Status and results of the Alteriss project on board of the ISS

MISS – Oxford

M. Casolino

INFN Roma Tor Vergata







Altcriss

Alteino Long Term cosmic ray measurements on board the ISS •In response to AO 2004 ESA (AO2004-067)

•ESA opportunity to start operations in the framewol of th ESA LDM (Long Duration Mission) – 4/5/2005

•Started on increment 12 (Dic 2005-Mar 2006)

•Currently increment 13 (Apr 2006 – Oct 2006)

Next operations for increment 14 (Sept 2006)
Three years of operations

ALTCRISS Collaboration

Dr. Francis Cucinotta, NASA Prof. Marco Durante, University of Napoli Dr. Christer Fuglesang, EAC Dr. Cesare Lobascio, Aleniaspazio Dr. Aiko Nagamatsu (JAXA) Prof. Livio Narici, University of Roma Tor Vergata Prof. Piergiorgio Picozza, University of Roma Tor Vergata Dr. Guenther Reitz (DLR) Dr. E. Semones, NASA Prof. Lembit Sihver, University of Chalmers (SE) Prof. Piero Spillantini, University of Florence Dr. V. Bengin (IBMP)













V. Bidoli¹, M. Casolino¹, M. P. De Pascale¹, M. Minori¹, A., L. Narici¹, P. Picozza¹, E. Reali¹, R. Sparvoli¹, V. Zaconte, A. Galper², A. Popov², S. Avdeev³, M. Boezio⁴, W. Bonvicini⁴, A. Vacchi⁴, G. Zampa⁴, N. Zampa⁴, G. Mazzenga⁵, M. Ricci⁵, P. Spillantini⁶, G. Castellini⁷, P. Carlson⁸, C. Fuglesang⁸, V. Benghin⁹, V. P. Salnitskii⁹, O. I. Shevchenko⁹, V. Shurshakov⁹, V. P. Petrov⁹, K.A.Trukhanov⁹

¹ Dept. of Physics, Univ. of Rome "Tor Vergata" and INFN Sez. Rome2, Italy; ² Moscow State Engineering Physics Institute, Moscow, Russia; ³ Russian Space Corporation "Energia" by name Korolev, Korolev, Moscow region, Russia ⁴ Dept. of Physics of Univ. and Sez. INFN of Trieste, Italy; ⁸ Dept. of Physics of Univ. and Sez. INFN of Perugia, Italy; ⁵ L.N.F. - INFN, Frascati (Rome), Italy; ⁶ Dept. of Physics of Univ. and Sez. INFN of Florence, Italy; ⁷ IROE of CNR, Florence, Italy; ⁸ Royal Institute of Technology, Stockholm, Sweden; ⁹IMBP, Institute of BioMedical Problems,Moscow, Russia

Scientific Objectives

 Measure of cosmic ray abundances and radiation environment on board the ISS (p-Fe >50-100MeV/n)

•Long term monitoring of solar modulation and solar particle events.

•Study of the effectiveness of different shielding materials on board the ISS – in parallel to Montecarlo and Beam Test studies

•Measures with passive dosimeters (JAXA, DLR, Fed II, INFN)

•Joint measures with Matroska, Pamela and Altea, IVCPDS, EVCPDS



Silicon detector Alteino, Pamela, Altea:



Left: AST detector tower open (without readout electronics): it is possible to see the stack of silicon detectors and the top scintillator (the detector is upside down). The bottom scintillator has been removed for clarity. Righ: One of the 8 silicon detector boards (X view). It is possible to see the segmentation of the 32 strips of the detector. (Photos taken during assembly in the clean room facilities of Tor Vergata.)

•8 silicon planes (4x,4y) •32 strips strip pitch 2.5 mm, $8x \ 8 \ cm^2$, thickness 380 µm •Total 256 Independent channels •Triggered by two scintillators $(E_{\min}=40 \text{MeV/n})$ •Geom Fact: 24 cm² sr Bidirectional •Max Field of view 39° • The front-end is a developed version of two 16 channels CR1 chip with a peaking time of 2 µs; a sensitivity of 5 mV/MIP and a maximum counting rate of 30 kHz.

Shielding and radiation measurements with active and passive detectors



Dosimeter arrangement





INCR. 12 PIRS module - PANEL 302

Cards and Control dosimeter ALTEINO detector

ethilene Til

Eschilo tile + dosimeters

PIRS module: PANEL 401 To Progress (nadir)

24/12/2005 Configuration



water and sumption A.C.

Ray Tracing Results

Shielding (pathlength in assigned material) along each of 5000 rays is colorcoded to the total amount of shielding [g cm⁻²]; thinnest shielding is white, thickest is blue.



M. Shavers et al, ASR 34 (2004) 1333



Starboard Cabin

CONFIGURAZIONE ISS AD APRILE 2002



Acquisition rate vs time, min (raw data, zoom)



All-Particle count world map 350 250 300 10^{-1}_{-50} 40 30 20 10 0 -10 -20 -30 -40 -50 0 200 -----150 100 50

Heavy nuclei world (Z>6) world map





Flux Comparison: Crew Cabins – Pirs Module (normalized by time)



Pirs- Service Module rel. abundance



Comparison with/without shielding



Heavy Nuclear Charge (Pirs module)



Heavy Nuclear Charge (Pirs – Service module)



Relative abundances comp. *(preliminary)*



Relative abundances comparison (2)



Fragmentation

•Alteino has multiple track identification capabilities

•It is therefore possible to identify showers in the detector





Fragmentation: relative flux



Fragmentation: normalize to straight tracks

Fragmentation: shielding effect

Number of Hits

Altea: Launched on 4/7/2006

•Operations start on August 2006 (With huge help by NASA) *Currently running in dose mode acquisition*

Real time data Downlink through Nasa to Tor Vergata (ops Center used for Lazio)
Real time link during Astronaut session
2 Gbyte/day

Altea

•Big Alteino: 6 boxes of 6 double silicon layers

Acquisition rate vs time

Asymmetry of trapped protons in boxes

ev n

Asymmetry of trapped protons in boxes

450Kg payload 20cm²sr **Time** of Flight

Magnetic Spectromete Microstrip detector

Silicon Tungsten Tracking calorimeter

Shower Catcher Scintillator Neutron Detector

Pamela World Maps: 350 – 650 km alt

neutron Counts

Nuclear abundances 2002

