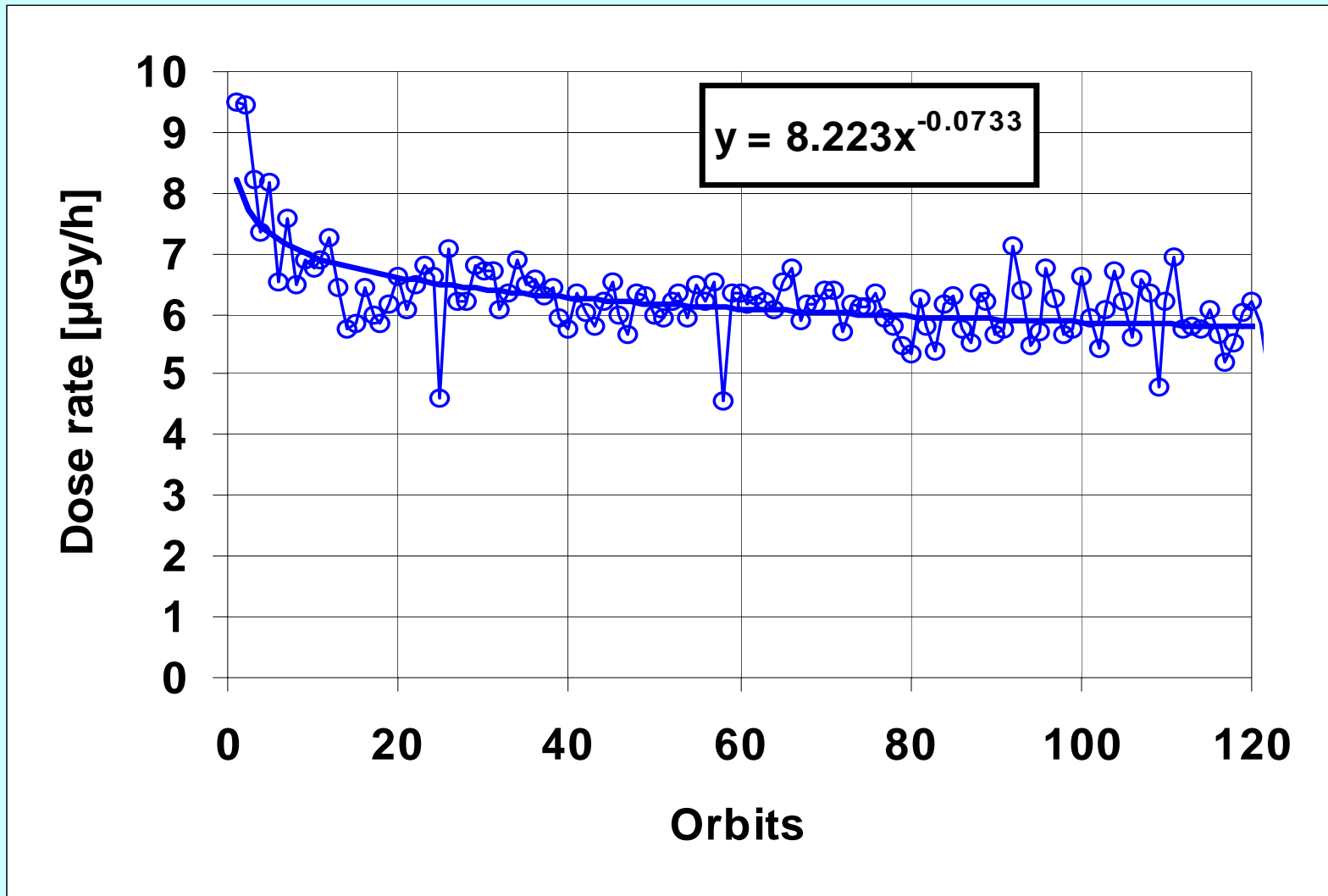


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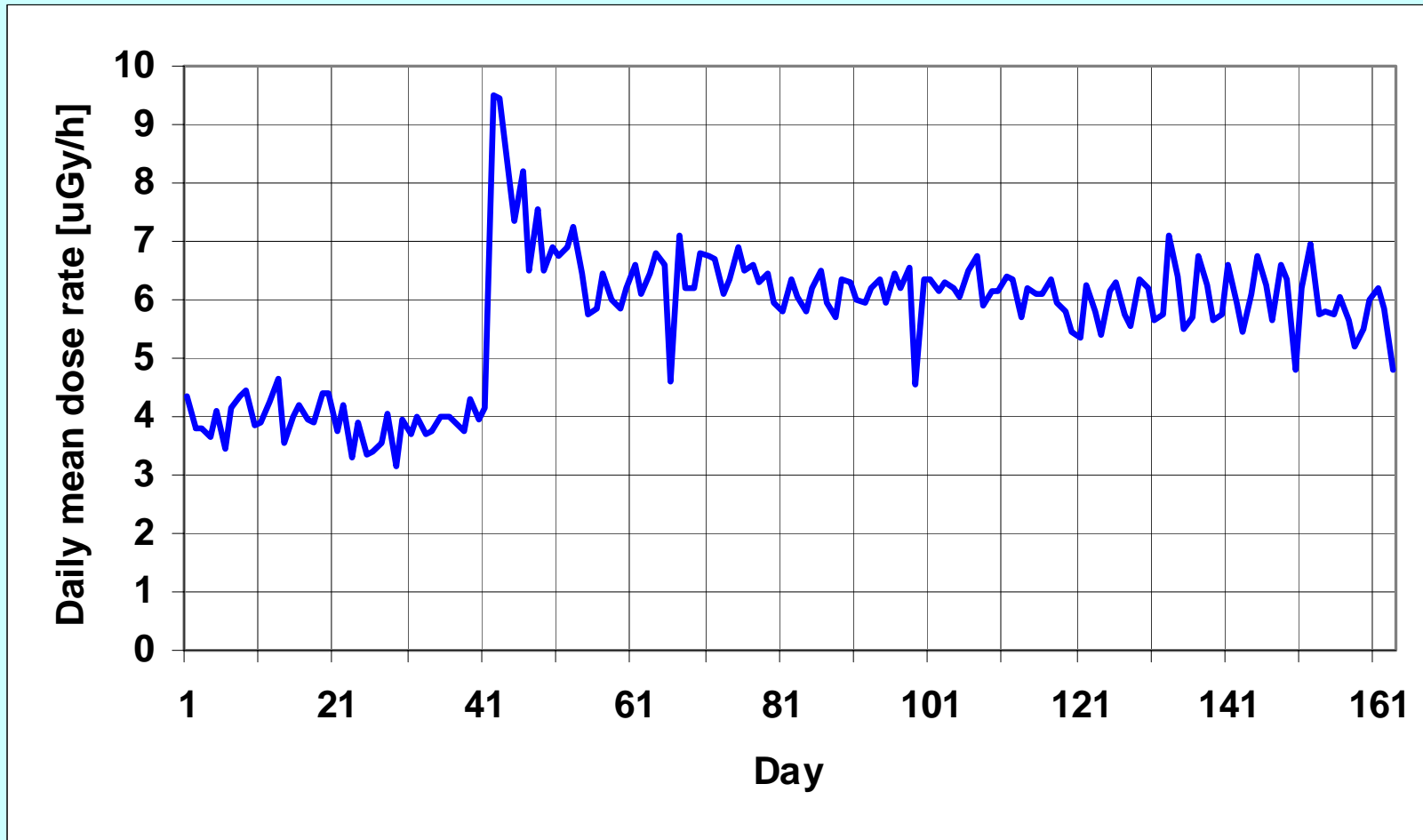
Automatic measurements (No. A0308 -12 days - A0309)



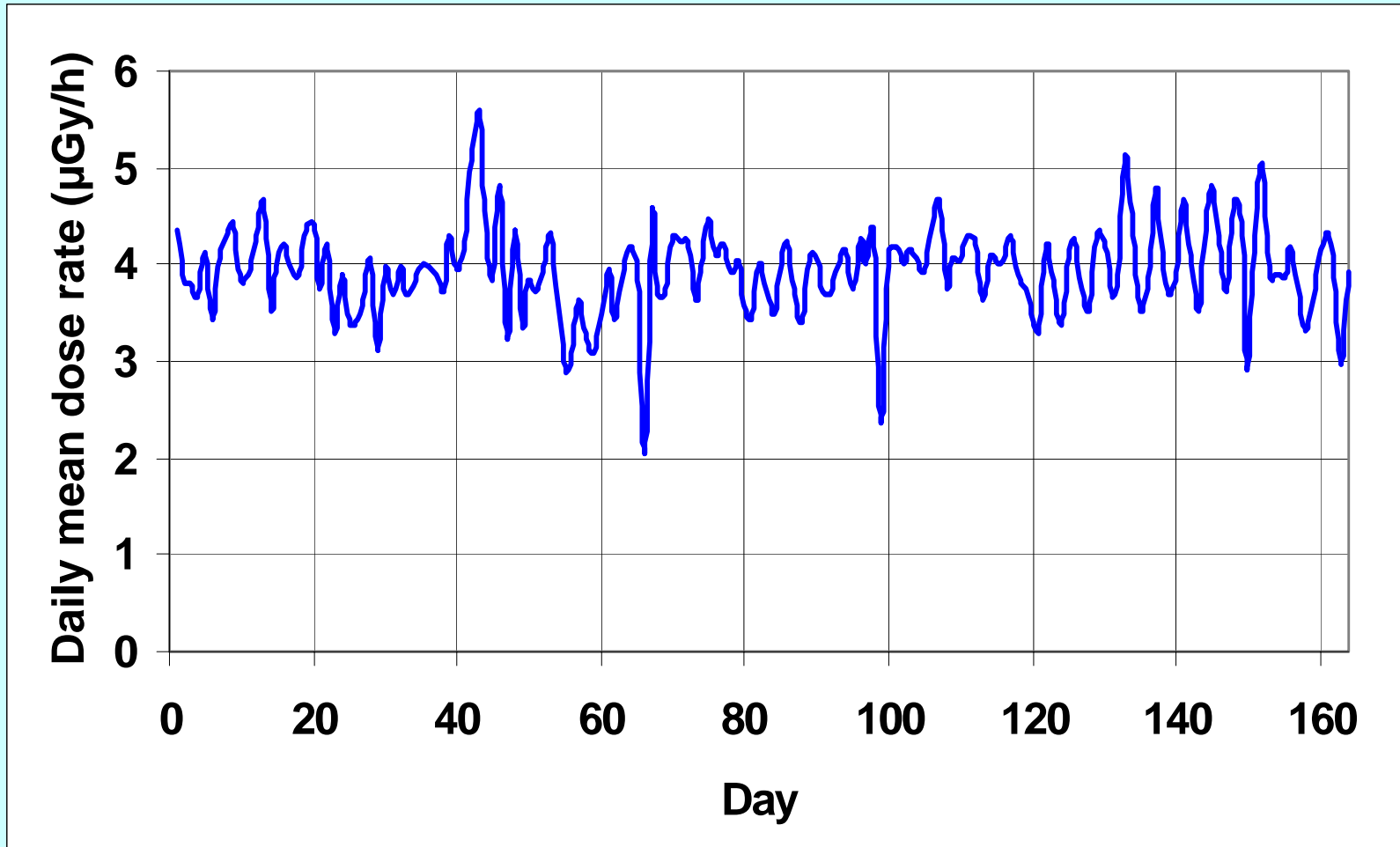
Automatic measurements (No. A0309)



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

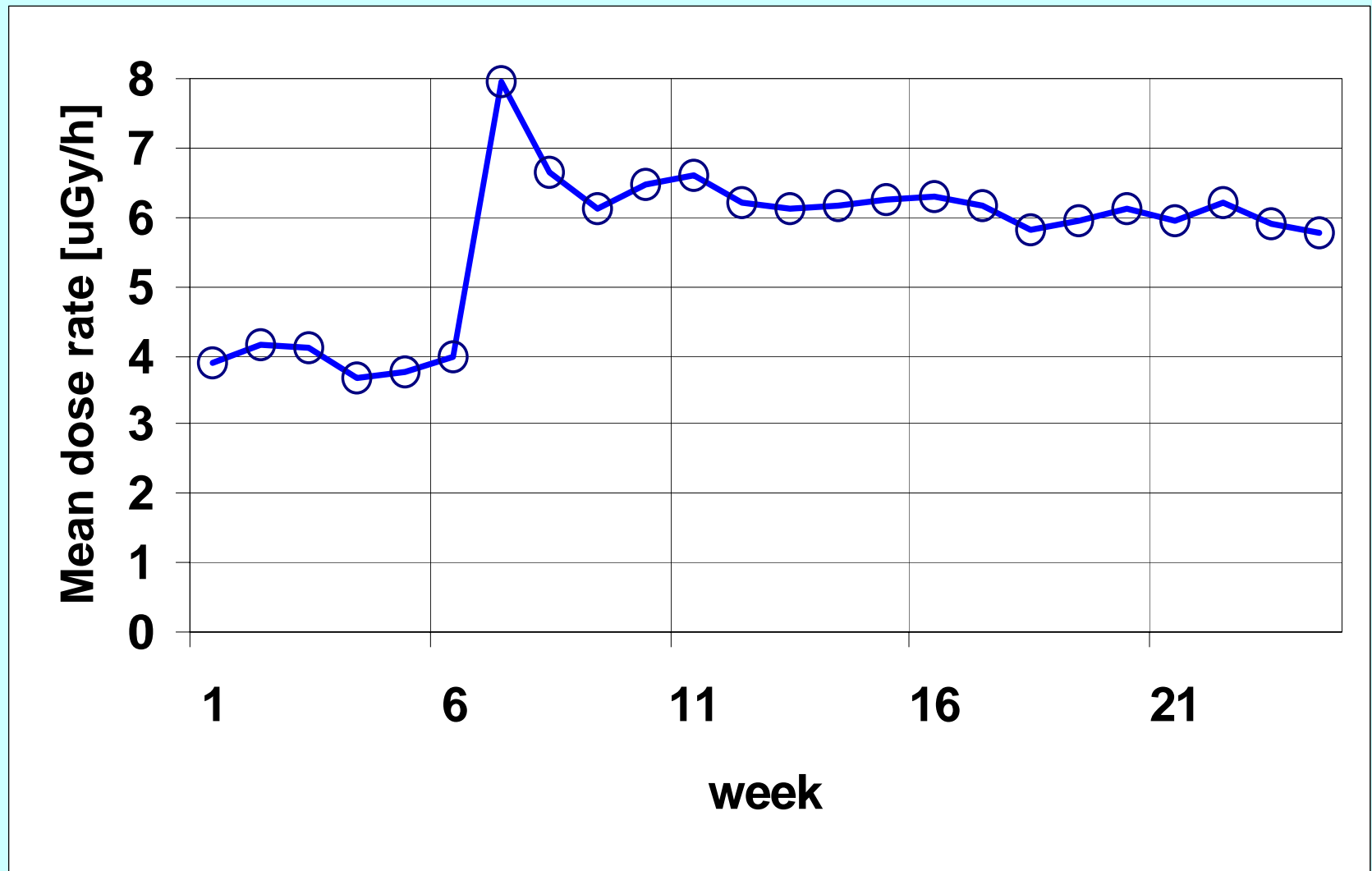


Daily dose rates (dosimeter No.8 and No. 9, with correction)



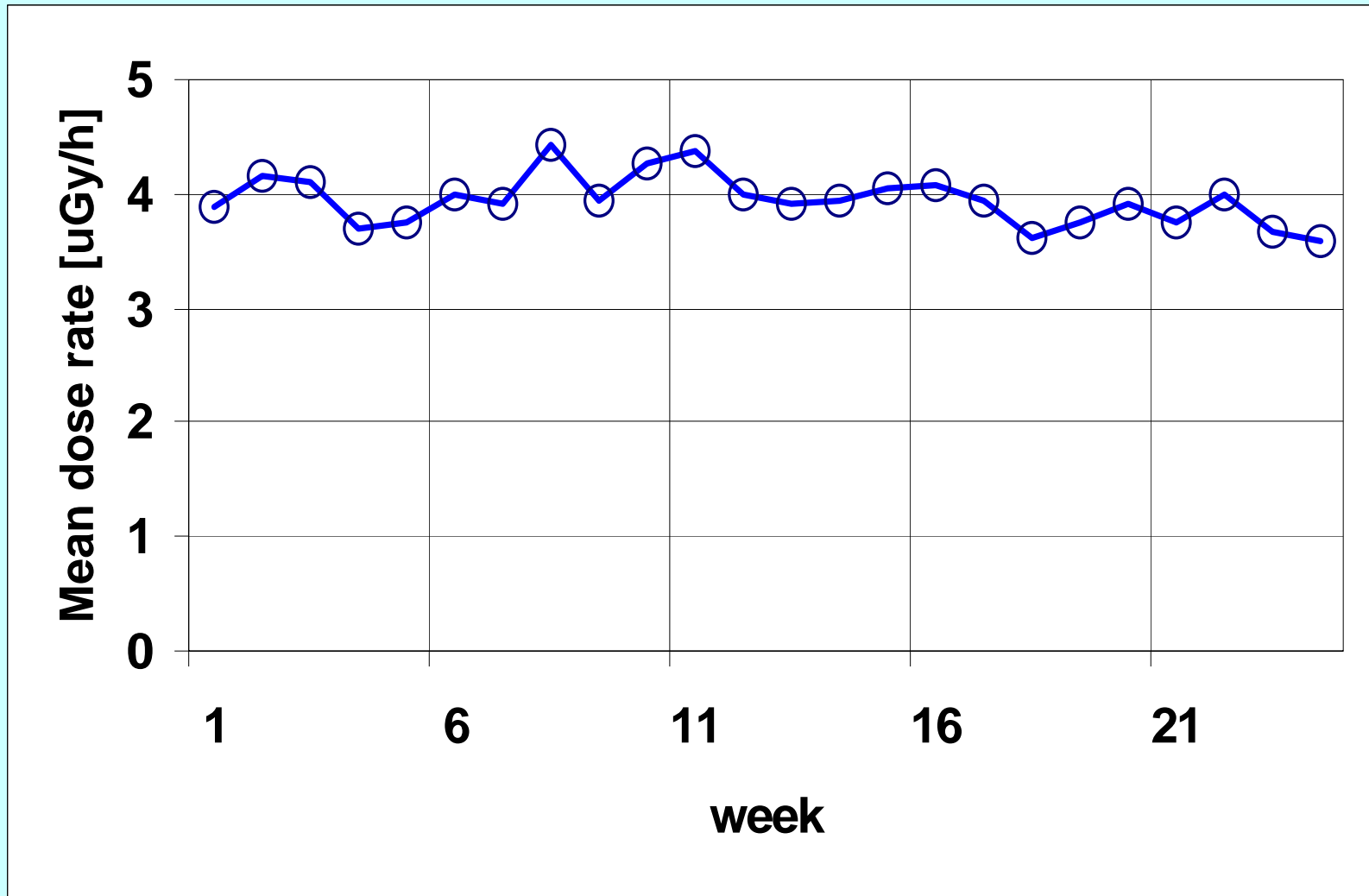
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Weekly dose rates without correction



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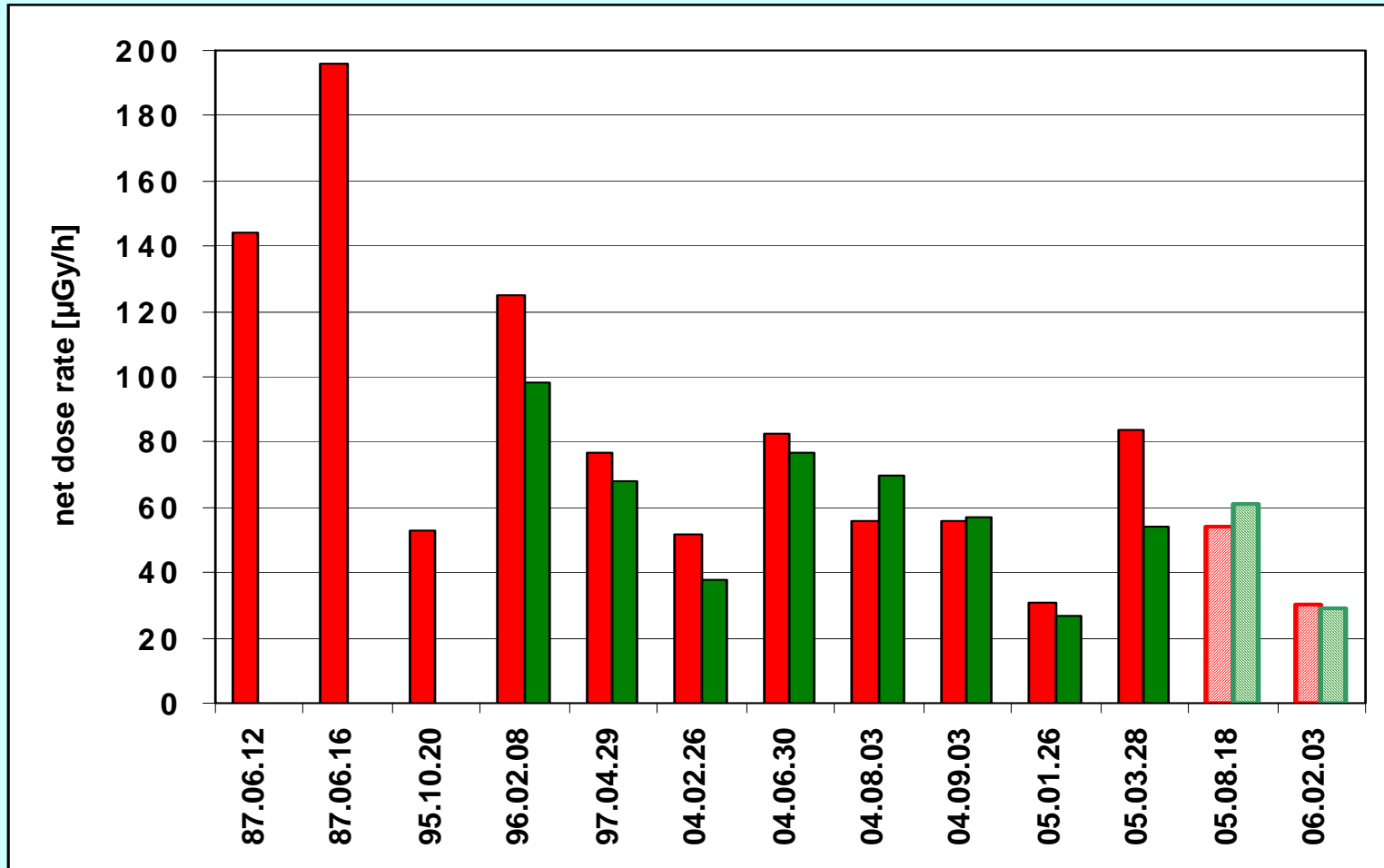
Weekly dose rates with correction



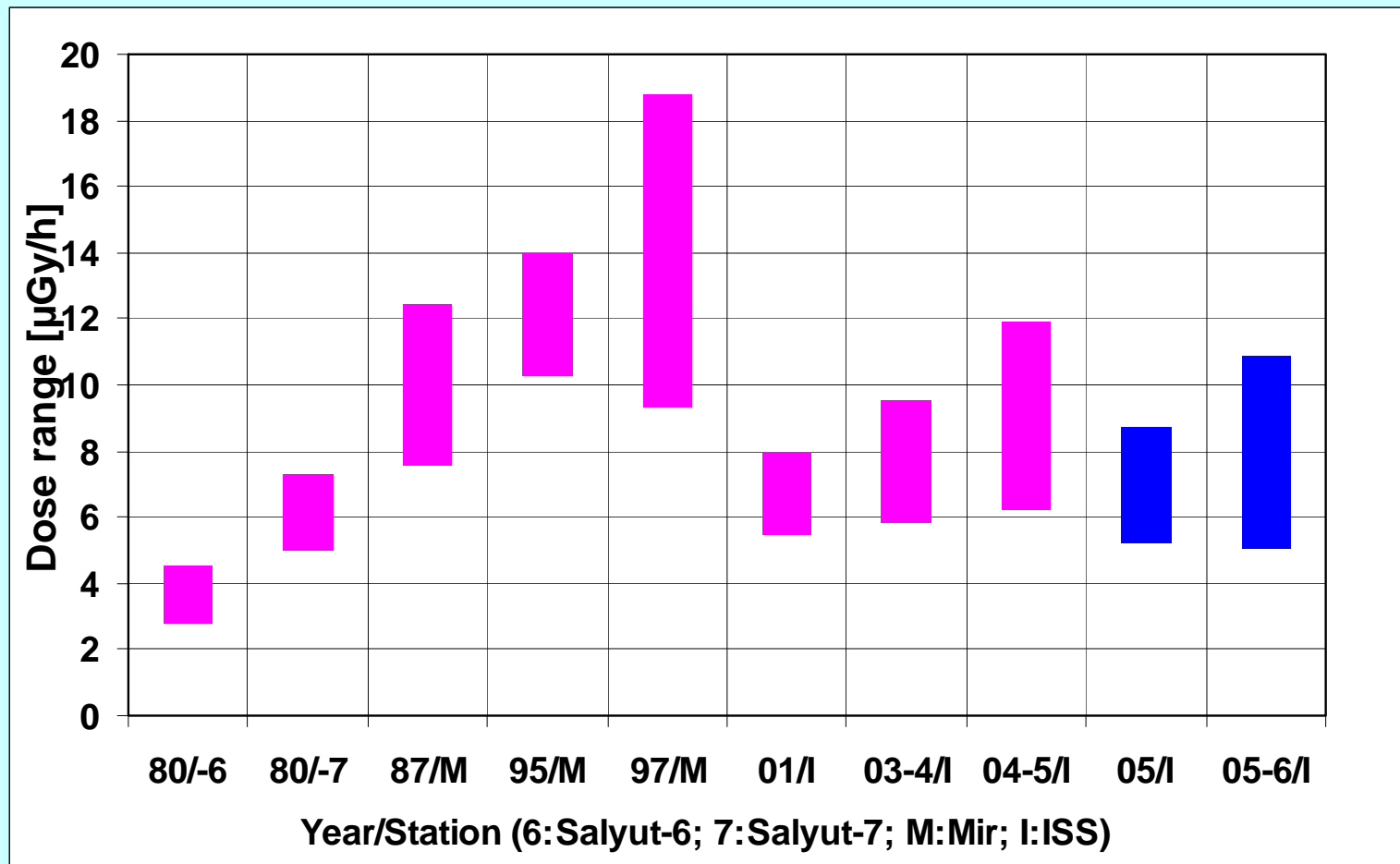
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EVA excess dose rates

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!

