In-flight operations and status of the AMS-02 silicon tracker

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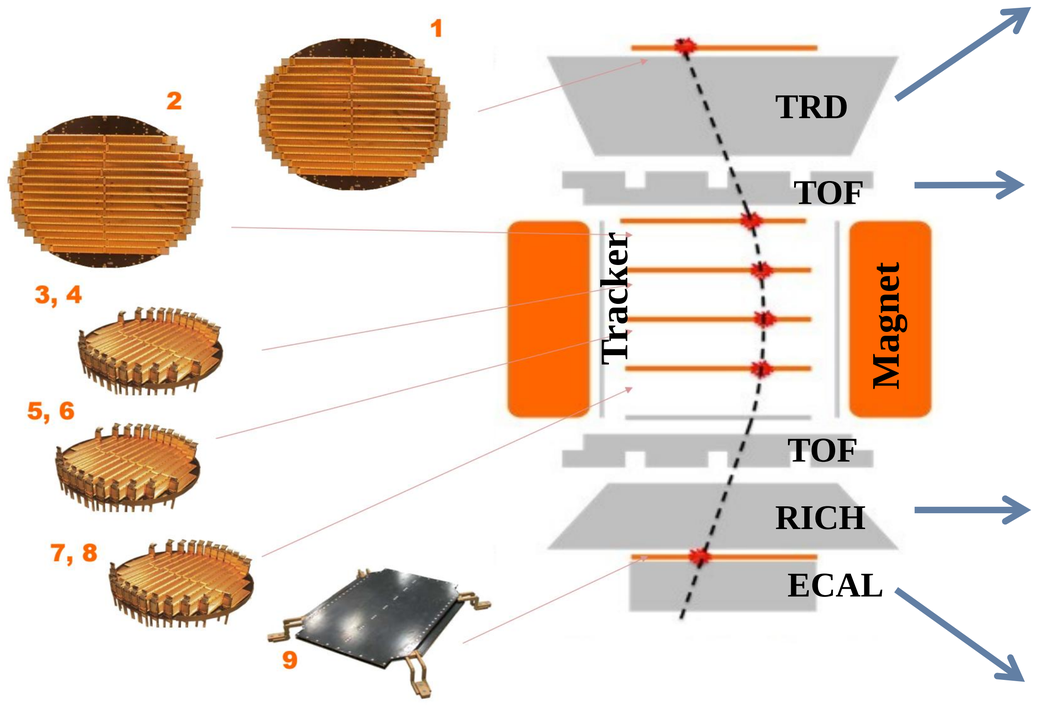
The Alpha Magnetic Spectrometer (AMS-02)

- On board of ISS since May 19th 2011
- Measures composition and energy spectra of charged cosmic rays up to **TeV**
- Has collected **>60 billion** events
- ~1% uncertainty

The Silicon Tracker

- 9 layers of double-sided silicon microstrip sensors
- Inner Tracker inside the magnet volume (an almost uniform magnetic field of 0.14 Telsa)
- Spatial resolution in bending direction: **~10 μm**
- Measurement of rigidity ($R=pc/Ze$) (MDR **~2 TV** for Z=1 particles)
- Charge discrimination of nuclei
- Measurement of the sign of charge



Transition Radiation Detector

- Identifies positrons, electrons by transition radiation and nuclei by dE/dx
- **e/p rejection > 1/10²**

Time of Flight

- Main trigger
- Measurement of velocity (Δt~180ps) and charge of particles

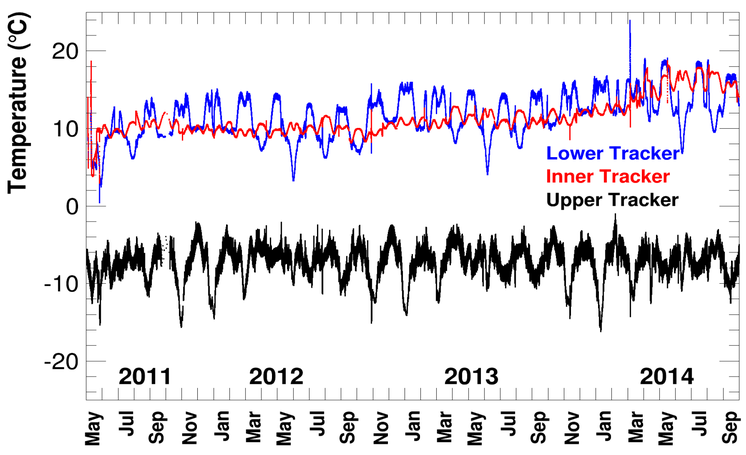
Ring Imaging Cherenkov

- Measurement of charge
- Measurement of velocity with 0.1% resolution

Electromagnetic CALorimeter

- Accurate energy measurement of $e^{\pm}$ and γ
- **e/p rejection > 1/10⁴**

Tracker Temperature



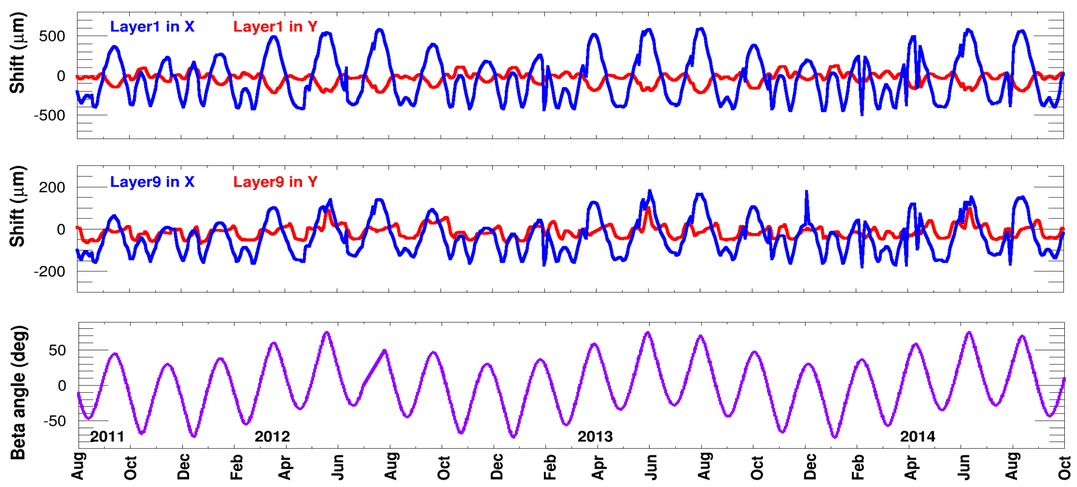
Thermal environment variables:

- **Solar beta angle**, defined as the angle between the ISS Orbital Plane and the Solar Vector, following a **~2 month** cycle calculated from ISS's nodal precession
- **Positions of ISS radiators and solar arrays**
- **ISS attitude**

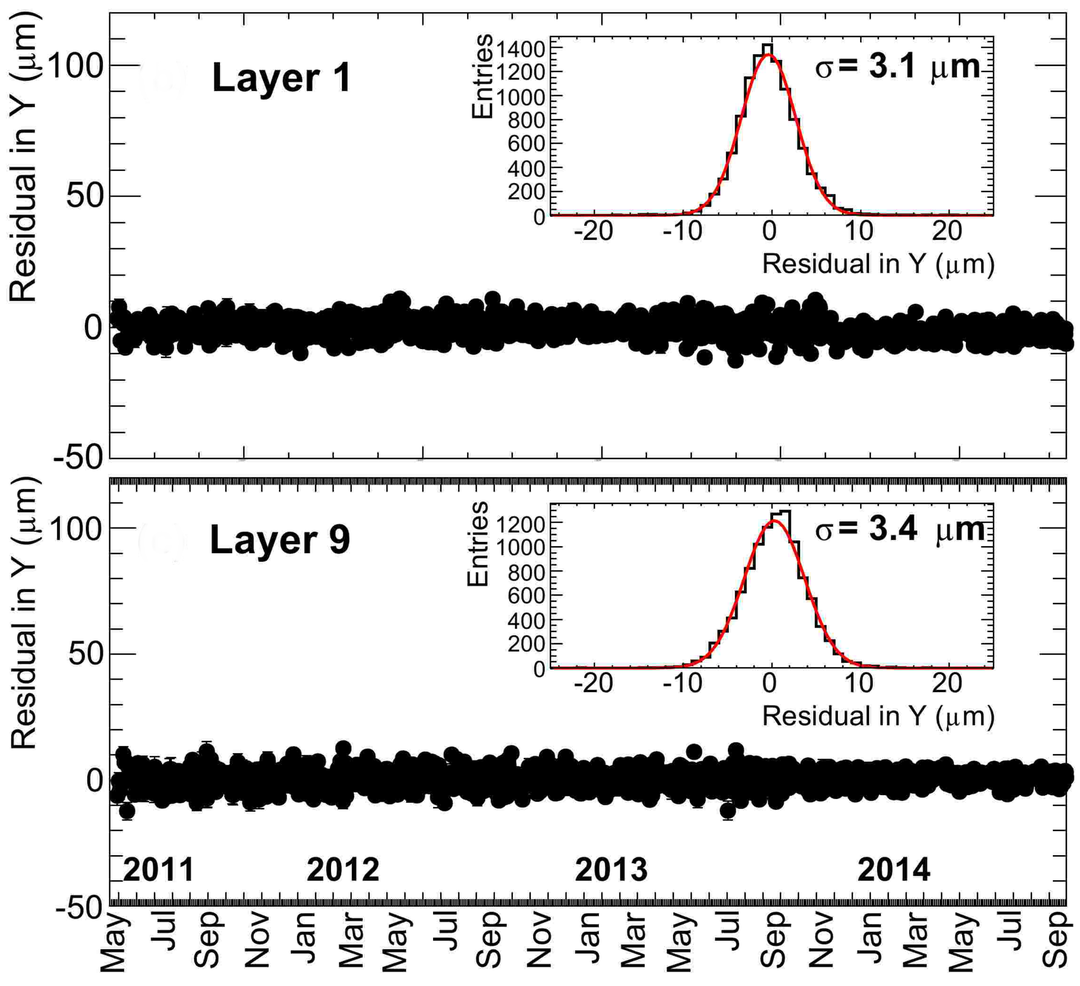
- Inner Tracker temperature within ~1 ℃ fluctuation of its nominal operational temperature
- The accurate control of Inner Tracker temperature guarantees the Tracker stability in terms of tracking efficiency and position measurement performance.

Outer Plane Displacement

Due to the temperature variation, shifts of outer planes up to few hundreds microns were observed. The time dependence of beta angle is shown as reference.



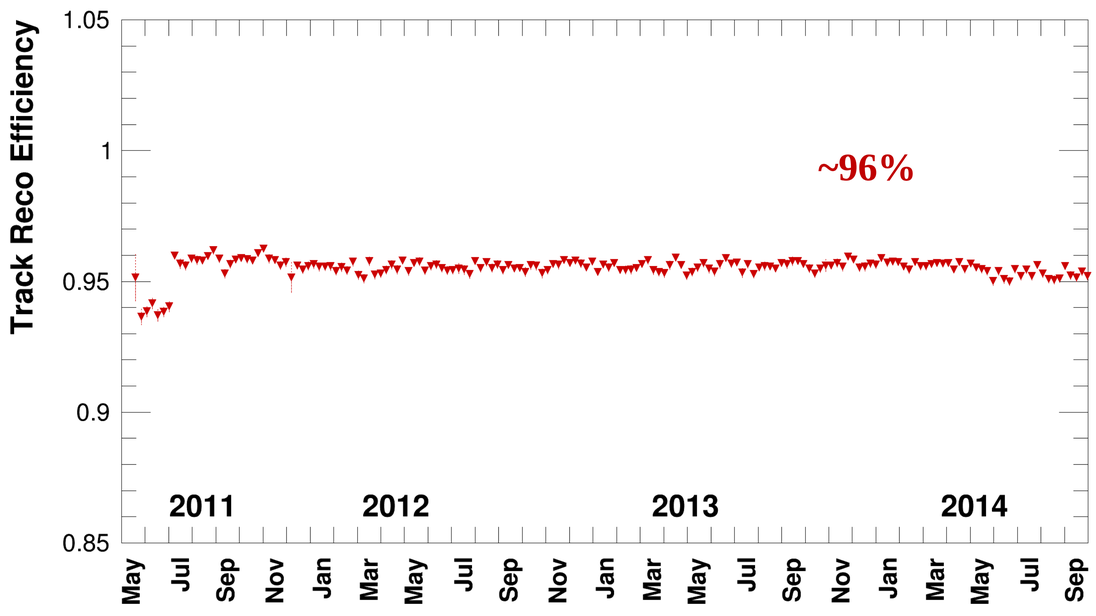
Outer Plane Stability After Alignment



To correct for the temperature dependence, the Outer Tracker is continuously aligned with cosmic rays. Track fit residuals on the bending side are stable to 3 μm level, well below the spatial resolution of the sensors.

Track Reconstruction

The track reconstruction efficiency is the efficiency that a particle passing through the detector acceptance has a track reconstructed and associated to the particle itself. As shown below, the efficiency is high and almost flat.



Evaluated using protons, selected by other AMS sub-detectors

Conclusion

- The Tracker shows high stability of temperatures and noise.
- The overall performance of the Tracker considering tracking efficiency and rigidity measurement is good and stable with time.
- No significant degradation of the Tracker performances has been observed. This allows AMS-02 detector to continue its measurements plan efficiently.

Acknowledgements

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