

13th WRMISS, KRAKOW, POLAND
September 8-10, 2008

RESULTS OF THE RADIATION MONITORING SYSTEM ONBOARD THE SERVICE MODULE OF THE INTERNATIONAL SPACE STATION

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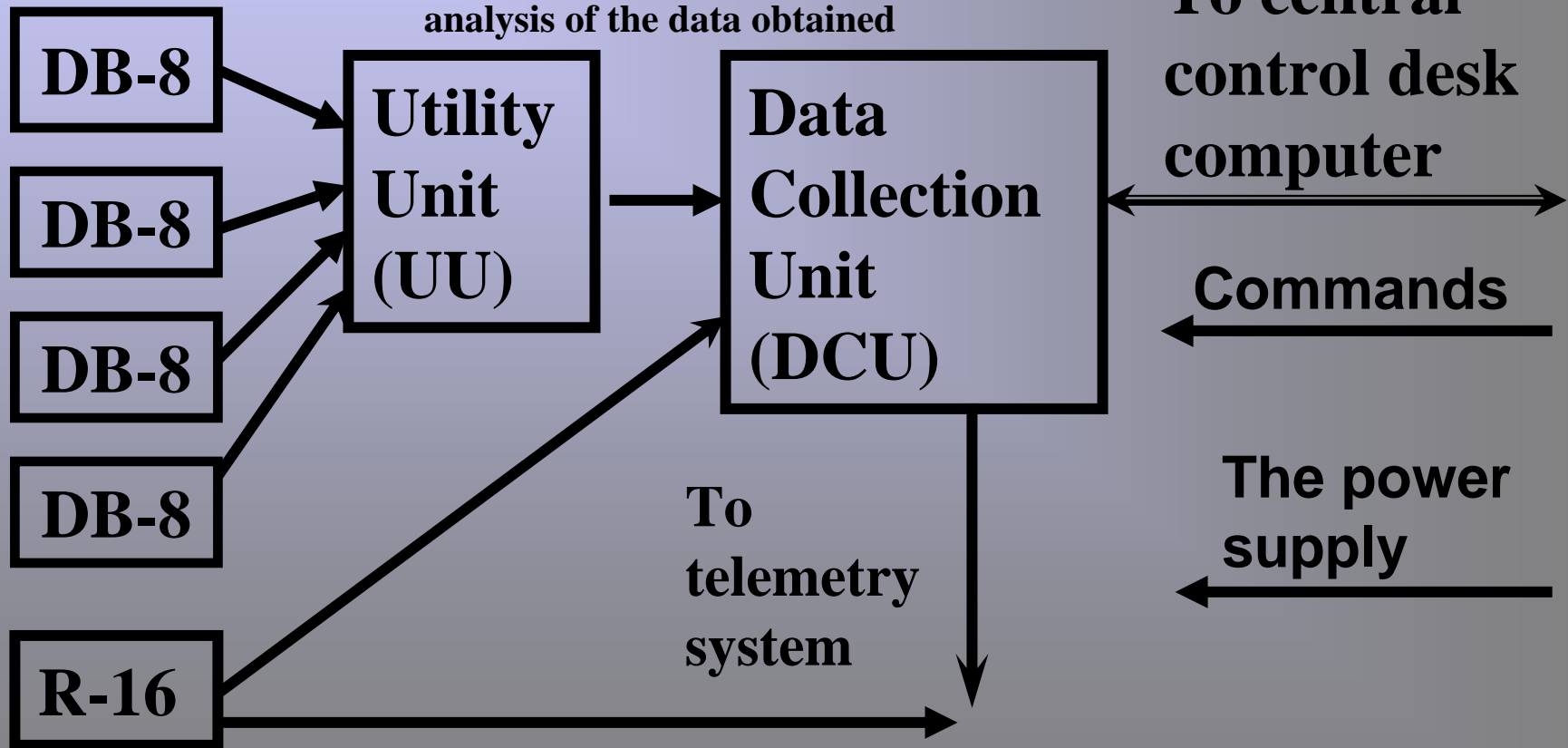
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³⁾ Rocket-space corporation "Energia"

Configuration of the Radiation Monitoring System (RMS)

Each DB-8 unit consist of two dosimeters with semiconductor radiation detectors

UU and DCU made for processing and analysis of the data obtained



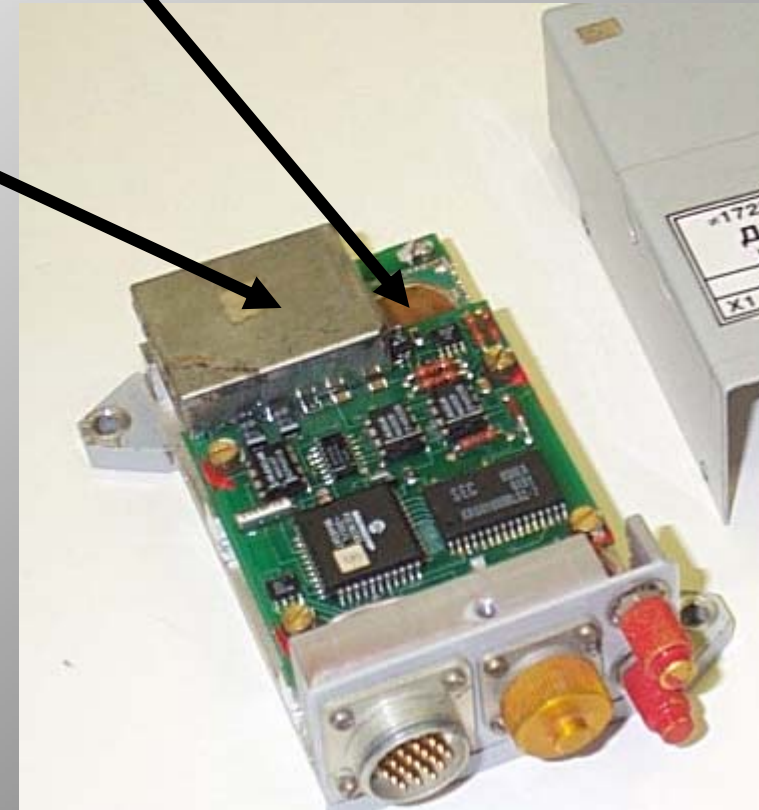
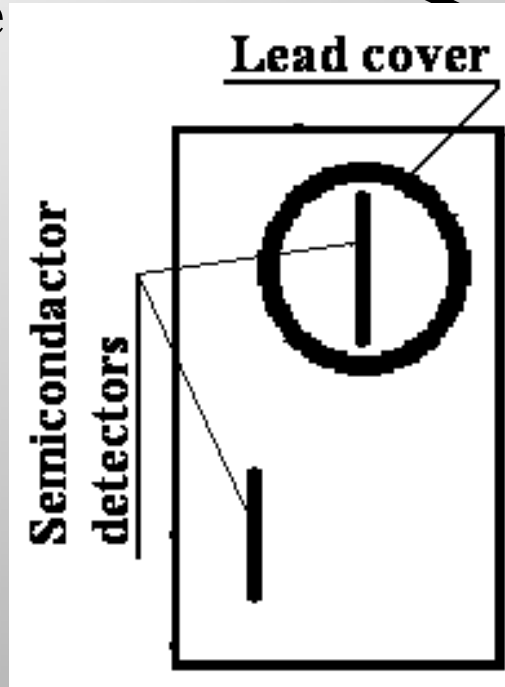
DB-8 unit without cover

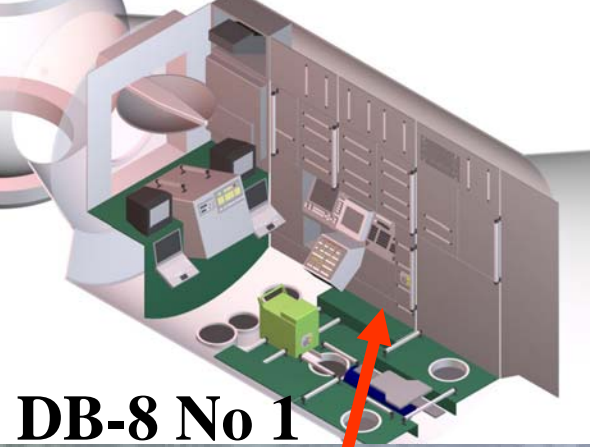
Shielded detector

Unshielded detector

The difference between the two channels is that one of the detectors has an additional lead shielding. The shielding is a sphere surrounding the detector.

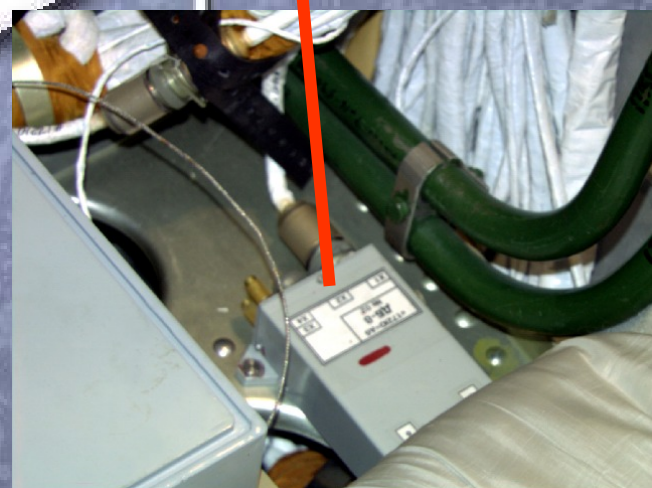
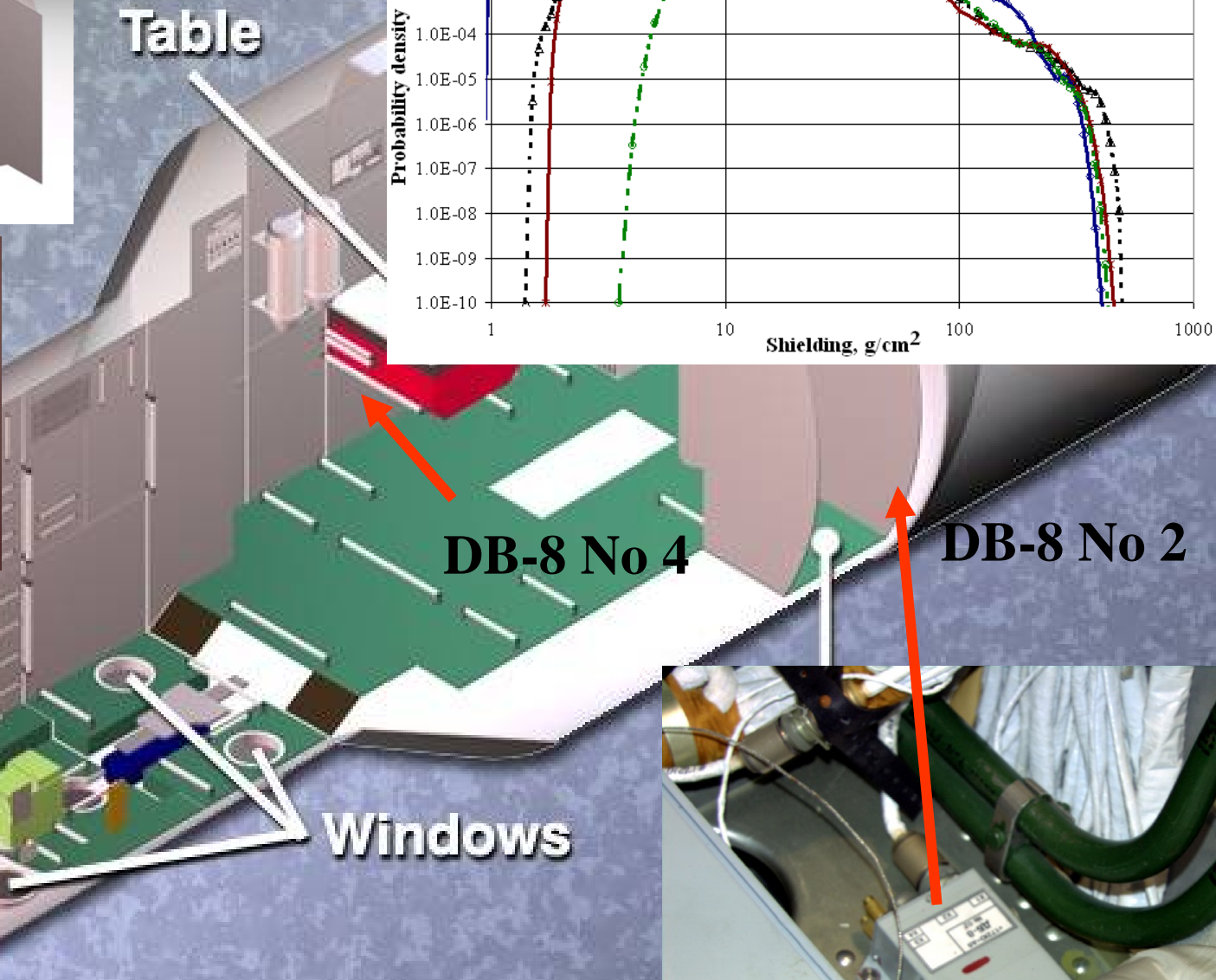
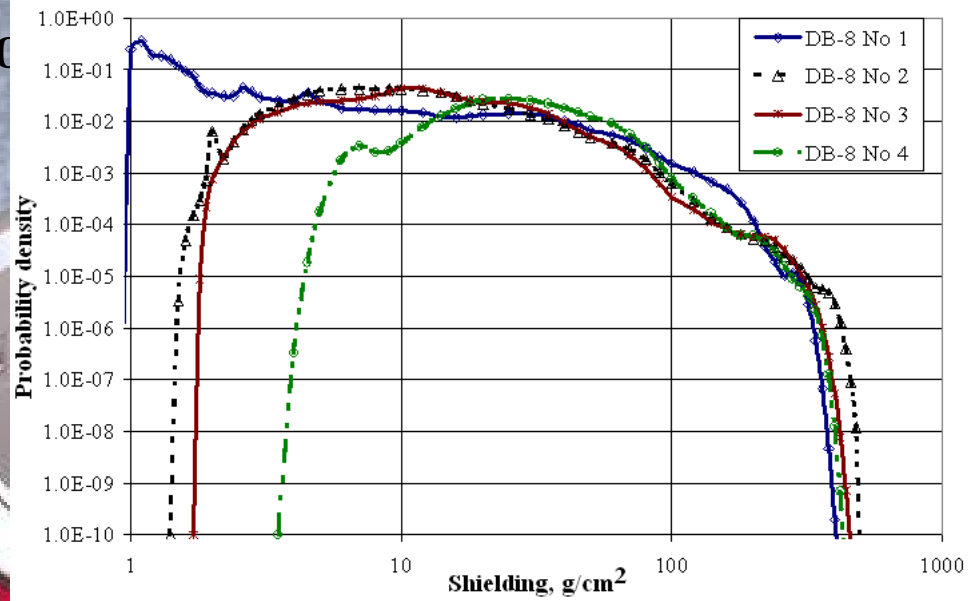
The sphere wall thickness is $3 \text{ g/cm}^2 \text{ Pb}$





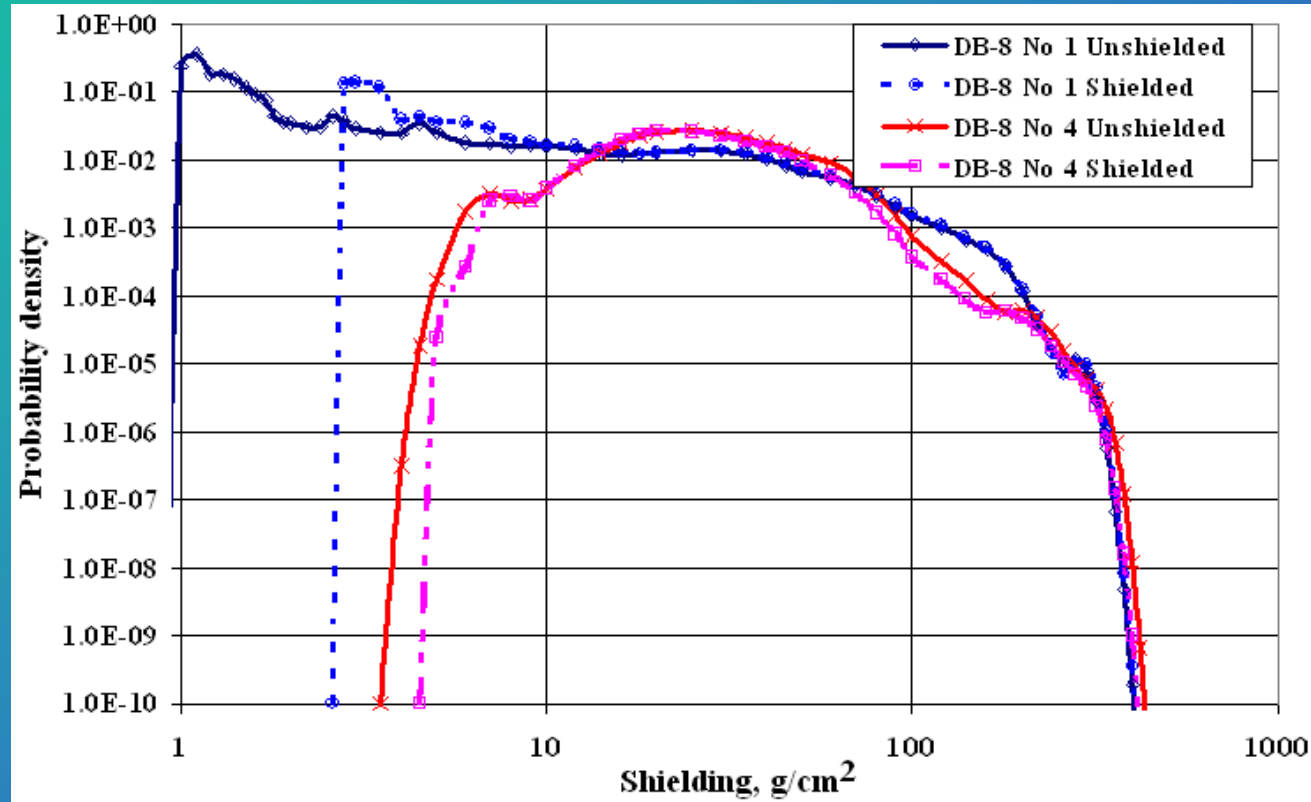
DB-8 No

Table

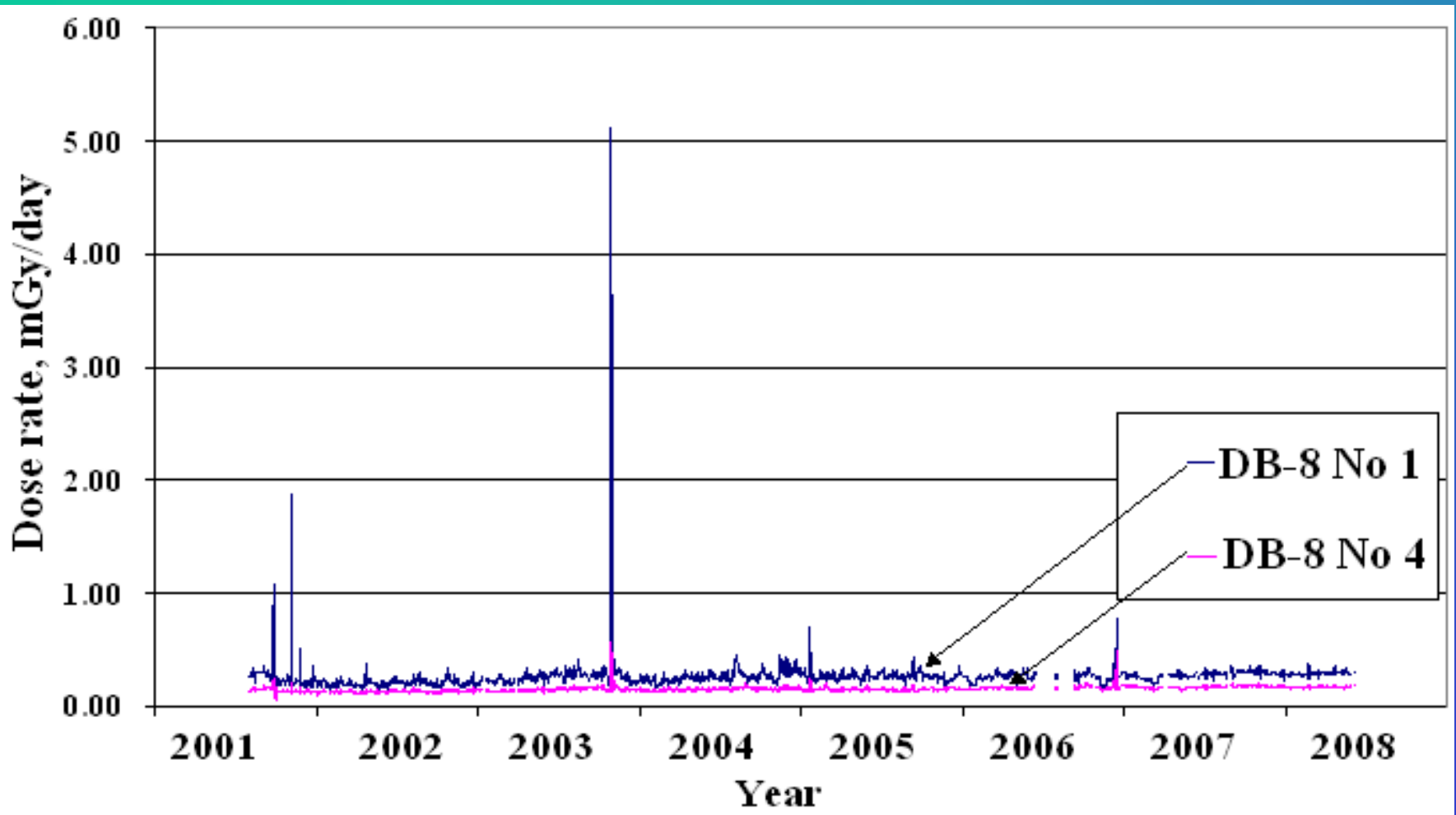


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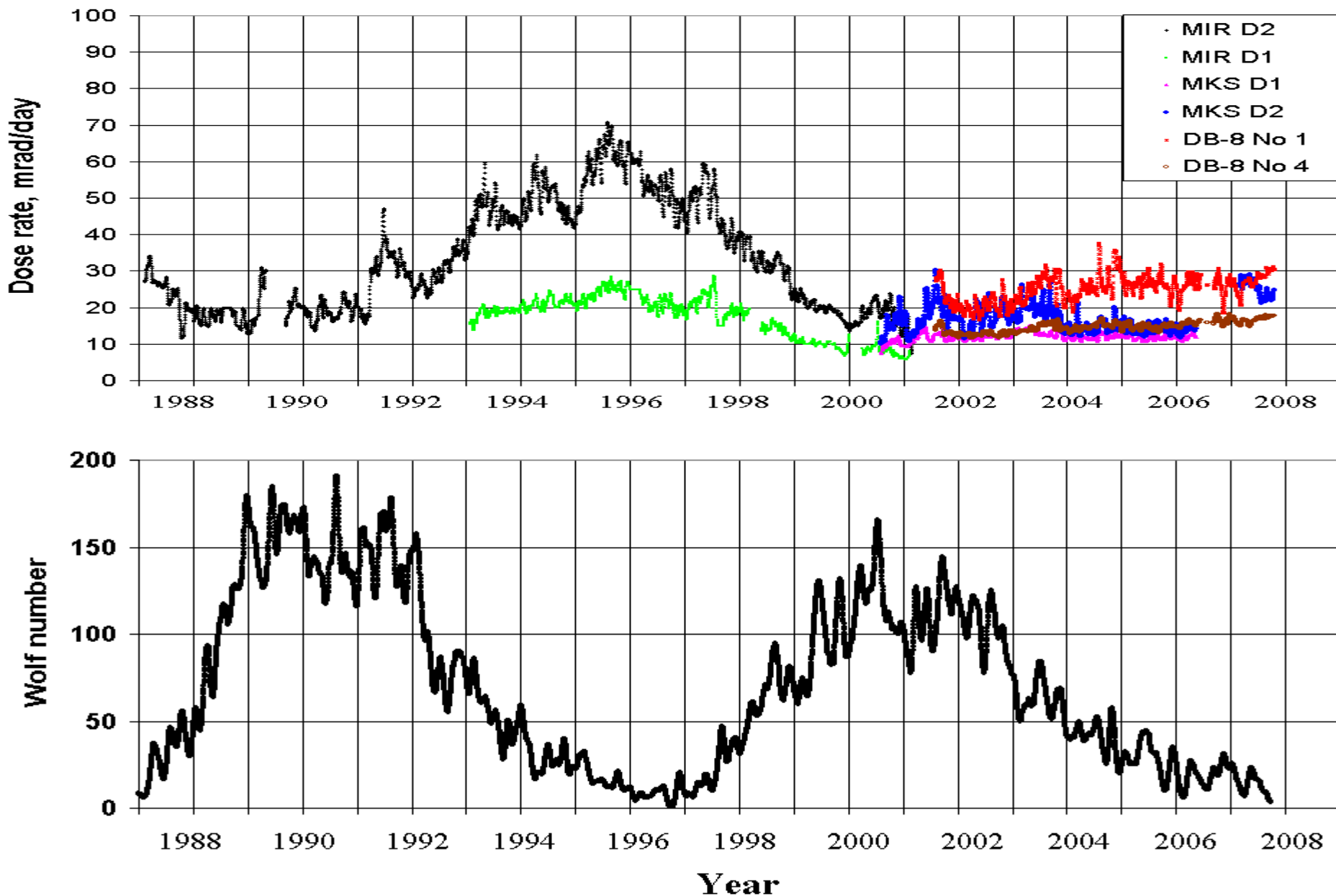
Contribution of the lead sphere to the detector shielding



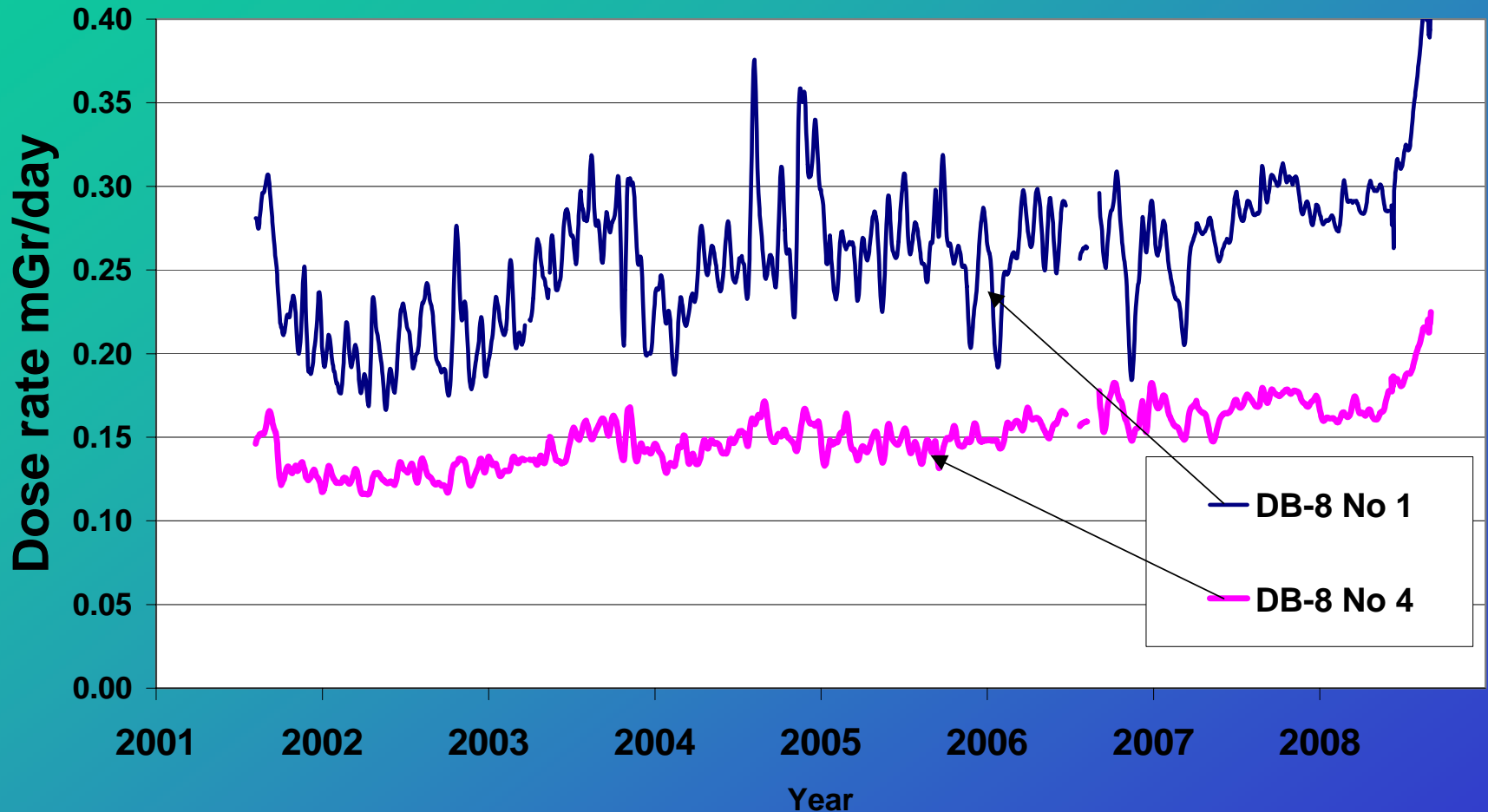
Dose rate measured from August 2001 to June 2008 with DB-8 units # 1 and # 4 unshielded detectors



Daily doses, measured with R-16 device on MIR and ISS (SPE excluded)



Dose rate measured from August 2001 to August 2008 with DB-8 units # 1 and # 4 unshielded detectors, SPE excluded



Dose rate from August 2001 to August 2008 measured with DB-8 units # 1 and # 4 unshielded detectors, SPE excluded

Solar activity level: daily Wolf numbers.

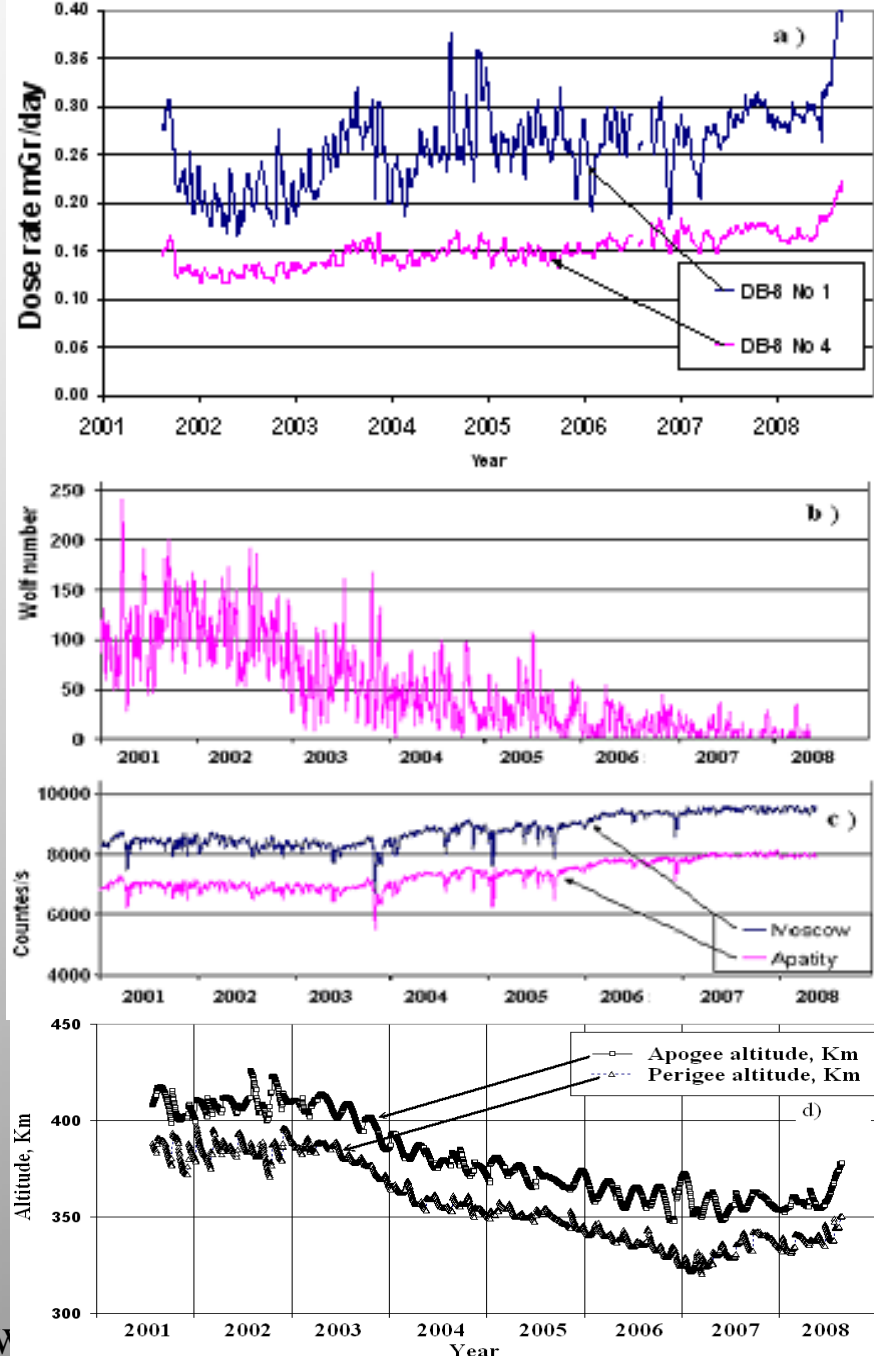
<http://www.ngdc.noaa.gov/stp/SOLAR/ftp/sunspotnumber.html>

Neutron monitor count rate (in Apatity and in Moscow)

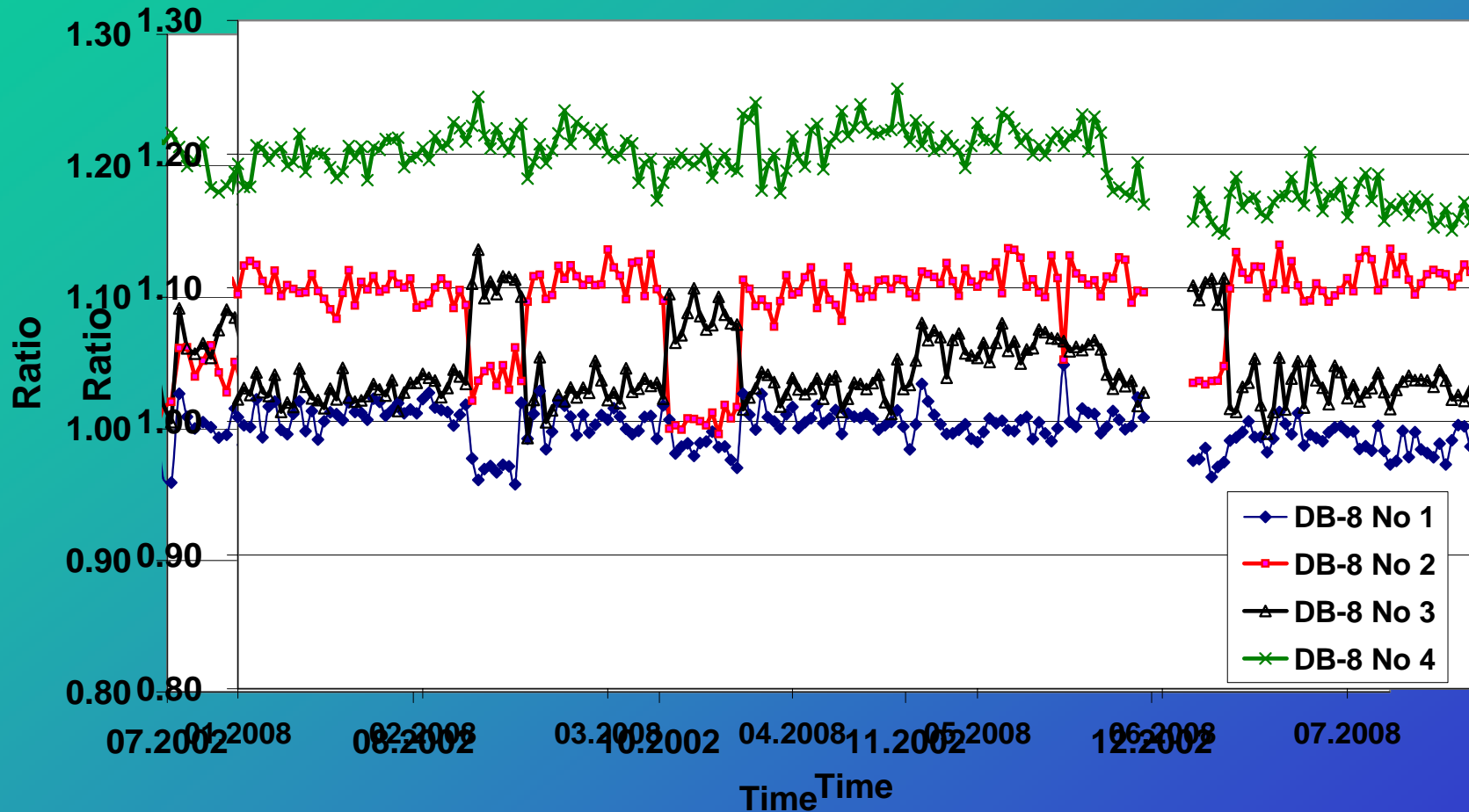
<http://pgia.ru/CosmicRay/>

<http://cr0.izmiran.rssi.ru/mosc/main.htm>

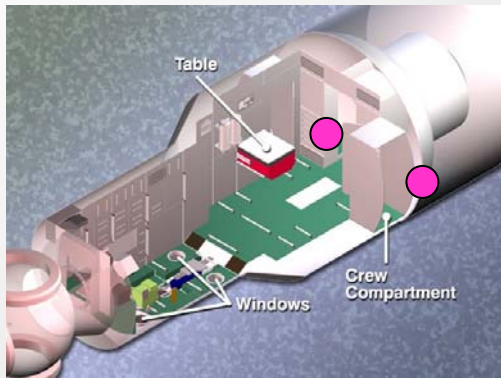
ISS apogee and perigee altitude.



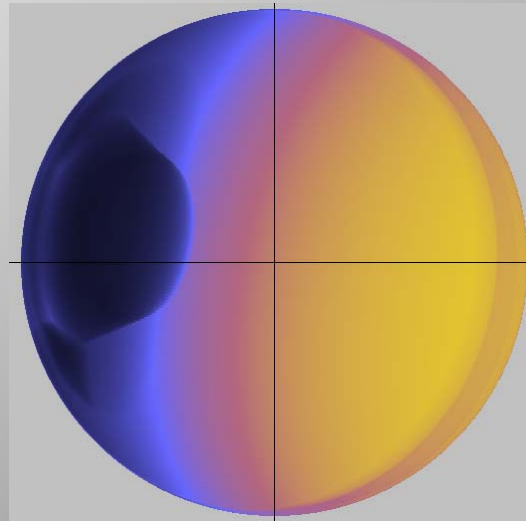
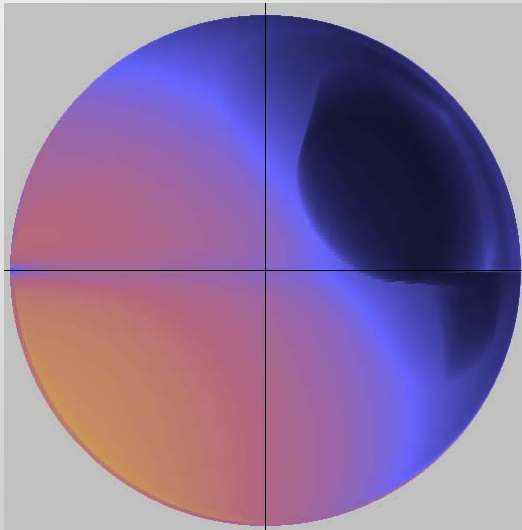
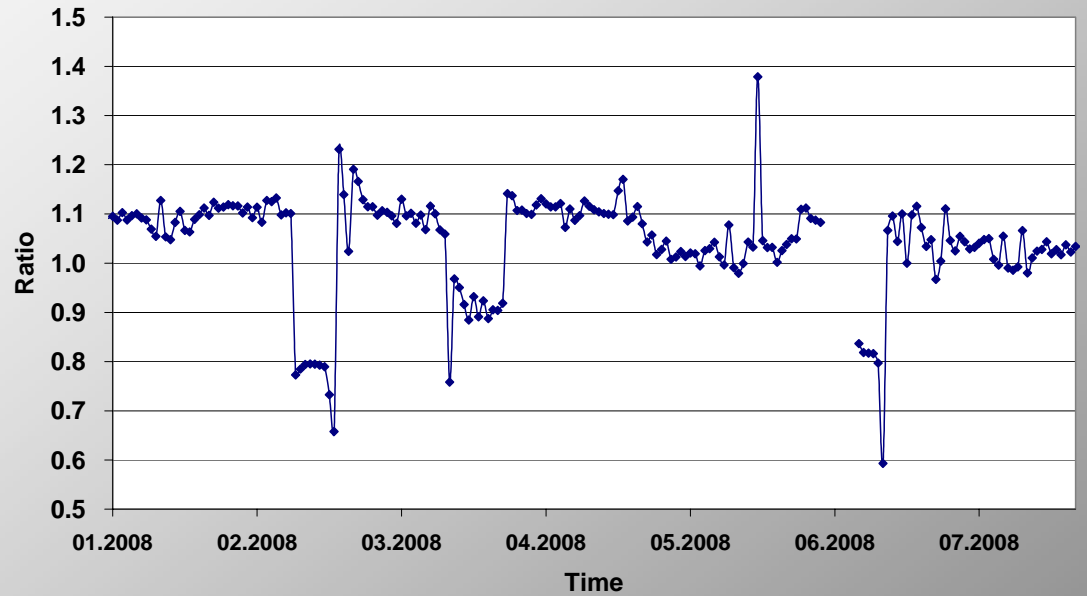
Ratio of daily doses for shielded and unshielded detectors of each DB-8 unit



Ratio of daily dose for unshielded detectors DB-8 #3/DB-8 #2

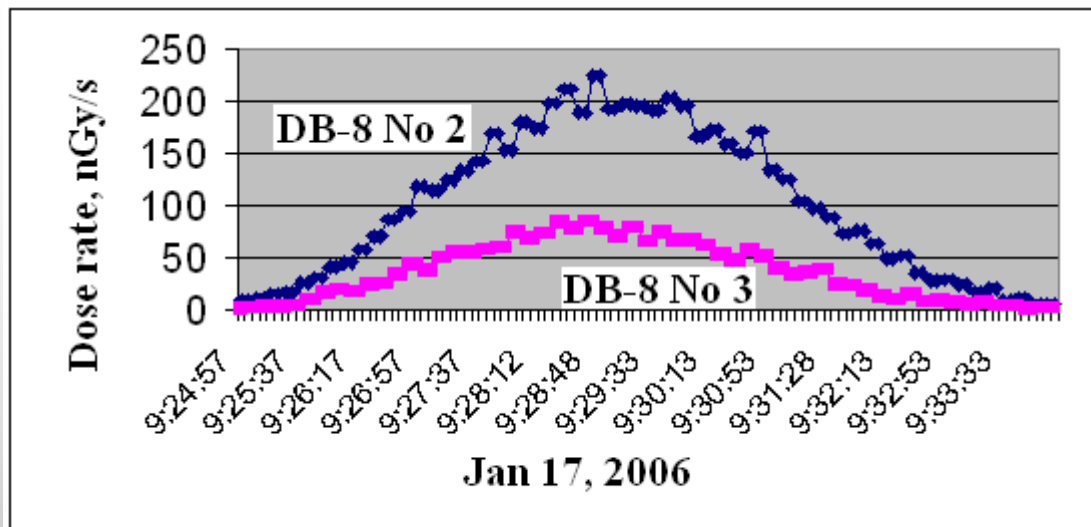


Direction of view

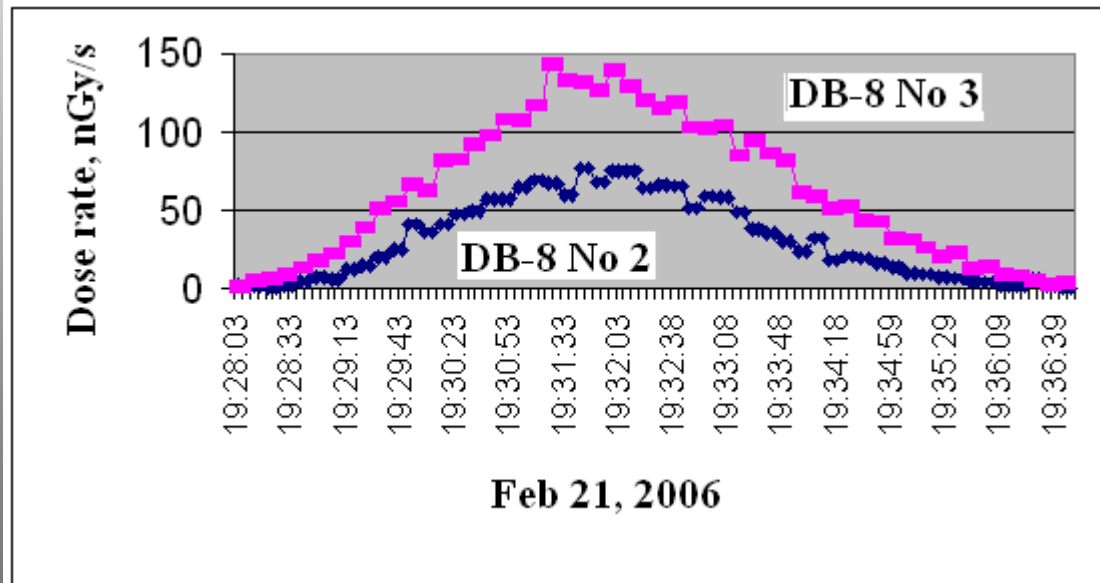


Angular distribution of shielding around the detector units

Experimental dependences of dose rate versus time, measured by dosimeters DB-8 No 2 and No 3 during SAA passage

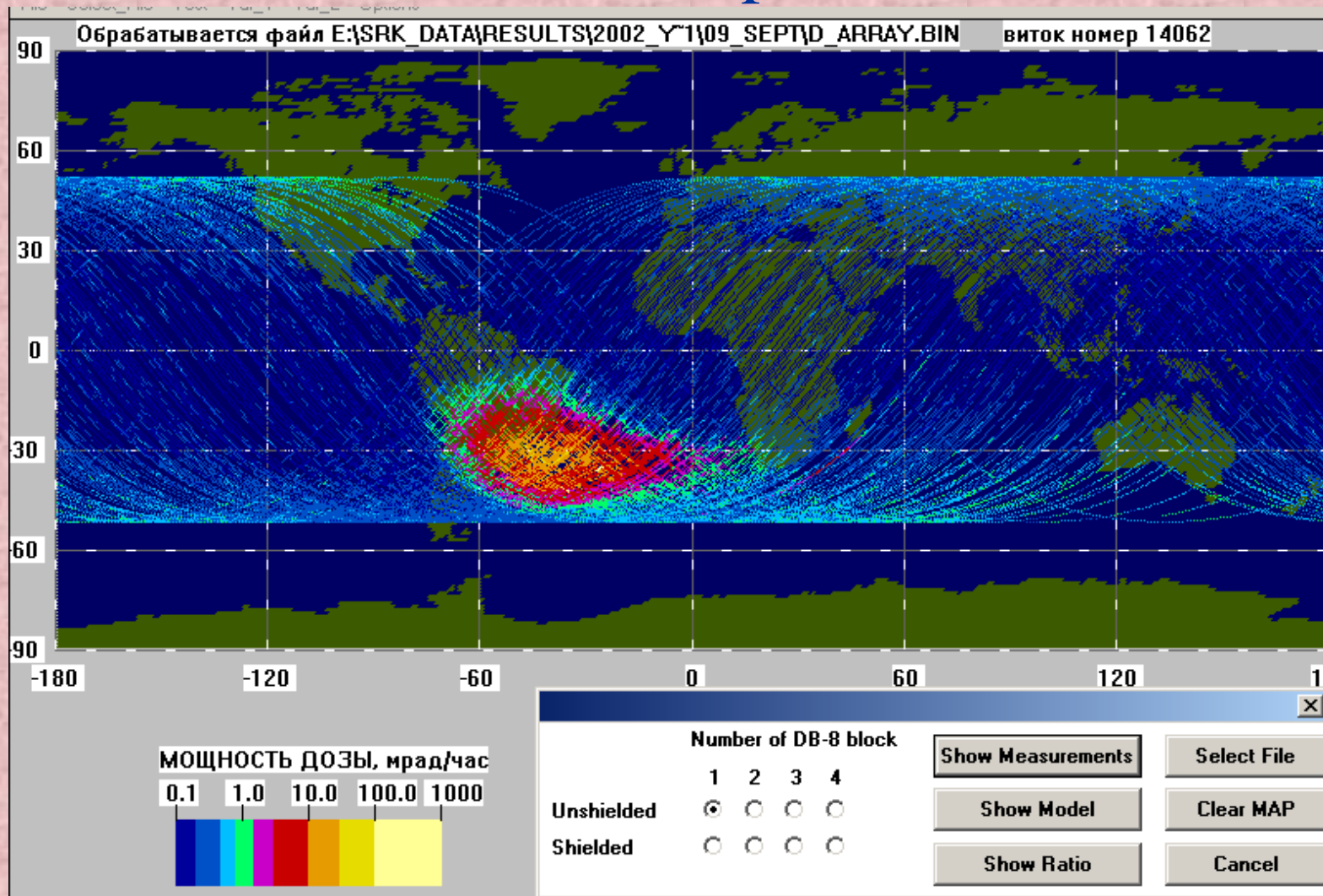


Ascending part of a trajectory. The ISS SM left board (DB-8 #2) is directed to the northwest

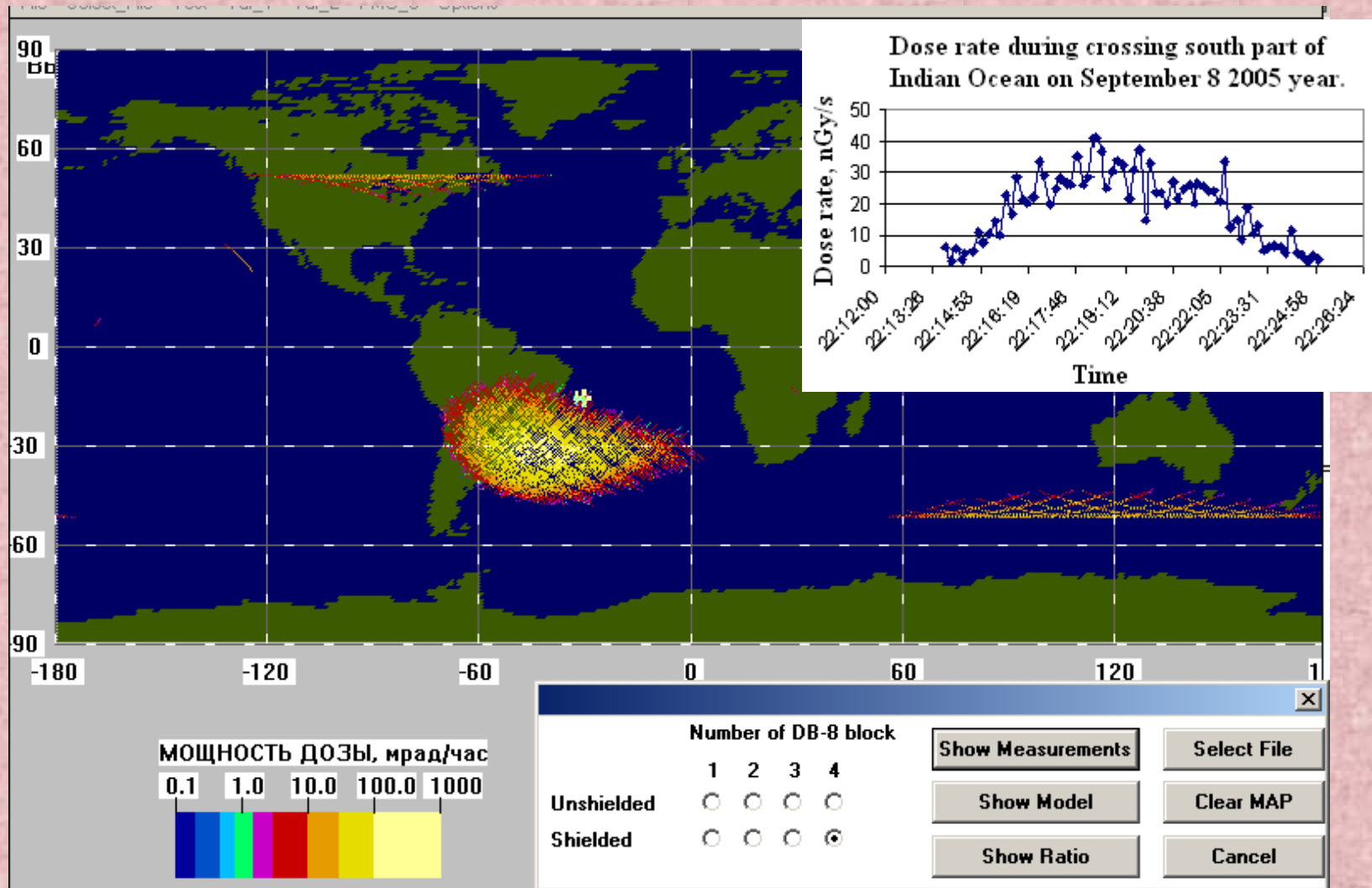


Ascending part of a trajectory. The ISS SM left board (DB-8 #2) is directed to the southeast

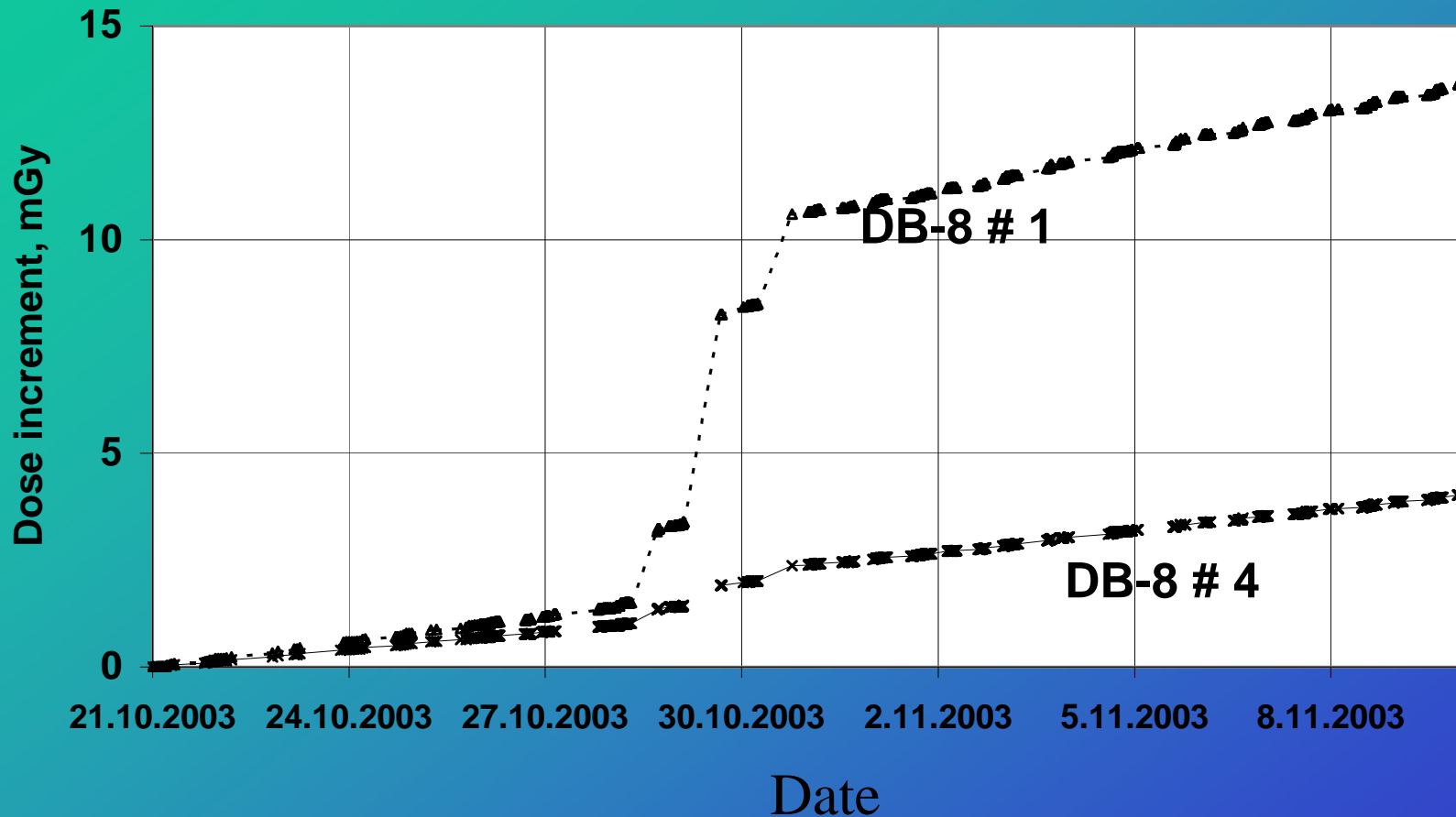
Dose rate distribution on the world map as measured in September, 2002



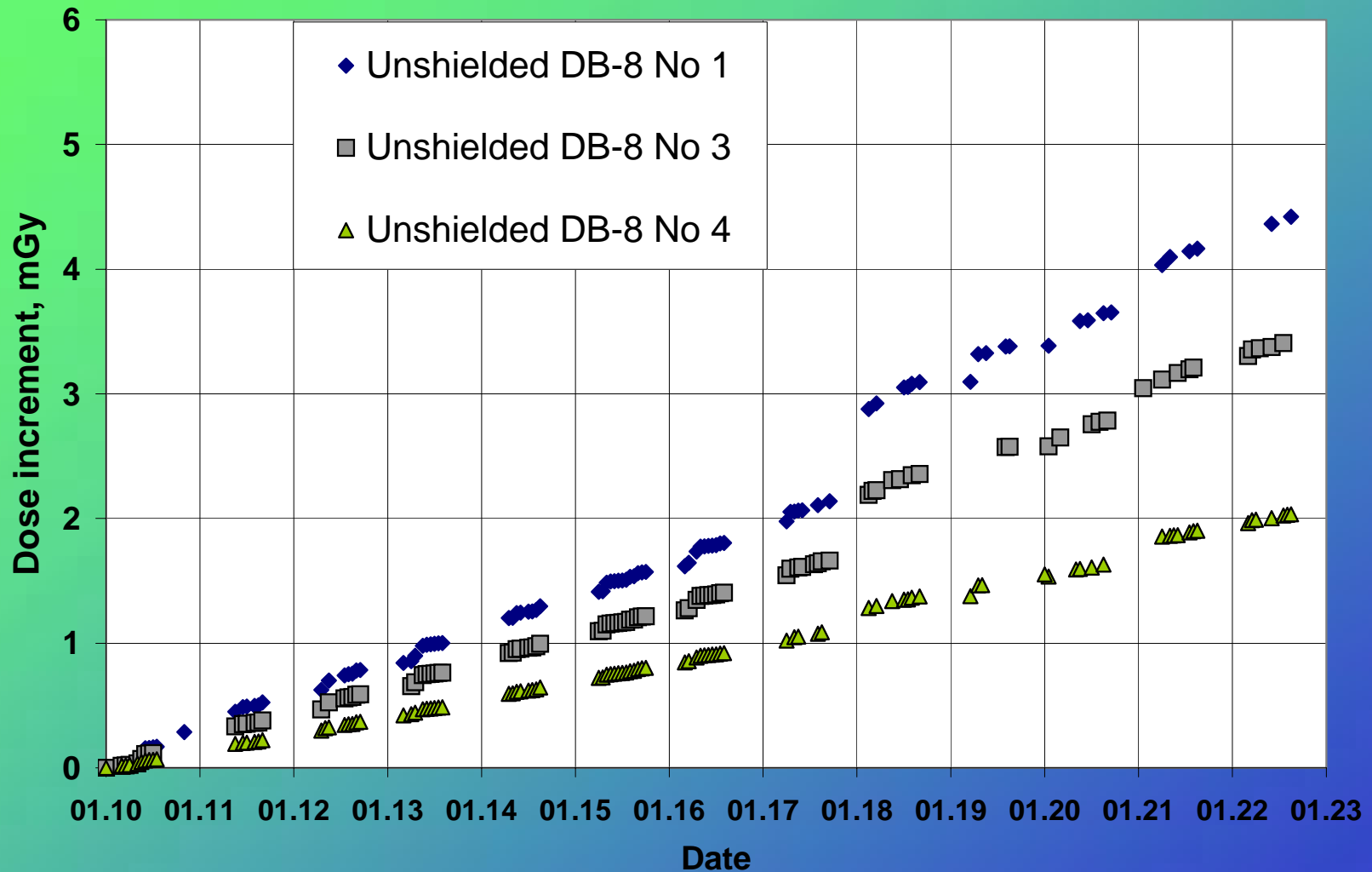
Dose rate distribution on the world map as measured in September, 2005 (SPE included)



Dose for October 28 and 29, 2003 SPE measured with unshielded detectors



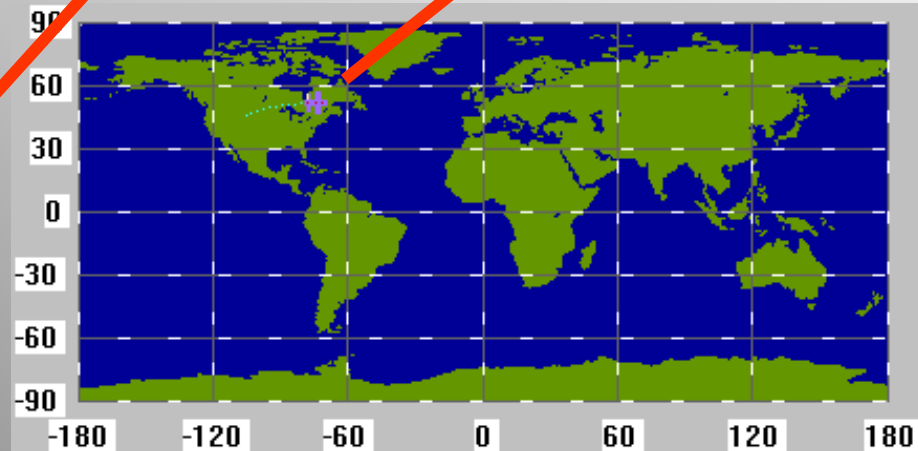
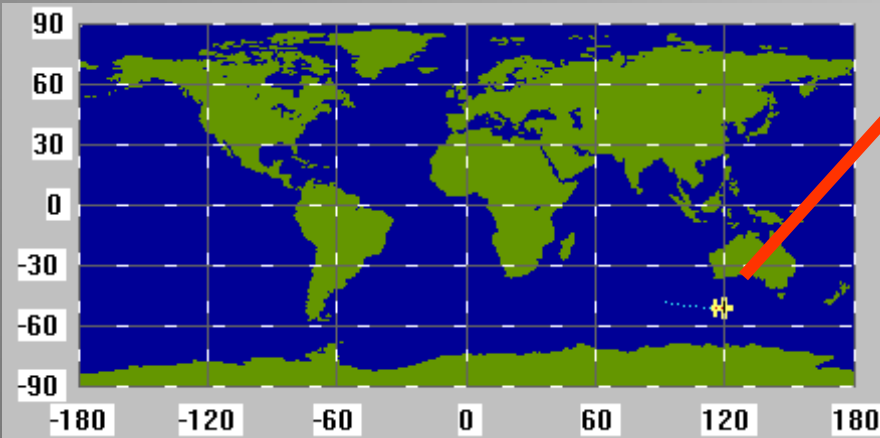
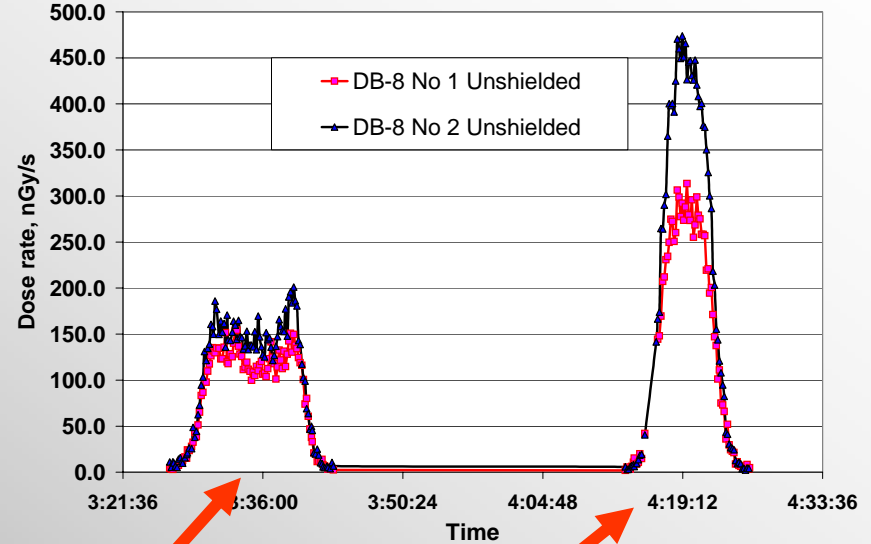
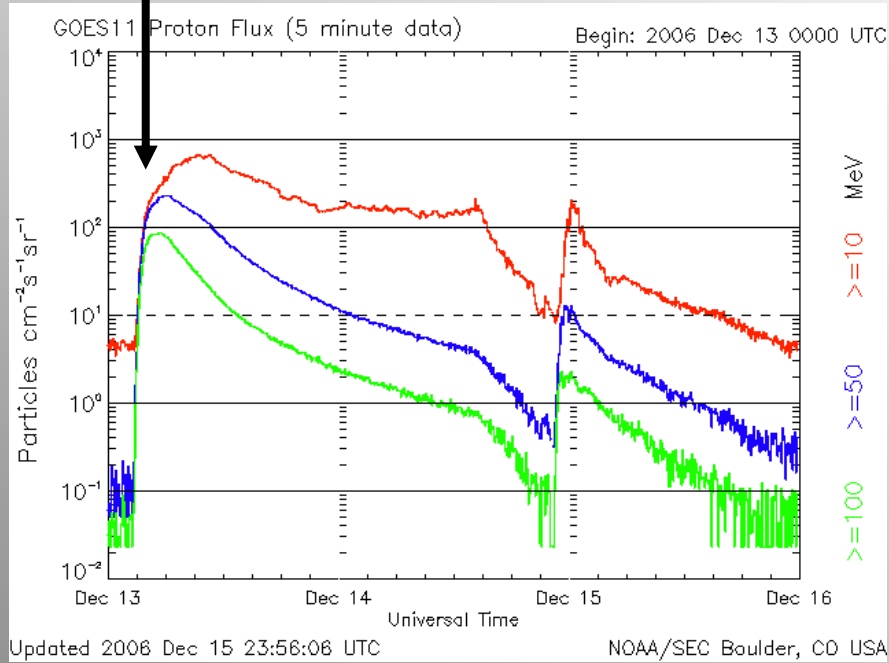
Accumulated dose increment during January, 2005 SPE



SPE doses obtained with DB-8, mGy

Date	DB-8 # 1		DB-8 # 2		DB-8 # 3		DB-8 # 4	
	Unshiel	Shielded	Unshiel	Shielded	Unshiel	Shielded	Unshiel	Shielded
2001/09/24	1.57	0.99	1.25	0.96	0.54	0.21	0.19	0.15
2001/11/04	2.66	1.31	1.18	0.49	0.84	0.54	0.08	0.04
28.10.2003	1.71	1.19	0.82	0.52	0.87	0.69	0.31	0.30
2003/10/29	6.82	3.14	3.00	1.18	2.11	1.35	0.67	0.52
2005/01/17	0.81	0.67	0.31	0.55	0.63	0.29	0.18	0.10
2005/01/20	0.21	0.18	0.13	0.14	0.13	0.14	0.08	0.07
2005/09/08	0.33	0.28	0.20	0.24	0.26	0.20	0.09	0.08
2006/12/13	0.51	0.47	0.67	0.67	0.43	0.42	0.32	0.32

SPE December 13, 2006



Angular Distribution of shielding around the detectors
December 13, 2006, 03:30 South high latitude region.
View in topocentric coordinate system.

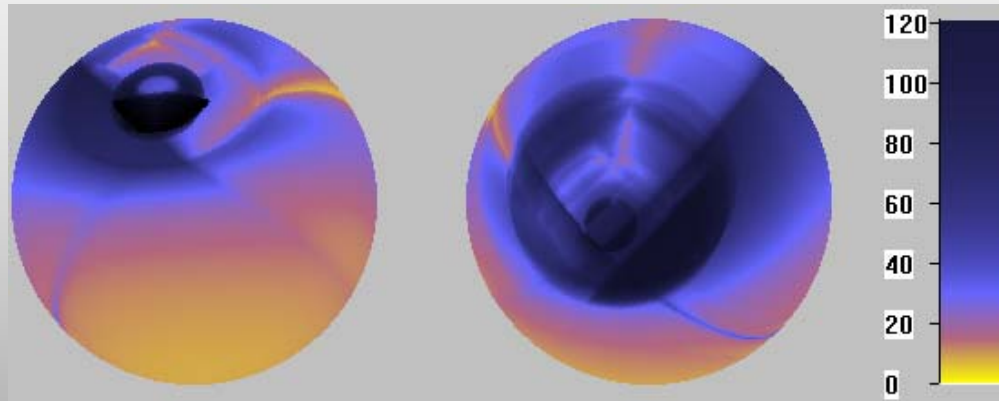
View from West

View from East

Zenith



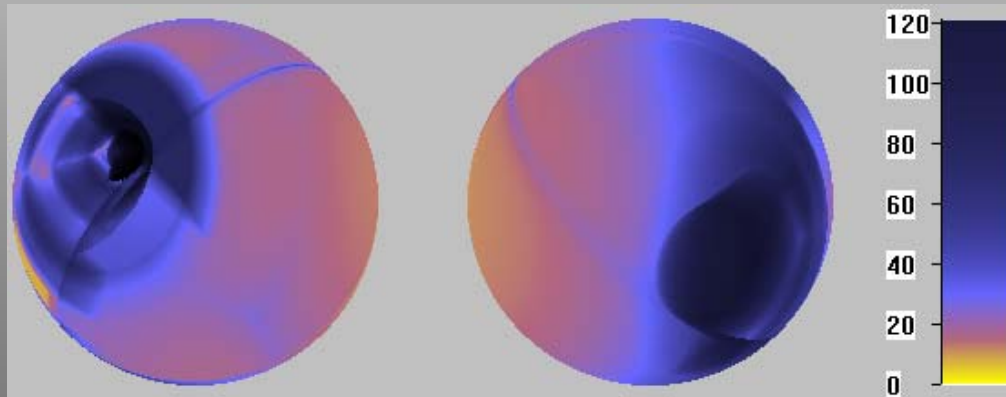
Nadir



DB-8 No 1

N ↔ S

S ↔ N



DB-8 No 2

Conclusion

- The radiation monitoring system has been working onboard the ISS since August 2001. RMS regularly provides the Radiation safety service group with operative dosimetry data
- The RMS measurement data set obtained up to now covers about 7 years
- The difference in daily doses measured in the ISS Service Module in undisturbed conditions is obtained to be about factor of 2
- In the decay phase of the 23th solar cycle, the dose rate change onboard the ISS was essentially smaller than corresponding change in solar cycle 22. The effect can be possibly due to ISS altitude decreasing when GCR flux increase began and different detector shielding conditions onboard MIR and ISS
- The results obtained demonstrate that the ISS attitude can essentially influence on the dose rate distribution inside the ISS Service Module.
- During SPE the difference in daily doses onboard the ISS can be as much as a factor of 10. However, during January 20, 2005 SPE characterized by very hard energy spectrum the difference was only 3 times

Thank you for your attention!