DOSE MEASUREMENTS ON BOARD THE ISS WITH THE PILLE TL SYSTEM

I. Apáthy[1], S. Deme[1], P. Szántó[1],
Y. A. Akatov[2], V. V. Arkhangelsky[2],
Igor Nikolaev[3]

[1]HAS KFKI Atomic Energy Research Institute, Budapest, Hungary
[2]Institute for Biomedical Problems, Russia
[3]RSC Energia, (Russia)

szanto@aeki.kfki.hu

Outline

The Pille TLD System

Pille on ISS

Position of the dosimeters

Results of Exp. 19-22

Ground investigation of the returned dosimeters

Summary

The Pille thermoluminescent dosimeter system

Space qualified, on-board TLD system

Dosimeters and the reader device

Dosimeters	
Type:	bulb
Material:	CaSO4:Dy
Dimensions:	ϕ 20 mm * 60 mm
Mass:	70 g (with carrying case)

Reader	
Measuring range (s<10%):	3 μGy ÷ 10 Gy ($CaSO_4$:Dy)
TLD Efficiency (ε=1±10%):	$LET_\infty(H_2O)$ < 10 keV/μ_m
Accuracy (above 10 μGy):	δ < 5%

High sensitivity

Even hourly read-outs are possible

On board of every space station since Salyut-6

More than 24 000 comparable read-outs from different space stations

Pille on ISS

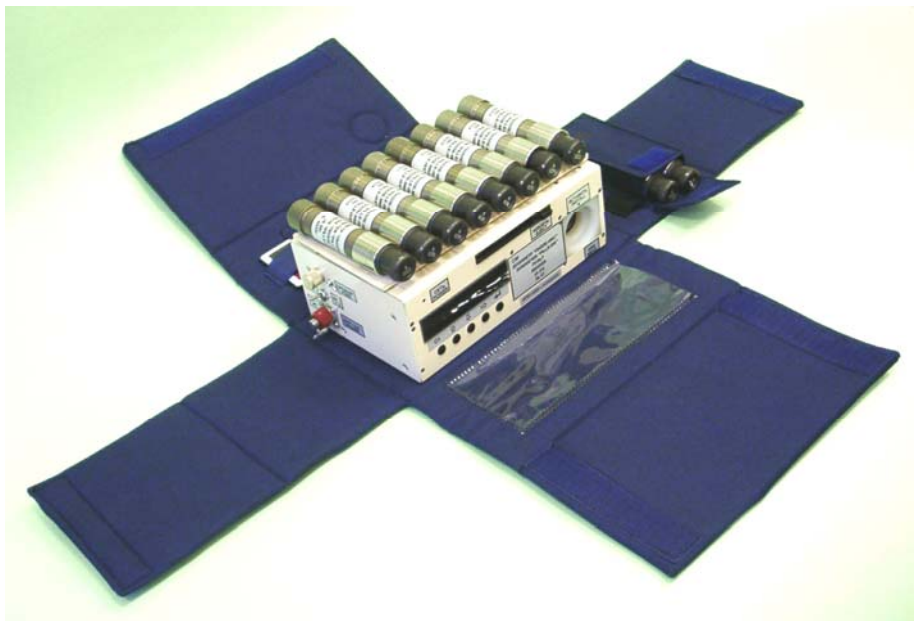
DOSMAP project

Service dosimetry system on Zvezda since 2003. (Exp. 8.)

- Dose mapping
- Personal dosimetry during CME-s
- Personal dosimetry during EVA-s
- Automatic read-out in every orbit

New dosimeters carried to ISS

Result presented on WRMISS 2010: Exp. 19-22.



Position of the dosimeters

A0301: At detector DB-8. No. 1, behind panel No. 410

A0302: Starboard crew quarters, left of window

A0303: **Returned in December 2009**

A0304: Port crew quarters, left side of window

A0305: Ceiling, on the system radiometer R-16, panel No. 327

A0306: Docking module, hemisphere, plane III, at a place free of equipment
D*edicated for EVA reference measurement inside ISS*

A0307: In pouch „Simonyi"
2010. 02. 14.: **relocated to docking module Pirs**

A0308: Inserted in the Reader, **returned in December 2009**

A0309, A0310: In the transporting case of the Reader, left to illuminator Nº 9
Dedicated for EVA personal measurements
2010. 02. 14.: **relocated to docking module Poisk**

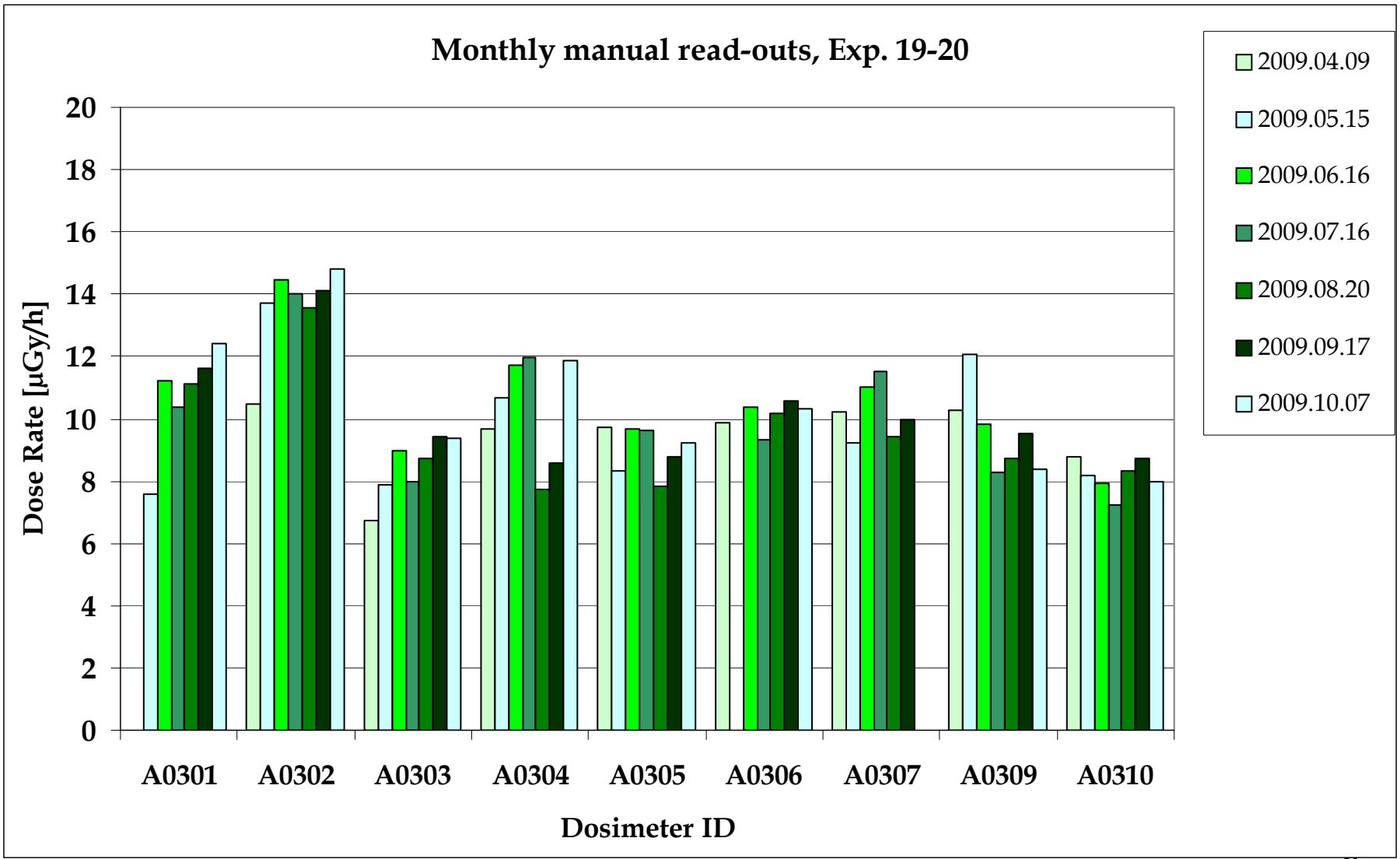
A0311: Inside the reader, *dedicated for automatic measurements*

A0312: In ASU (automatic control system) zone, on panel No. 457

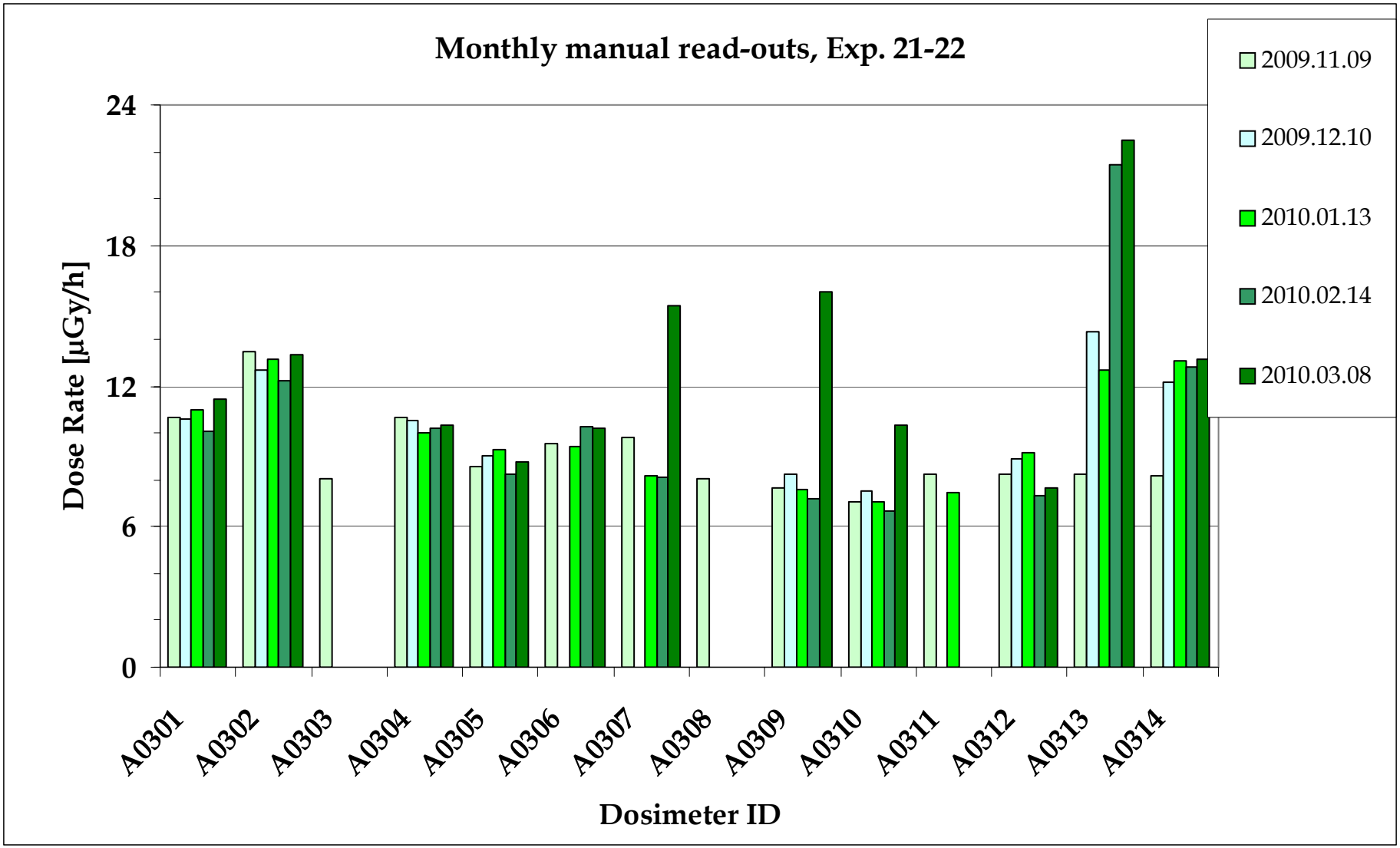
A0313: **In Reentry module of Transport spacecraft Soyuz No. 226**

A0314: At detector DB-8 No.1 behind panel No. 447

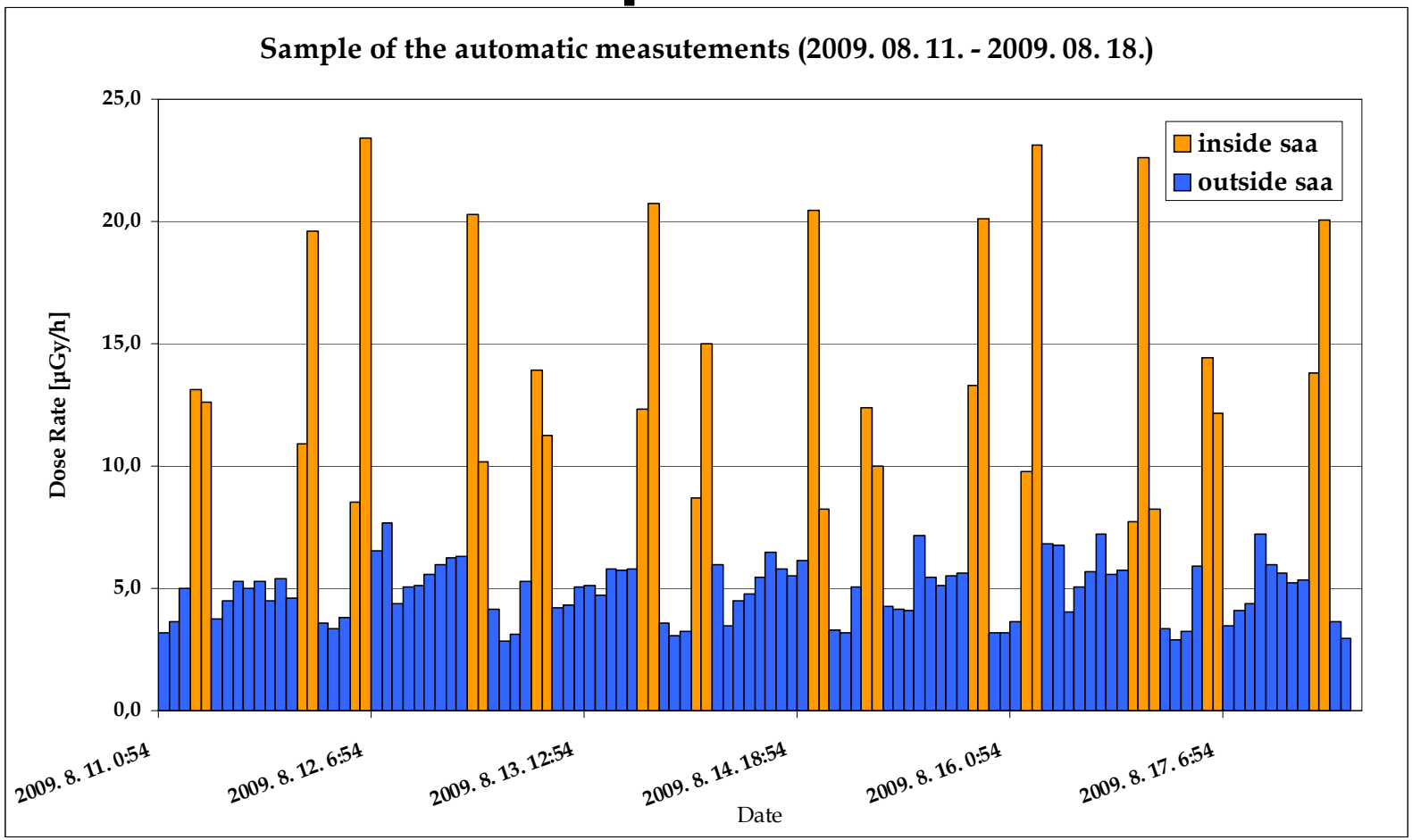
Monthly manual read-outs, Exp. 19-20.



Monthly manual read-outs, Exp. 21-22.



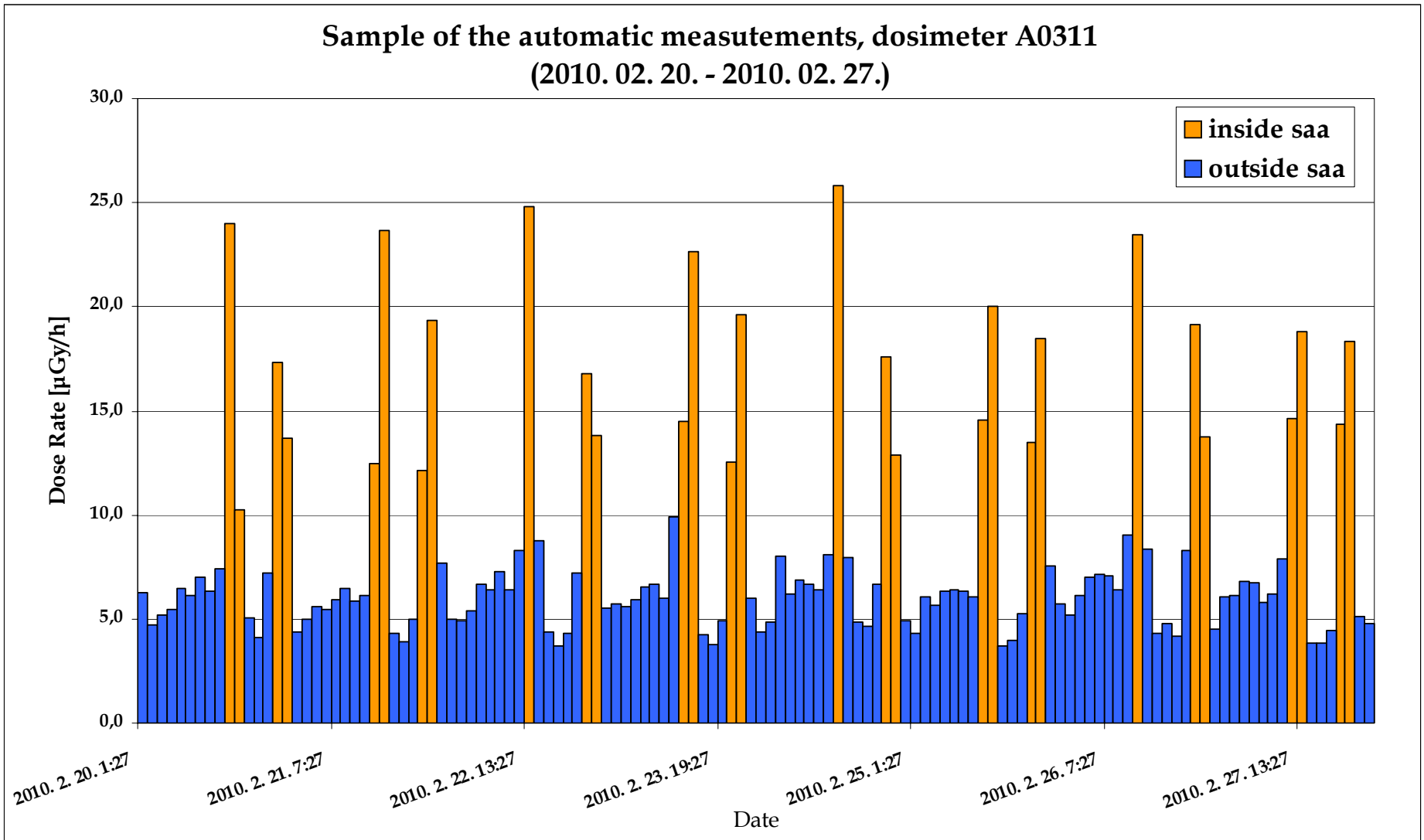
Sample from the automatic measurements, Exp. 19-20.



One third of the dose of the astronauts are caused by the South Atlantic Anomaly.

No solar activity was detected by Pille during Exp. 15 and 16.

Sample from the automatic measurements, dosimeter A0311, Exp. 21-22.



Ground investigation of dosimeters A0303 and A0308

A0308 and A0303 were returned in 2009

Visual inspection: no defects found

A0303

A0308

Ground investigation of dosimeters A0303 and A0308

A0308 and A0303 were returned in 2009

Visual inspection: no defects found

A0303

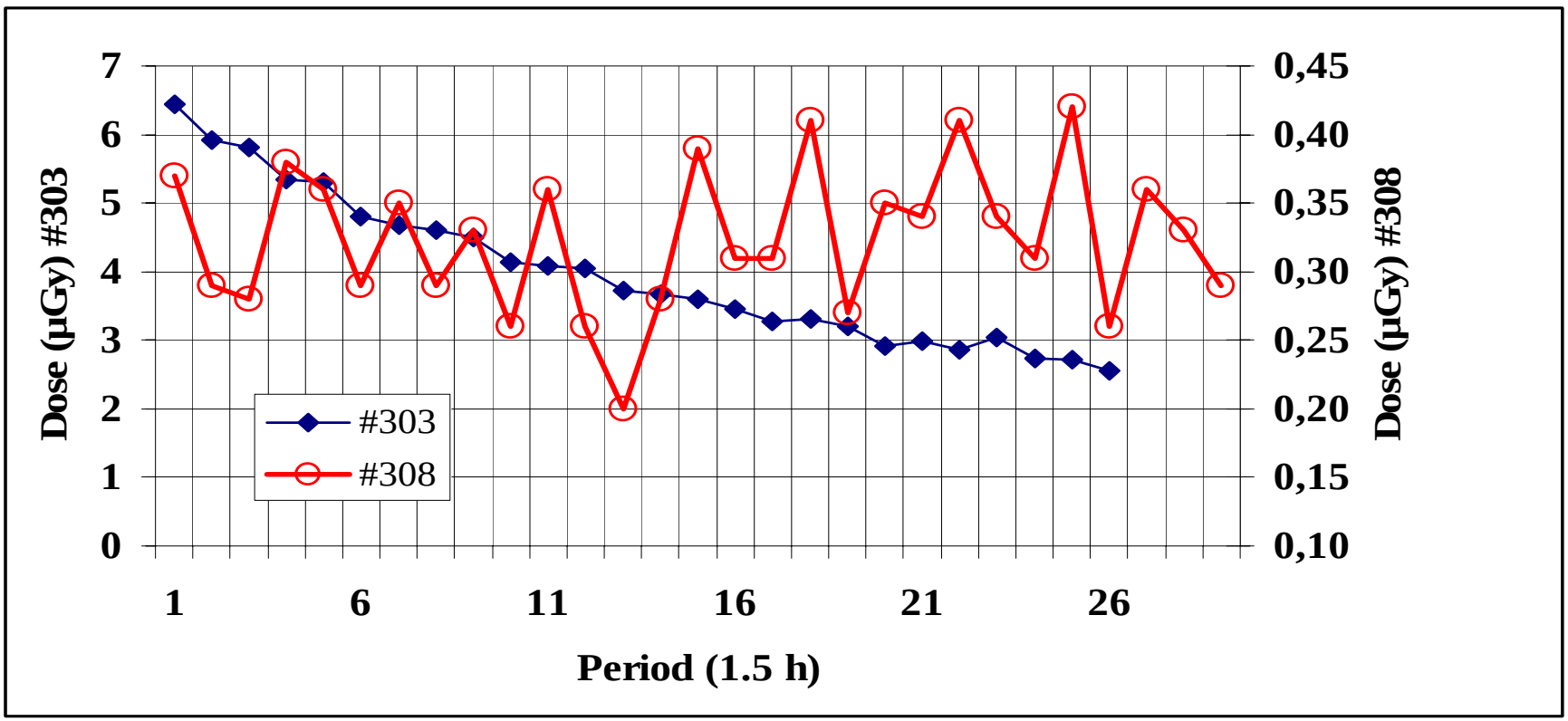
A0308

Ground investigation of dosimeters A0303 and A0308

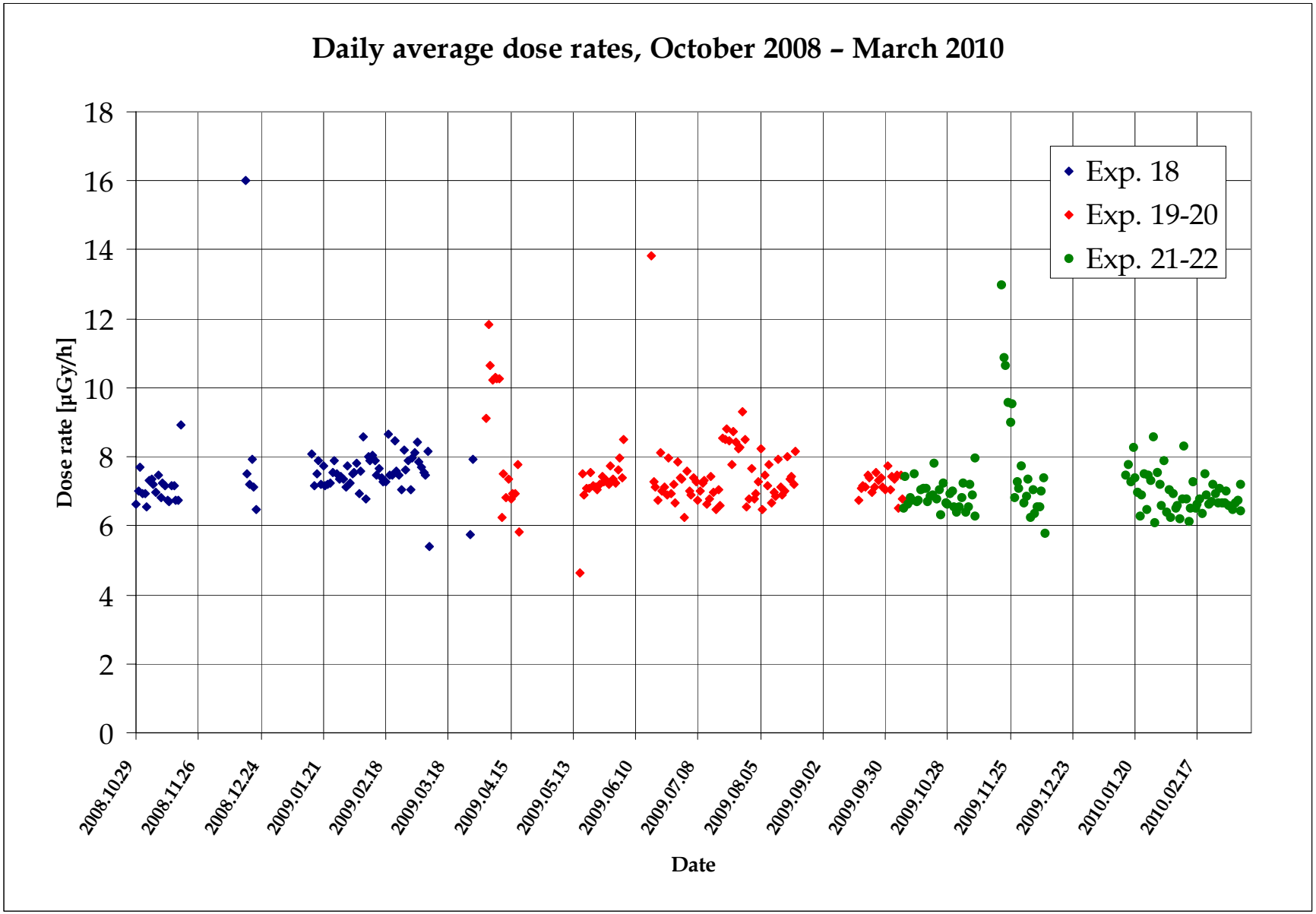
A0308 and A0303 were returned in 2009

Background

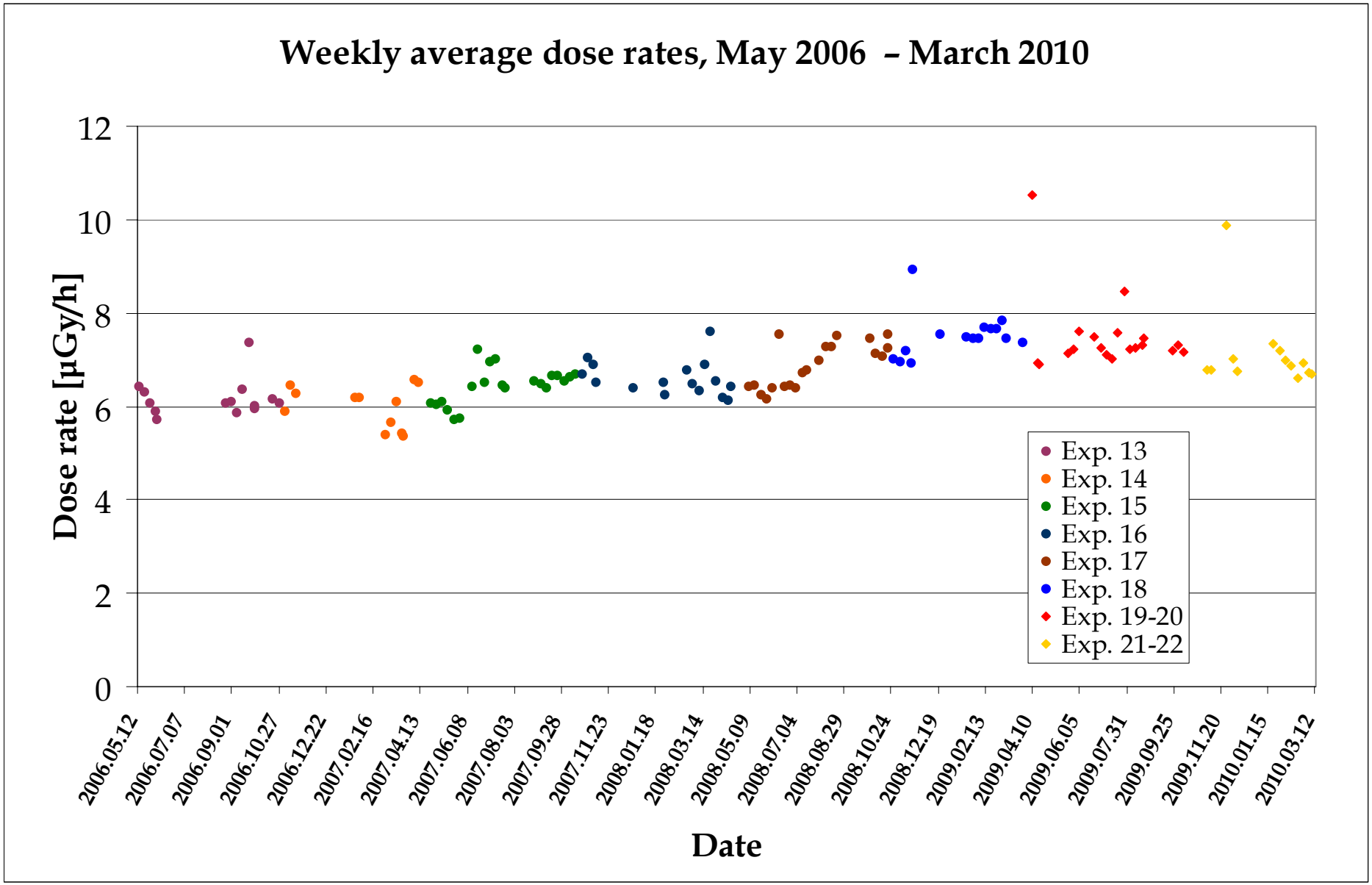
Subsequent readouts without irradiation



Daily average dose rates, Exp. 18 - 19-20 – 21-22.



Weekly average dose rates, Exp. 13-22.



EVA measurements

EXP. 19-20.

2 EVAs were measured

EVA date	Extra dose [µGy]	Extra dose rate [µGy /h]	Extra dose [µGy]	Extra dose rate [µGy /h]
2009. 06. 5.	598	122	451	92
2009. 06. 10.	205	66.5	371	120

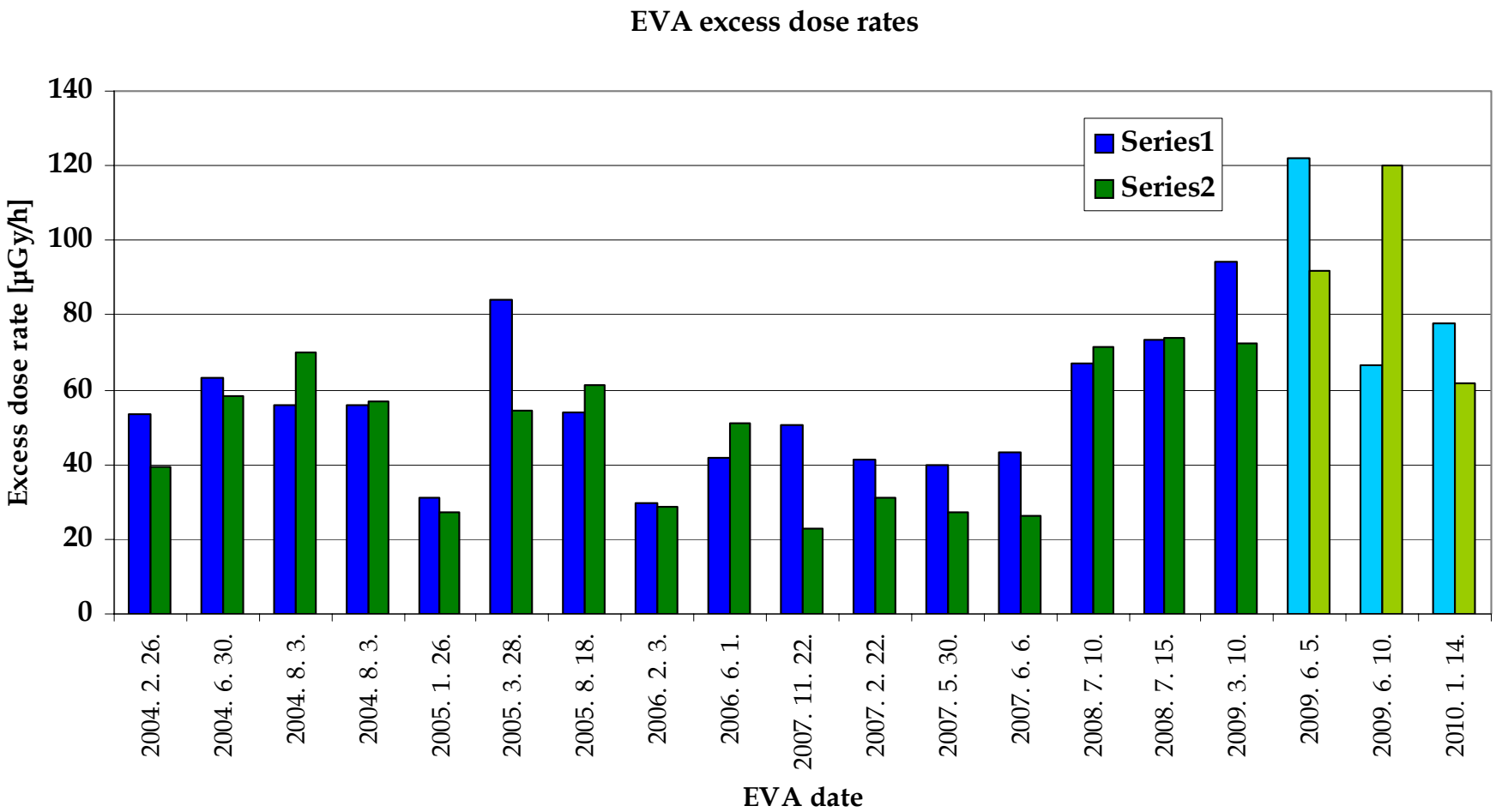
EXP. 21-22.

1 EVA was measured

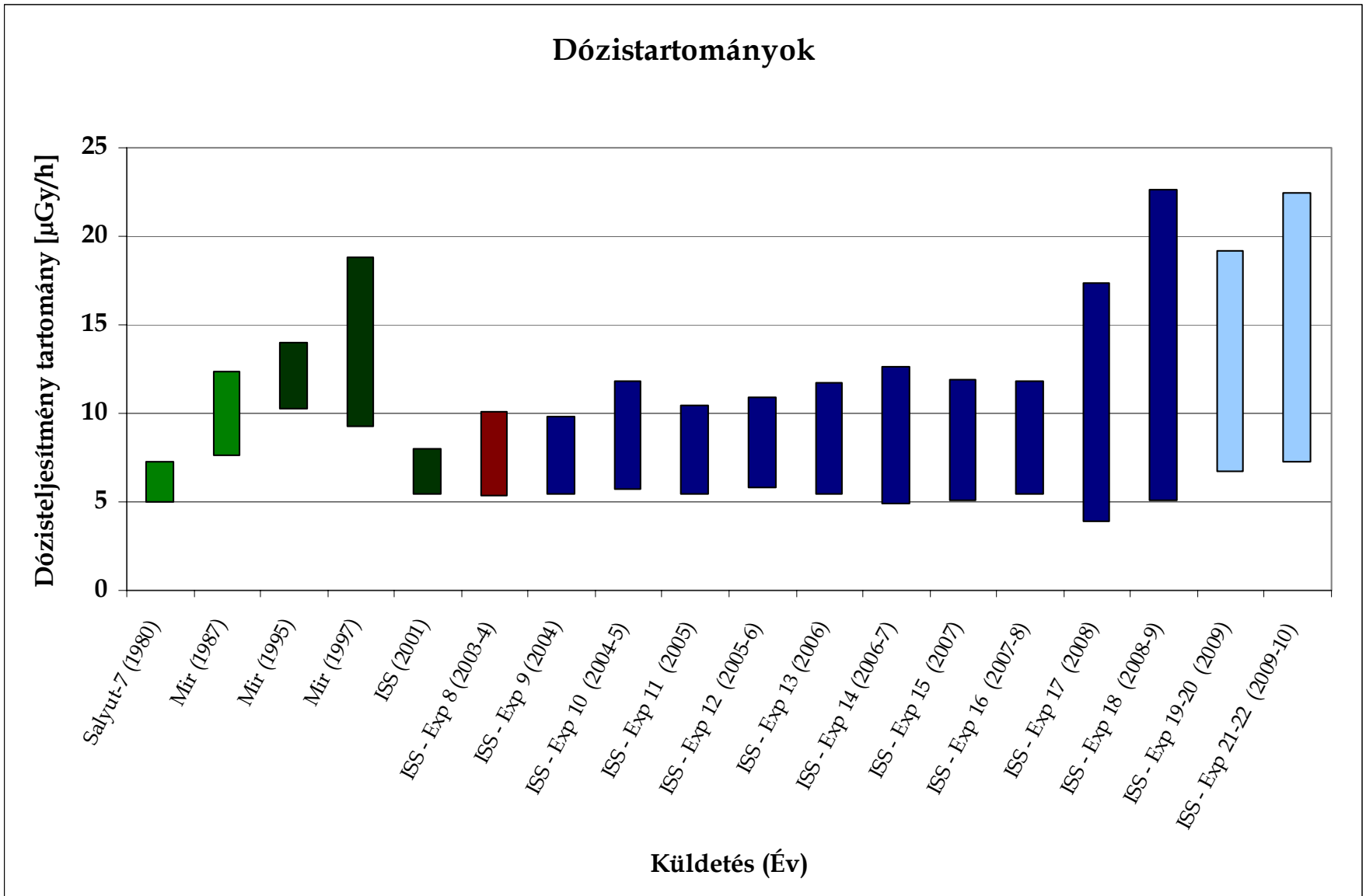
- Dosimeter A0306 was used as reference dosimeter

EVA date	Extra dose [µGy]	Extra dose rate [µGy /h]	Extra dose [µGy]	Extra dose rate [µGy /h]
2010. 01. 14.	367	77.6	291	61.5

EVA excess dose rates



Dose ranges measured by Pille



Further work and summary

Dose rates of Exp. 19-22. were similar to the previous measurements

Since November 2009 dosimeter A3011 was used for automatic measurements

Background of dosimeter A0311 should be investigated further

There are still uncertainties about positions of the dosimeters

In spite of the lower sensitivity, A0303 and A0308 are reliable dosimeters

The sensitivity have not changed in the past seven years

A0308 as dosimeter dedicated for automatic measurements was read out 21 459 (!) times in the last 7 years onboard ISS

(2 oldtimers)

Thank you for your attention