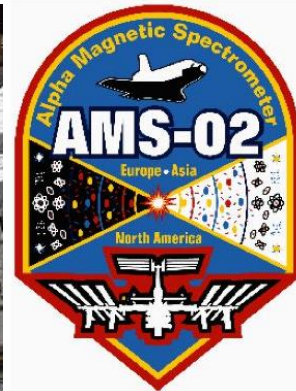


# *AMS Status*

*Luísa Arruda, Fernando Barão, Luis Batalha,  
Pedro Nunes, Rui Pereira, Bruno Santos  
(LIP - Lisboa)*

# *The AMS experiment*

- Broad international collaboration for the detection of primary cosmic rays in space: around 600 scientists, 56 institutes from 16 countries
- LIP group:
  - Team leader: Fernando Barão
  - 2 Post-Docs: Luísa Arruda, Rui Perreira
  - 3 Master Students: Luís Batalha, Pedro Nunes, Bruno Santos



The AMS-02 detector on the International Space Station

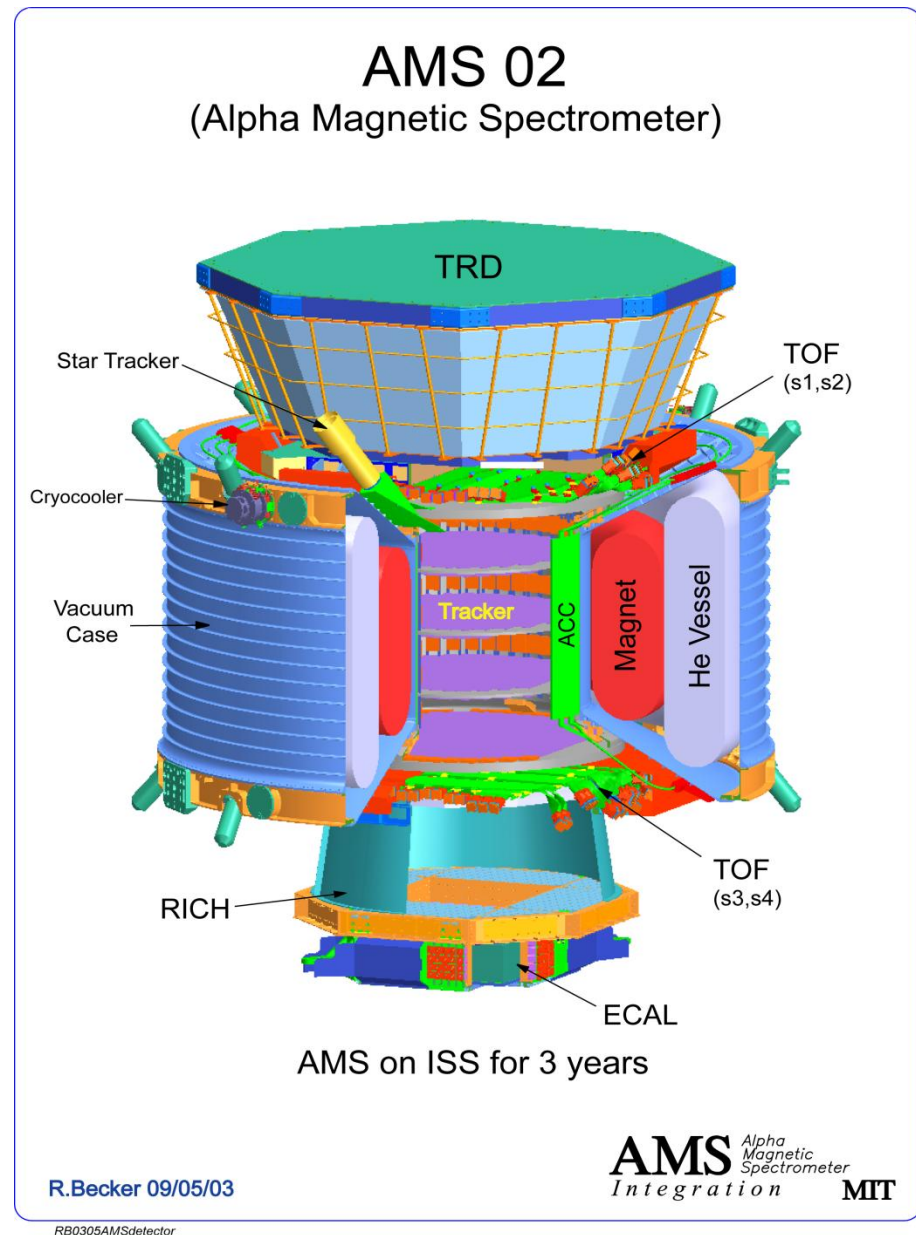
# *The AMS experiment*

- Data taking: ~10 years on the International Space Station
- Final detector AMS-02 installed on ISS on 19 May 2011
- Main goals:
  - *Detailed study of cosmic ray spectra*
    - AMS will provide an unprecedented statistics of charged cosmic ray measurements between ~100 MeV and ~1 TeV
    - Charge identification up to iron ( $Z=26$ )
    - Precise velocity measurement allows isotope separation in the GeV region
  - *Search for dark matter*
  - *Search for antinuclei*
- LIP group works mainly on RICH detector & data analysis
  - Beta and electric charge measurement
  - Solar modulation effects on AMS data
  - Deuteron fluxes measurement



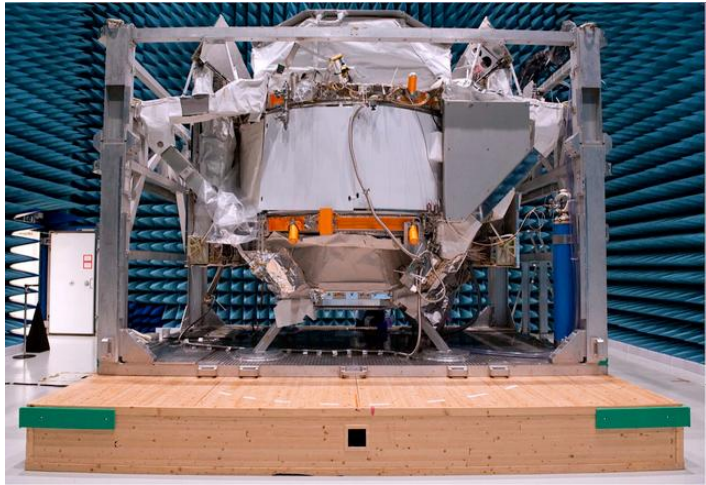
# AMS-02 detector

- Has the following subdetectors:
  - ◆ *Transition Radiation Detector*
  - ◆ *Time-of-Flight detector*
  - ◆ *Silicon Tracker*
  - ◆ *Ring Imaging Čerenkov detector*
  - ◆ *Electromagnetic Calorimeter*
  - ◆ *Anti-Coincidence Counter*
- Detector capabilities:
  - ◆ *Particle bending*
    - ★ permanent magnet (0.15 T)
  - ◆ *Measurements of particle:*
    - ★ **Rigidity** =  $p/Z$  (Tracker)
    - ★ **Direction** (ToF, Tracker, RICH)
    - ★ **Velocity** (RICH, ToF, TRD)
    - ★ **Charge** (RICH, Tracker, ToF)
  - ◆ *Trigger*
    - ★ ToF, ECAL, ACC
- Total statistics:  $>10^{11}$  events
- Acceptance:  $\sim 0.5 \text{ m}^2\text{sr}$



# *AMS-02 assembly and testing*

- AMS-02 assembled at CERN between 2008 and 2010
  - Subdetectors previously assembled at different locations
  - ◆ Testing of fully assembled detector performed at CERN & ESTEC



Detector testing, ESTEC, April 2010



Arrival at Kennedy Space Center, 26-Aug-2010



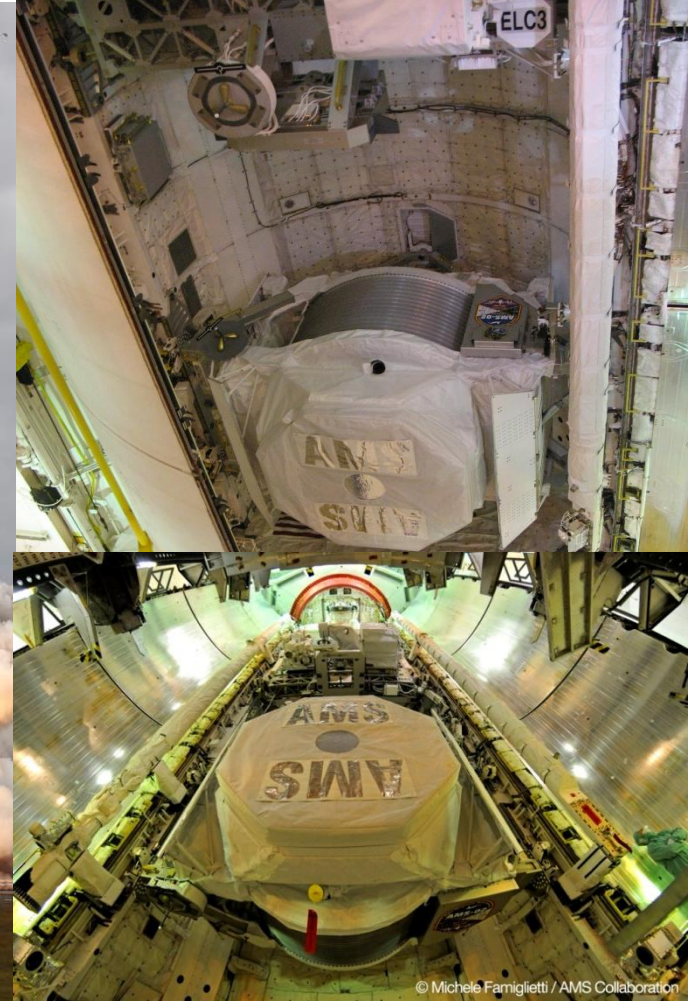
Detector boarding aircraft in Geneva, 26-Aug-2010



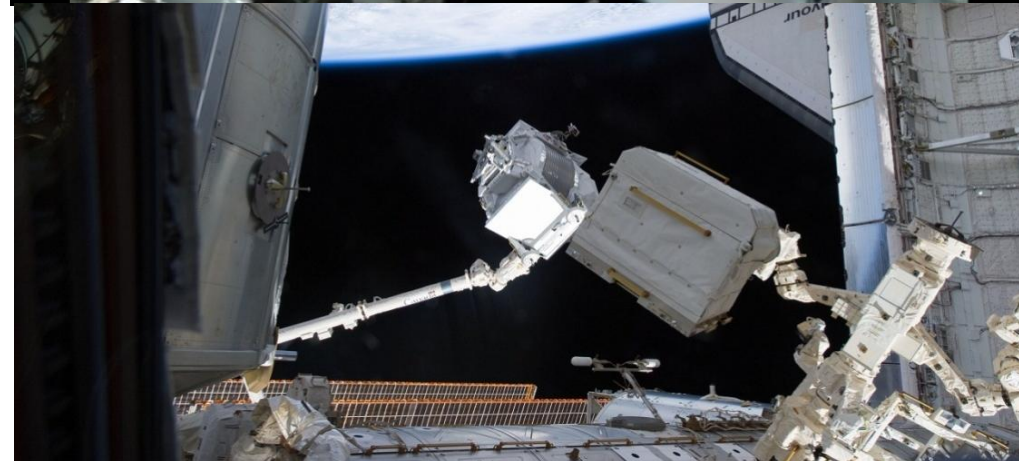
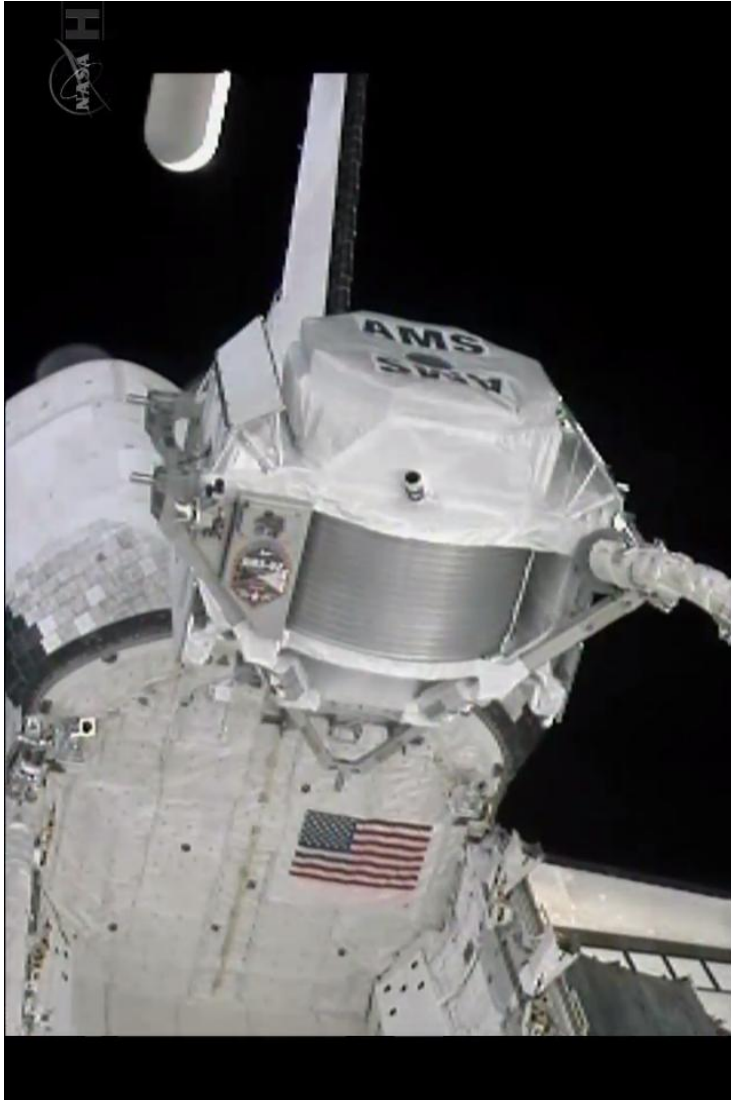
AMS-02 at KSC, September 2010



# *STS-134 liftoff: 16 May 2011*

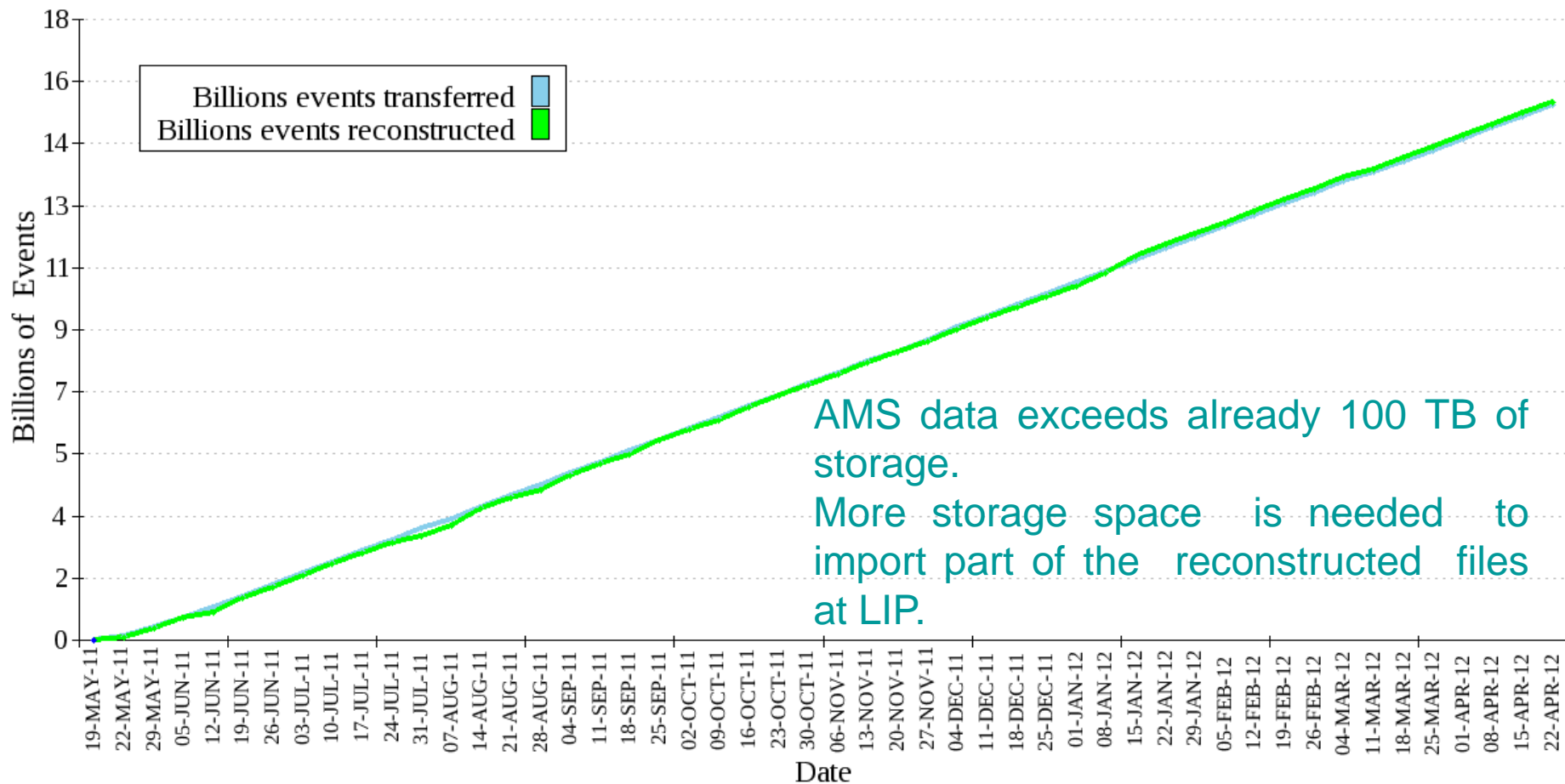


# *ISS installation: 19 May 2011*



# AMS-02 on the ISS

- Detector taking data continuously since installation (19 May)
- $> 4 \times 10^7$  events being collected per day (rate  $\sim 500$  Hz)
- $\sim > 15 \times 10^9$  events collected up to this moment



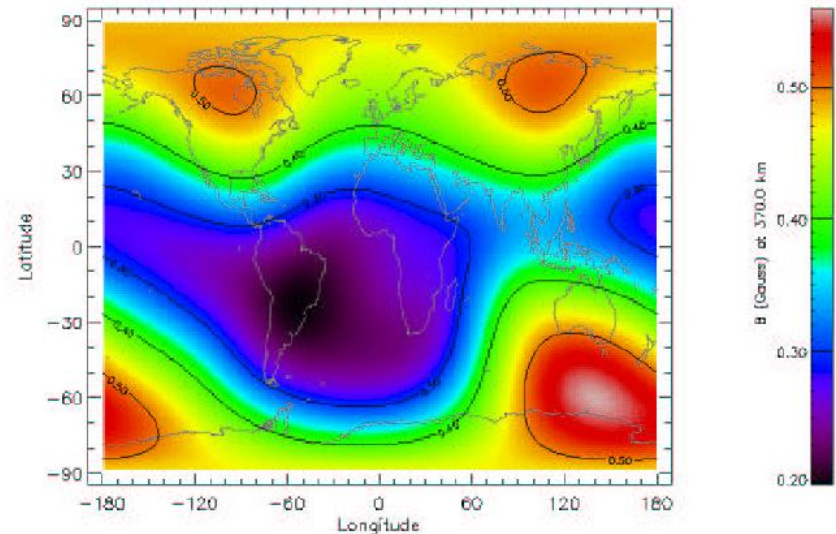
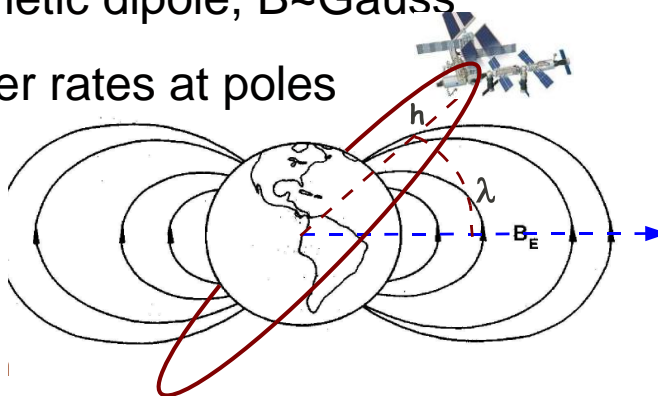


# AMS02: collecting data...

- Space Station makes a full orbit around the Earth every 90 minutes
- The status of AMS is **continuously** (24h/24h) monitored and actions/commands taken from a Payload Control Center installed at CERN (Geneva) . LIP team has been taking part of this effort and will keep on contributing.
- The cosmic rays detected by AMS are affected by the Earth magnetic field

- magnetic dipole,  $B \sim \text{Gauss}$

- Higher rates at poles

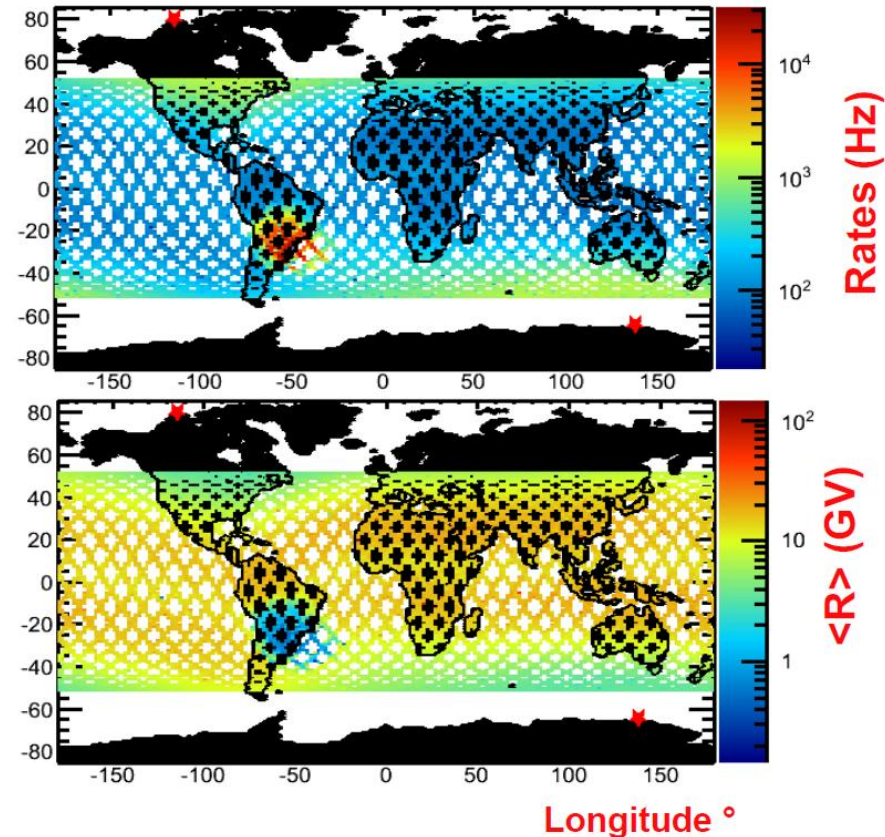
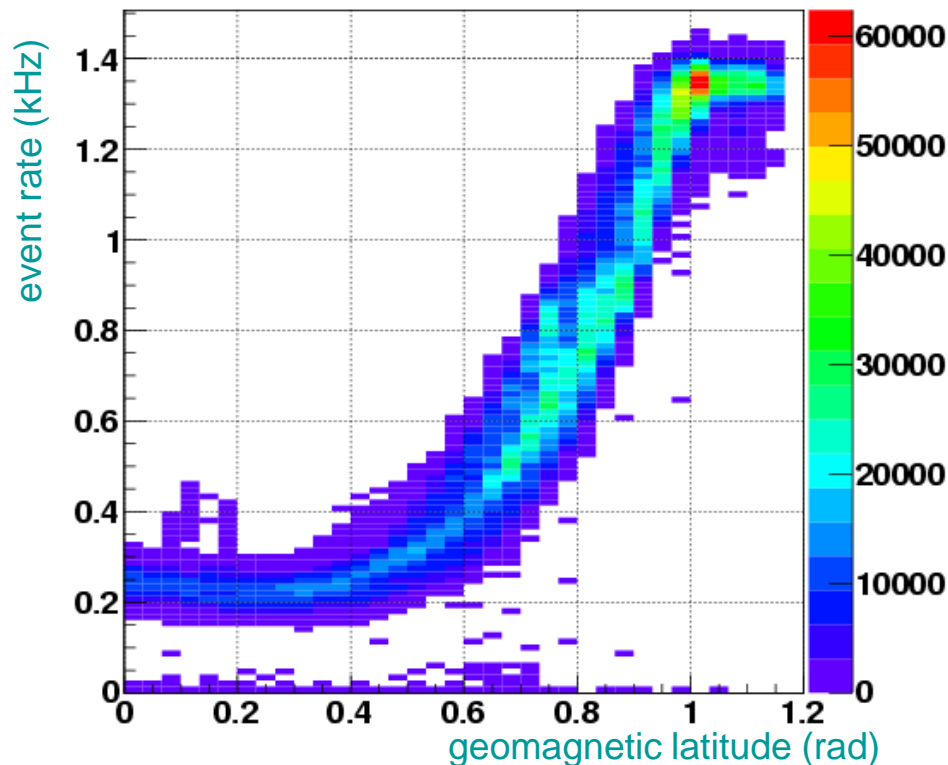


(Altitude = 370 km)

# AMS-02 on the ISS

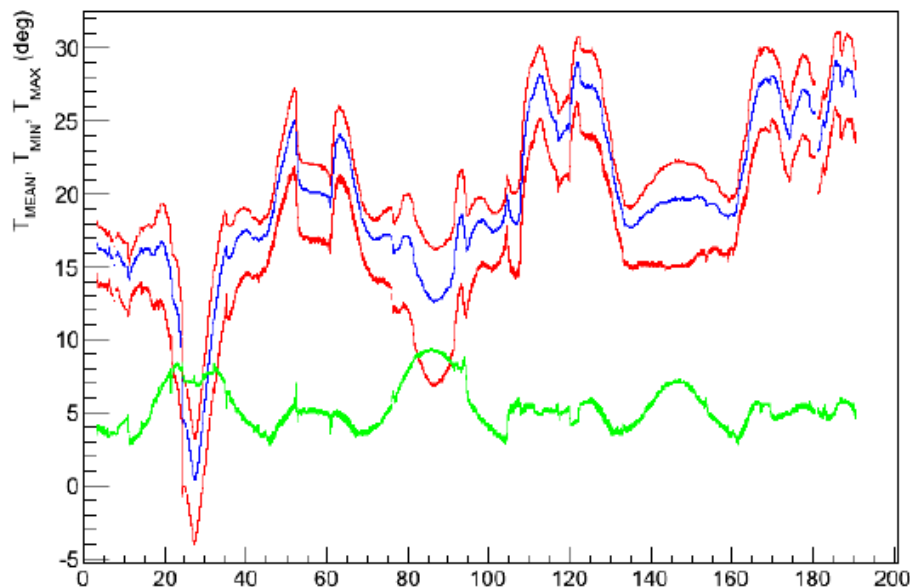
- Particle flux is not uniform during AMS/ISS orbit
- Higher event rates at high latitudes where rigidity cutoff is lower

Gen: Y= AcqRate vs geomag lat

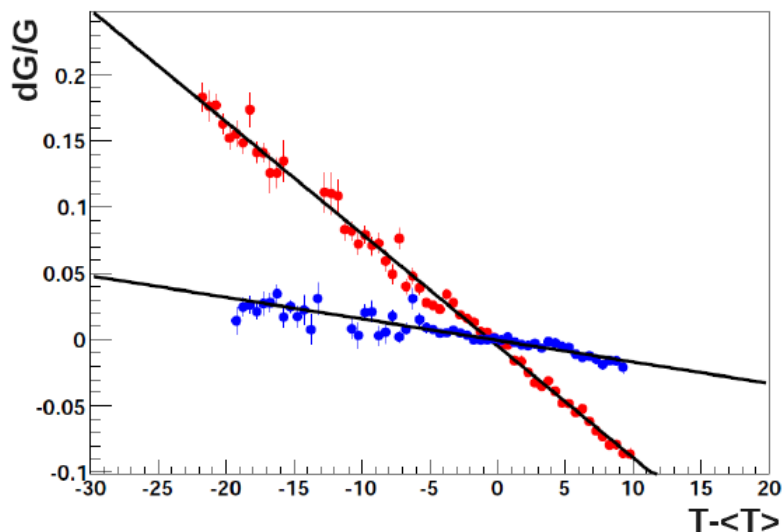


# Detector monitoring: RICH control

RICH PMT Plane Temperature vs time



6 months (22.May - 26.Nov)



- $T_{MAX}$
  - $\langle T \rangle$
  - $T_{MIN}$
  - $T_{MAX} - T_{MIN}$
- Temperature control:** Significant temperature variations may occur on a scale of days or weeks (maximum slope is  $\sim 1^\circ\text{C} / \text{day}$ )
- $T_{min} > -5^\circ\text{C}; T_{max} < 32^\circ\text{C} \Delta T < 10^\circ\text{C}$
  - ◆ Related to ISS orientation

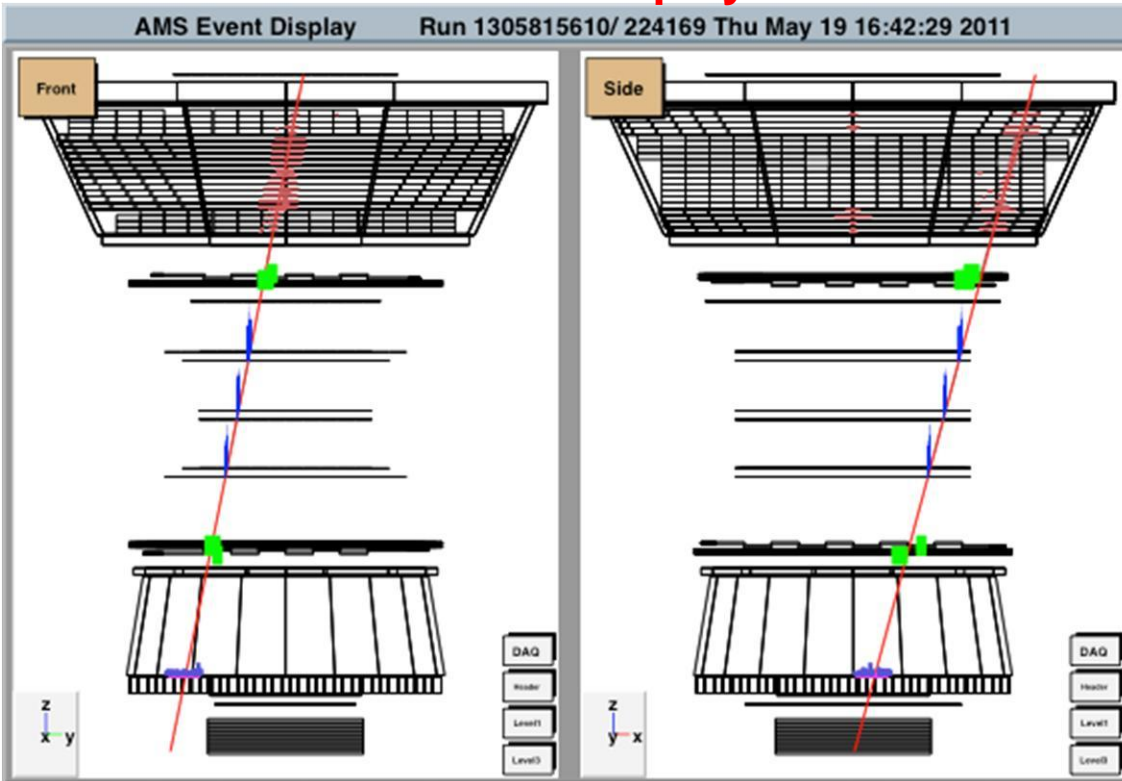
- PMT gain variations show linear dependence with PMT temperature



# Reconstructed events

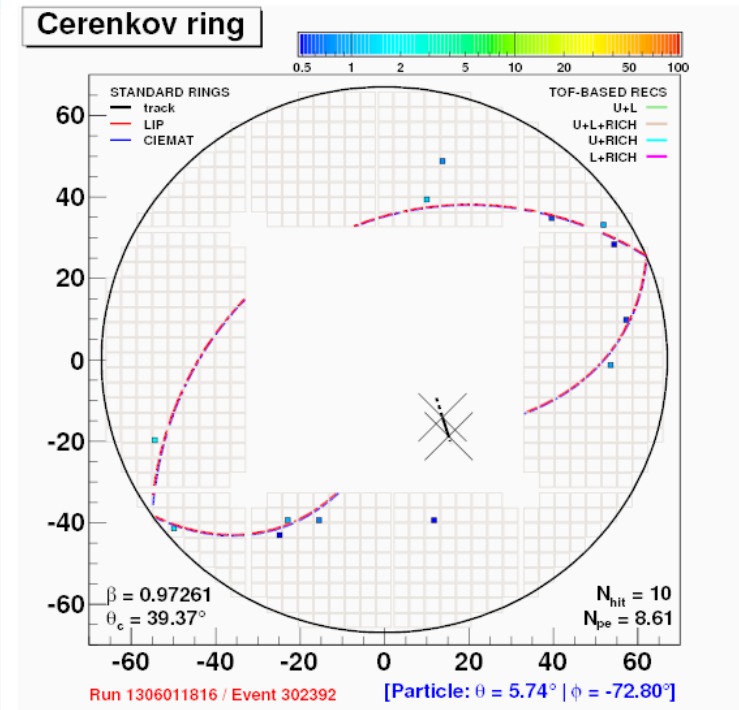
- Examples of reconstructed events:

## AMS event display



Carbon 42GeV/nuc

## RICH event display (LIP)



Helium event in NaF

# *Summary of LIP work*

- Commissioning of the AMS detector in particular RICH detector
- Control of the quality of velocity and charge reconstruction:
  - ◆ Monitoring and improvement of the LIP algorithms
- Physics:
  - ◆ Solar modulation and flux studies
  - ◆ Light isotopic separation
  - ◆ Nuclei identification (charge selection)
- Data taking and detector control at POCC (CERN)

# Conclusions

- After more than a decade of detector development and testing, AMS-02 has been installed on the ISS on 19 May 2011
- First data indicate the detector is working as expected
- Data acquisition expected to continue for ~10 years, total statistics will be much larger than any previous cosmic-ray experiment
- Stay tuned for results from AMS!

