

3D Survey of the radiation environment in the ISS-USLab with the ALTEA detector

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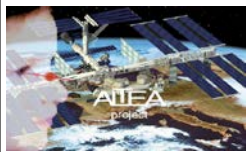
University of Rome
"Tor Vergata"



space radiation & plasma environment monitoring ws
9 - 10 may 2012

European Space Agency





Background and rationale

Radiation monitoring is a mandatory step for human exploration

A detailed knowledge of the radiation environment is required:

for **accurate risk assessments**

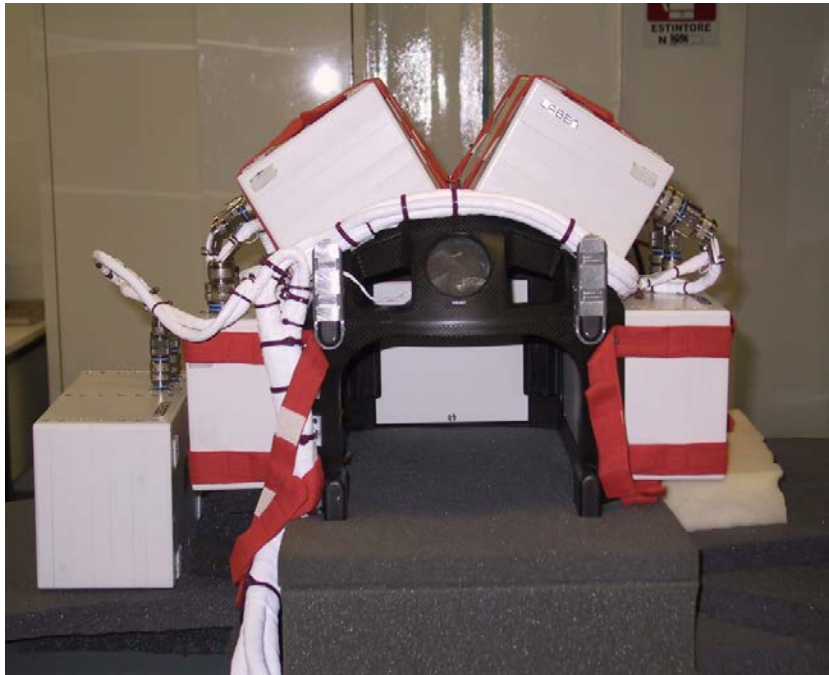
[increasing evidence for the importance of *radiation quality* (i.e. Z , E_{in} , rate)]

to **validate models** for future extrapolations in outer space.

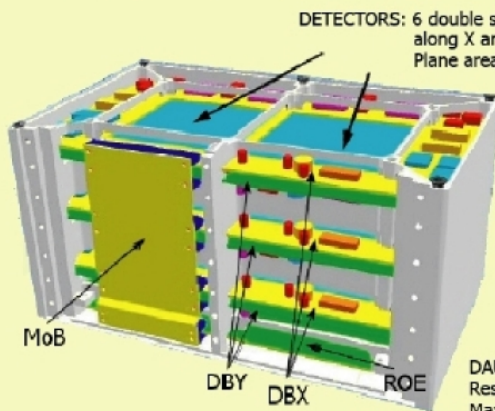
[available simulations must be further validated to reach confidence in the extrapolation to outer space]



ALTEA: the detector



SDU: Silicon Detector Unit

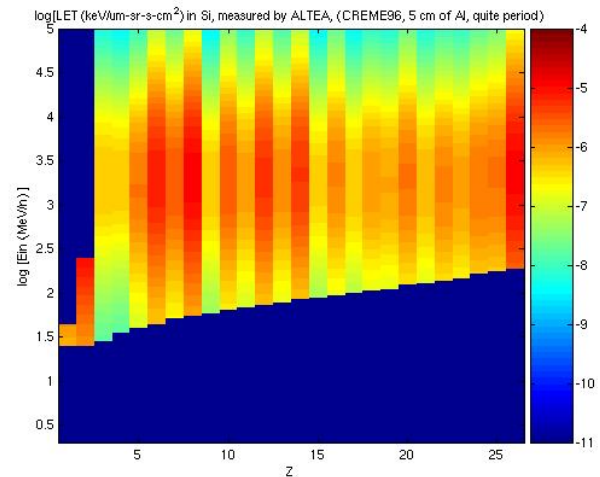


DETECTORS: 6 double strip silicon layers arranged alternately along X and Y directions
Plane area: $2 \times (8 \times 8) \text{ cm}^2$

Thickness: $380 \mu\text{m}$
Distance X-Y planes: 3.75 cm
Maximum error of angular reconstruction: 1.8°
Geometric Factor (bidirectional): $200 \text{ cm}^2 \text{ sr}$

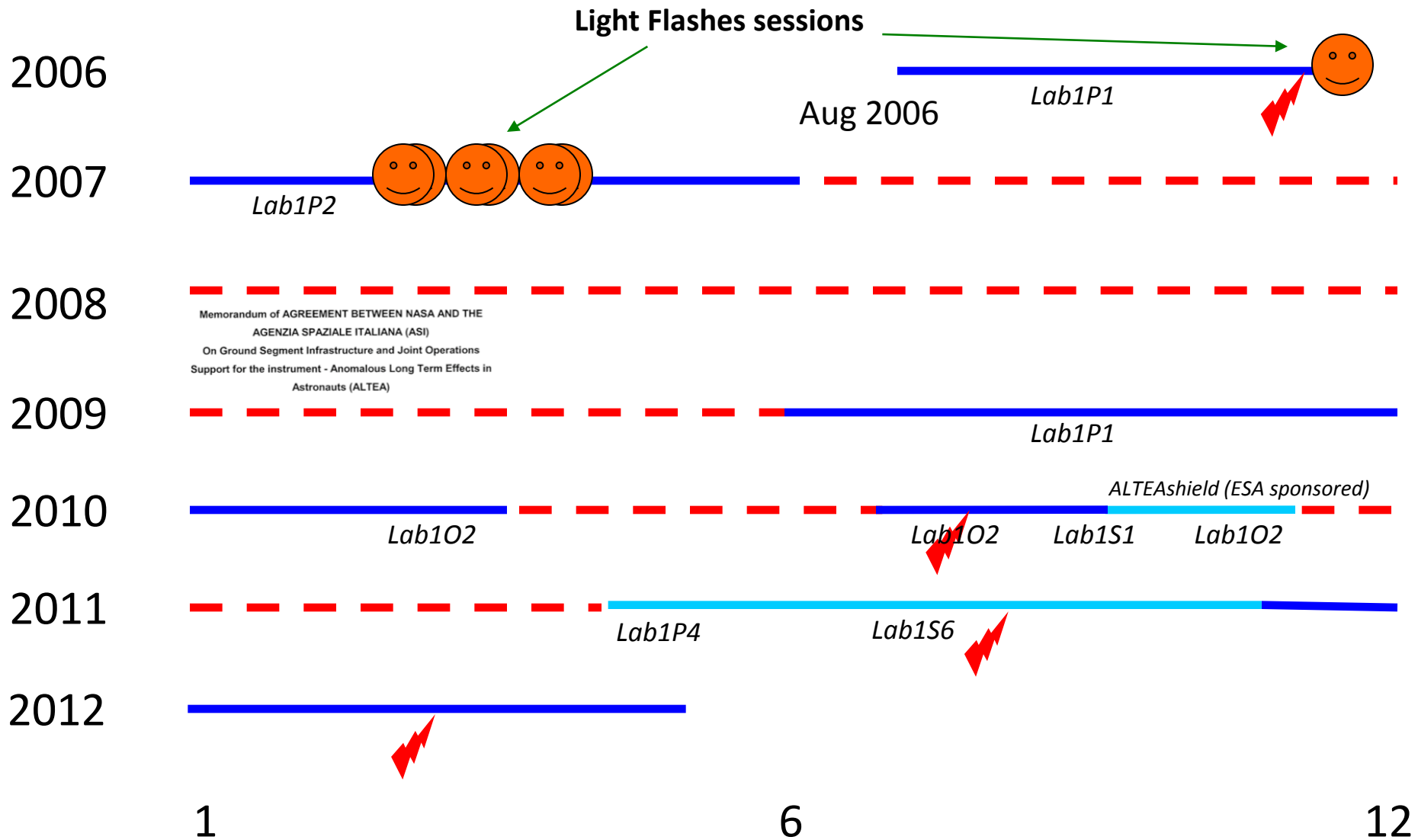
PERFORMANCES:
Threshold: 5.33 MIP
Saturation: 2400 MIP (1 MIP=109 KeV/plane)
ADC: 12 bit

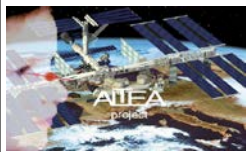
DAU SOFTWARE PARAMETERS:
Resolution: 0.64 MIP/ADC ch
Maximum Acquisition Rate: 700 Hz
Autotrigger (logic OR or logic AND of X planes, software switchable)





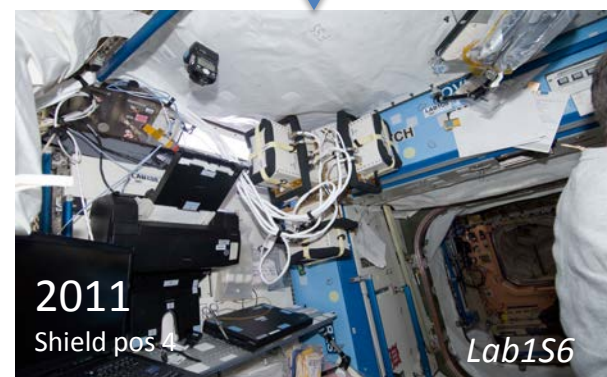
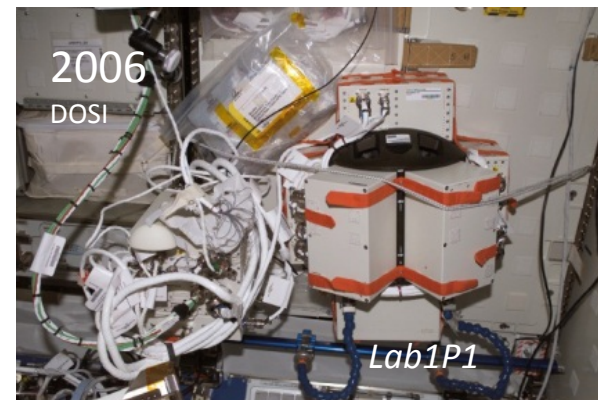
ALTEA: running times

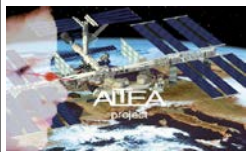




Experiments 2006 - 2012

<i>year</i>	<i>location</i>	<i>experiment</i>
2006	Lab1P1	ALTEA-DOSI (ASI)
2007	Lab1P2	ALTEA-DOSI (ASI)
2009	Lab1P1	ALTEA-DOSI (ASI-NASA)
2010	Lab1O2	ALTEA-DOSI (ASI-NASA)
2010	Lab1S1	ALTEA-shield/survey pos 1 (ESA)
2010	Lab1O2	ALTEA-shield/survey pos 2 (ESA)
2011	Lab1P4	ALTEA-shield/survey pos 3 (ESA)
2011	Lab1S6	ALTEA-shield/survey pos 4 (ESA)
2012	Lab1S6	ALTEA (ASI-NASA)





ALTEA: real time in Rome DFURTV - UHB

ALTEA RT Client 8.0.0

Connection: 127.0.0.1, 880
 Server IP address: Apid
 Connect: 30 Cycles
 Queue size (Kbyte): 0.0
 Received Packets: 0

Storage: C:\, File Chunk size (Mb): 10
 Stored packets: 0

Packet Mode: File
 EHS
 11
 Xfer Mode: Time Picker

Packet Counter:
 SD: 107969
 HK: 1072
 CMD: 120
 DAU: 140
 EEG: 0

Time Gap: 221 ms

Options: SD Viewer, Rate, EEG, 55AA

Flux and Dose Viewer

SD Viewer

Event Info: Debug
 Particle Event
 Pedestal
 Calibration

24 Strip hit
 7696641 AlteaTime
 1260992400 TimeTag
 945027603 CCSDS Time
 2009-350/19:40:03

Eye Pass: Right: 0, Left: 0, Both: 0
 1.5 Distance: Sphere, Cube

Options: Graph Window, TrackView
 Custom Integration Time: 5400

Global Counters

Triggers	Aligned	Filtered-10%
SDS	83381	56858
SDU0	15113	6979
SDU1	26613	17504
SDU2	17516	8687
SDU3	15680	7934
SDU4	11105	6510
SDU5	17524	9528
Total Pedestal	3610	

One-minute Counters

SDU Count	Triggers	Aligned	Filtered
SDU0	100	41	25
SDU1	100	25	12
SDU2	100	34	22
SDU3	100	31	17
SDU4	100	34	25
SDU5	100	32	21

Ion Recognition

Reference Spectrum	Global	IT
H	6849.83%	3.2843%
He	1325.85%	0.3744%
B	152.238	0.3233%
C	358.245%	0.0839%
N	122.492%	0.0348%
O	224.722%	0.8990%
F	38.0380%	2.0364%
Ne	44.6924%	0
Na	25.4710%	0
Al	13.4039%	0
Si	33.8582%	0
P	4.58537%	0
S	5.56399%	0
Cl	3.70096%	0
Ar	2.54162%	0
K	4.54854%	0
Ce	3.52148%	0
Sc	2.07899%	0
Ti	3.66032%	0
V	1.33602%	0
Cr	1.95326%	0
Mn	3.02915%	0
Fe	12.8733%	0



ALTEA: real time in NASA - JSC

ISS ALTEA 24-HOUR DISPLAY

[View Enlarged Chart](#)

SDU0
 SDU1
 SDU2
 SDU3
 SDU4
 SDU5

Cumulative

		Total	Yesterday	Today	Last 24 Hours
		(Since Beginning of the Month)			
ALTEA-SDU0	Dose (mrad)	3018.7	258.9	263.5	283.5
ALTEA-SDU1	Dose (mrad)	3024.9	246.4	253.9	273.8
ALTEA-SDU2	Dose (mrad)	4259.5	240.9	261.8	283.3
ALTEA-SDU3	Dose (mrad)	4281.9	258.2	263.1	284.9
ALTEA-SDU4	Dose (mrad)	18021.6	461.1	472.1	541.8
ALTEA-SDU5	Dose (mrad)	7007.8	436.7	438.6	490.0

Current

	GMT (Last Update)	Dose Rate (mrad/min)	Dose Equiv Rate (mrad/min)	Location	Position	Direction
SDU0	137/22:42:55	0.580	8.413	US Lab	S1	Zenith
SDU1	137/22:42:55	0.362	3.984	US Lab	S1	Nadir
SDU2	137/22:42:55	0.393	1.489	US Lab	S1	Aft
SDU3	137/22:42:55	0.428	1.873	US Lab	S1	Forward
SDU4	137/22:42:55	0.302	1.031	US Lab	S1	Port
SDU5	137/22:42:55	0.397	1.305	US Lab	S1	Starboard

[View Enlarged Chart](#)

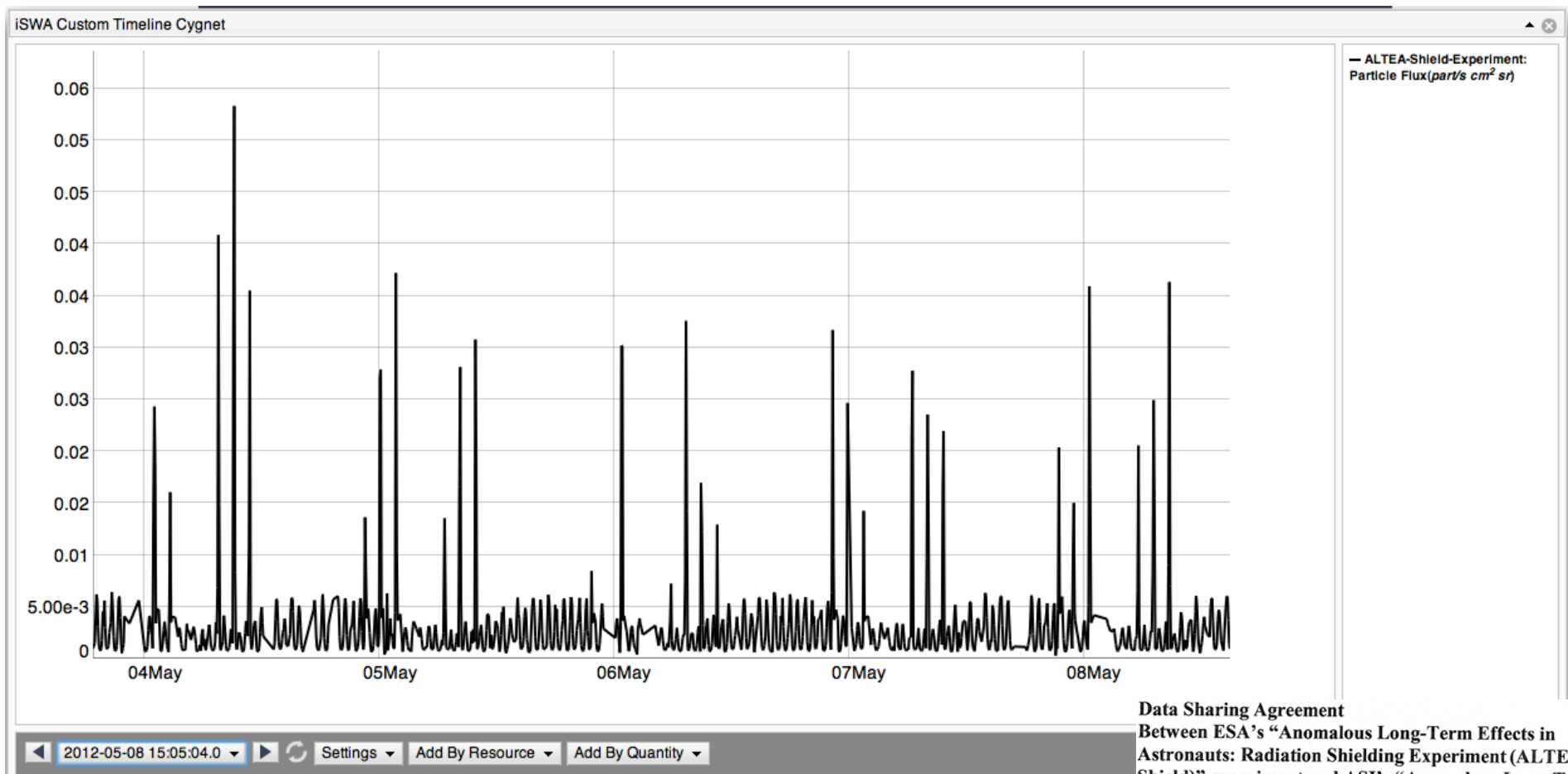
[View Enlarged Image](#)

Memorandum of AGREEMENT BETWEEN NASA AND THE AGENZIA SPAZIALE ITALIANA (ASI) On Ground Segment Infrastructure and Joint Operations Support for the instrument - Anomalous Long Term Effects in Astronauts (ALTEA)

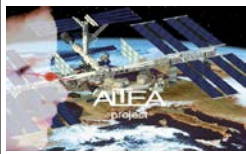
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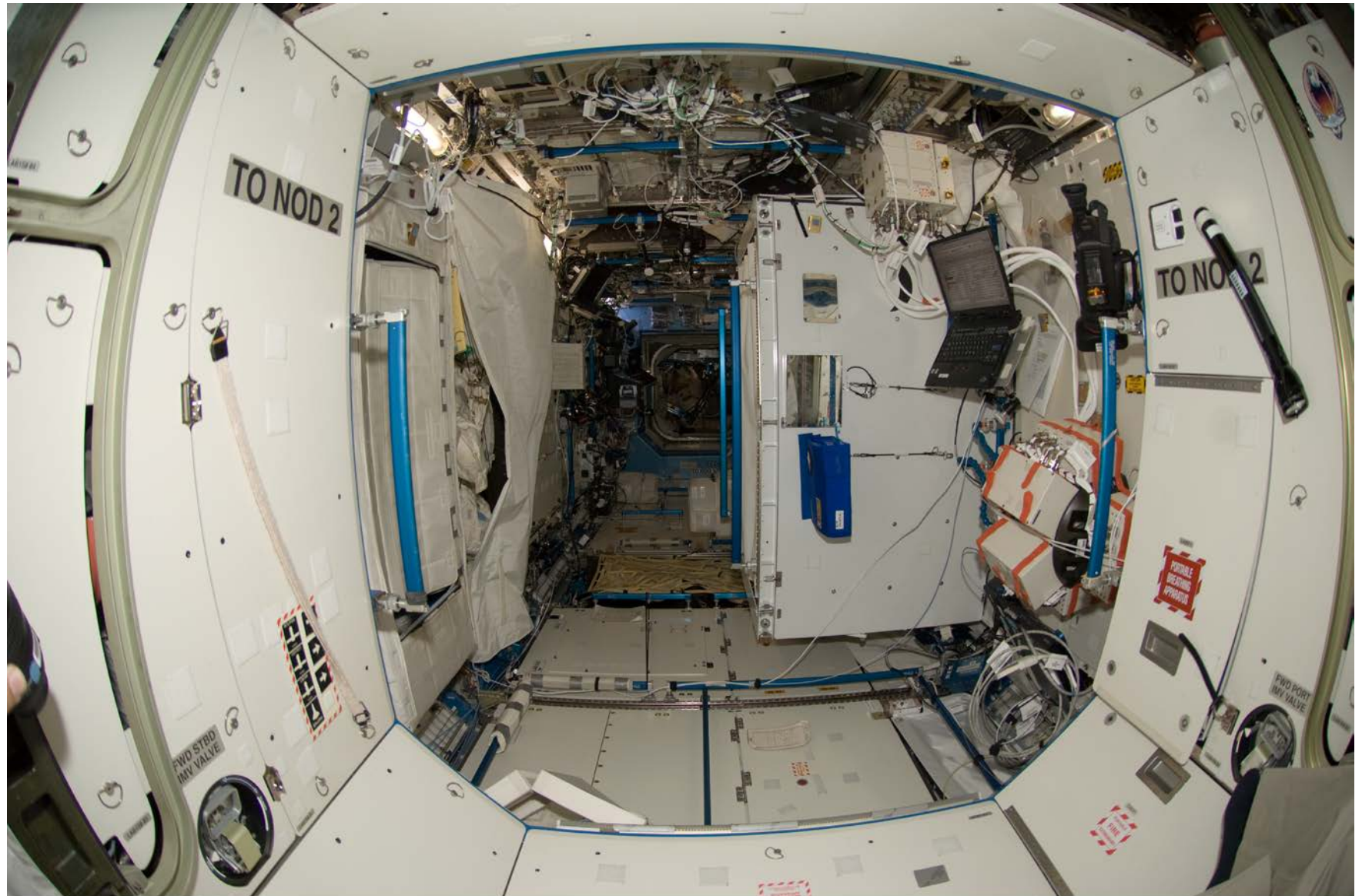
ALTEA: real time in the NASA – GSFC [iSWA – web (public)]



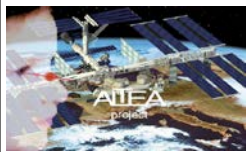
Data Sharing Agreement
Between ESA's "Anomalous Long-Term Effects in Astronauts: Radiation Shielding Experiment (ALTEA-Shield)" experiment and ASI's "Anomalous Long-Term Effects in Astronauts (ALTEA)" experiment, with NASA Goddard Space Flight Center Space Weather Laboratory



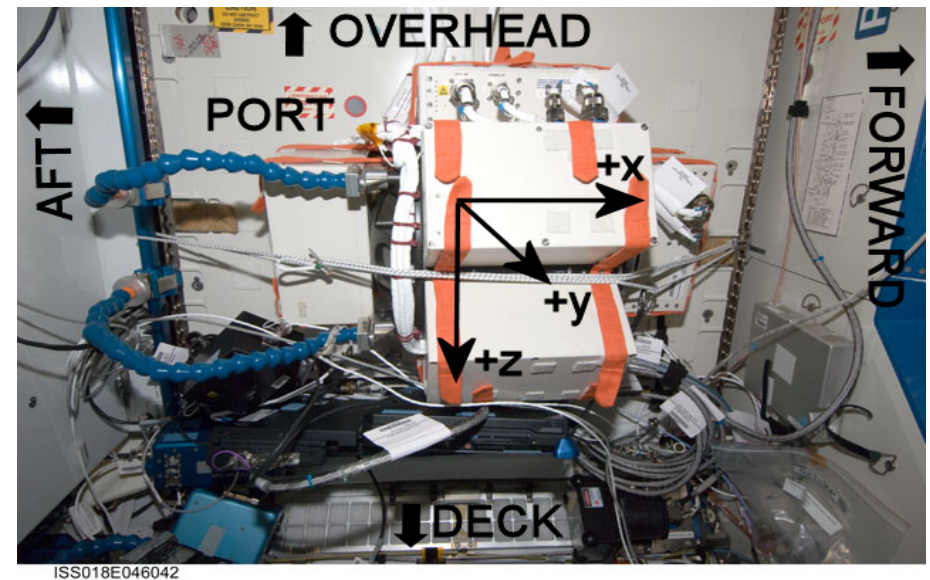
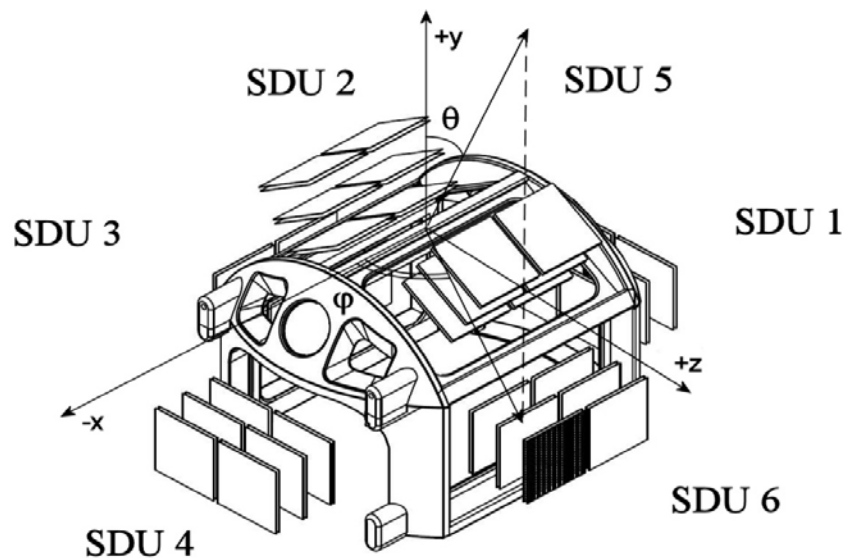
ALTEA in 2009 (Lab1P1)



S127E011093



ALTEA: first 3D radiation analysis

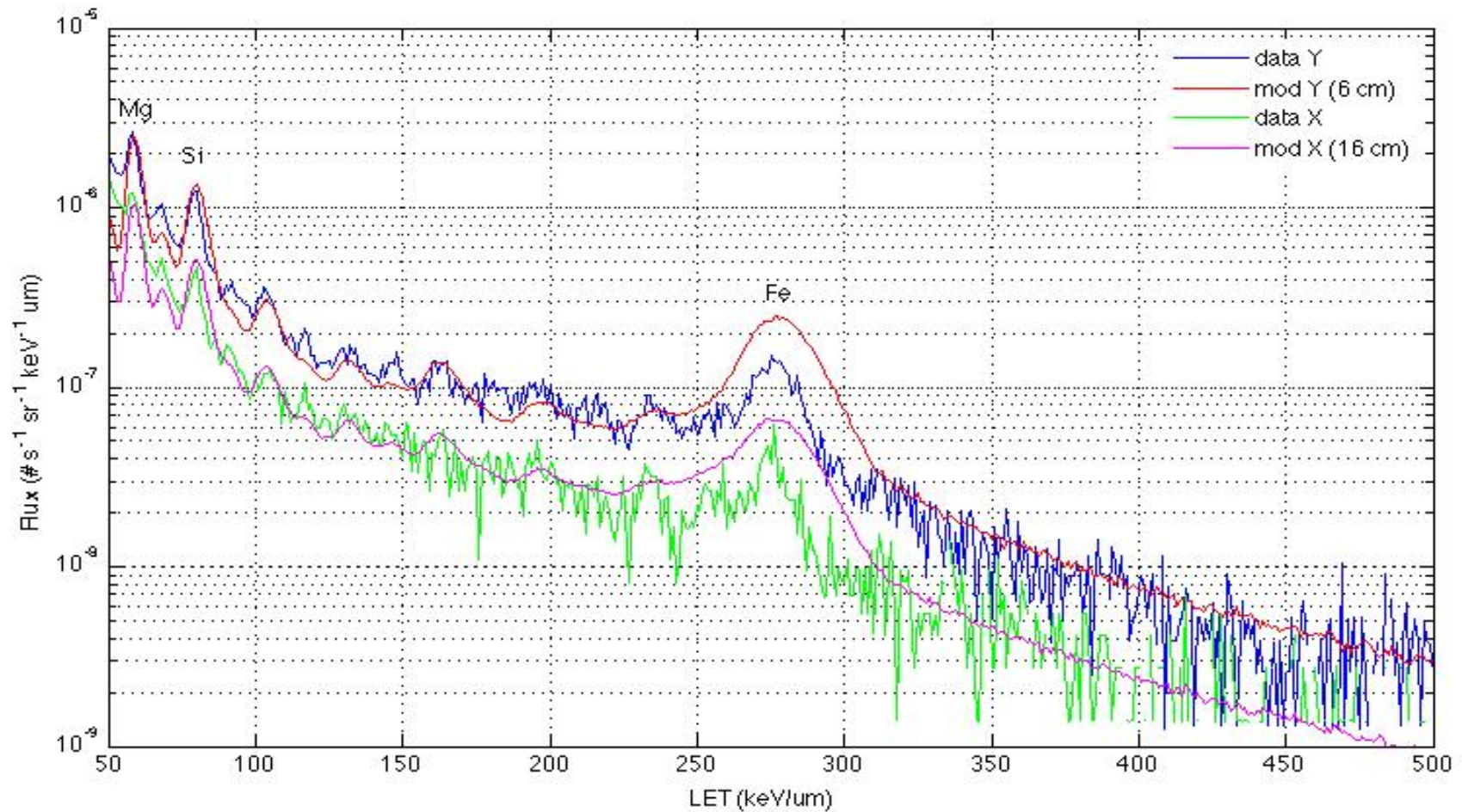


Observation period: ~ 74 effective days: 01/06/2009 – 28/09/2009

About 6×10^6 s 5×10^7 triggers

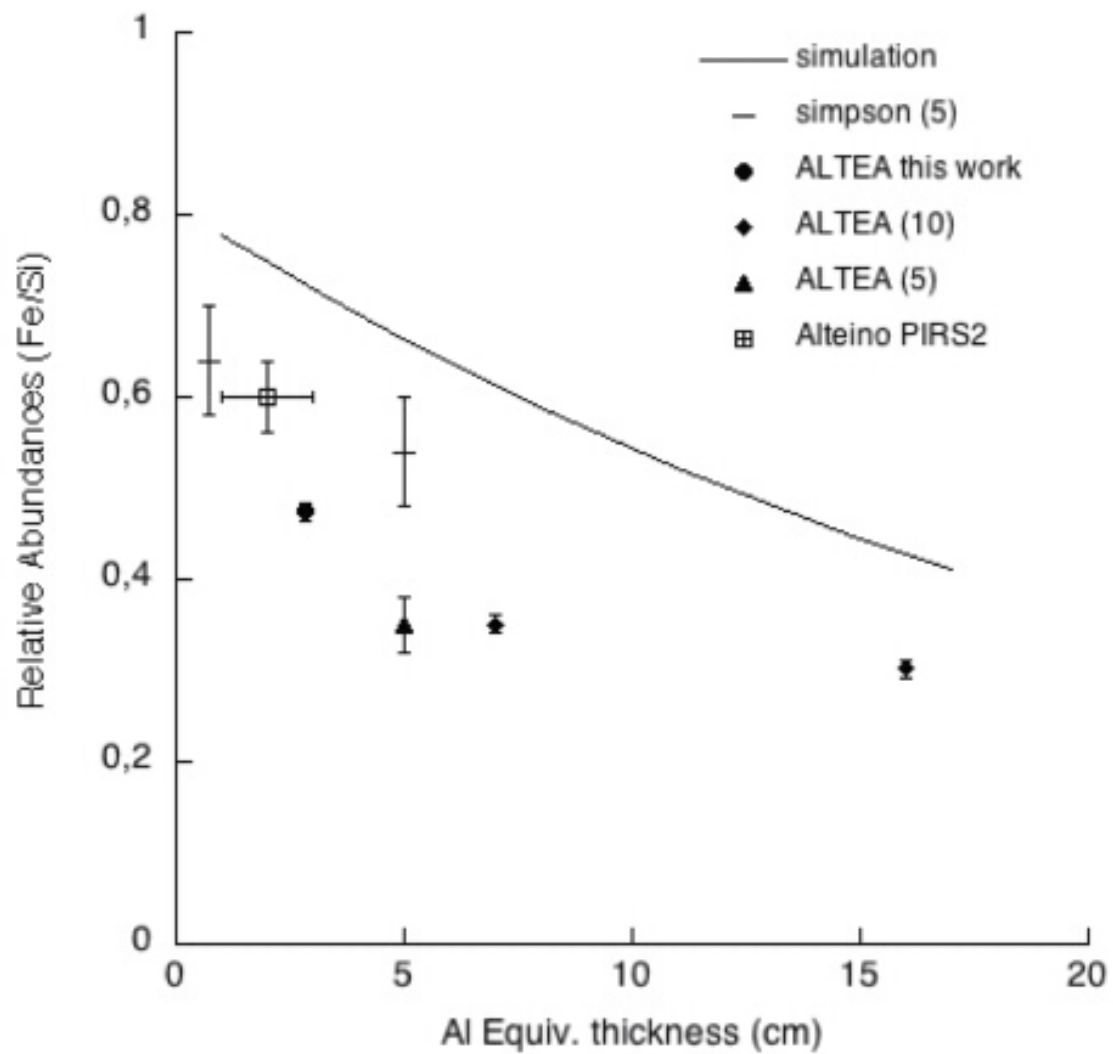


ALTEA: first 3D radiation analysis



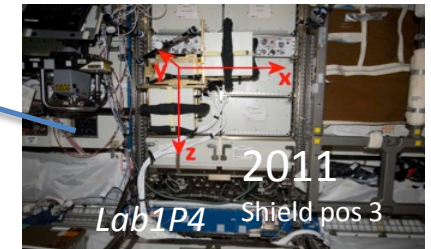
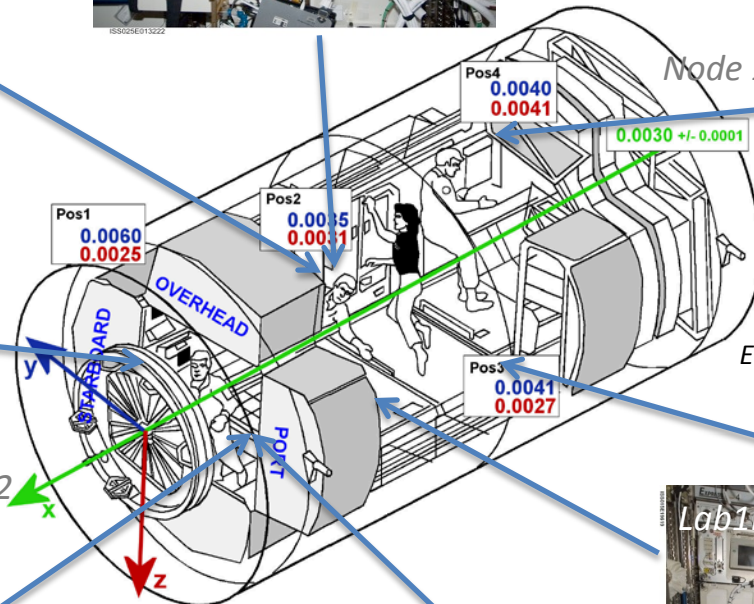
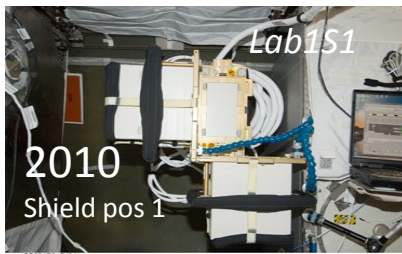
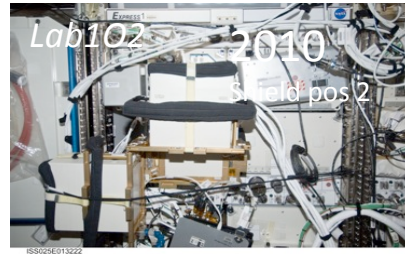
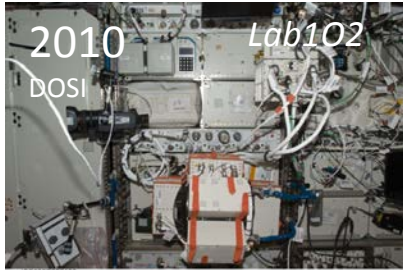


Overestimation of Fe abundance by model





ALTEA: USLab survey





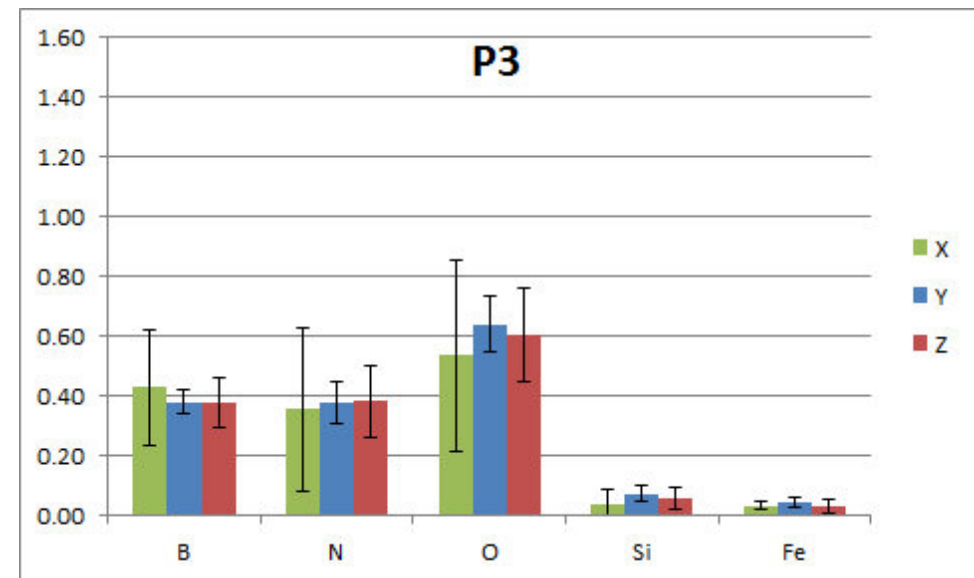
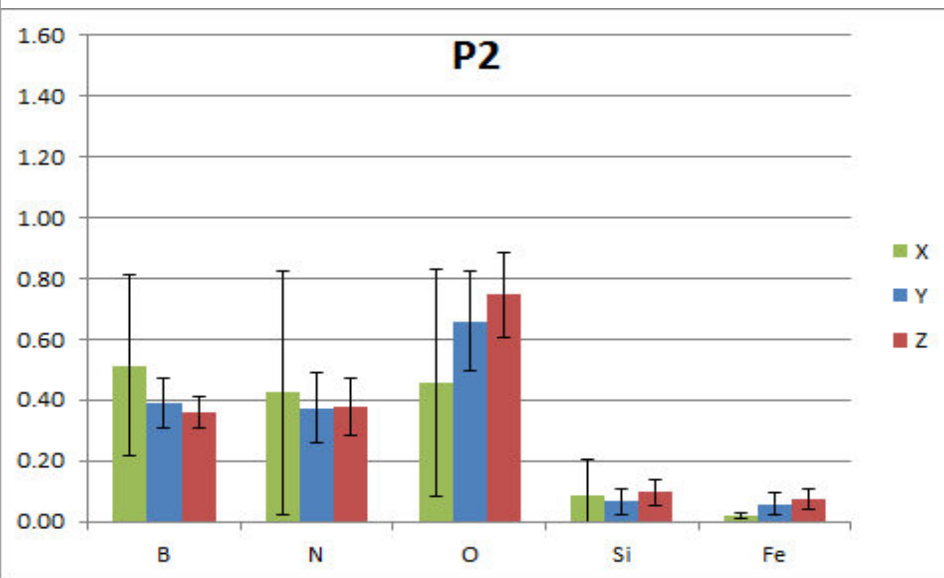
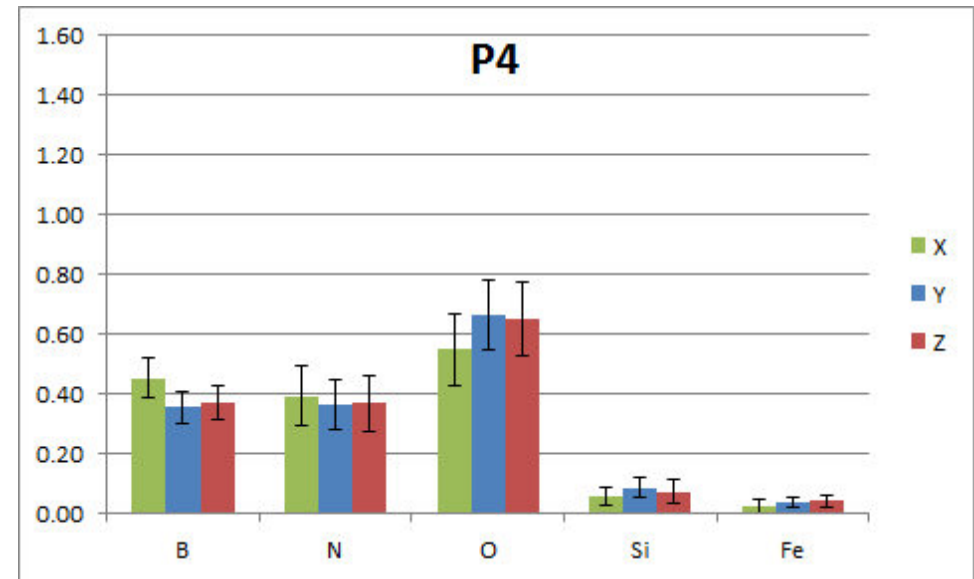
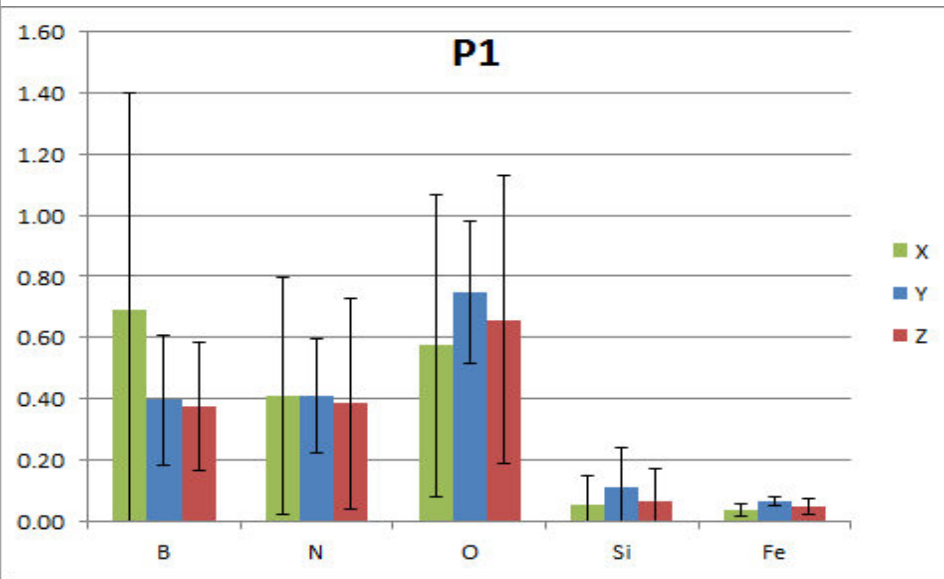
ALTEA in 2010 (going to Lab1S1)

Beginning of experiment ALTEA-shield/survey (ESA-ASI)



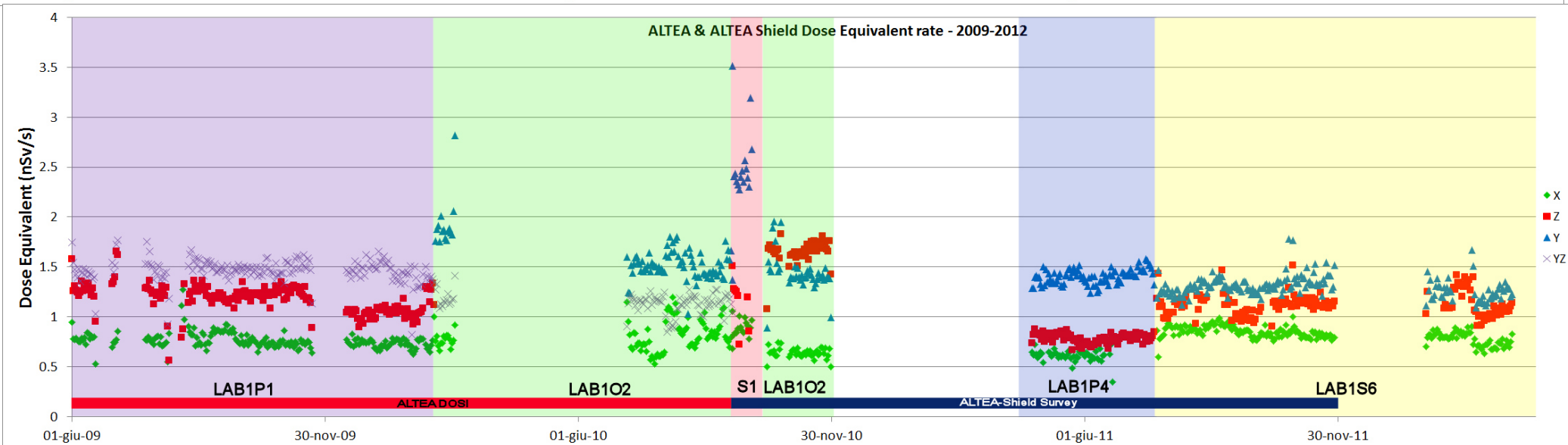
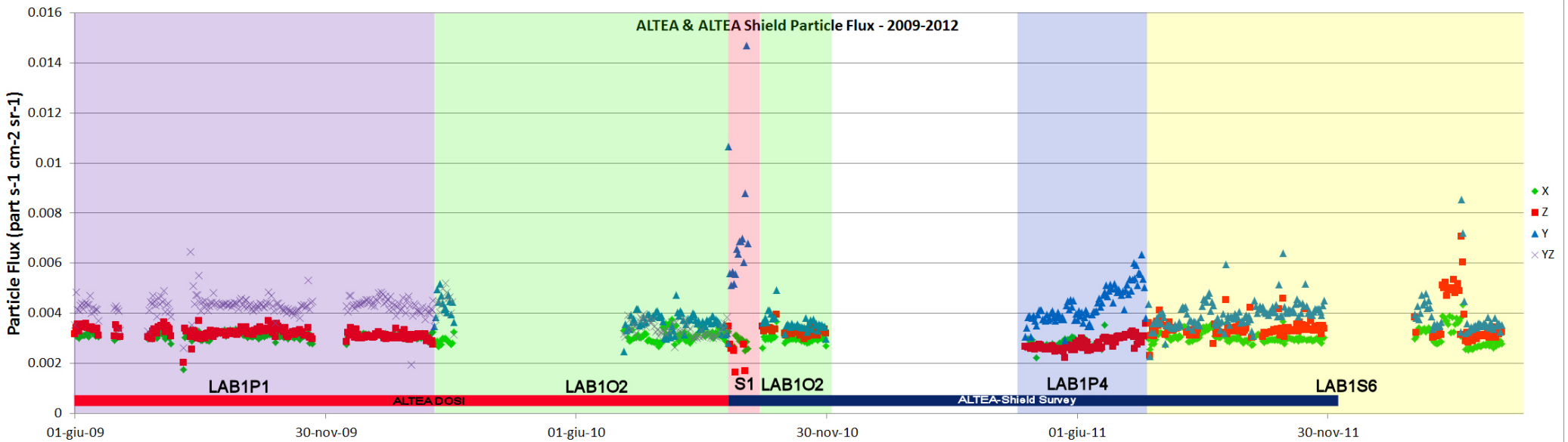


ALTEA-shield/survey: nuclear identification



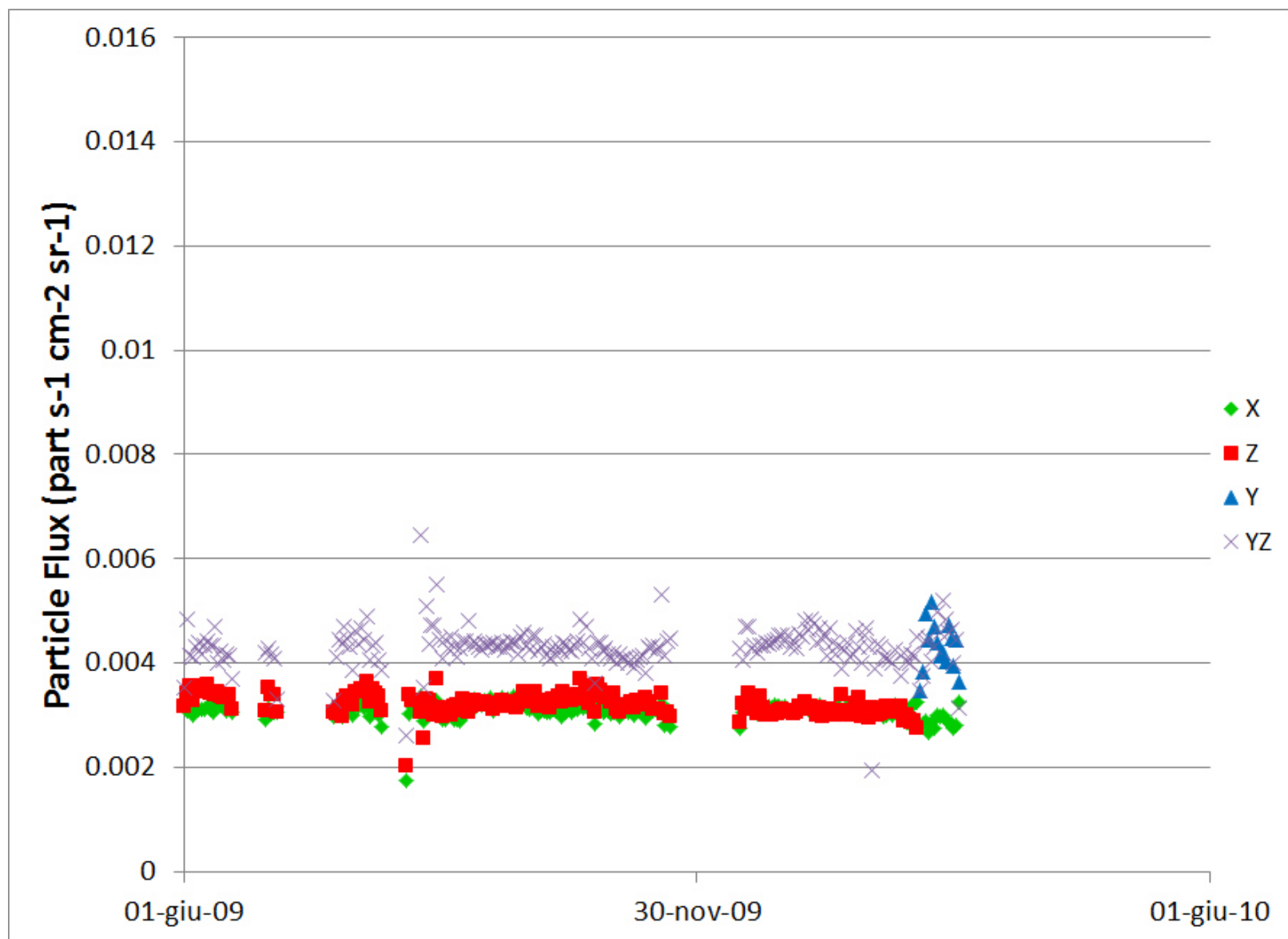


ALTEA, ALTEA-shield/survey: flux and dose equivalent rate 1



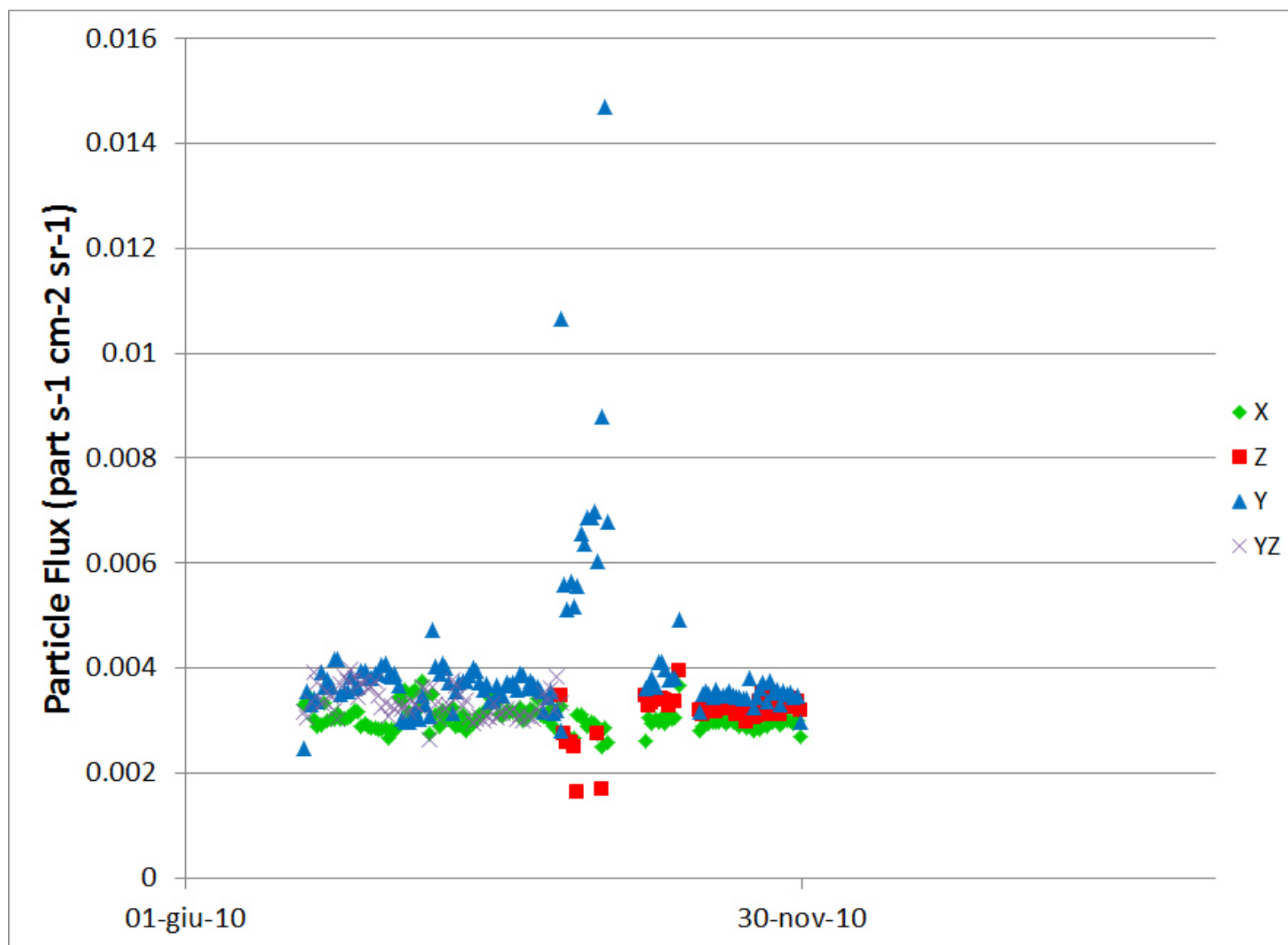


ALTEA flux 2009 (Lab1P1)



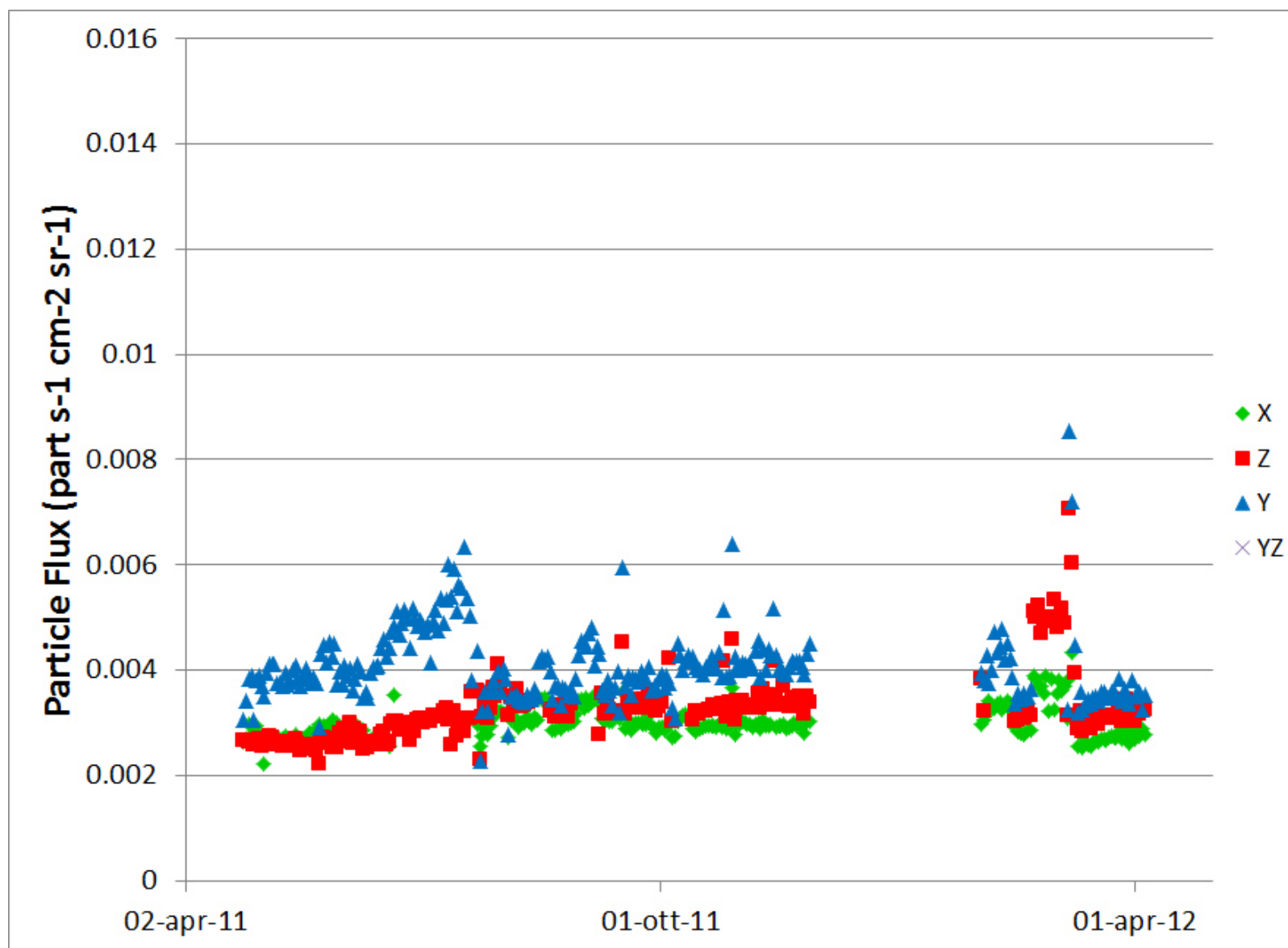


ALTEA, ALTEA-shield/survey: flux 2010 (Lab102, Lab1S1, Lab102)



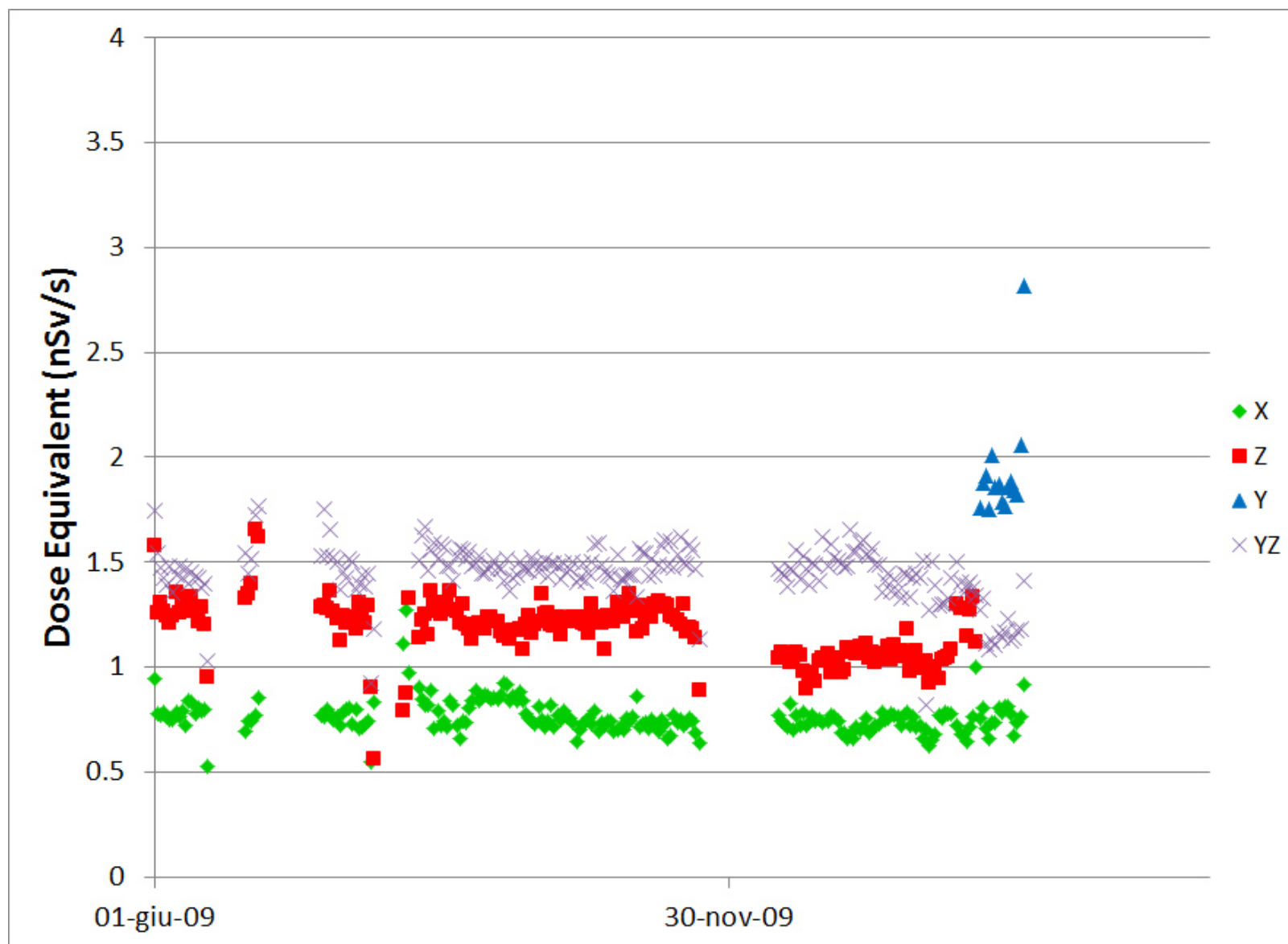


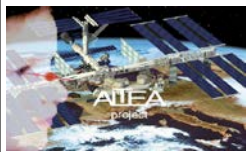
ALTEA-shield/survey, ALTEA: flux 2011-12 (Lab1P4, Lab1S6)





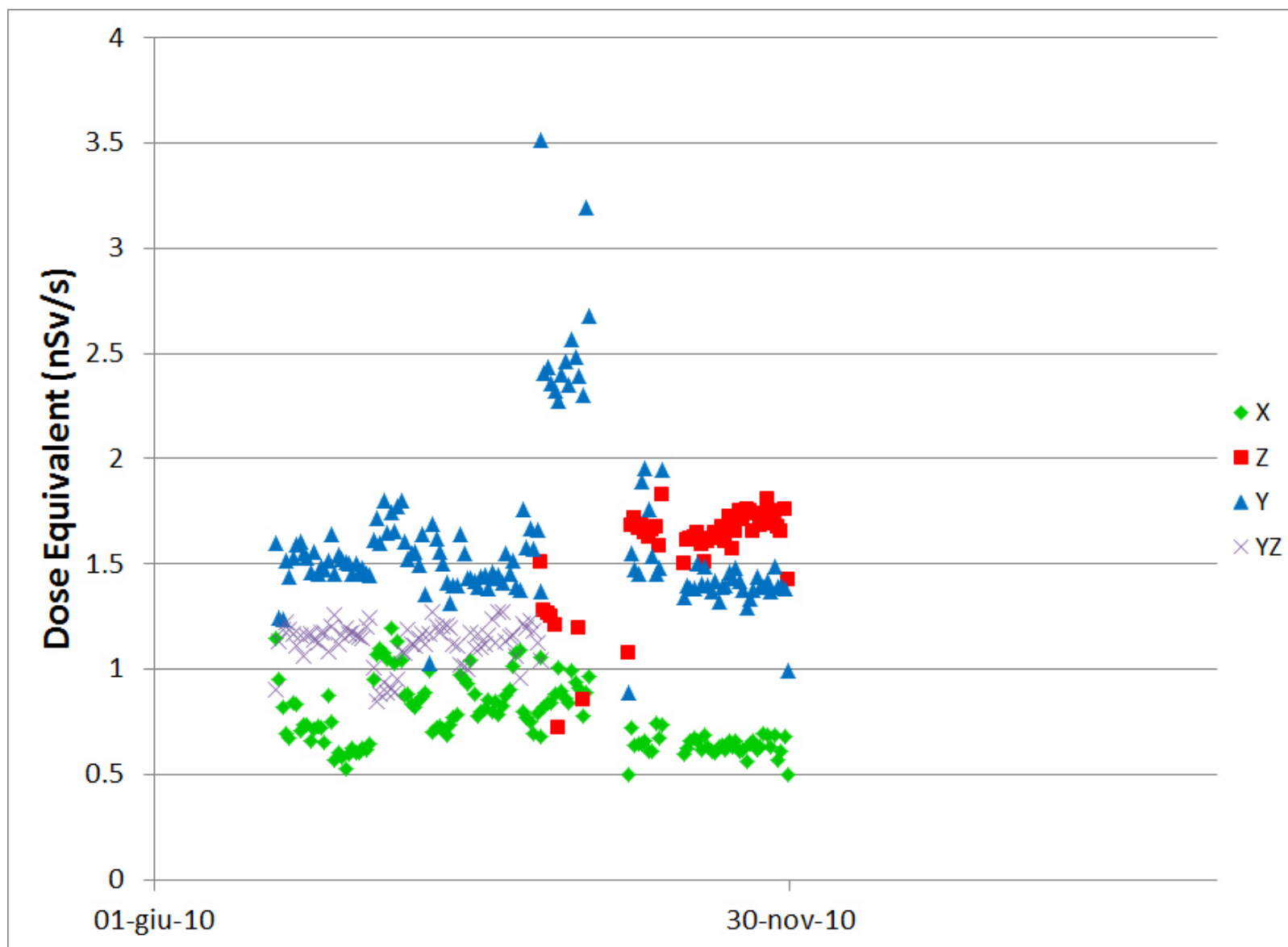
ALTEA-shield/survey: dose equivalent rate 2009 (Lab1P1)

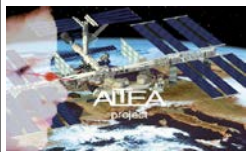




ALTEA, ALTEA-shield/survey: equivalent dose rate 2010

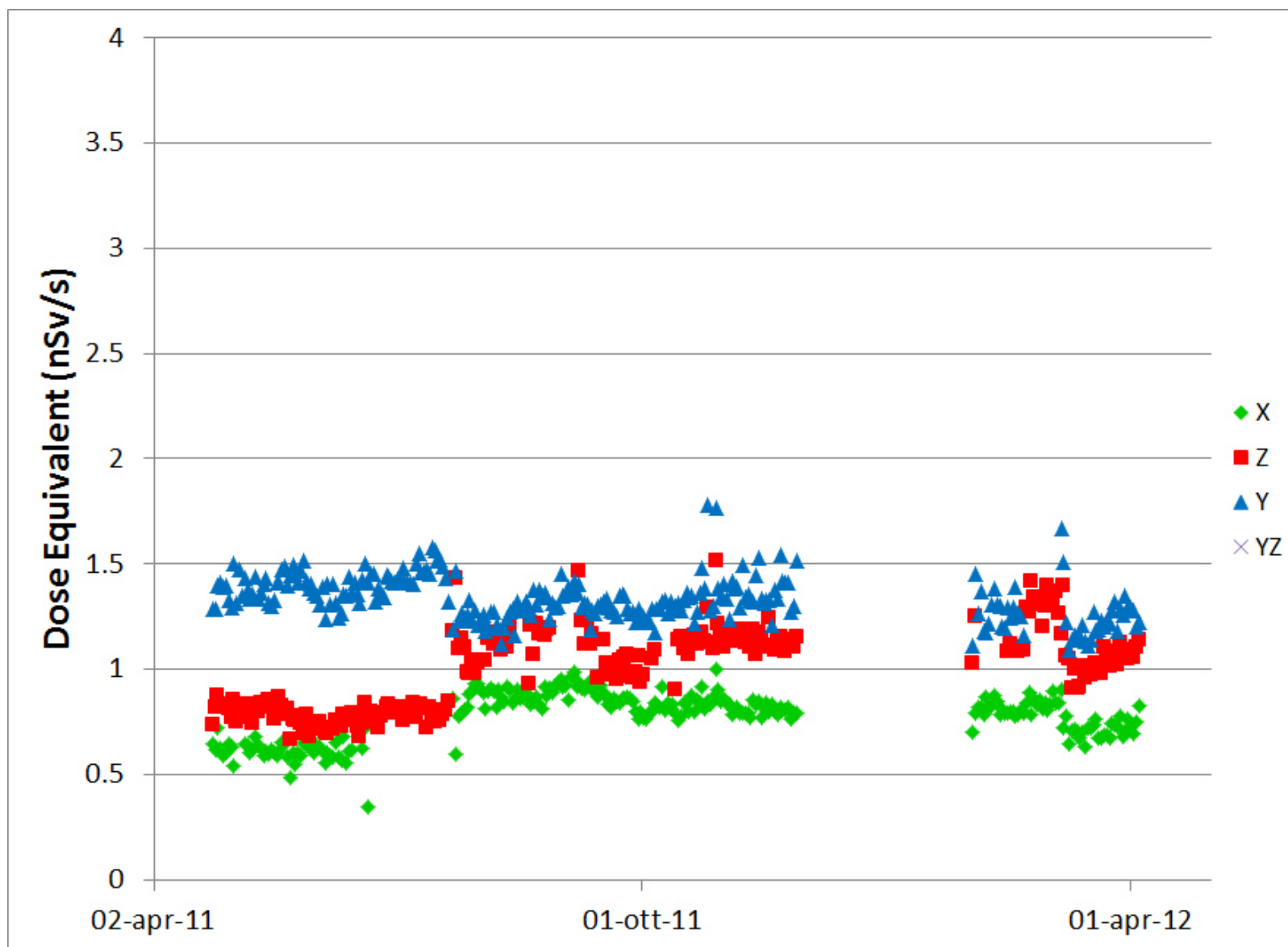
(Lab102, Lab1S1, Lab102)





ALTEA-shield/survey, ALTEA: equivalent dose rate 2011-12

(Lab1P4,Lab1S6)



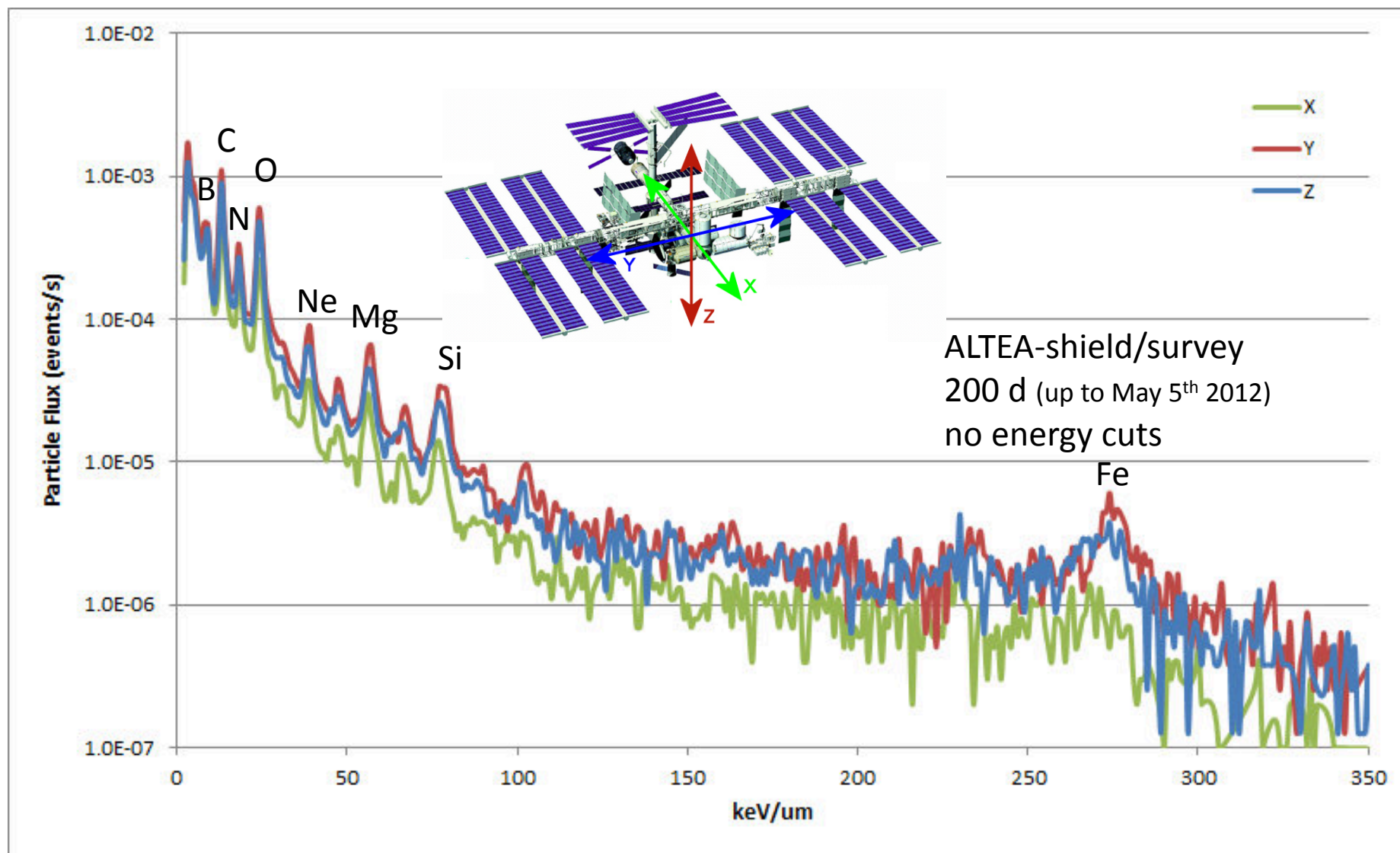


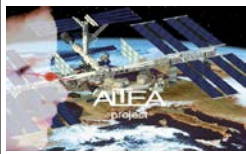
ALTEA-shield/survey: ... NOW ... (Lab1S6)



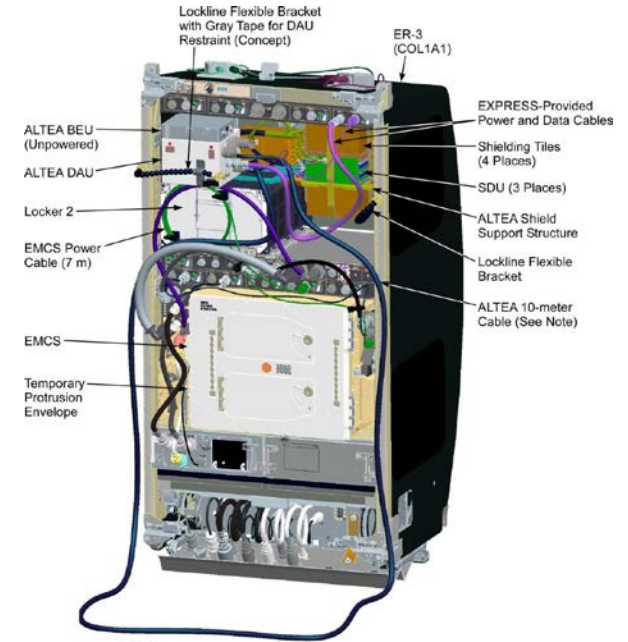
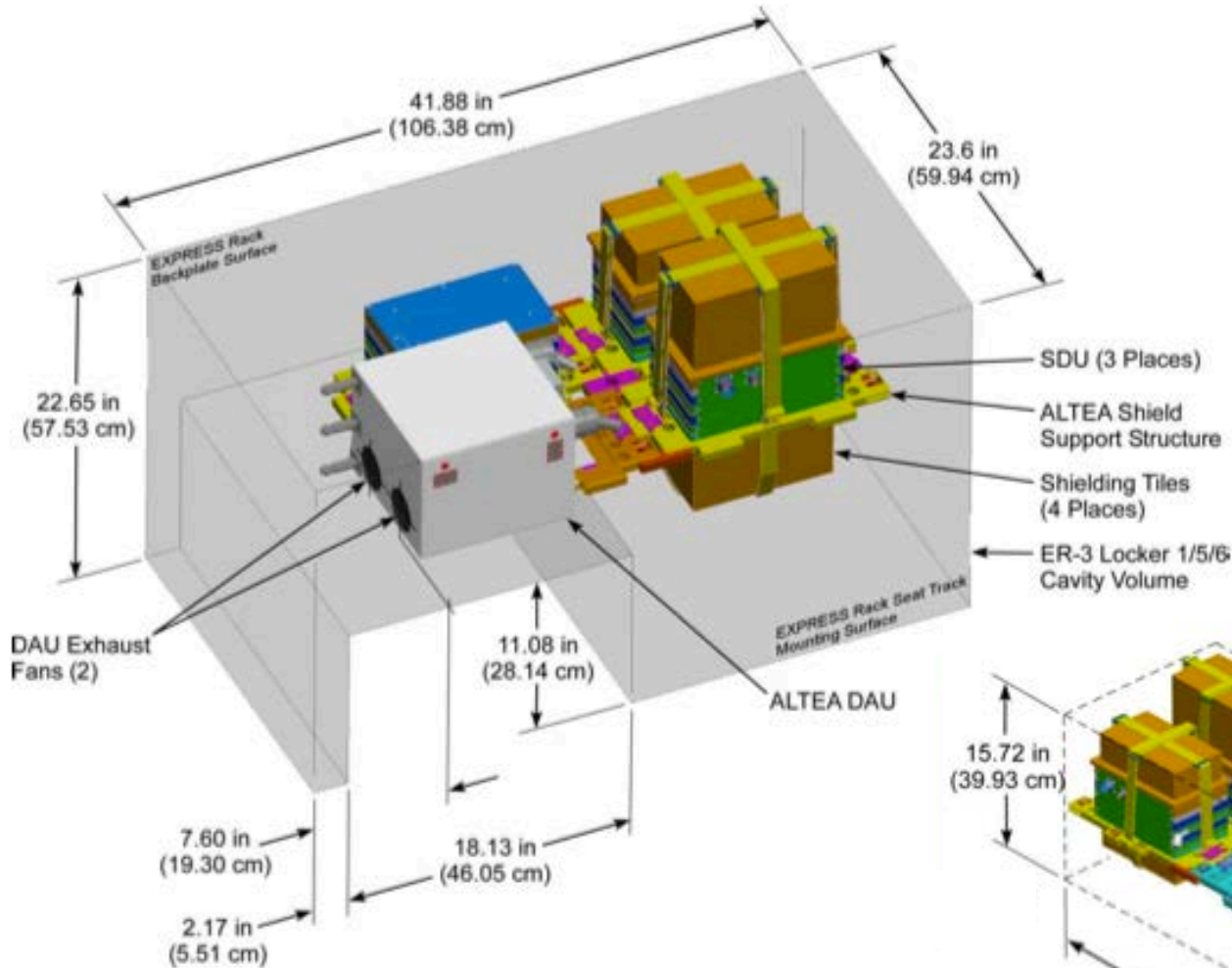


ALTEA: spectra in Lab1S6 (200 days)

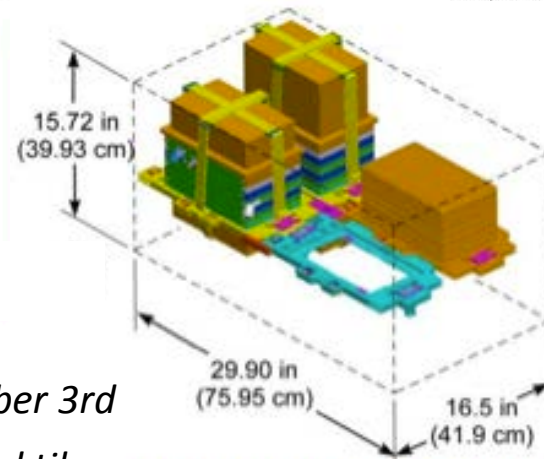




ALTEA-shield/shield: next step (May 28th-October 2012)

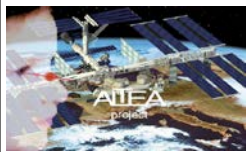


NOTE:
The ALTEA 10-meter cable is routed out of the rack volume (ESA to establish acceptable routing) to avoid coiling the cable, which introduces 'noise' into the system.



Materials:
Kevlar
Polyethylene

*New configuration for ER#3. Approved by PCB on October 3rd
The experiment lasts 60 days for each shielding material tiles.*



ALTEA the international team

Dept. di Physics, Univ. of Rome "Tor Vergata" and INFN Sect. Roma2 , Roma

Dept of Physics, Univ. of Pavia, Pavia

Dept of Physics, Univ. of Milan, Milan

DISM-Univ. of Genoa, Genoa

L.N.F. - INFN, Frascati (Rome)

CERN - INFN

Dept. of Physics, Univ. e Sect. INFN of Trieste, Perugia, Firenze

Dept. of Sc. and Chemical Tec., Univ. of Rome "Tor Vergata"

Dept. of STB - Univ. of L'Aquila, L'Aquila

Univ. Paris Sud, 91406 Orsay Cedex, France

GSI - Biophysik, Darmstadt, Germany

Royal Institute of Technology, Stockholm, Sweden

Chalmers University of Technology, Sweden

Johnson Space Center, NASA, Houston TX, USA

Goddard Space Flight Center, NASA, USA

Brookhaven National Laboratory, NY, USA

Lawrence Berkeley National Laboratory, CA, USA

Loma Linda University, CA, USA

Cole Eye institute, The Cleveland Clinic, Cleveland, OH, USA

Wyle Laboratories, TX, USA

Eril Research, CA, USA

Institute for BioMedical Problems, Moscow, Russia.

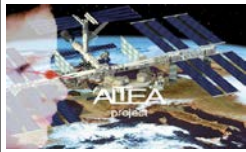
Russian Space Corporation "Energia" by name Korolev, Korolev, Moscow region, Russia

Moscow State Engineering Physics Institute, Moscow, Russia

JAERI, Japan



+ others joining in



Thank you for your attention