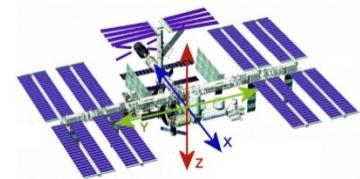


# ALTEA real-time monitoring of radiation environment inside the ISS-USLab and off-line data management

V. Zaconte<sup>1,2</sup>, M. Casolino<sup>2</sup>, C. De Santis<sup>2</sup>, L. Di Fino<sup>1,2</sup>, M. Larosa<sup>1,2</sup>,  
L. Narici<sup>1,2</sup>, P. Picozza<sup>1,2</sup>

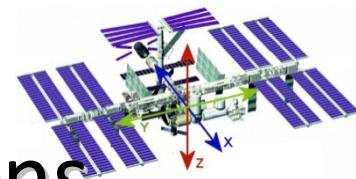
<sup>1</sup>*University of Rome Tor Vergata, Rome, Italy*

<sup>2</sup>*INFN (Istituto Nazionale di Fisica Nucleare), Rome, Italy*

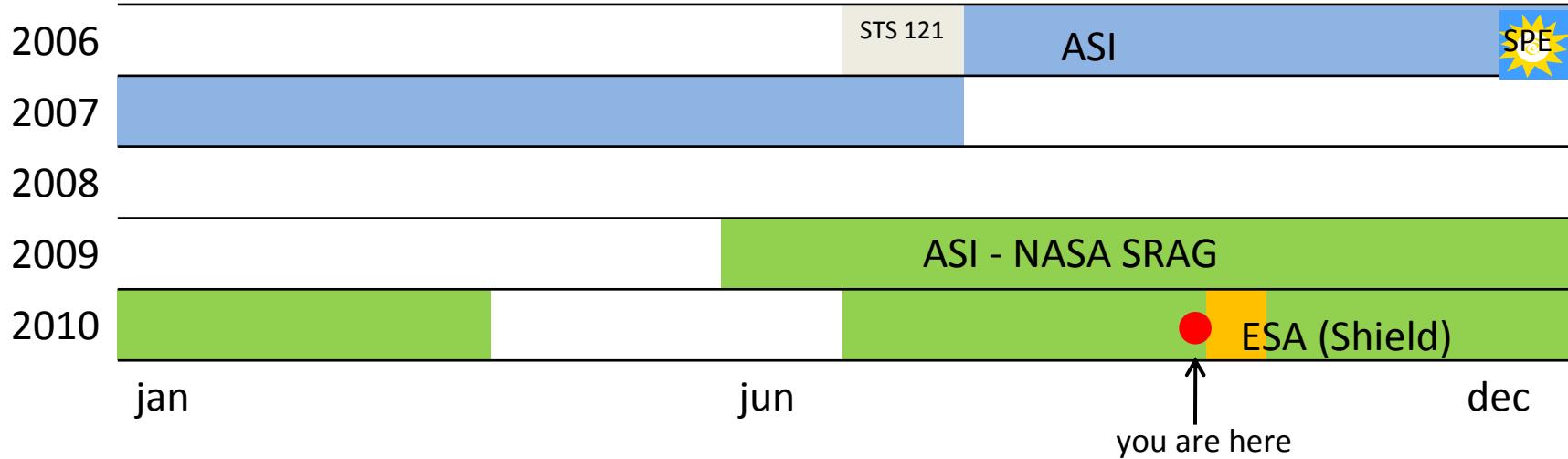


# Contents

- ALTEA-space: summary of the operations
- ALTEA data format
- RT analysis: processing and outputs
- RT software
- latest RT results
- offline data management
- ALTEA DB structure
- web interface



# ALTEA: Summary of the operations

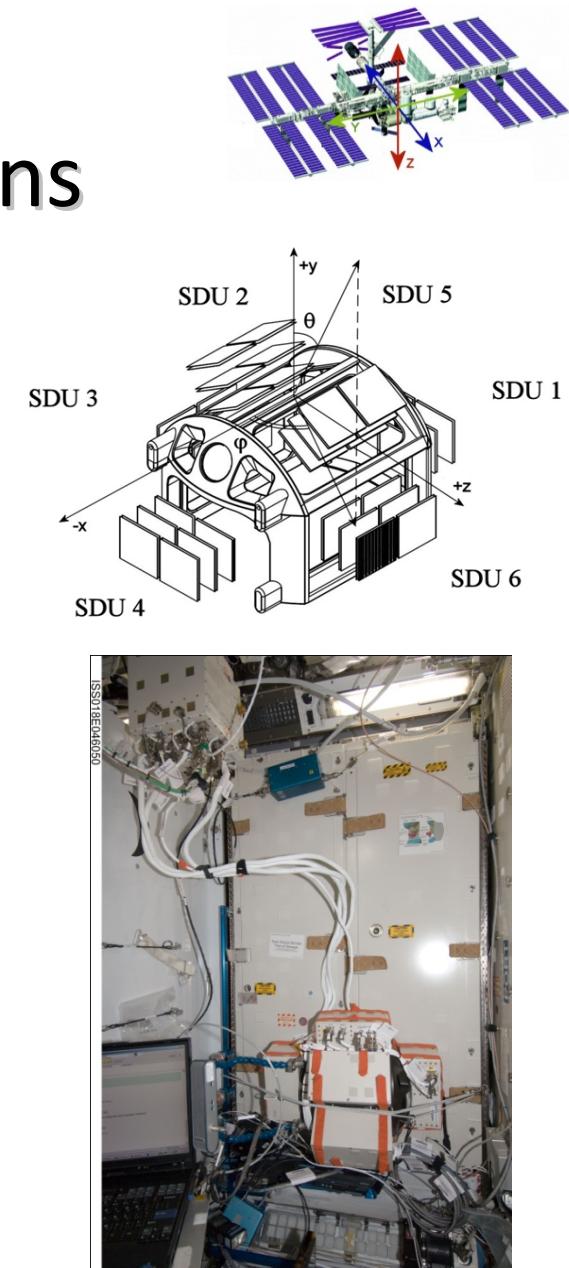


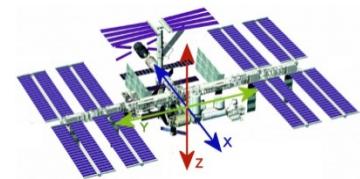
- more than 500 days of operations
- 700.000 triggers per day
- 180 MB raw data per day
- 400 GB total data in the DB

# Detector specifications

- **6 SDUs, each with 6 planes**
- two  $8 \times 8 \text{ cm}^2$  silicon chips per plane (silicon thickness:  $380 \mu\text{m}$ )
- GF:  $230 \text{ cm}^2 \text{ sr}$  (bidirectional) per SDU,  $1190 \text{ cm}^2 \text{ sr}$  total
- **64 strips per plane – 384 strips per SDU**
- LET range:  $3 - 800 \text{ keV}/\mu\text{m}$
- trigger on pass-trough particles
- **typical event: 24 strips (4 strips per plane)**

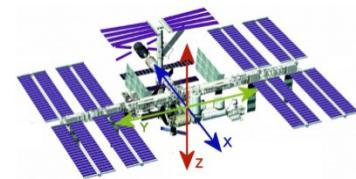
...Data management has to take in account the complexity of the data!





# Data processing

- RT processing
  - pedestal subtraction
  - alignment check
  - incidence angle calculation
  - energy correction to normal incidence ( $E_{\text{corr}} = E * \cos(\alpha)$ )
  - dead time (5 ms per event)
- RT outputs
  - Particle rate (trigger/s)
  - Particle flux (part/s cm<sup>2</sup> sr)
  - *LET* rate (KeV/um cm<sup>2</sup> sr)
  - *Dose* rate (nGy/s)
  - *Equivalent dose* rate (mSv/s)
  - LET spectra
  - Ion recognition on fast particles

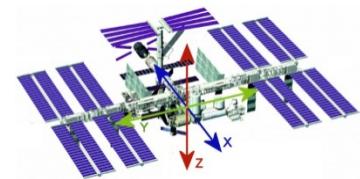


# RT software

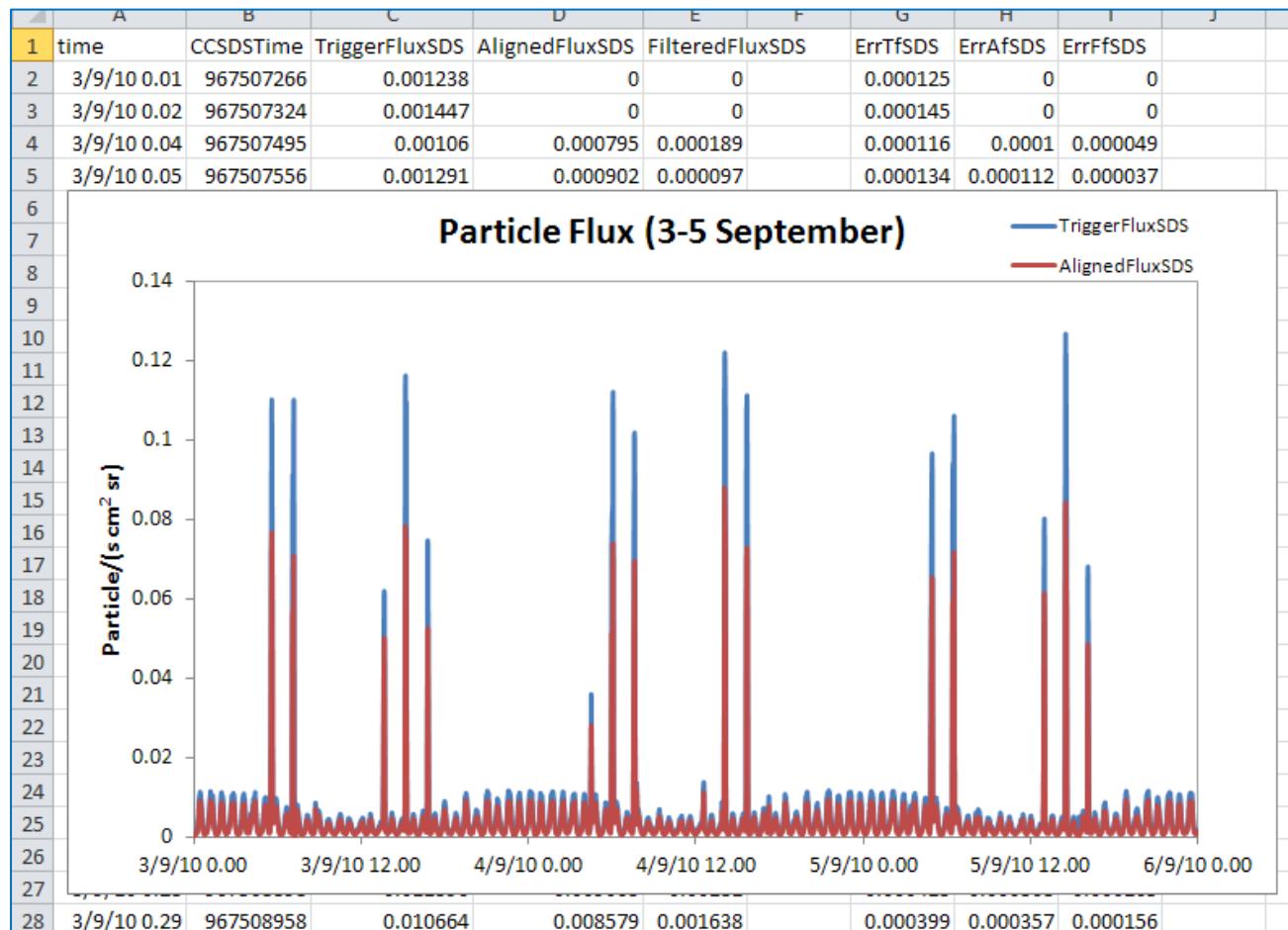
- ALTEA telemetry is downloaded in RT using ku-band
- RT data are not complete because of the TDRSS satellite coverage

Availability/**Loss** of Signal during this session:

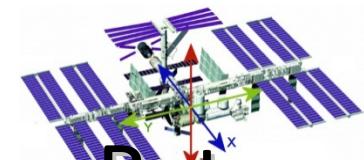




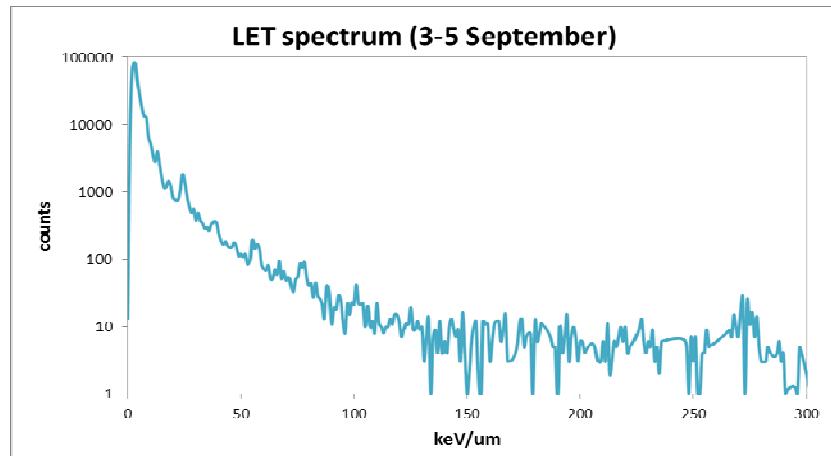
# RT results: Particle Flux



- RT output files contain the desired parameters already calculated with associated statistical errors



# RT results: Let spectrum, Let and Dose Rate



$$\log (\text{LET}_{\infty} \text{ H}_2\text{O}) = -0.2902 + 1.025 \log (\text{LET}_{\infty} \text{ Si})$$

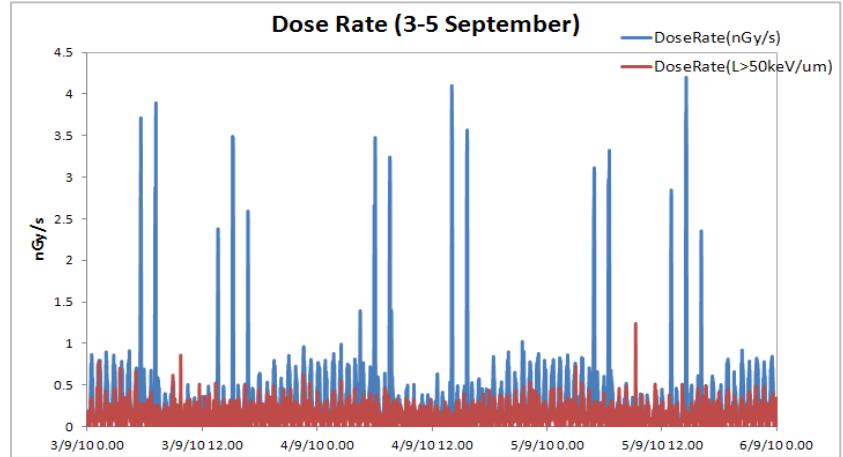
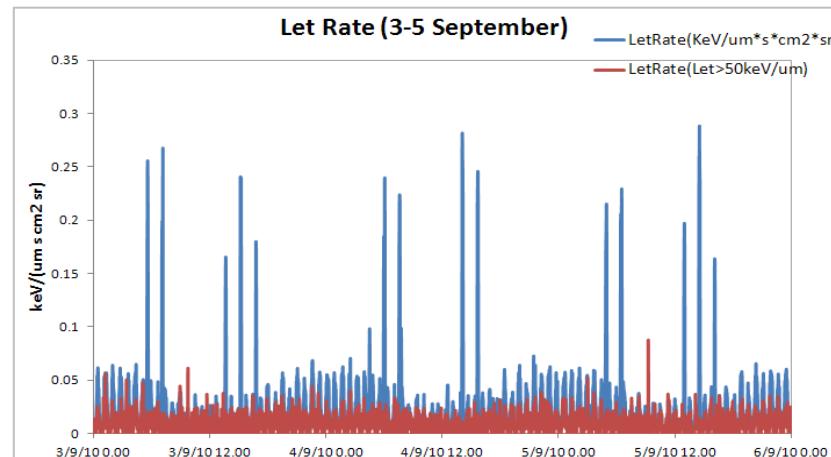
(E. R. Benton, E. V. Benton, and A. L. Frank)

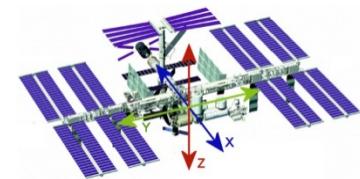
Dose (nGy) =  $4 \pi * 1.6 * \text{LET}_{\infty} \text{ H}_2\text{O}$

$$H_{4c} = \sum_{\text{all particles}} Q_p D_p$$

$Q(\text{LET}) = 1$  for:  $L < 10 \text{ keV / } \mu\text{m}$   
 $Q(\text{LET}) = 0.32L - 2.2$  for:  $L = 10 \text{ to } 100 \text{ keV / } \mu\text{m}$   
 $Q(\text{LET}) = 300 / V \text{ LET}$  for:  $L > 100 \text{ keV / } \mu\text{m}$

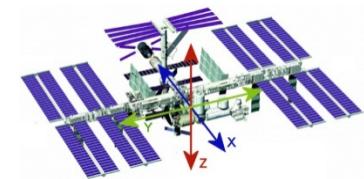
(NCRP 116, 1993, Table 4.2)



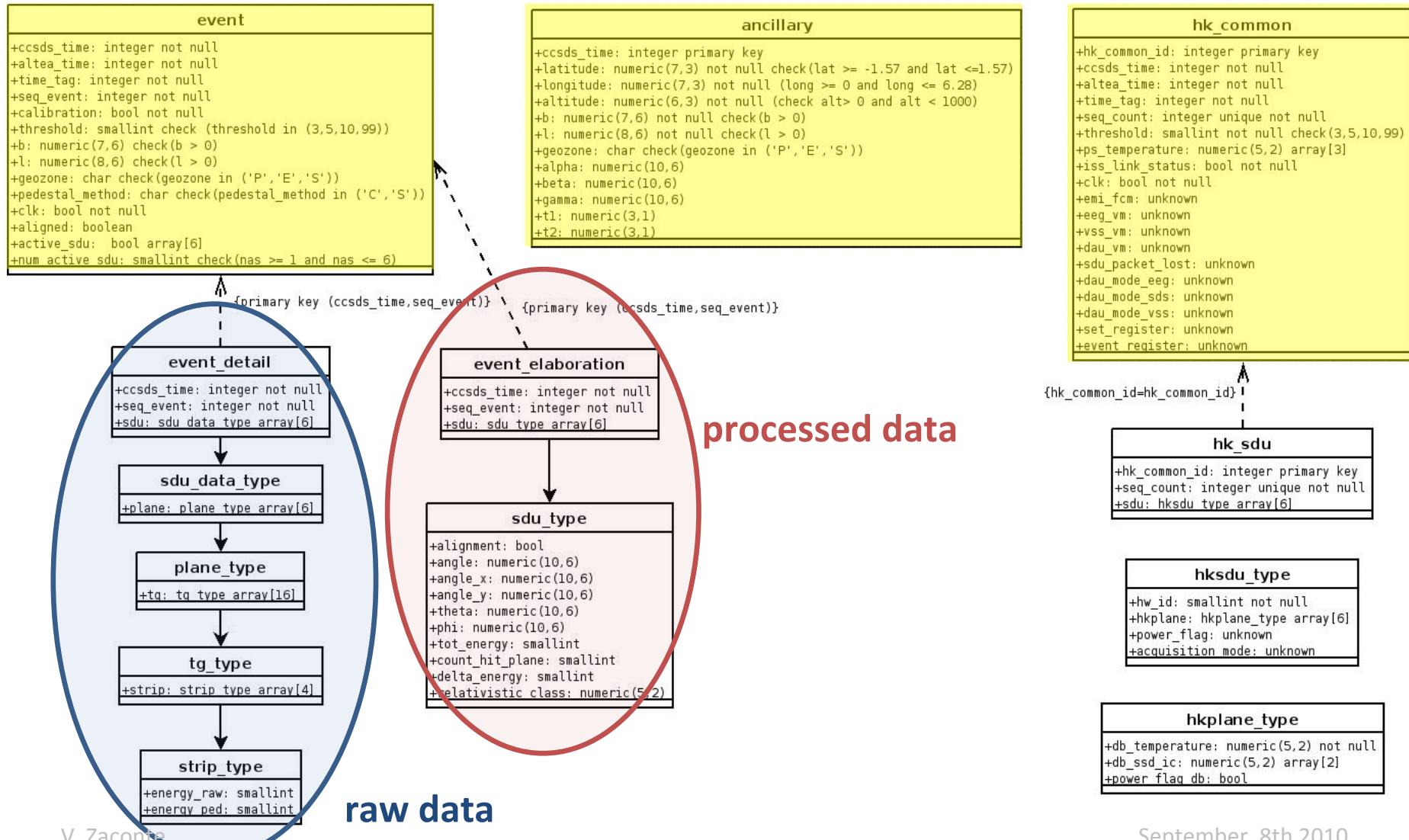


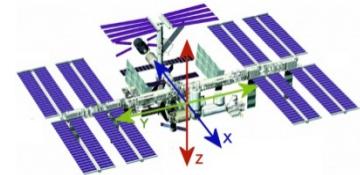
# Offline data management

- complete ALTEA data downloaded once a day:
  - NASA EHS web interface
  - data merged and sorted from RT and Dump2 modes
  - automatic data retrieval and download via FTP
- data processed using the same sw classes of the RT application with a dedicated software that ingest them into the ALTEA DB
- a dedicated procedure has been developed to include orbital information
  - orbital parameters interpolated from TLE  
<http://www.ngdc.noaa.gov/IAGA/vmod/igrf.html>
  - geomagnetic parameters from IGRF (scan every 15 s)  
<http://celestrak.com/NORAD/elements/>
- Postgresql 8.3; it allows the creation of user defined data types and arrays
- ~400GB ingested data



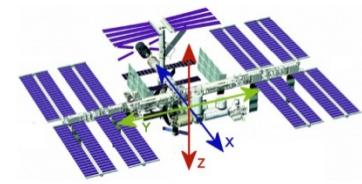
# DB structure





# DB data retrieval

- queries are submitted through calls to predefined functions (rate, spectra,...) with advanced options to select (geo-zone, time intervals, hit SDUs,...)
- this approach allows the user to write scripts to perform complex sequences of queries (ex. particle flux each 15 min during the December 2006 Solar Particle Event)



# DB Web Interface

AlteWeb Form - Windows Internet Explorer

http://alteadb.roma2.infn.it/alteaweb/form.php?current\_tab=Adv

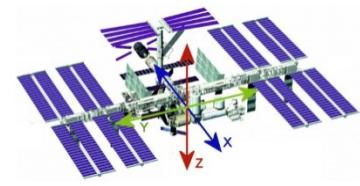
Preferiti | Siti suggeriti | Scarica altri add-on | AlteWeb Login Page

FastW... ALTE... WEB... Gmail... Alt... Pagina Sicurezza Strumenti ? >

All	2006	2007	2009	GW	F20061206	Month	Week	Day	Advanced
<b>SELECTION</b>									
Name	Min			Max					
<input type="radio"/> CCDSD TIME									
<input checked="" type="radio"/> DATE									
# ACTIVE SDU	1			6					
<b>CUTS</b>									
Relativistic Class <= (RC <= 0 Means No Cut)					10				
DATATYPE		<input checked="" type="checkbox"/> Science <input checked="" type="checkbox"/> Calibration							
GEOZONE		<input checked="" type="checkbox"/> S <input checked="" type="checkbox"/> P <input checked="" type="checkbox"/> E							
ALIGNED		<input checked="" type="radio"/> true <input type="radio"/> false							
SDU		<input type="radio"/> AND <input checked="" type="radio"/> OR			<input checked="" type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input checked="" type="checkbox"/> 6				
<b>OUTPUT</b>									
Filename					result.out				
TYPE		<input checked="" type="radio"/> Spectrum <input type="radio"/> Angles <input type="radio"/> Rate							
FORMAT		<input checked="" type="radio"/> Plot <input type="radio"/> ASCII							
<input type="button" value="Search!"/> <input type="button" value="Clear"/>									
<input type="button" value="Logout"/>									

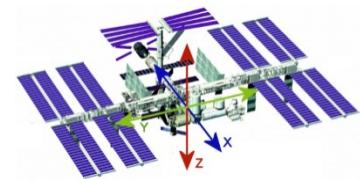
Internet | Modalità protetta: attivata

100%



# Conclusions and future work

- ALTEA is working as RT monitoring device both in URTV and at JSC
- the dose calculation performed by ALTEA needs to be extended to LET<3keV/um by means of models
- a final version of the RT software will be delivered
- SRAG is interfacing the ALTEA RT sw with their DB
- ALTEA DB will be updated with dosimetric informations
- ALTEA DB will be available to external users



# Acknowledgments

ALTEA is funded by ASI, INFN and URTV.

*We want to thank*

*NASA SRAG (in particular Kerry Lee)*

*ESA*

*for their support.*

Thanks for the attention!