

ALTEA

Anomalous Long Term Effects in Astronauts calibration and status of the project

Livio Narici

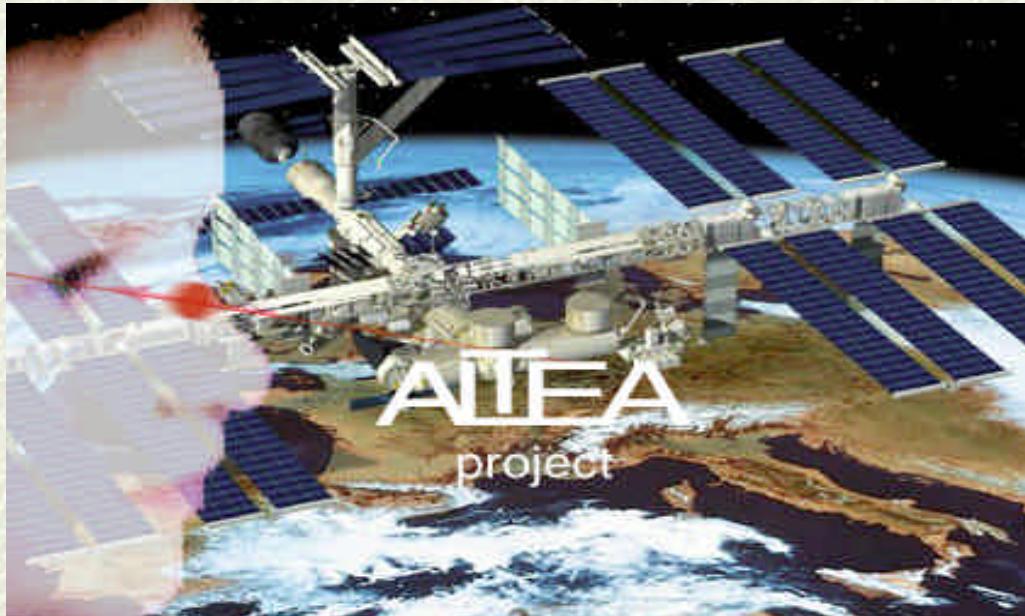
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University of Rome
"Tor Vergata"



University of Genoa



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The ALTEA team



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DISM-Univ. of Genoa, Genoa, e Dept. of Psychiatry, SUNY, Stony Brook, NY, USA
L.N.F. - INFN, Frascati (Rome)

Dept. of Fisica, 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

GSI - Biophysik, Darmstadt, Germany

Royal Institute of Technology, Stockholm, Sweden

Moscow State Engineering Physics Institute, Moscow, Russia

Russian Space Corporation "Energia" by name Korolev, Korolev, Moscow region, Russia
Institute for BioMedical Problems, Moscow, Russia.



Johnson Space Center,
NASA, Houston TX, USA
Brookhaven National
Laboratory, NY, USA
Cole Eye institute, The
Cleveland Clinic, Cleveland,
OH, USA

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Ball S.

Belli F.

Bengin V.

Bidoli V.

Bisti S.

Boezio M.

Bonvicini W.

Carlson P.

Carozzo S.

Casolino M.

Castellini G.

Cotronei V.

Cucinotta F.

DePascale M.P.

Di Fino L.

Fuglesang C.

Furano G.

Galper A.

Gianelli G.

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Romagnoli P.

Ruggieri D.

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Spillantini P.

Trukhanov K.A.

Vacchi A.

Vavilov N.

Vazquez M.

Vittori R.

Zaconte V.

Zampa N.

+ others joining in



Rationale

-Long space missions require investigation of

- the radiation environment in space habitats (..ISS)
- the transient/long-term functional effects of space environment and cosmic radiation on the Central Nervous System (CNS).

Anomalous Light Flash perceptions suggest that abnormal (though possibly transient) CNS functional states may result.

If visual pathways are affected, other cortical areas may as well be.

⇒Need to study the possible cortical **functional** alteration due to particle passages in microgravity conditions.



Background

- Tobias prediction of LF (1952)
- Apollo and other 70's space missions
- Laboratory and space experiments in the 70's

Most recently:

- MIR (SilEye)

Nature 2003, 422:680
Acta Astronautica 2002, 81:511-525
J.Phys. G27, 2001:2051-2064

- ISS (Alteino)

Nucl. Phys. 2002: 71-78

ALTEA program: a multiple approach

Experiment in Space
On board ISS

ALTEA-space

*ISS - Take off in
2005*

Alteino

*On board ISS
since April 2002*

**ALTEA
L.F. questionnaire**

Started 2003

*+ ... other uses of
the ALTEA
facility*

Controlled, laboratory
based experiments

ALTEA-MICE

GSI-BNL

Started 2001

ALTEA-HIT

GSI

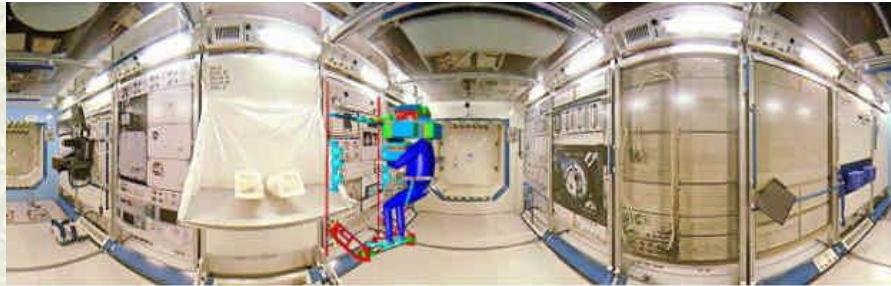
Started 2004

ALTEA-biophys

GSI-BNL

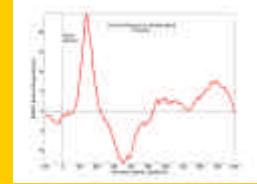
Started 2003

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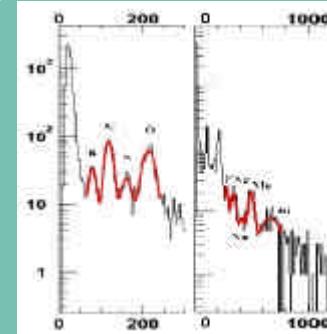


- Measure particle fluxes in the ISS (..Z .. trajectories ..energy ..)
- Measure particle trajectories in the brain
- Measure electrophysiological dynamics
- Monitor the visual system status

Cortical Signal caused by particle passages in the retina in a mouse
(ALTEA-MICE GSI August 2004)



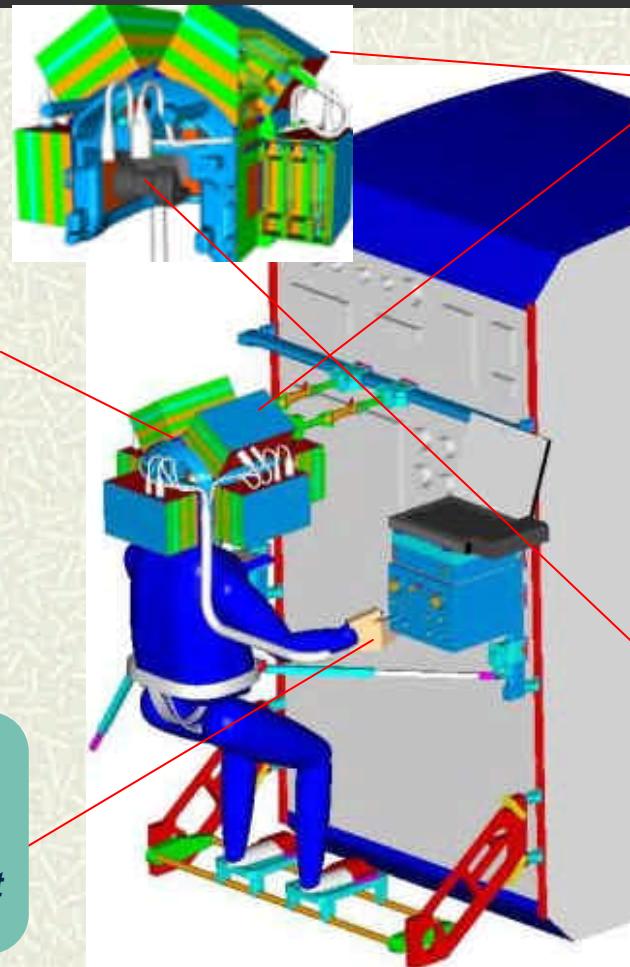
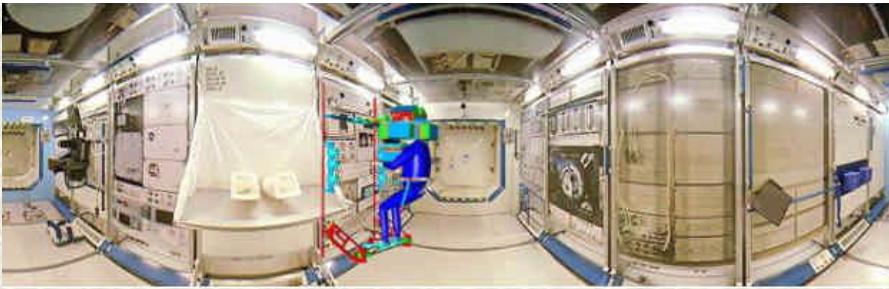
- Use Alteino experience



Alteino (AST)
• ISS 2002
• ion identification capability
• 131 h particle data acquisition
• B, C, N, O F, Ne, Na, Mg

- Build a multipurpose facility

ALTEA - space



EEG

32 channels
128 - 16384 Hz
per channel

PushB.

Three independent
pushbuttons

SDS

6 SDUs

1 SDU:

3 silicon planes with double detectors, view X & Y
Area: $2 \times (8 \times 8) \text{ cm}^2$

Maximum error of angular reconstruction: $\pm 1.8^\circ$
Geometric factor: $160 \text{ cm}^2 \text{ sr}$

VSU

Two color LCD-TFT oculars
XGA, 1024 x 768 pixels at 60 Hz
Field of view: 35° diagonal (21° V 28° H)
Luminance 5-50 FL Contrast 40:1
256 colors out of a 16 million colors palette
Video memory: 2 MB

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The ALTEA experiment

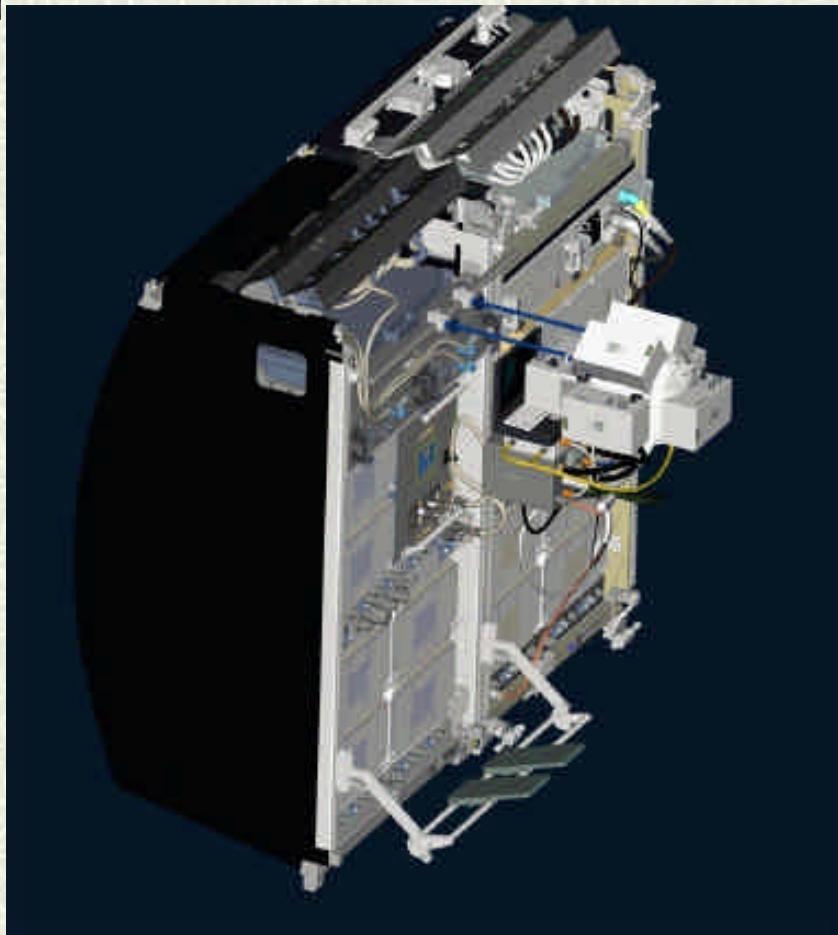
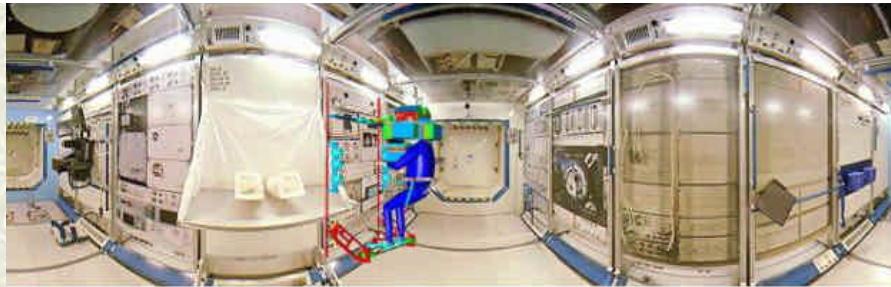
Two protocols:

- **DOSI:** *unmanned*
the SDS is tilted 90° downwards to minimize protrusion
the SDS is 'on' continuously. Data is downlinked in real time
- **CNSM:** *manned; 6 sessions approximately 1 month apart to each other*
the astronaut:
 - wears the EEG cap with the electrodes and check their impedances
 - 'wears' the helmet and restraints himself
 - close VSU, start dark adaptation and stimulation procedure
 - start session (1 orbit)

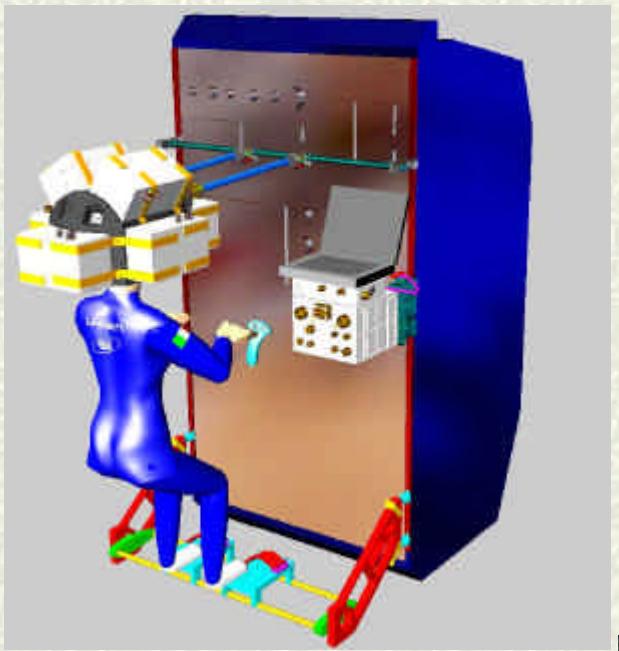
The ALTEA facility

The three subsystems (particle detectors, EEG, Visual Stimulator) can work in any combination.
The SDS can be re-positioned
Possible experiments in particle physics, dosimetry, psychophysics, electrophysiology, etc.

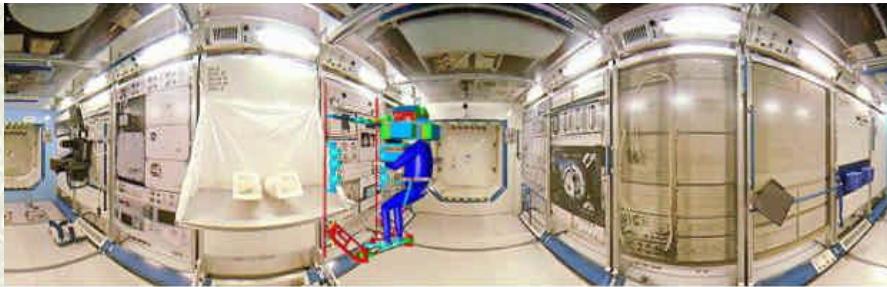
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CNSM Mode



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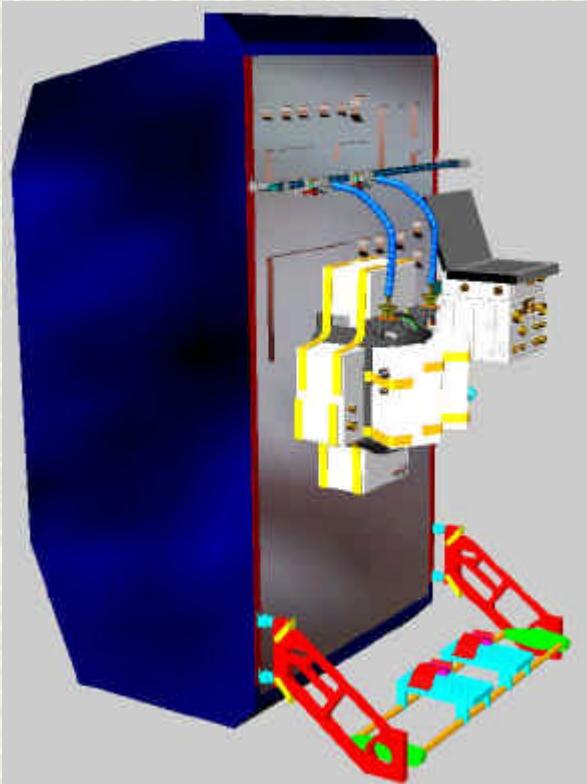


EXPRESS RACK 3

EXPRESS RACK 1



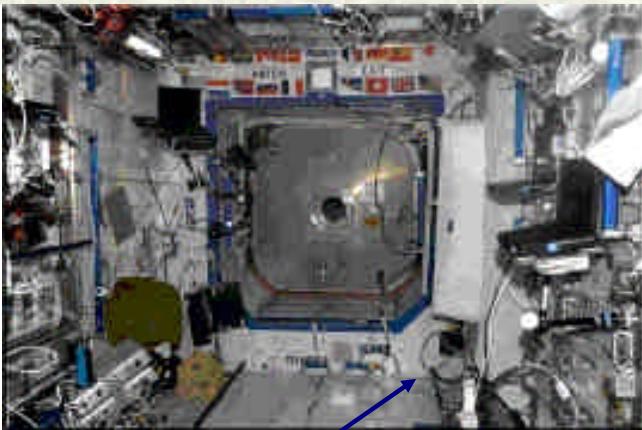
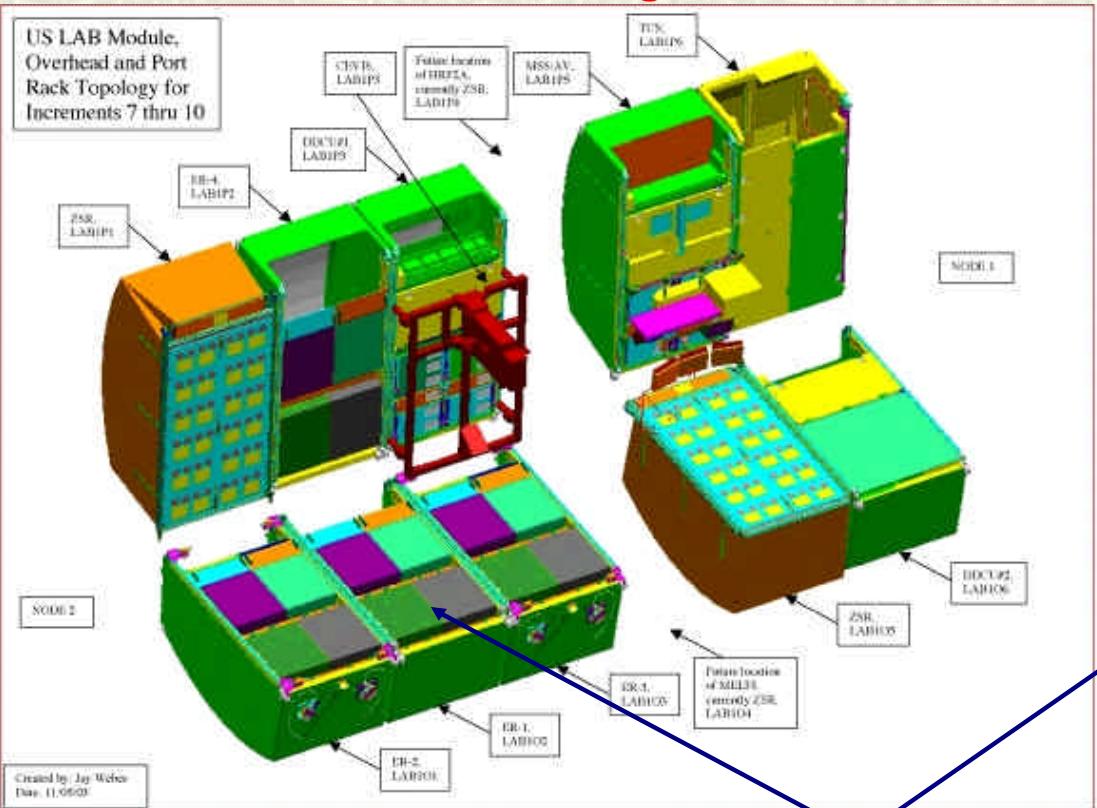
DOSI Mode



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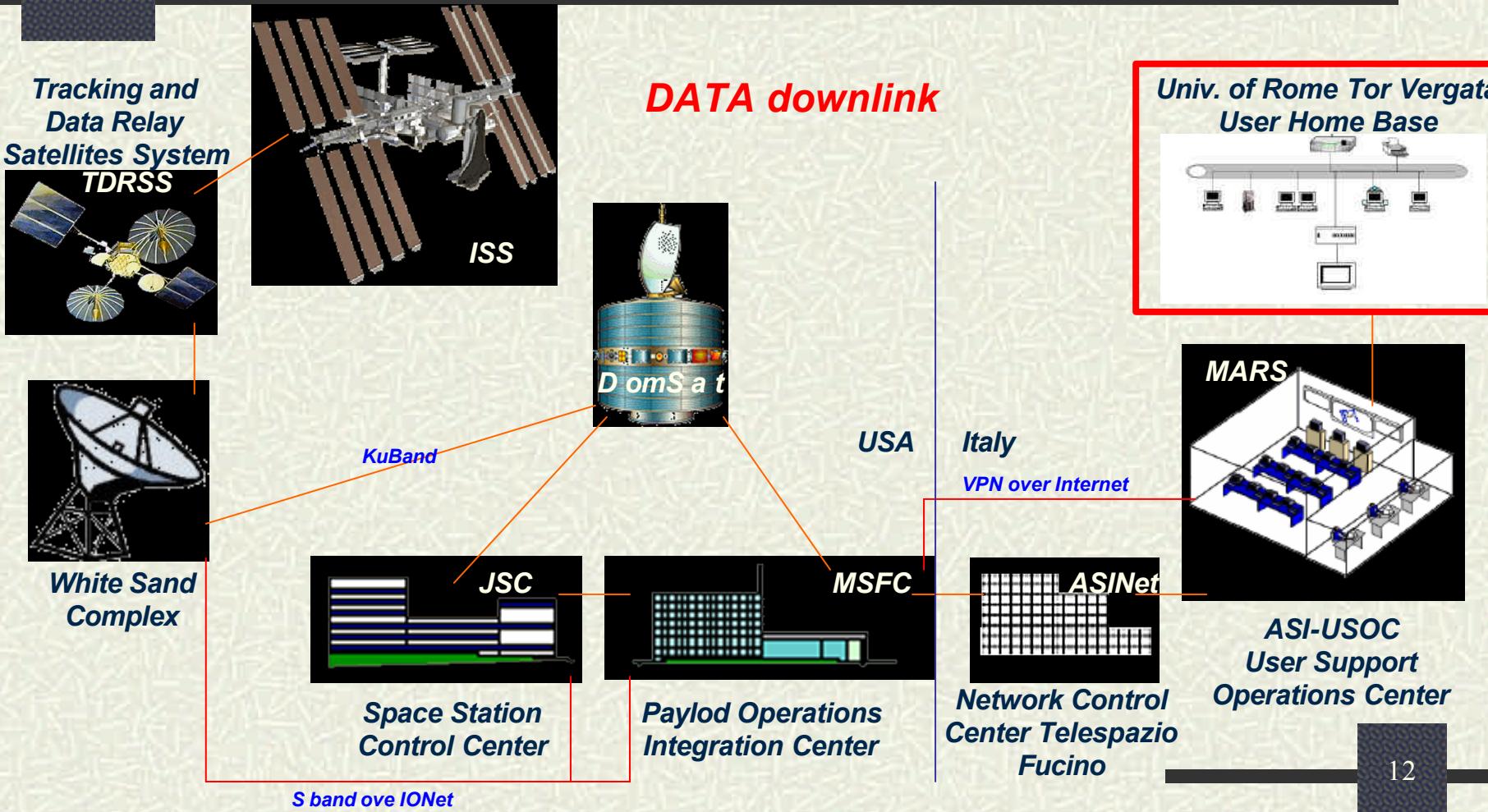
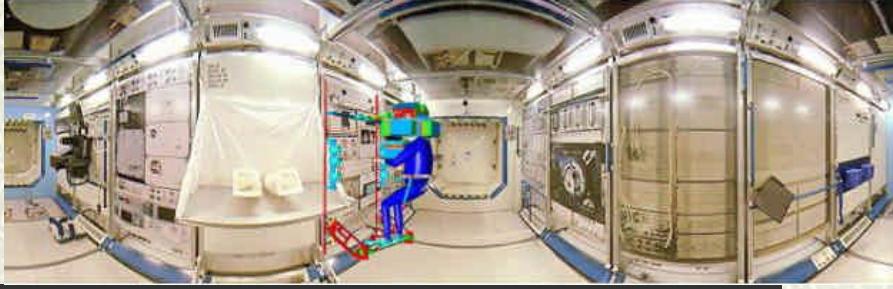


ALTEA Positioning in the USLab



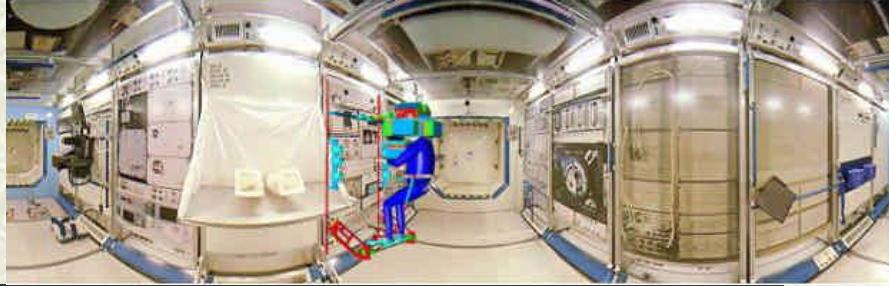
Current ALTEA position: ER1 (Lab102)

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ALTEA - space



Time schedule

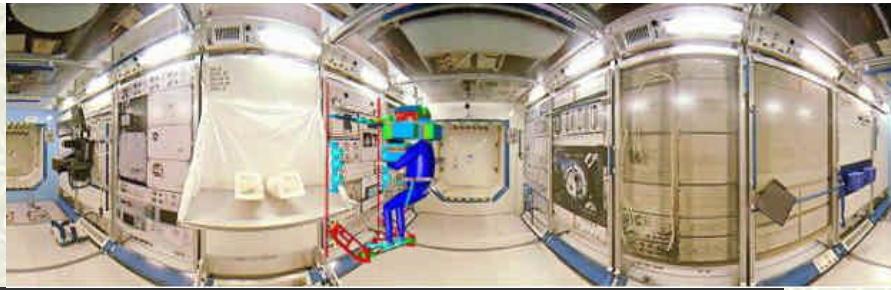
-  Mock Up Model: *delivered to NASA (August 2004)*
-  Engineering/Training/BDC Model: *delivered to NASA (August 2004)*
calibrated at GSI - (November 2003 / April 2004)



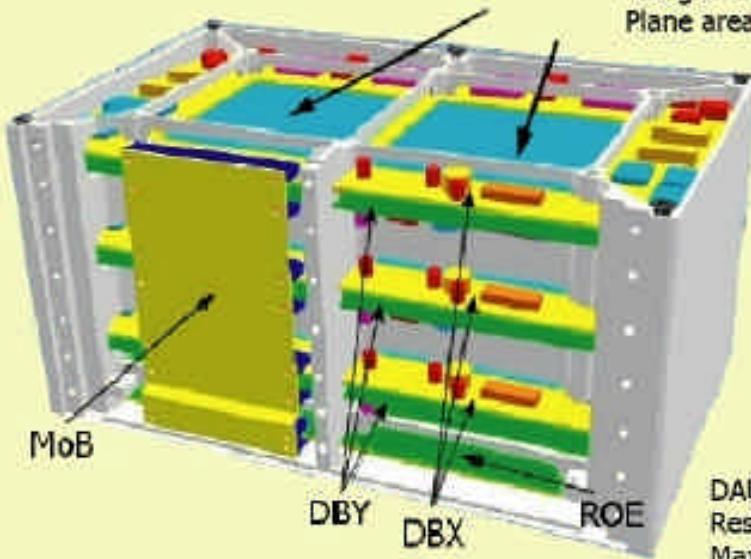
Flight Model: *final tests, scheduled for delivery to NASA at the end of October 2004*
calibrated at GSI - (November 2003 / April 2004)

Launch: *manifested for flight 12A.1 (NET 1.12.2005)*

ALTEA - space



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): $160 \text{ cm}^3 \text{ sr}$

PERFORMANCES:

Threshold: 5 -33 MIP

Saturation: 2400 MIP

(1 MIP=109 KeV/plane)

ADC: 12 bit

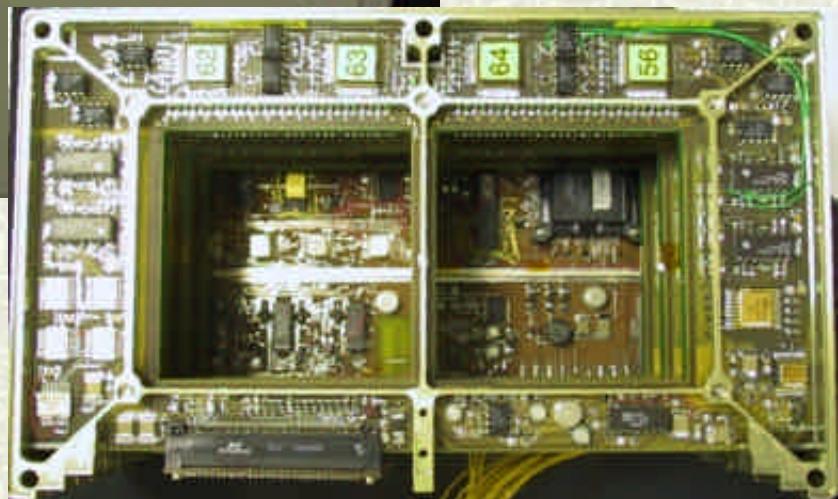
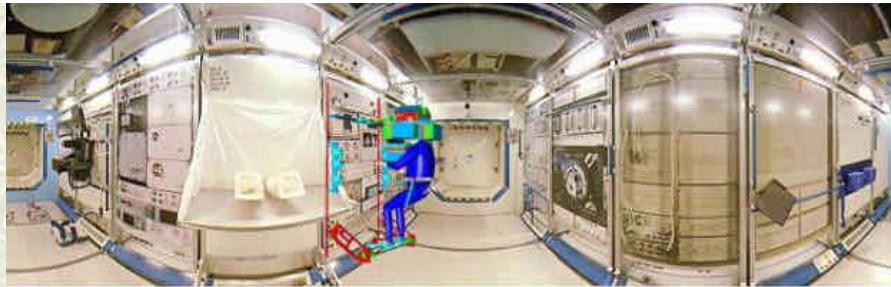
DAU SOFTWARE PARAMETERS:

Resolution: $0.64 \text{ MIP}/\text{ADC ch}$

Maximum Acquisition Rate: 700 Hz

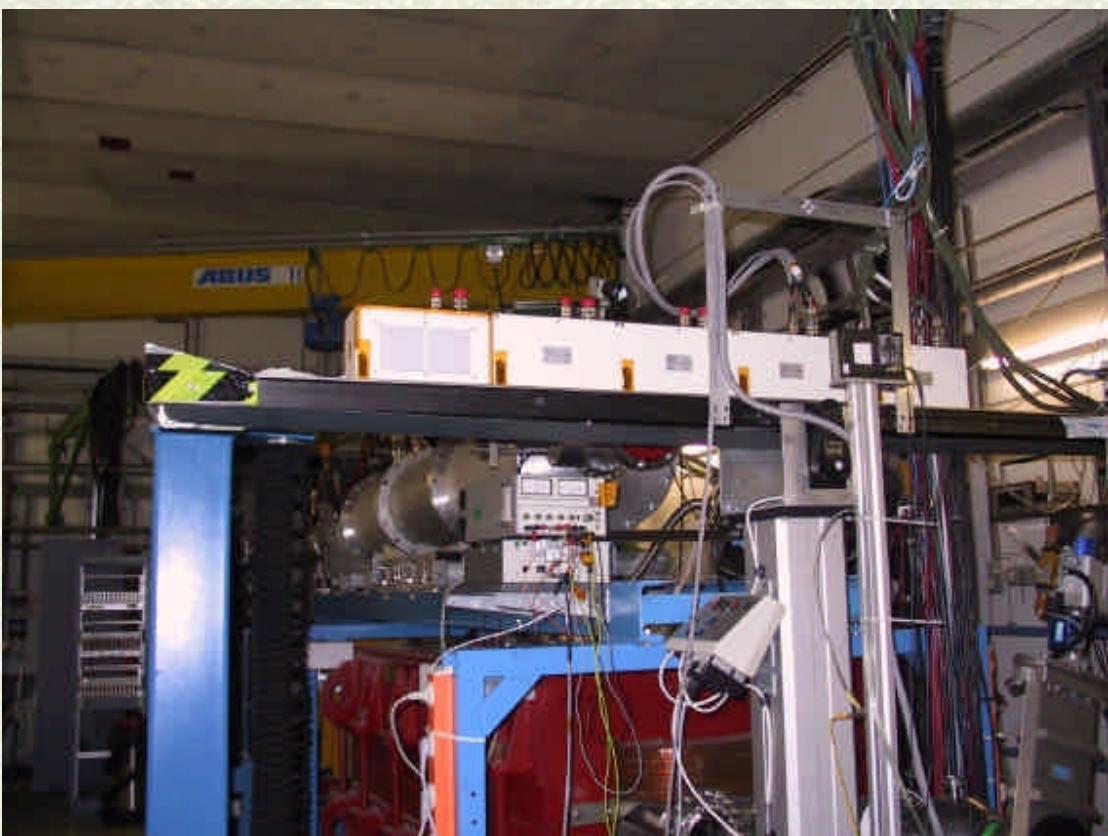
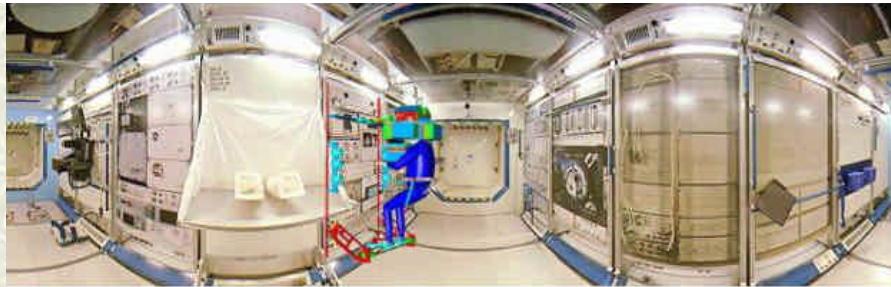
Autotrigger (logic OR or logic AND of X planes, software switchable)

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*The SDU open, seen from above
With silicon not yet bonded*

ALTEA - space

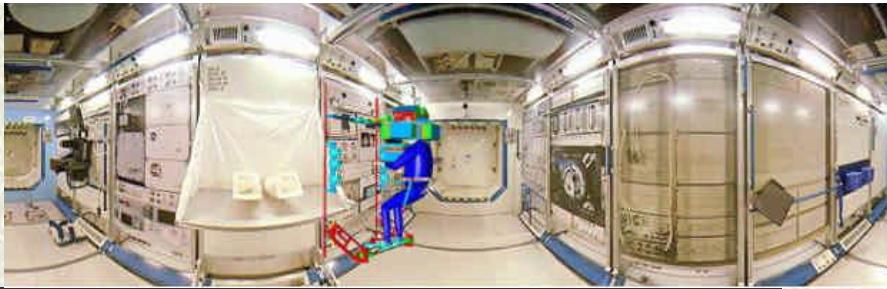


Calibration at GSI

- November 2003 (SDU-FM1)
 $C @ 100, 150, 400, 600 \text{ MeV/n}$
- April 2004 (all SDUs)
 $C @ 100, 600, 1000 \text{ MeV/n}$
 $Ti @ 200, 600 \text{ MeV/n}$

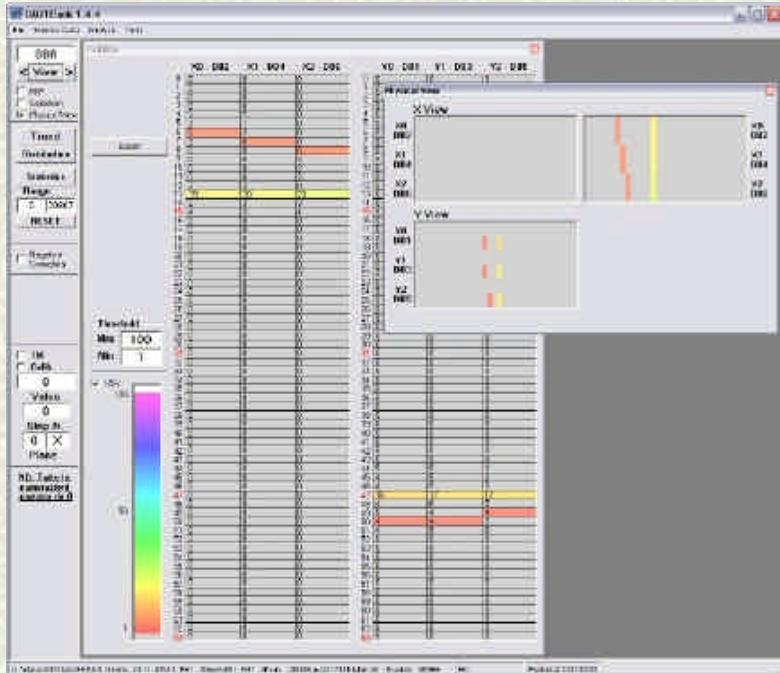


ALTEA - space

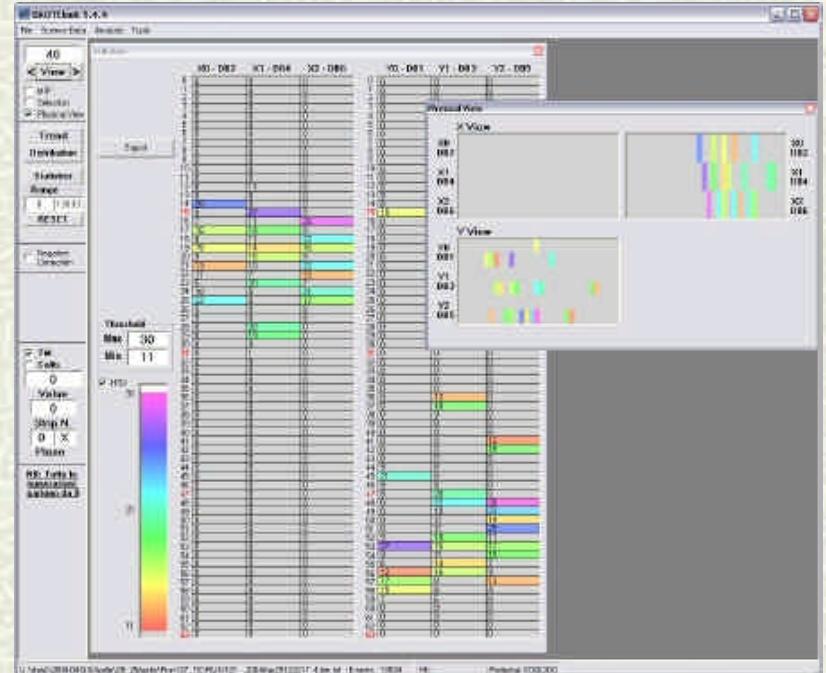


DATA QuickLook

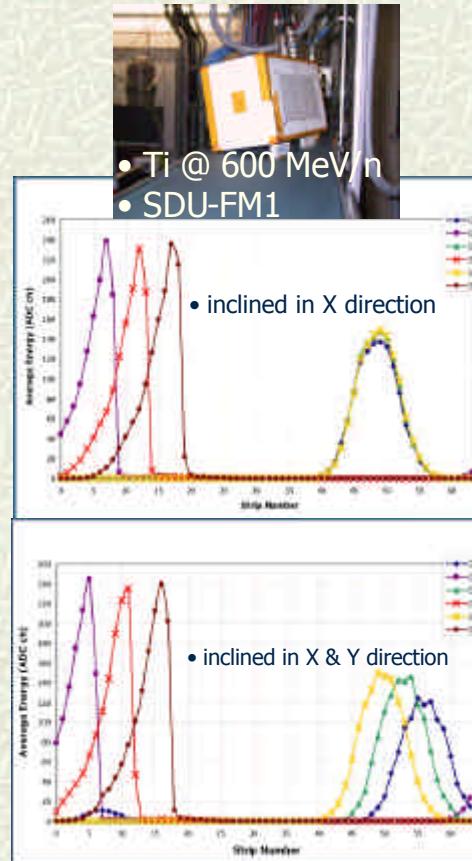
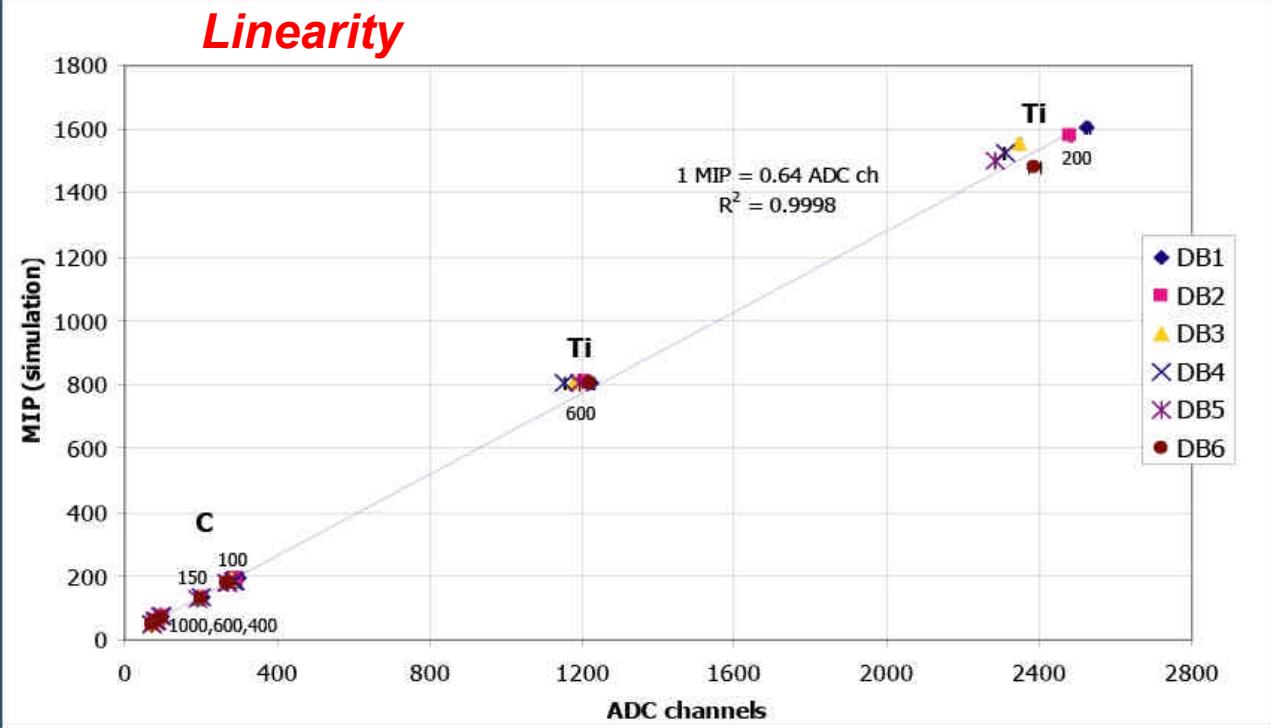
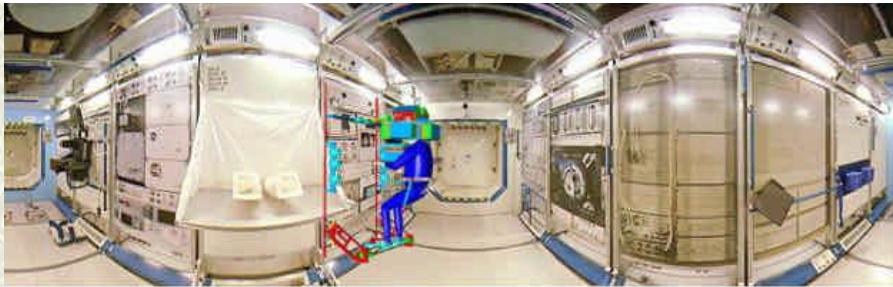
Two particle tracks



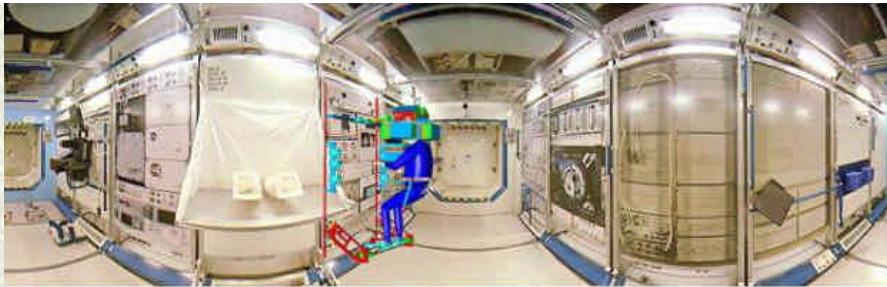
Multiple tracks



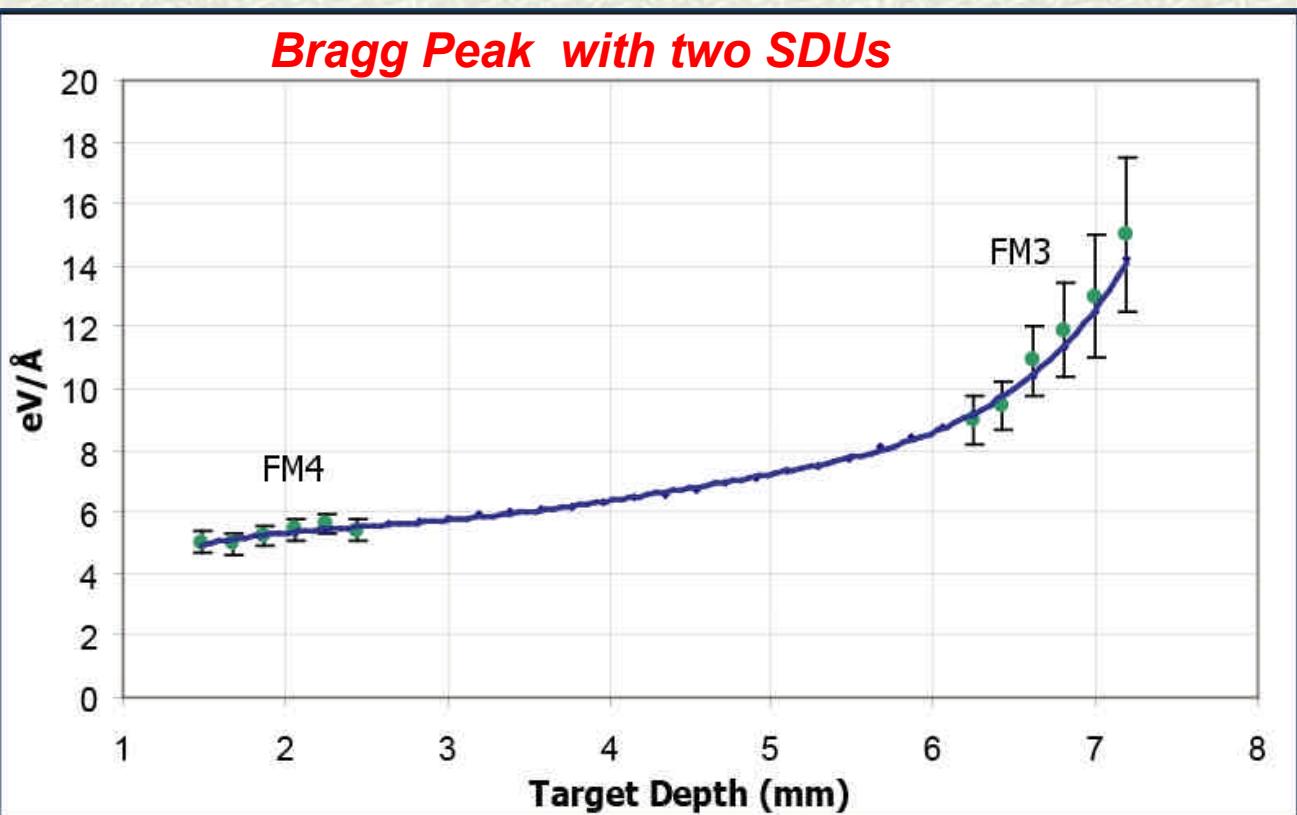
ALTEA - space



ALTEA - space

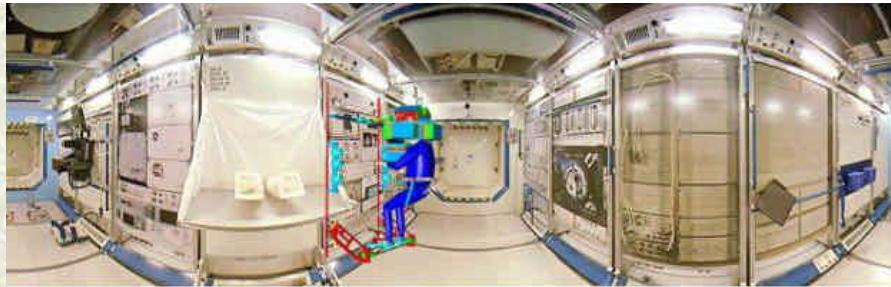


Bragg Peak with two SDUs

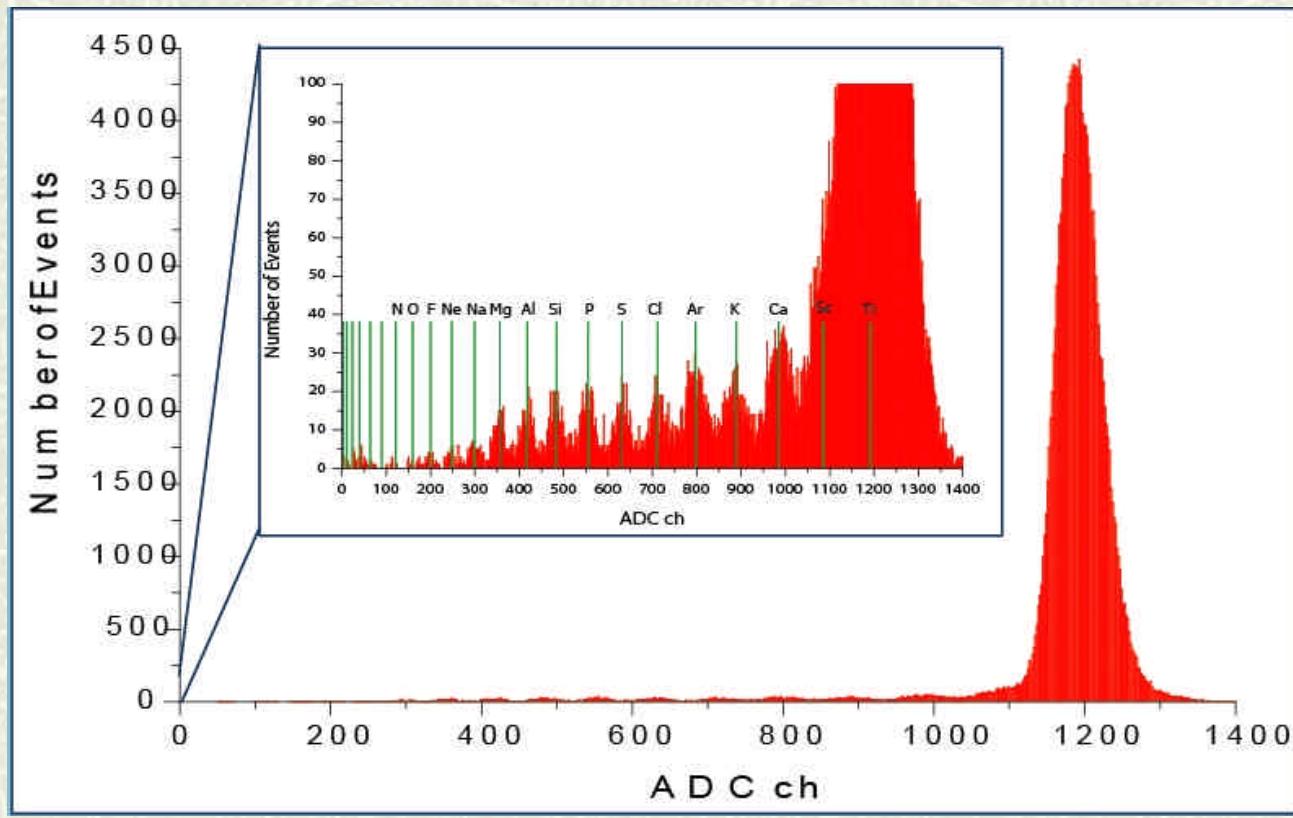


- C @ 100 MeV/n
- SDU-FM4 & FM3
- Montecarlo simulation
- Equivalent silicon thickness

ALTEA - space



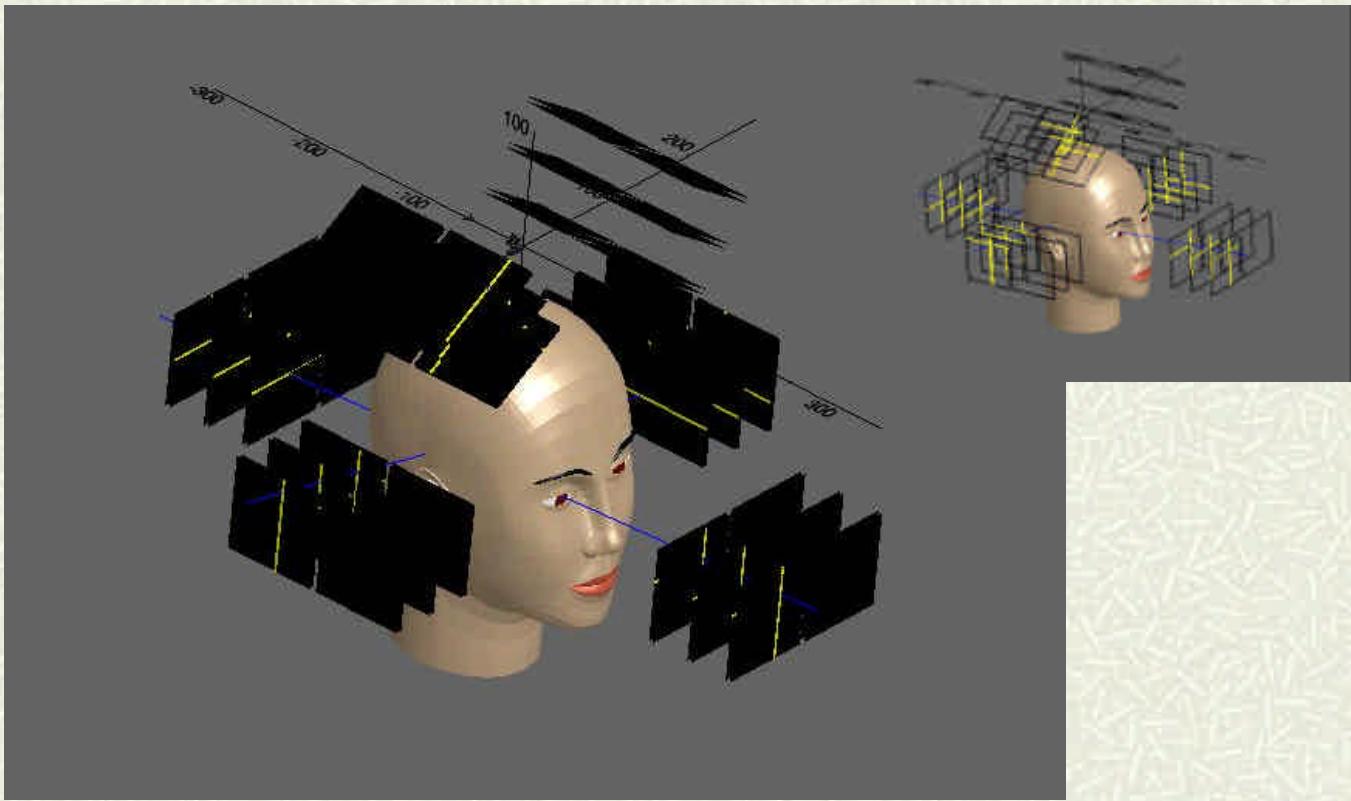
Fragments Detection



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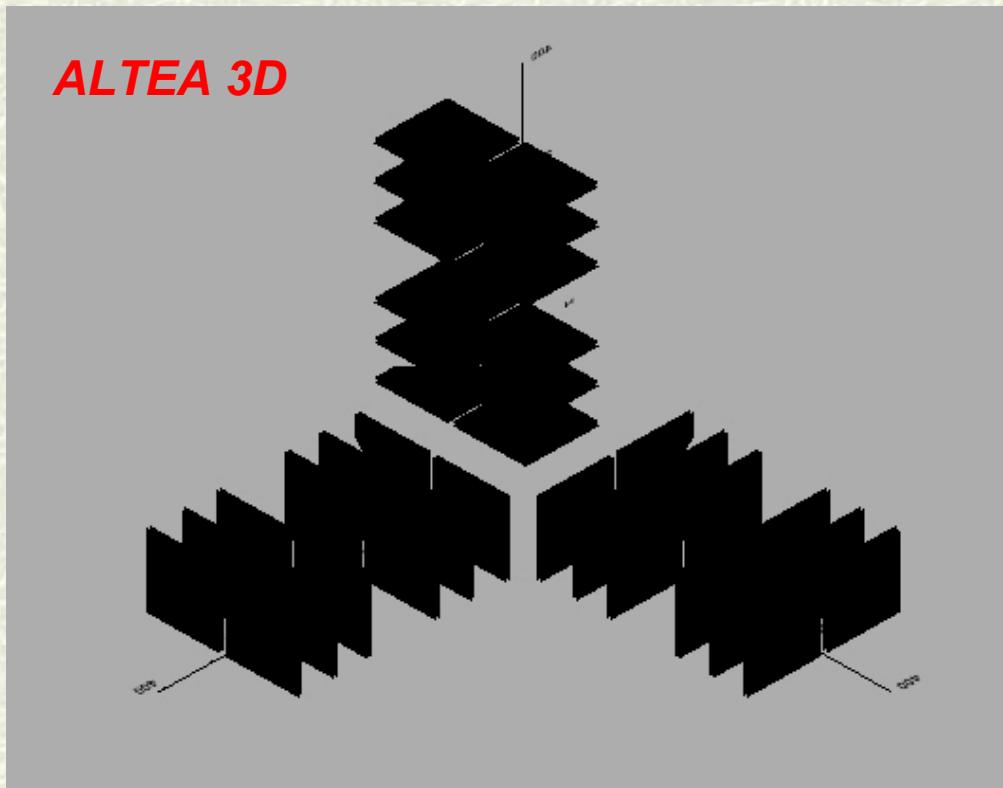


An example of the particle **data presentation** in ALTEA CNSM (.. under construction ..)



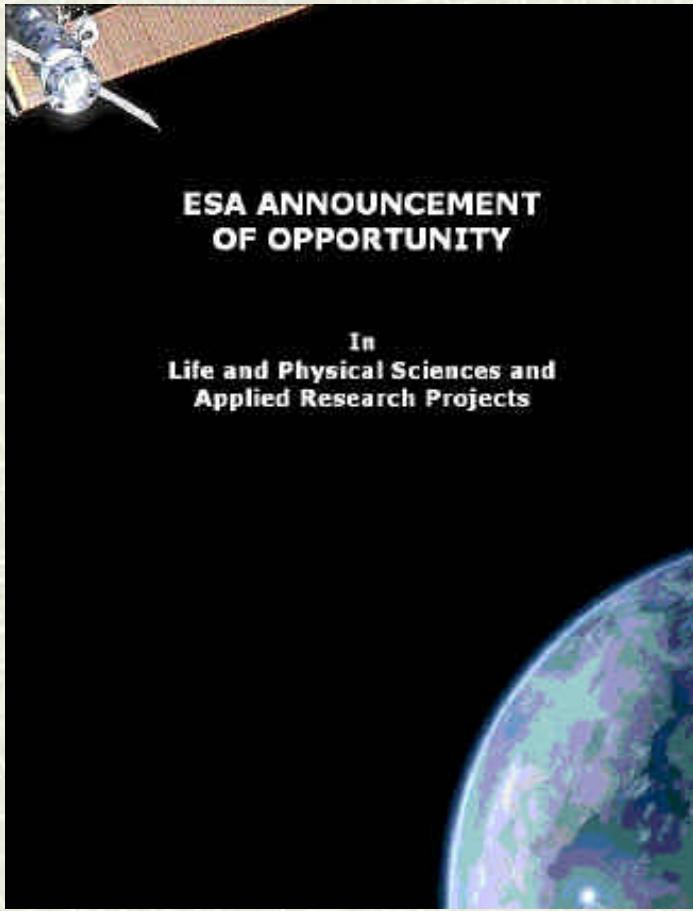


ALTEA - .. Future²





ALTEA - ... future



7.2 Facilities for human physiology

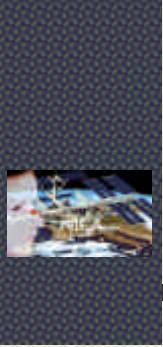
- Advanced Silicon Telescope Facility **ALTEINO** (Italian Space Agency) Is a particle telescope continuously operating, measuring the radiation environment of the International Space Station.
- **ALTEA** (Italian Space Agency)
ALTEA is a programme aimed to study the interaction between particle passages in the brain and possible brain functional transient or long term anomalies, in particular related to the visual system.

Notice of Interest due 31 August 2004

Proposals -submission deadline: 12 November 2004

Proposal Workshop and Networking Meeting:

13 September 2004 @ ESTEC, Noordwijk



Thank you for your attention