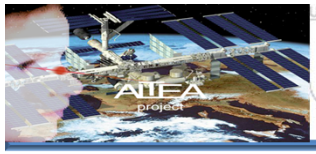

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Human Space Exploration Radiation Lab

LIDAL: update of the project, ground tests and perspectives

L. Narici[a,b,f], R. Messi[a,b], C. Berucci[a,b], L. Di Fino[a], A. Rizzo[a,b,g], C. De Donato[a,b], G. Masciantonio[a,b], M.C. Morone[a,b], F. Tommasino[c,d,b], C. La Tessa[c,d,b], M. Pullia[h], M. Ferrarini[h], Carrubba[e], G. Neri[e], A. Bardi[e], M. Passerai[e]

a University of Rome Tor Vergata, Physics Department, Rome, Italy
b INFN Rome Tor Vergata, Rome, Italy
c Trento Institute for Fundamental Physics and Application - TIFPA INFN - Povo (Trento), Italy
d University of Trento, Physics Department, Povo (Trento), Italy
e Kayser Italia, Livorno, Italy
f ASI, Rome, Italy
g ENEA, Roma, Italy (since Feb 1st 2019)
h CNAO – Pavia, Italy

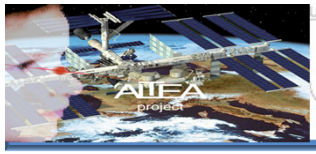
asi agenzia spaziale italiana

INFN

KAYSER ITALIA

CNAO

TIFPA



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Content

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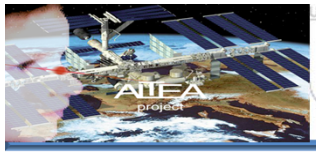
- LIDAL motivation and objectives
- Accelerator tests
- Timeline



Objectives

LIDAL (Light Ion Detector for the ALTEA detector system): an upgrade of **ALTEA**

- enhanced triggering capability (extension of **ALTEA** energy acceptance for protons and He nuclei)

- Time of flight measurements (direct measurement of velocity, enhanced particle discrimination)

  - *Design and project by the Department of Physics – University of Rome Tor Vergata*
  - *Final development and integration by Kayser Italia*
  - *Beam Tests at TIFPA (IT) & CNAO (IT)*

ASI 2016 contract, to be launched with the Luca Parmitano Mission with NG12, Oct 21st 2019

Objectives

J. Space Weather Space Clim., **5**, A37 (2015)

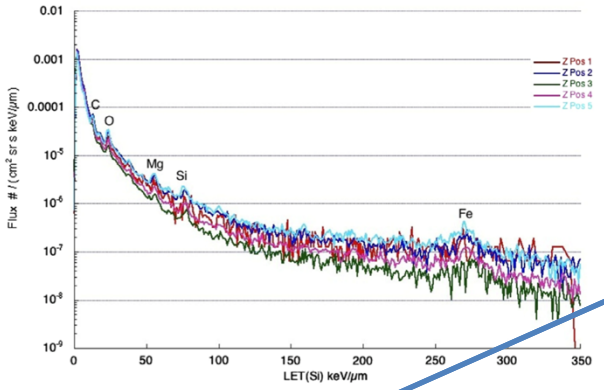


Fig. 11. LET (Si) spectra (*HL*) in the *Z* direction for the five detector positions (including the last site in Columbus).

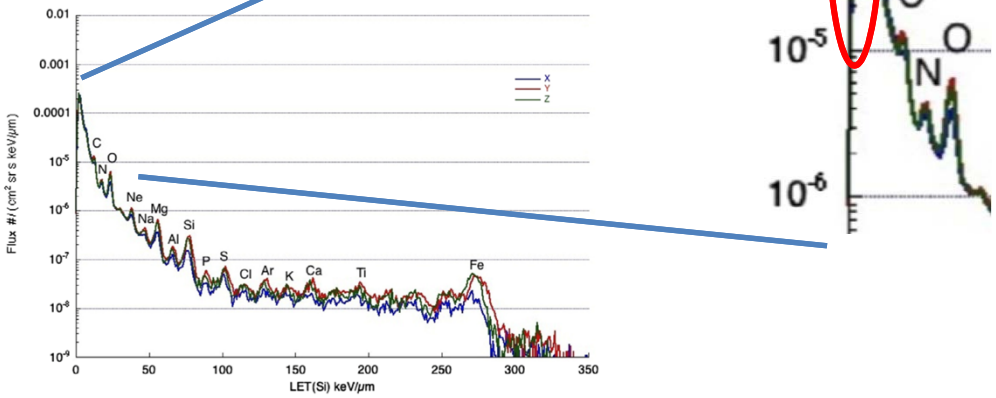
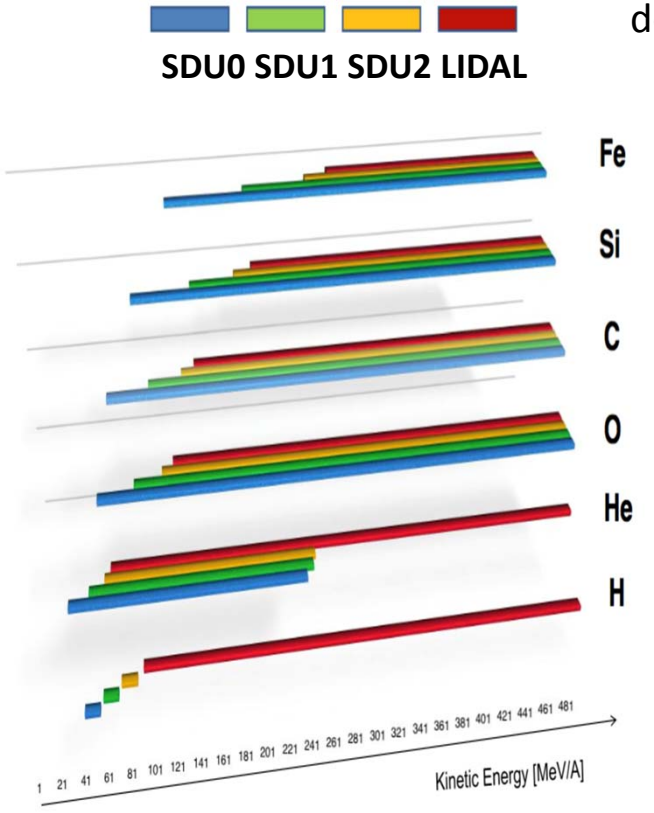
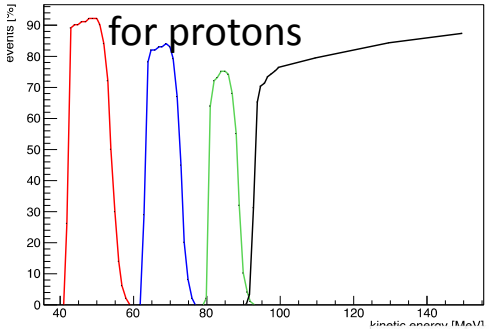


Fig. 12. LET (Si) spectra measured at low latitude (*LL*) in the three direction for the fourth detector position (P4).

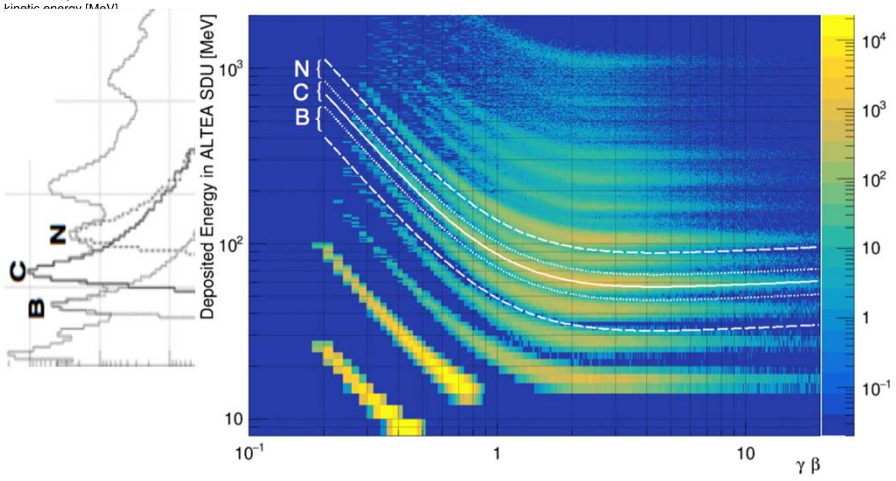
Triggering & nucl. discrimination

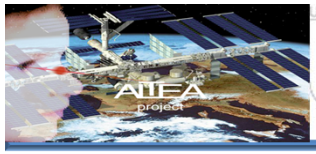


Triggering of the different detectors in LIDAL-ALTEA



ToF and nuclear discrimination in LIDAL-ALTEA





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Development strategy

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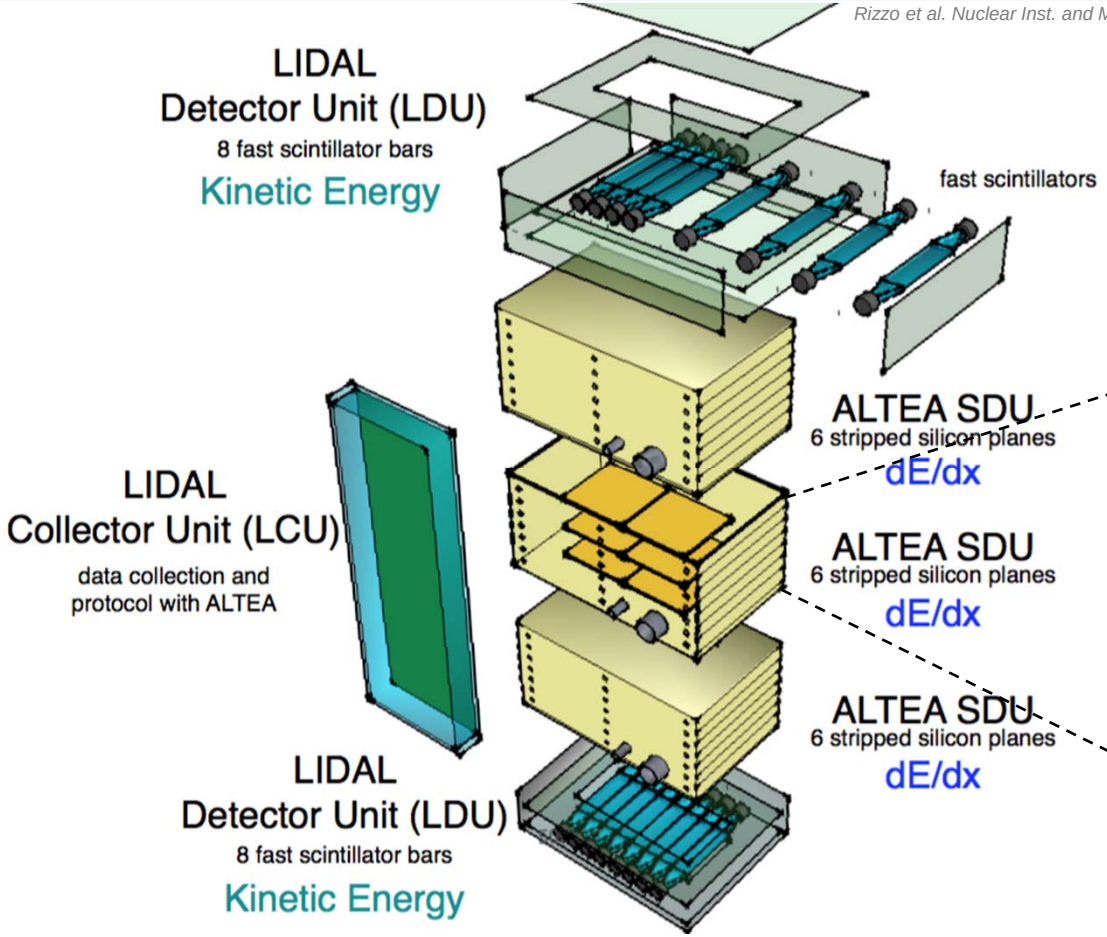
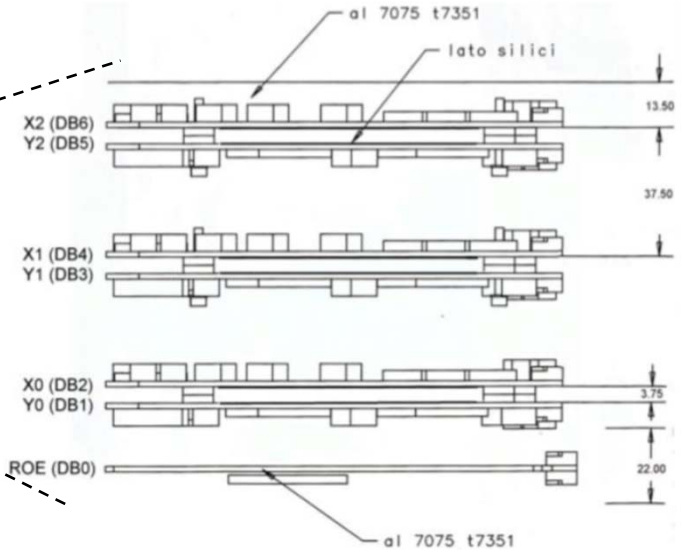
- use plastic scintillators for fast timing applications read by Photo-Multiplier-Tubes (PMTs)
- custom Front End Electronics (FEE) [final time resolutions (scintillators + FEE) < 100 ps for protons]
- scintillators designed and built at the University of Rome Tor Vergata
- prototype tests at the proton beam line in TIFPA - Trento, Italy
- Develop identical TM & FM detector systems
- TM & FM tests at TIFPA (protons) and CNAO (Carbon ions)

LIDAL-ALTEA – exploded view

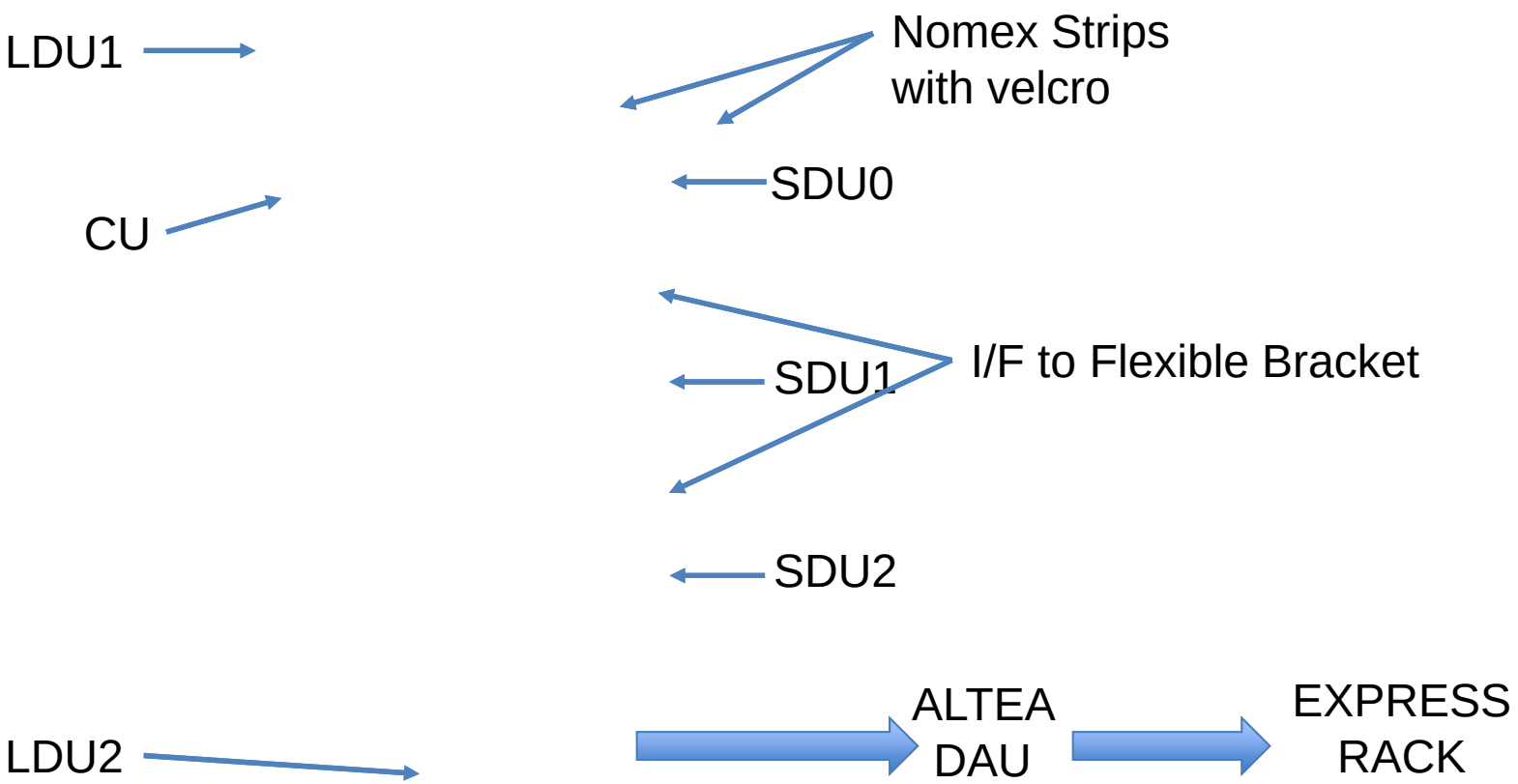
Rizzo et al. Nuclear Inst. and Methods in Physics Research, A 898 (2018) 98–104



ALTEA DAU



LIDAL-ALTEA


LDU1
Nomex Strips
with velcro
SDU0
CU
SDU1
I/F to Flexible Bracket
SDU2
LDU2
ALTEA
DAU
EXPRESS
RACK

Test and upload strategy

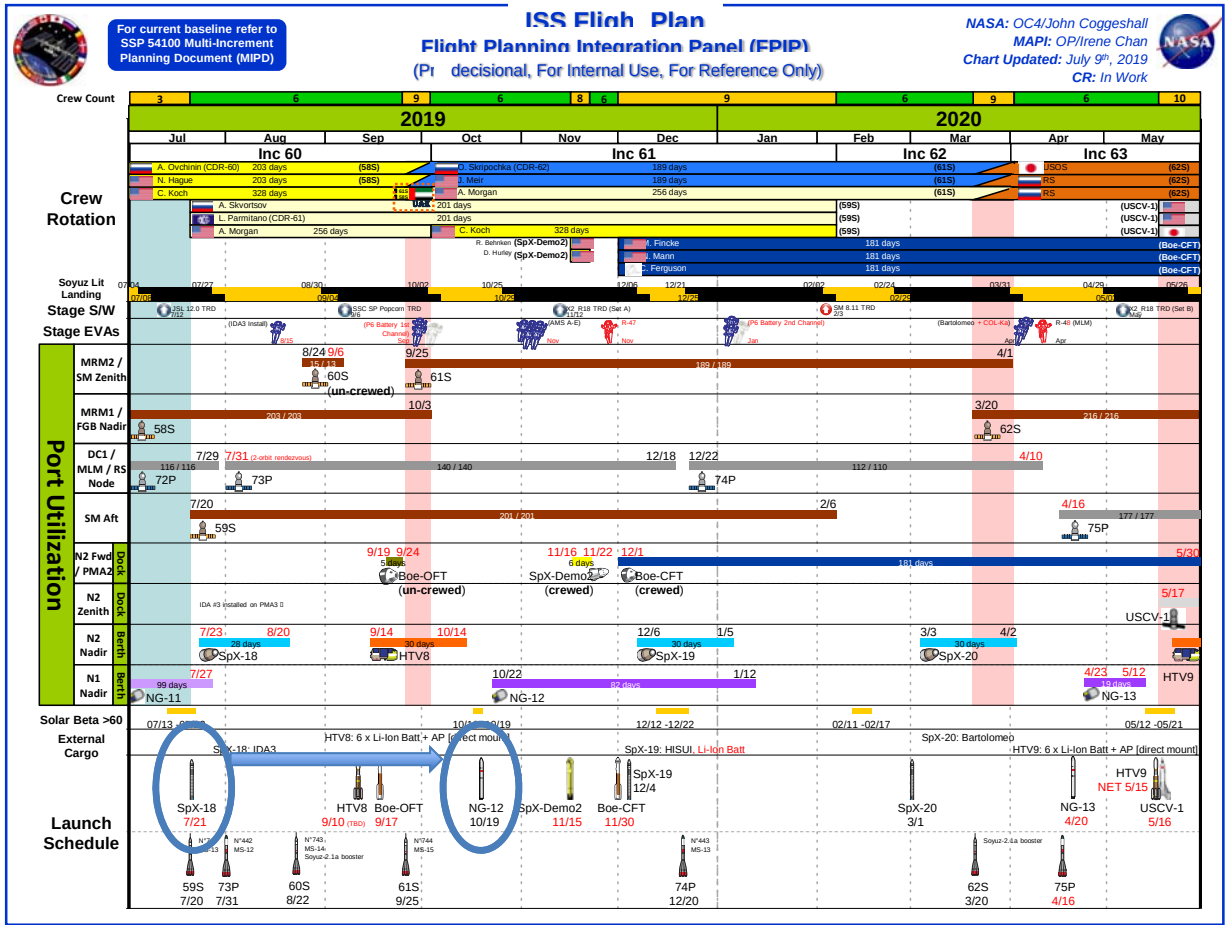
- test on the Engineering model at TIFPA
- test on the Flight model at TIFPA / CNAO
- delivery to NASA in July 2019
- **Upload to ISS in Oct 2019**

New plan

All internal coding problems have been solved.

The upload flight has been moved from SpaceX 18 to NG 12 (July 21st → Oct 21st)

The Payload has been delivered to NASA in July 2019



Test at CNAO– Pavia (^{12}C) - TM

June 7 – 9 2019

Test at CNAO– Pavia (^{12}C) - FM

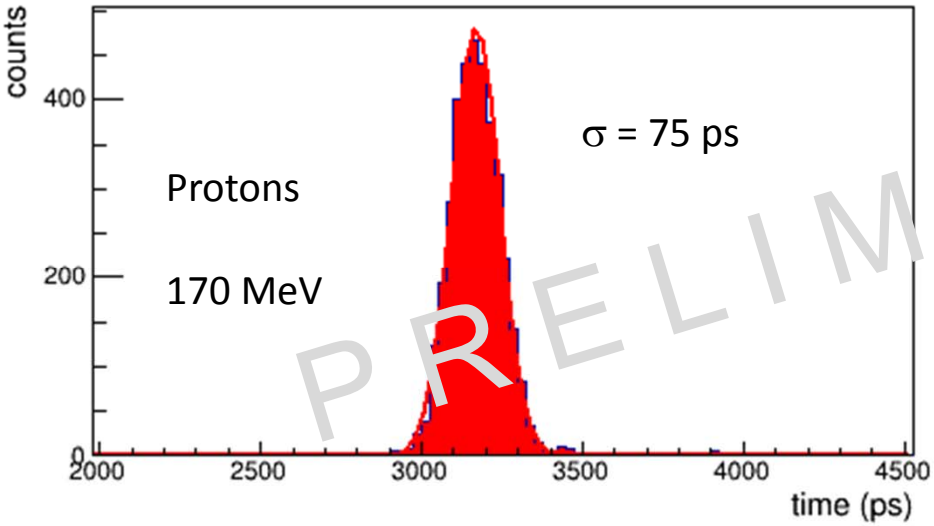
June 7 – 9 2019

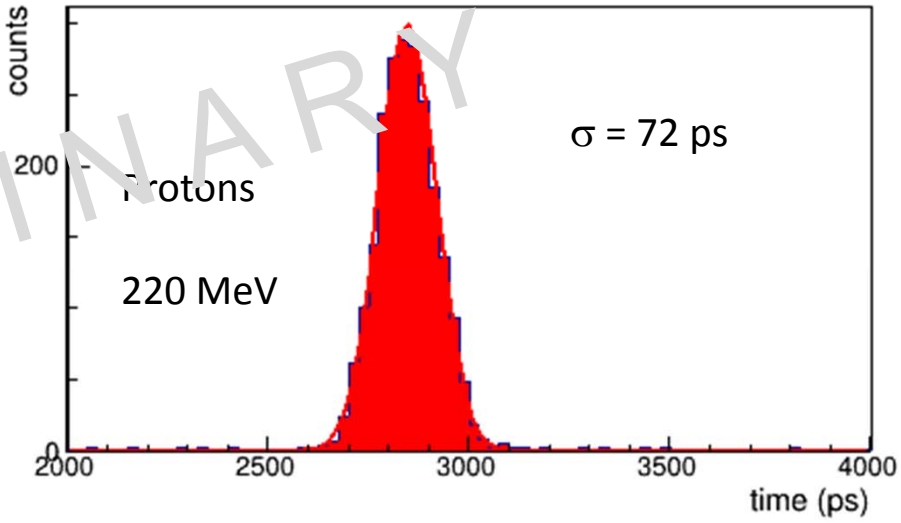
Test at TIFPA – Trento (^{1}H) - FM

June 10 – 15 2019

Time of Flight performances

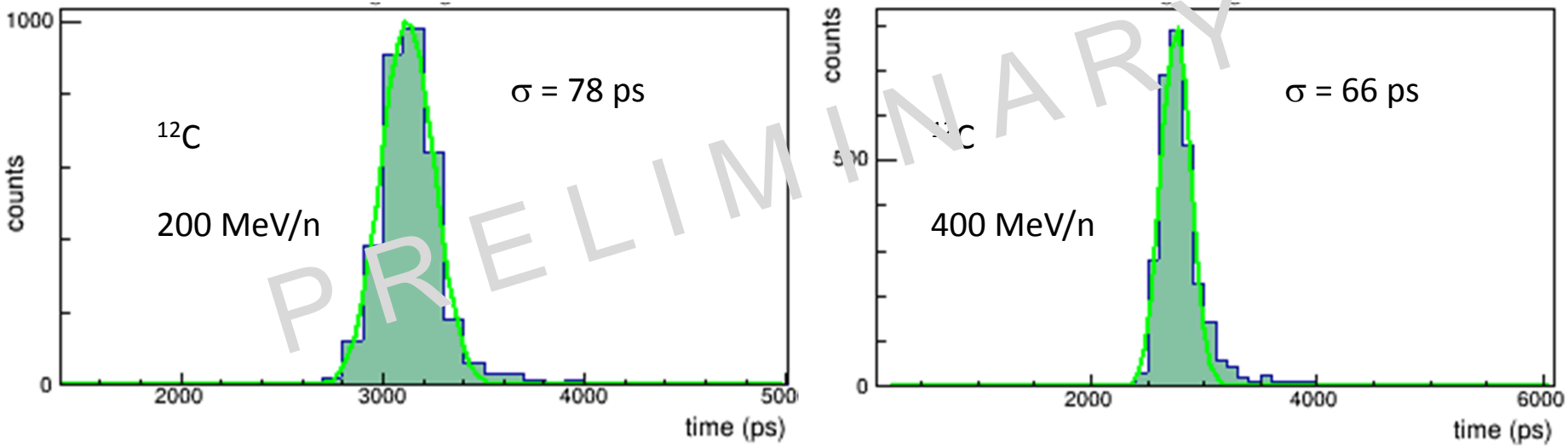
Protons – TIFPA (Trento)



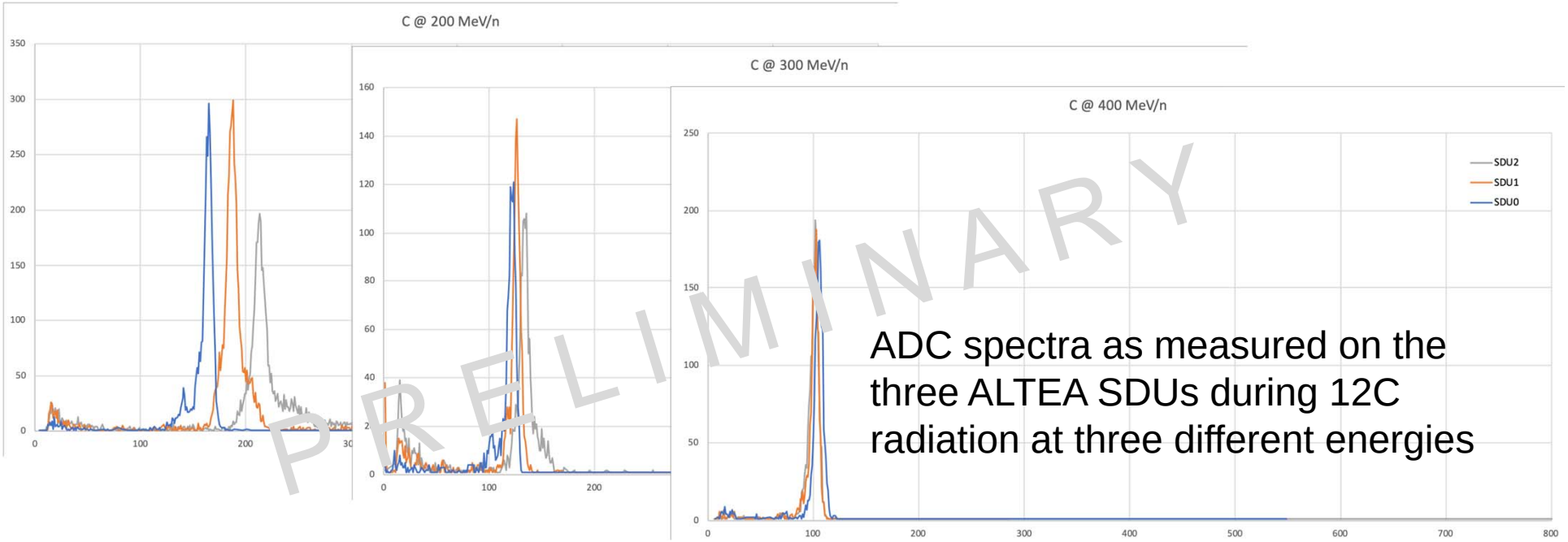


Time of Flight performances

^{12}C – CNAO (Pavia)



ALTEA spectra

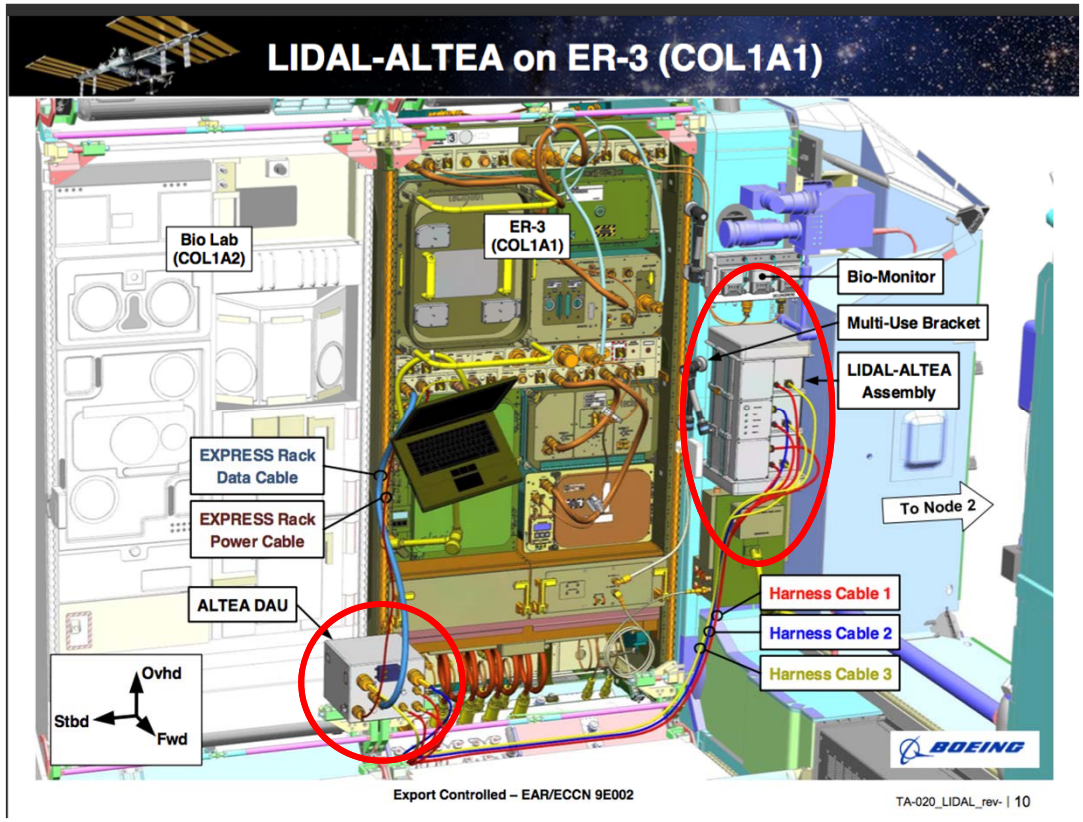


ADC spectra as measured on the three ALTEA SDUs during 12C radiation at three different energies

Delivery/SW tests at MSFC

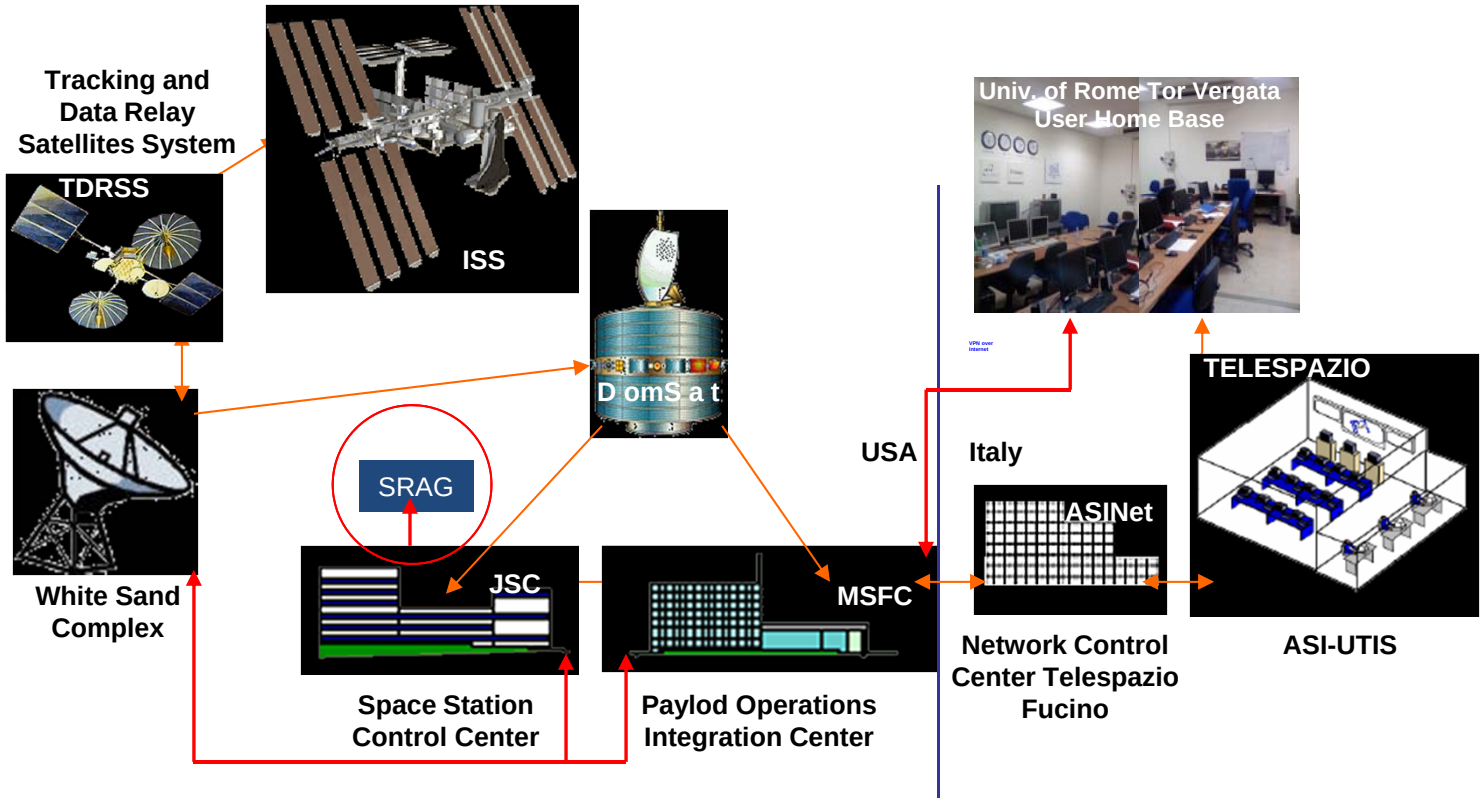
July 8 – 29 – Aug 5 2019

ALTEA first site

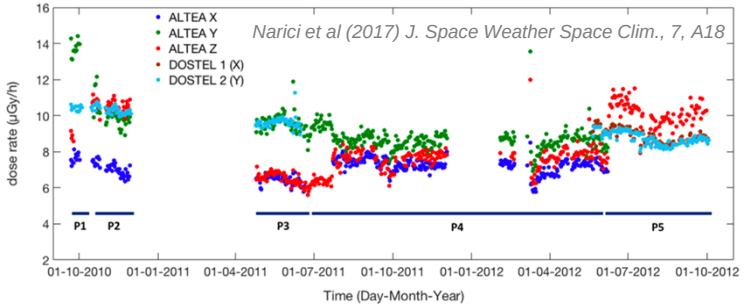


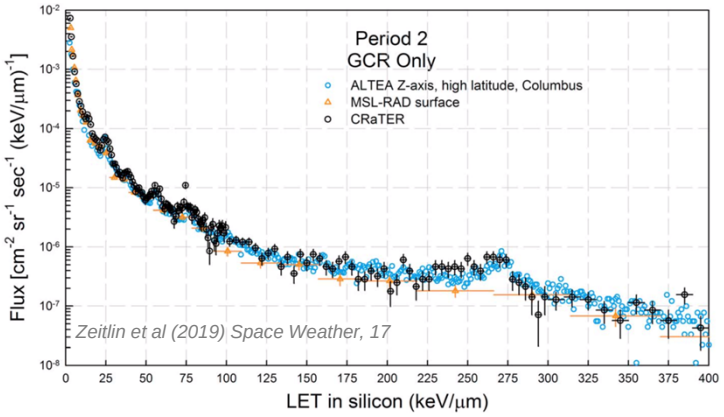
LIDAL-ALTEA data downlink

The foreseen data downlink route



Comparisons





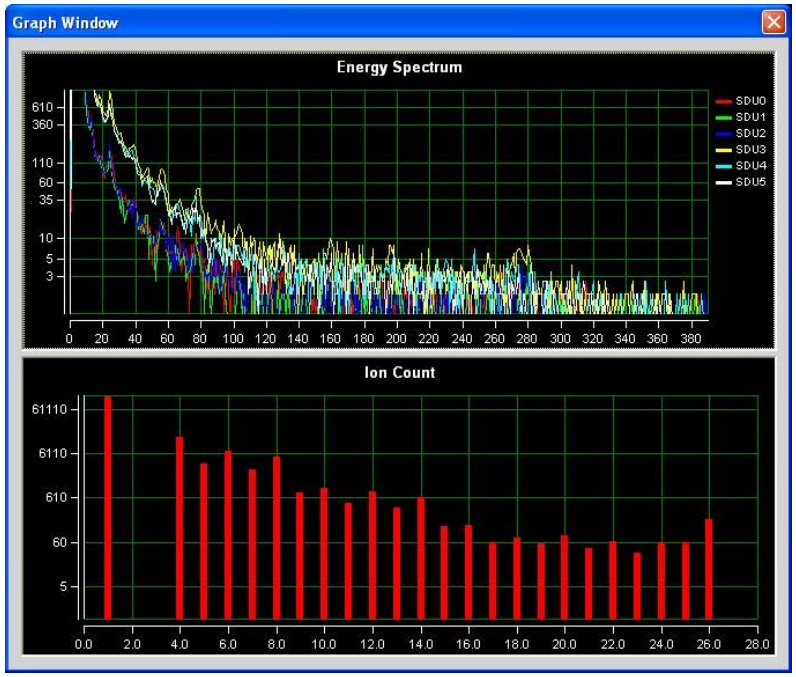
- Need to prepare the comparison campaigns in advance

- Medipix cross calibration: agreement (**still**) in development (!!!)
- DOSTEL/RAD cross calibration?

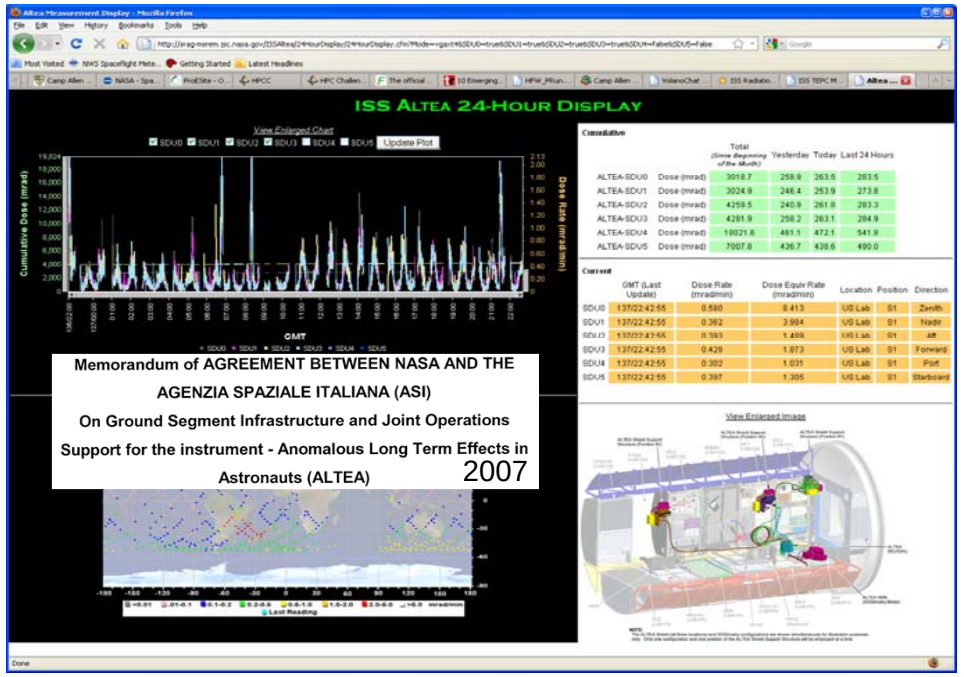
RT data analysis

For ALTEA …

In Rome URTV



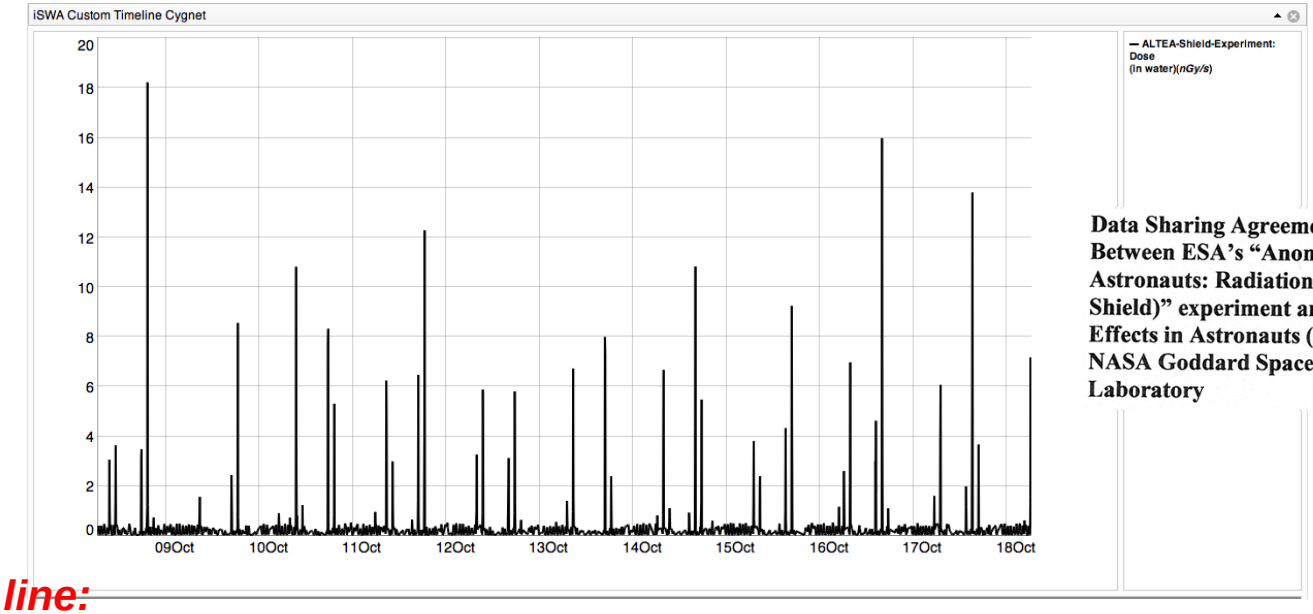
In Houston JSC



…. also for LIDAL!

Storing in public DB

For ALTEA …
In Langley - NASA



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 2011

Still on line:

http://iswa.ccmc.gsfc.nasa.gov:8080/IswaSystemWebApp/index.jsp?i_1=388&l_1=4&t_1=27&w_1=1239&h_1=614&s_1=0

…. also for LIDAL!

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Conclusions

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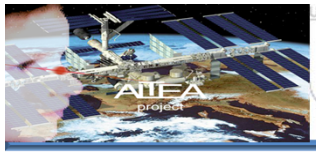
- LIDAL-ALTEA is on schedule and will be launched in October
- The new detector system will individually measure (released energy, trajectory, ToF)
- 18 (48) months of measurements (in 3 directions)
- Agreements for RT analysis, DB storage and cross calibrations still ‘in progress’



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M. Crisconio
F. Ferranti
G. Mascetti
S. Piccirillo
G. Valentini

L. Narici
A. Rizzo
R. Messi
L. Di Fino
C. Morone
C. Berucci
C. De Donato
G. Mascianonio

M. Casolino
P. Picozza

P. Cipollone
M. Iannilli
G. Nobili
D. Pecchi
E. Reali
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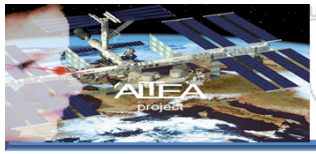
A. Bardi

S. Thompson



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Thank you for your attention

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TIFPA

CNAO