The AMS-02 Anticoincidence Counter

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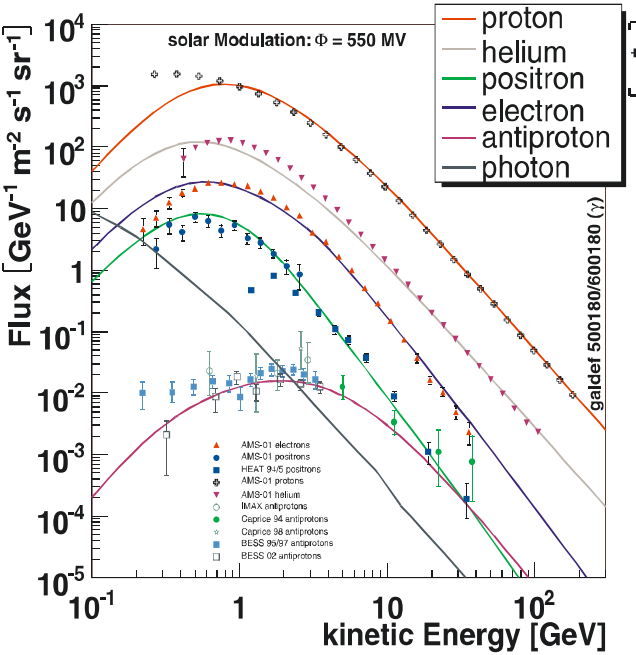
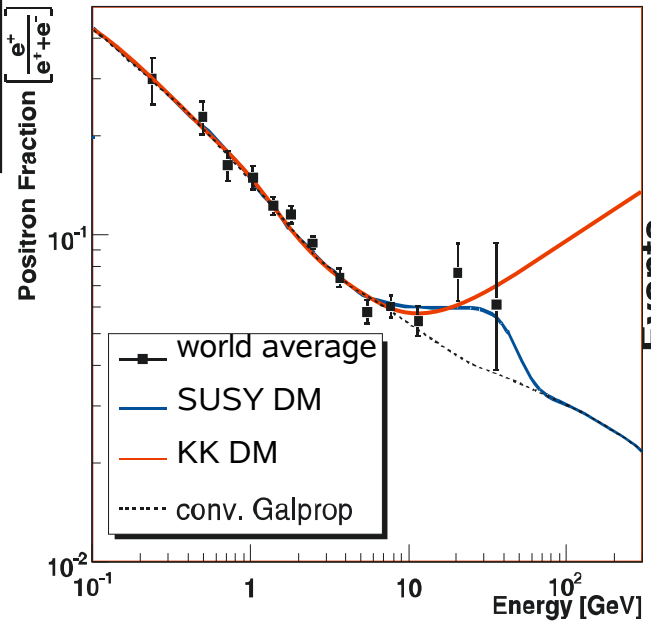
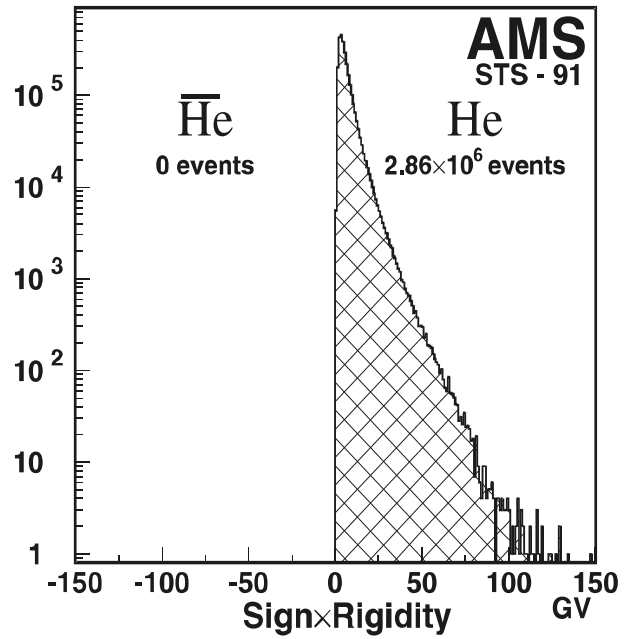
Cosmic Rays in the GeV Range

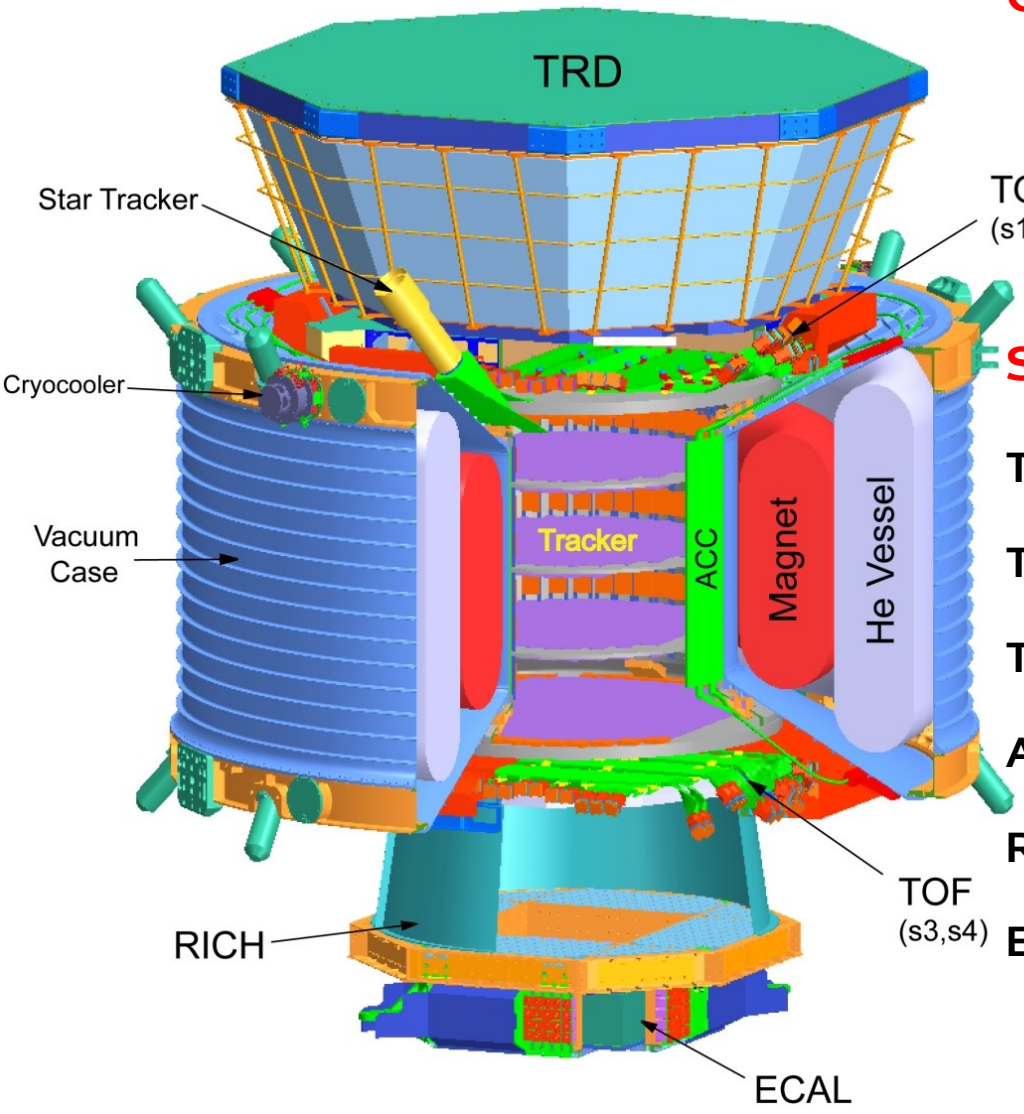






- good agreement of data and propagation models, but some unexplained features in the antiparticle/photon fluxes
- some theories exist to explain a possible excess
- so far no antimatter was found in cosmic rays. Needs a very good determination between Helium and Antihelium ➡ **Anticounter**

AMS02 Overview



Goals of AMS02:

- precise spectroscopy of cosmic rays without interactions in the atmosphere on the ISS
- measurement/bounds on antimatter
- indirect dark matter search

Subdetectors:

Transition Radiation Detector (TRD)
- classify particles by γ=E/m

Time of Flight (ToF)
- trigger, velocity, dE/dx

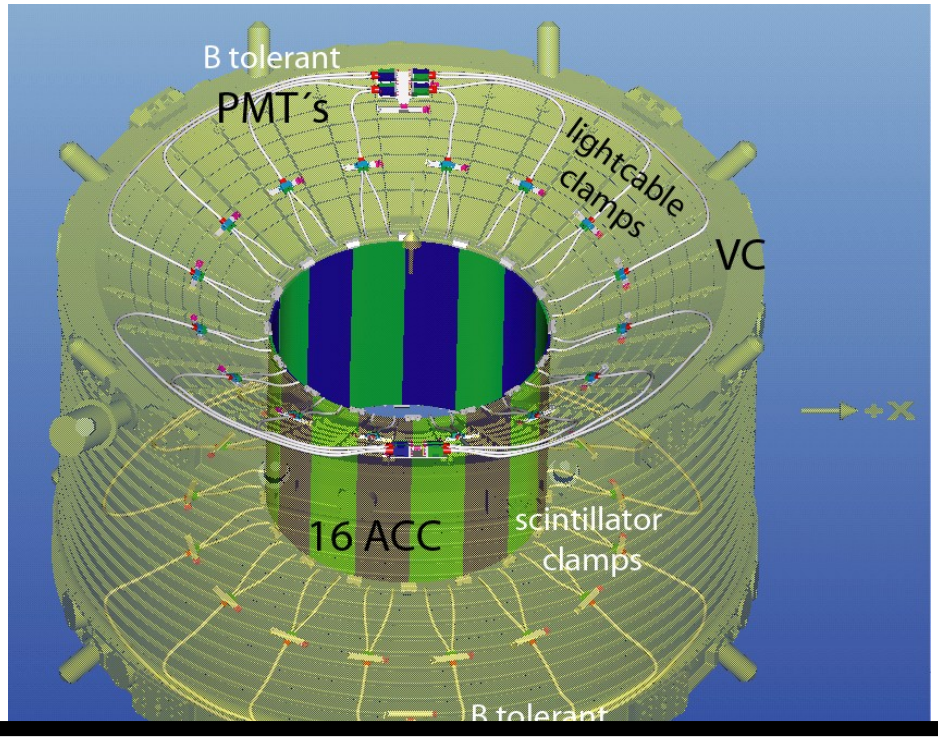
Tracker
- track reconstruction, momentum, dE/dx

Anti-Coincidence Counter (ACC)
- event selection ⟶ next slide

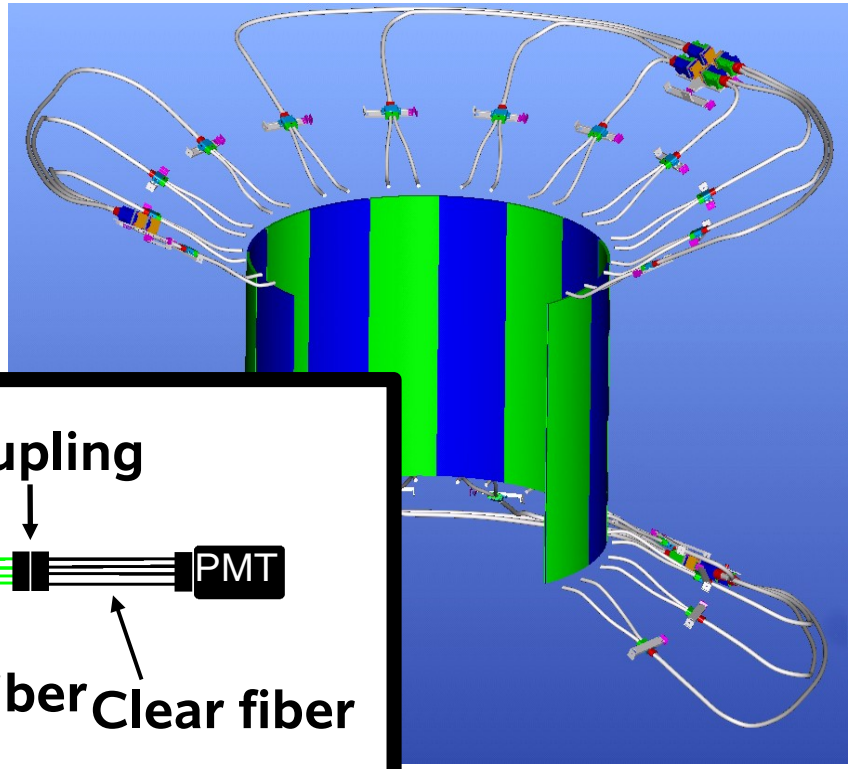
Ring Image Cherenkov Detector (RICH)
- precise velocity mesaurement

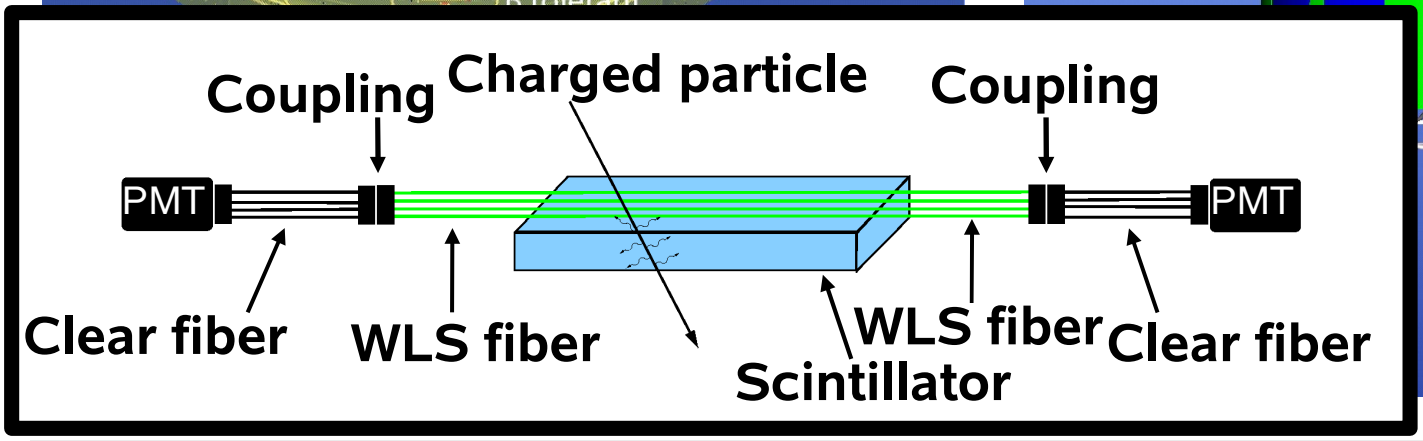
Electromagnetic Calorimeter (ECal)
- shower shape and energy determination

ACC System



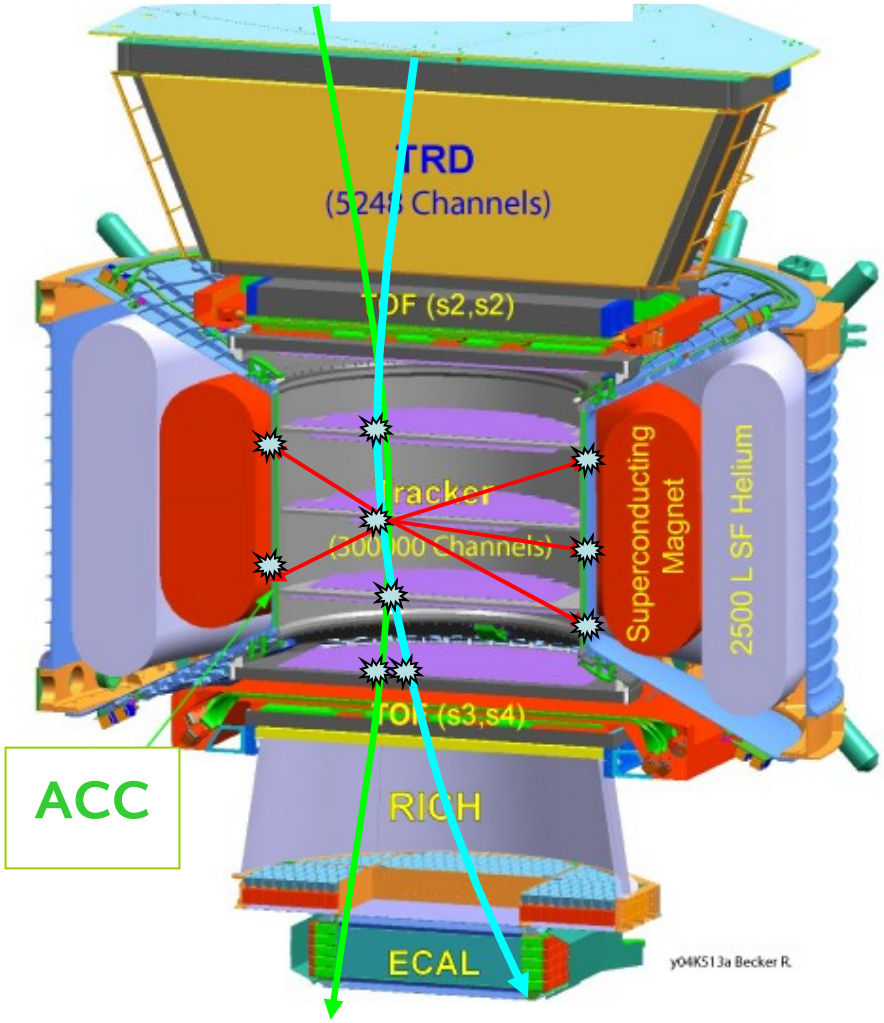
- small ACC inefficiency needed ($<10^{-4}$) for measurement of antimatter with very clean single tracks
- reduce trigger rate e.g. south atlantic anomaly



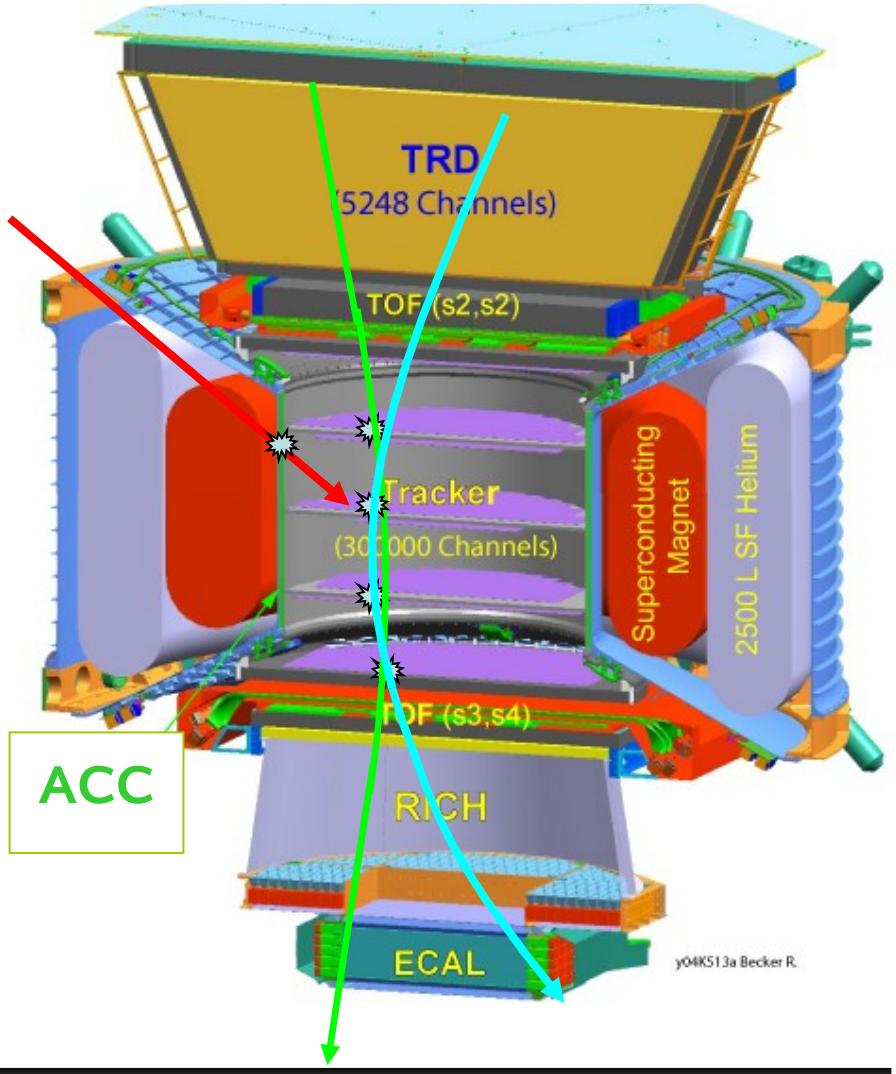


Important Events for the ACC

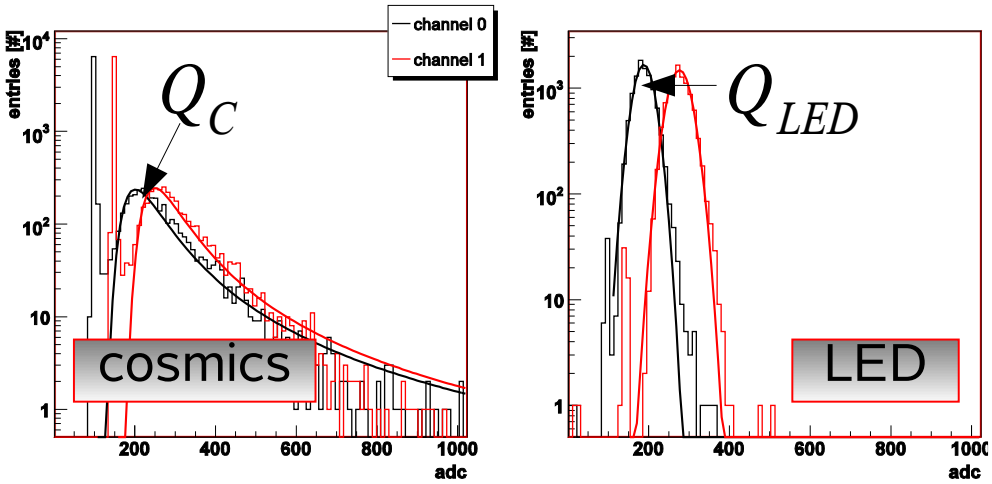
Rejection of internal events

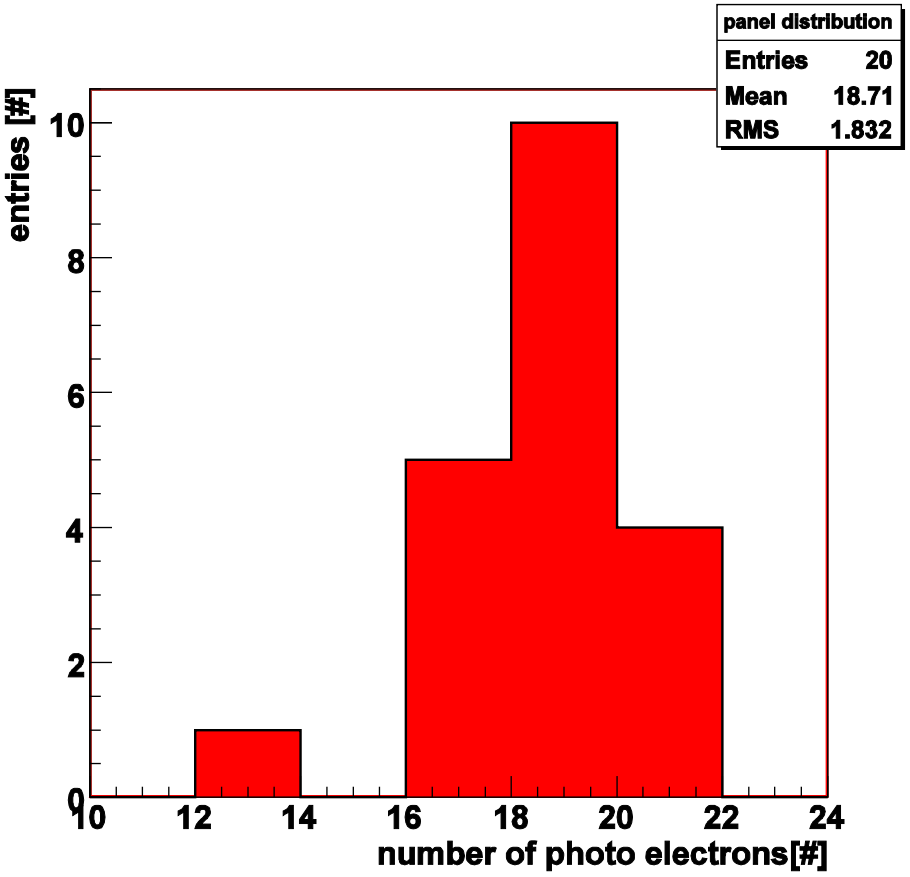


Rejection of external events



Calculation of Photo Electron Number



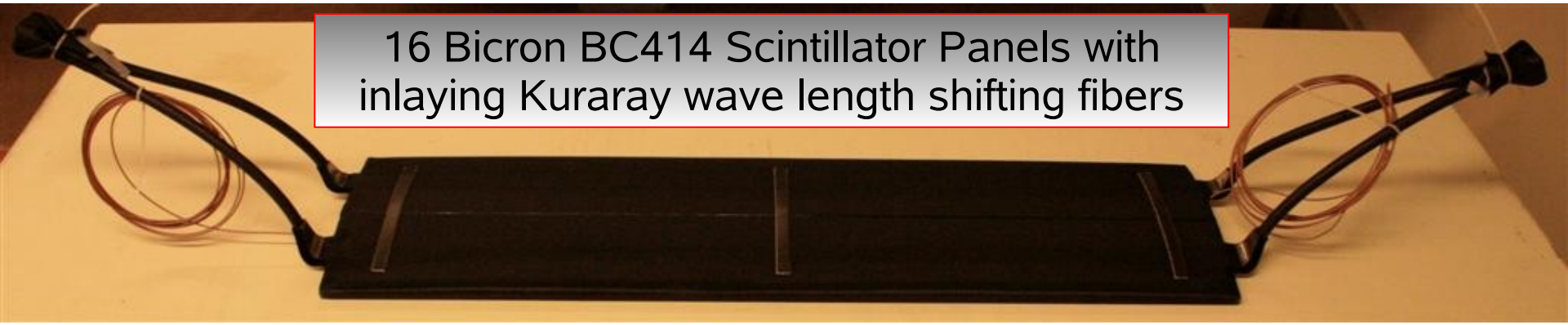


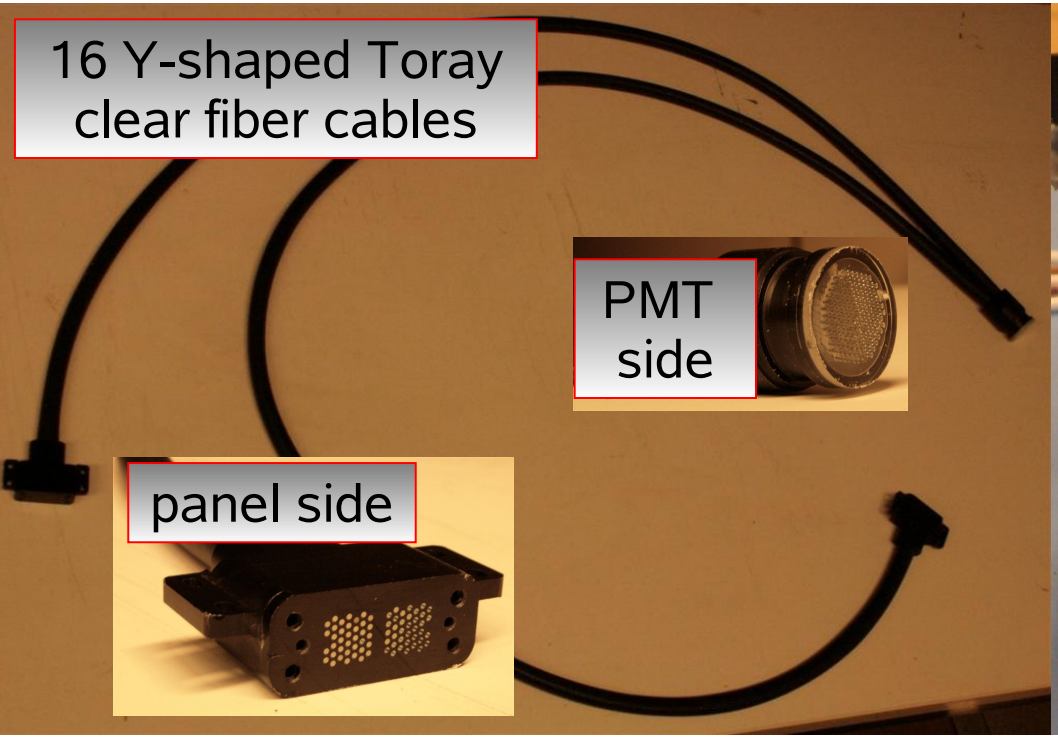
- measurement of MOP with cosmics
- calibration with LEDs implemented in panels
- AMS-01 average 20 p.e. with 20% more material

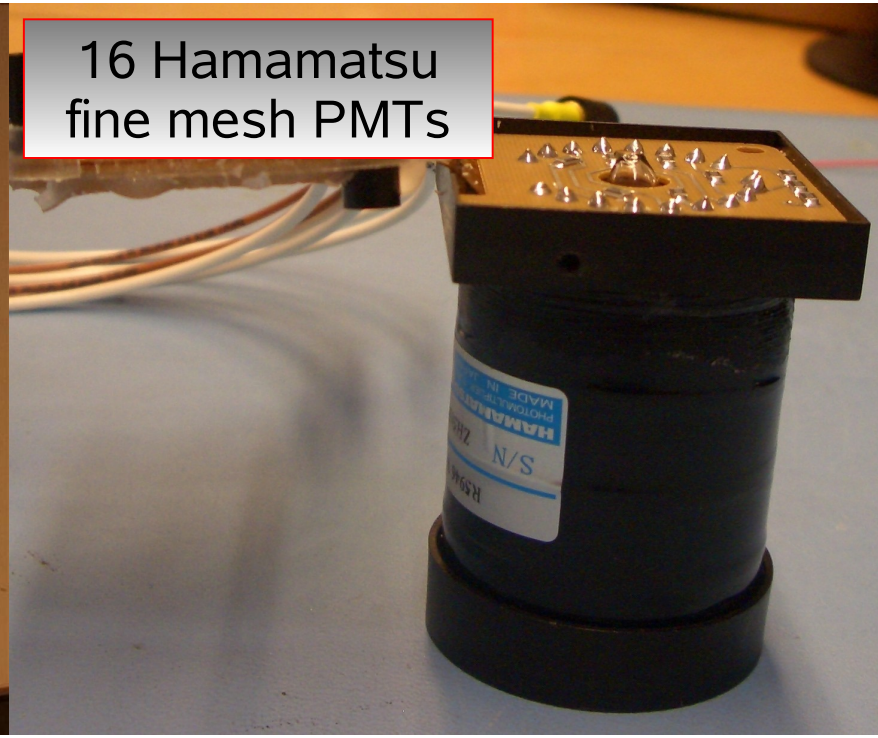
calculation of photo electron number

$$N_{pe} = \frac{Q_C Q_{LED}}{\sigma^2_{LED}}$$

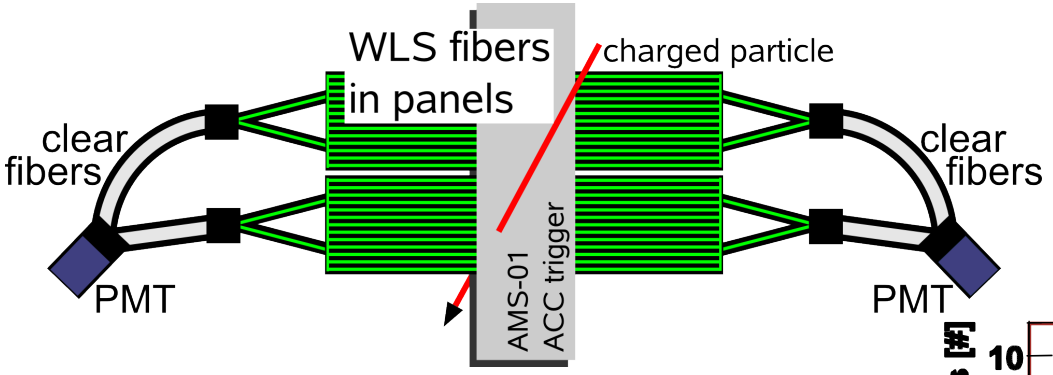
ACC Hardware Parts



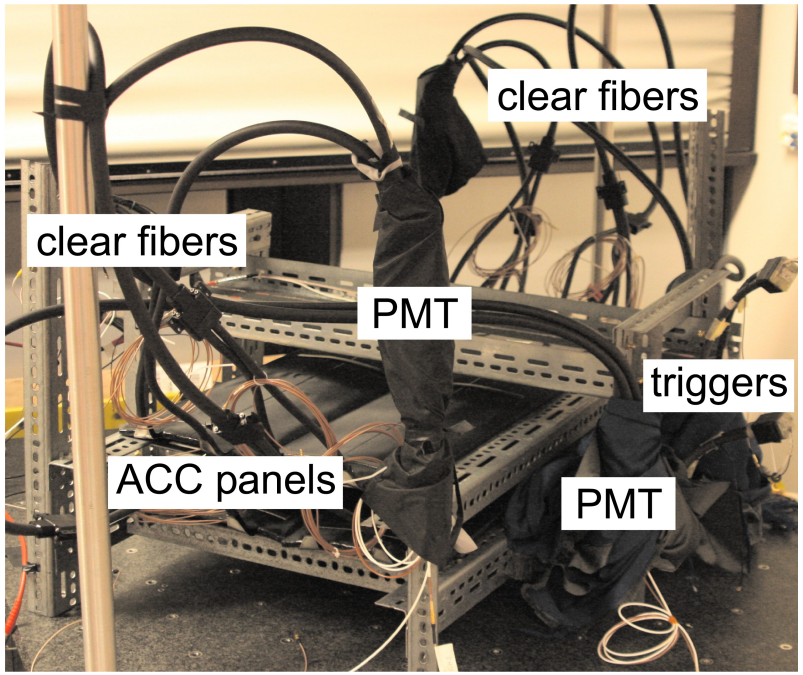


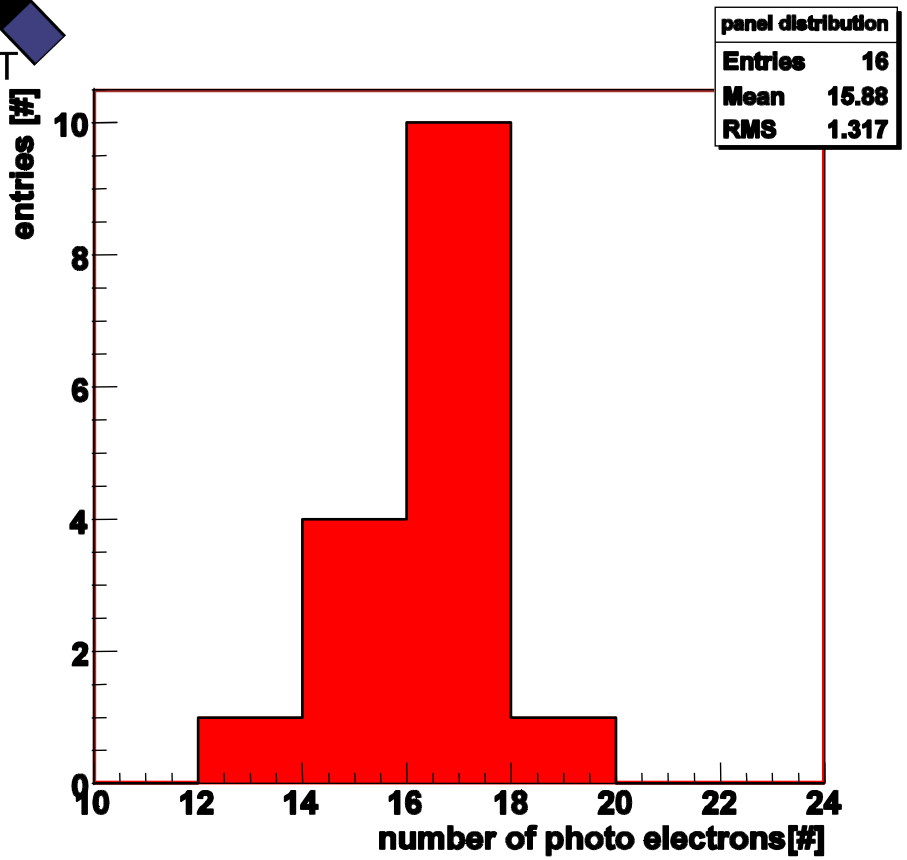


Complete System Test

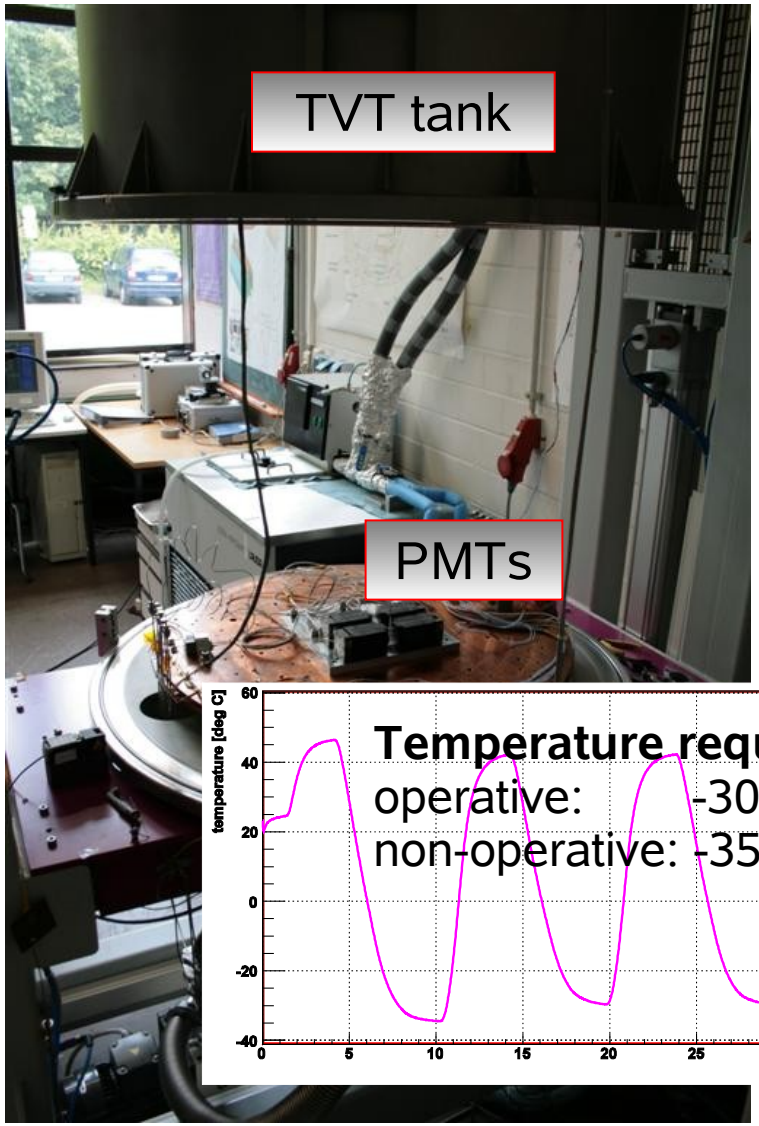


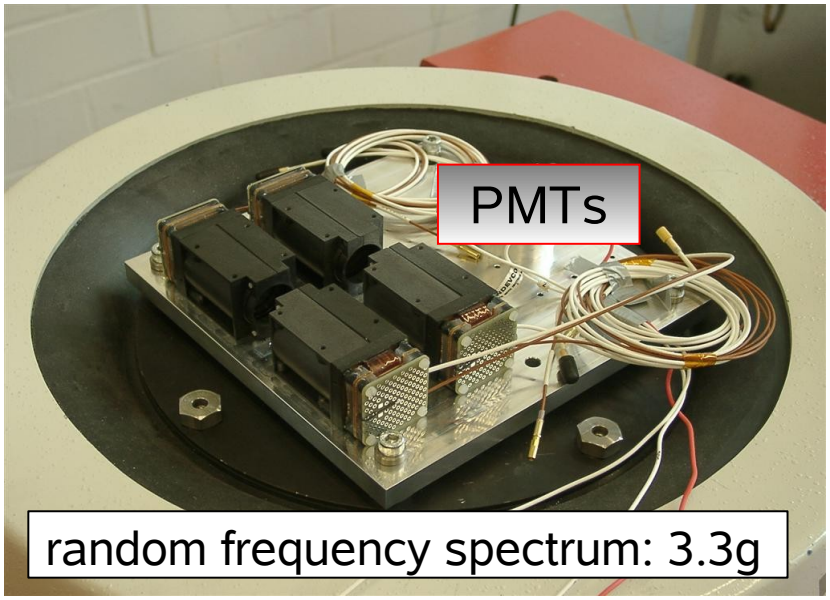
Test of complete chain:
panel + clear fiber + PMT
show good results!





Space Qualification - PMTs



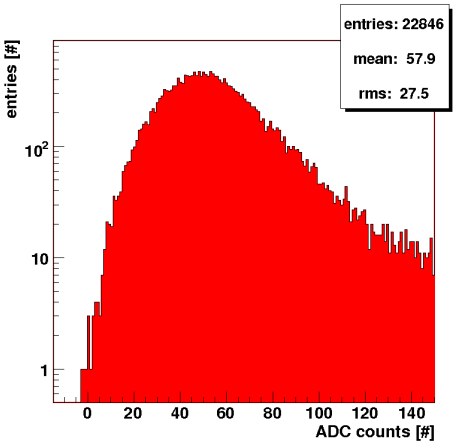


Temperature requirements:
operative: -30 - +45 °C
non-operative: -35 - +50 °C

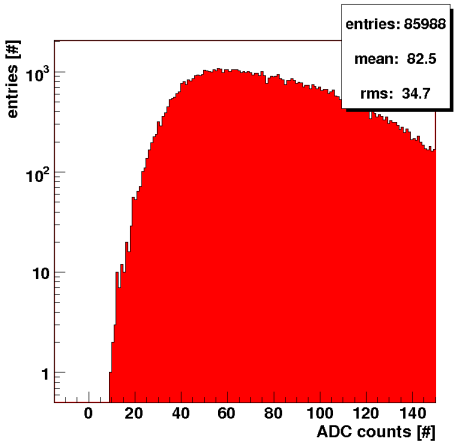
PMTs did not change within 5% after Space Qualification

Beamtest – Inefficiency Measurement

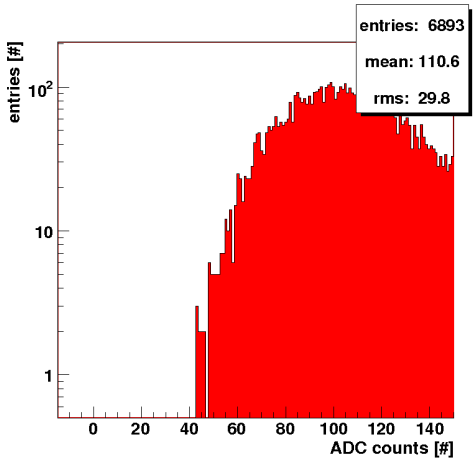
Highest ADC counts from both PMTs on one panel for each event



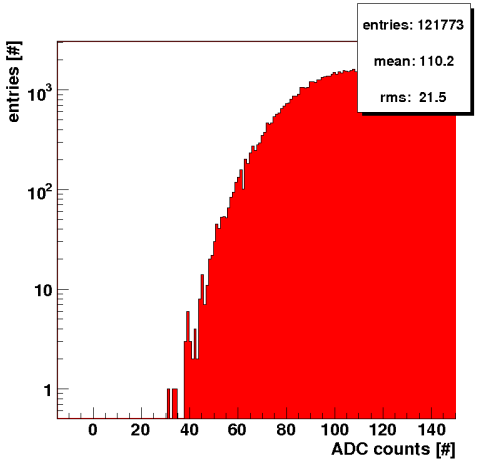
slot



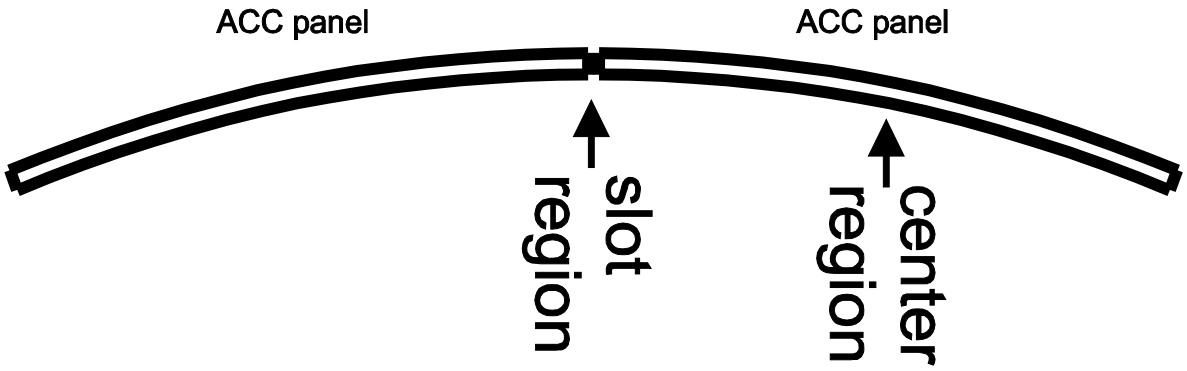
2.6 mm from slot



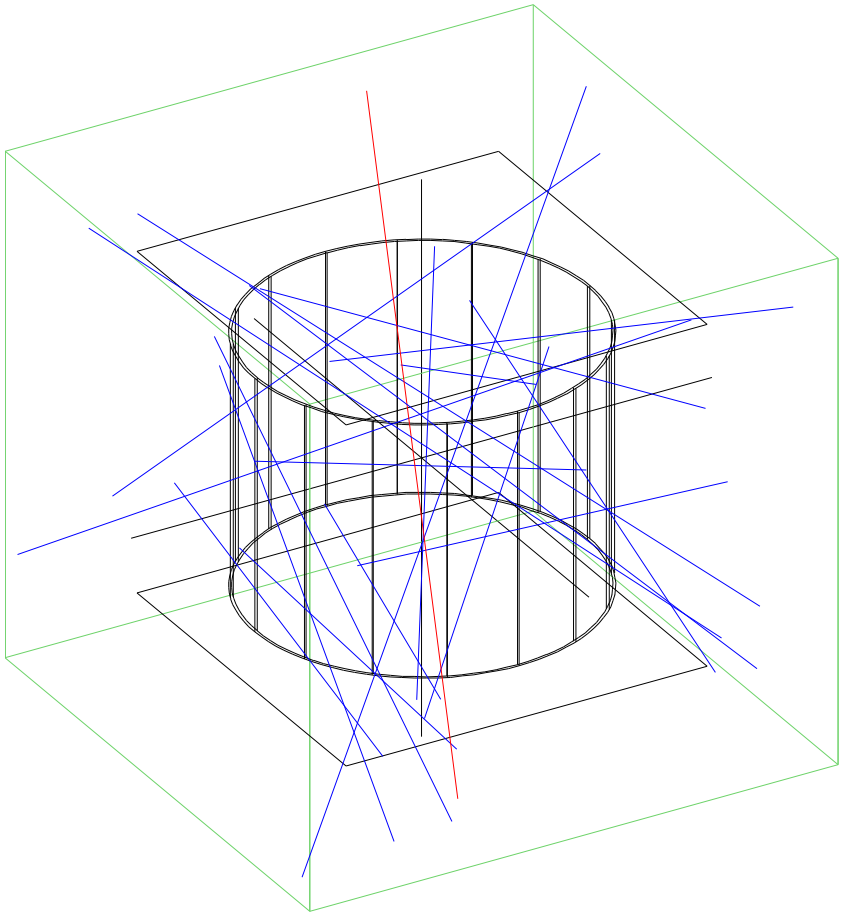
14.3 mm from slot

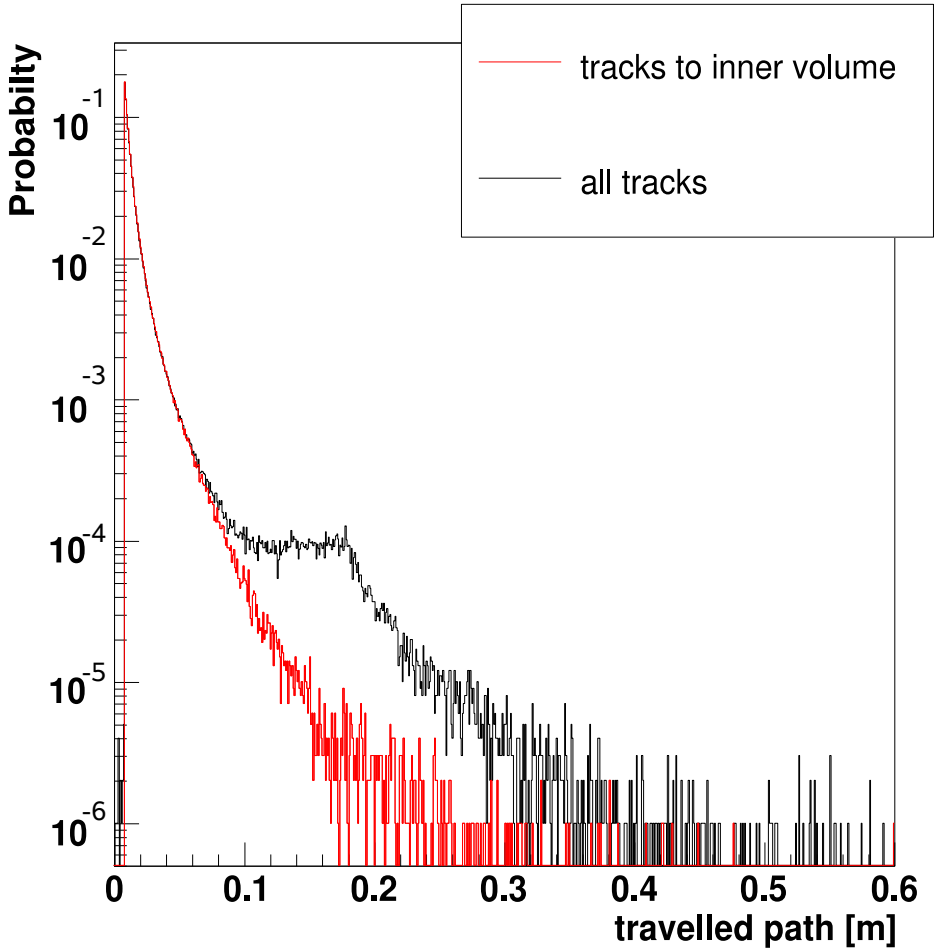


central



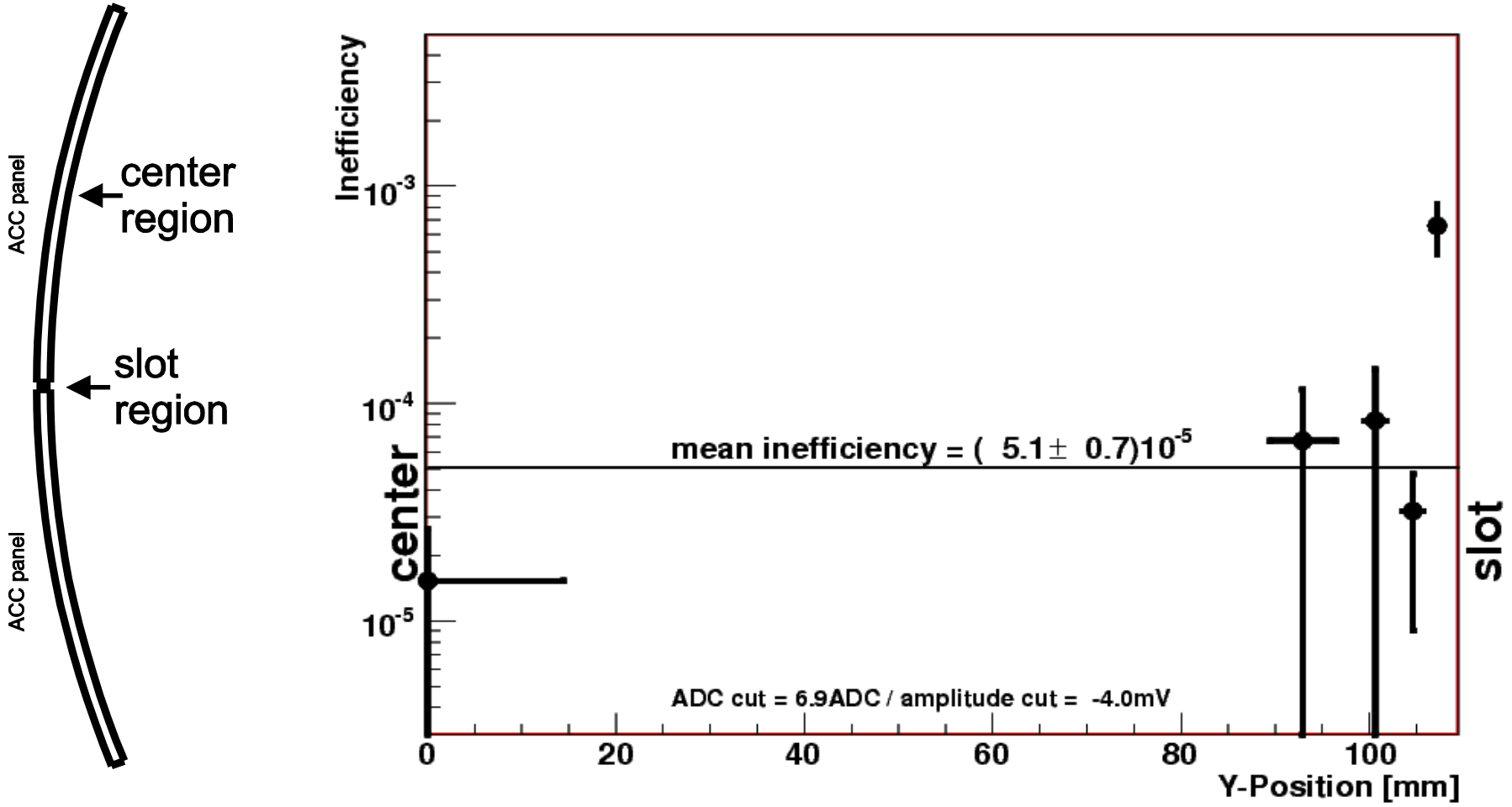
Isotropic Particle Distribution in Panels





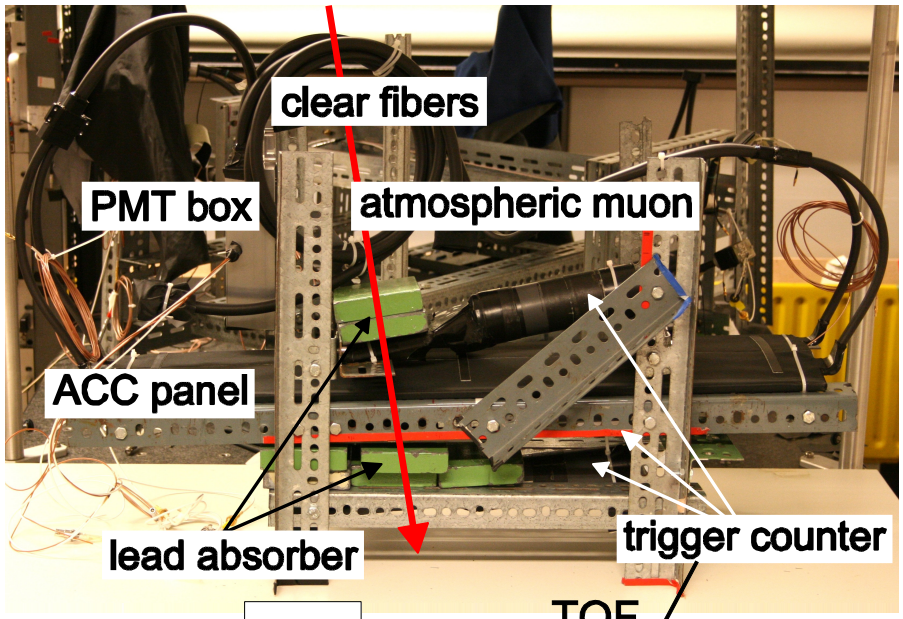
- **beamtest**: straight infall to panel
- **space**: isotropic particle distribution leads to **longer** path lengths in scinitillator

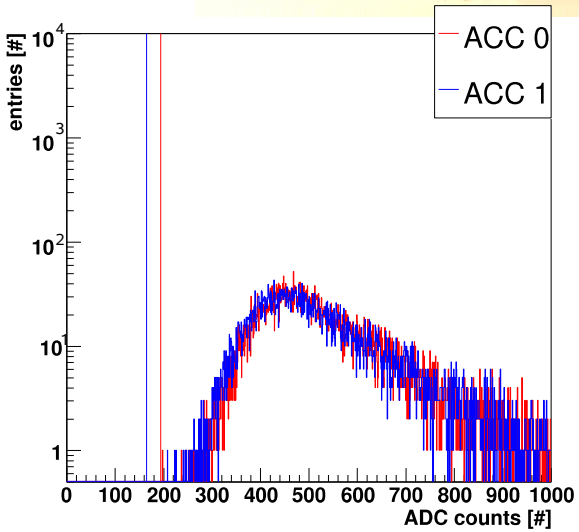
Inefficiency of ACC

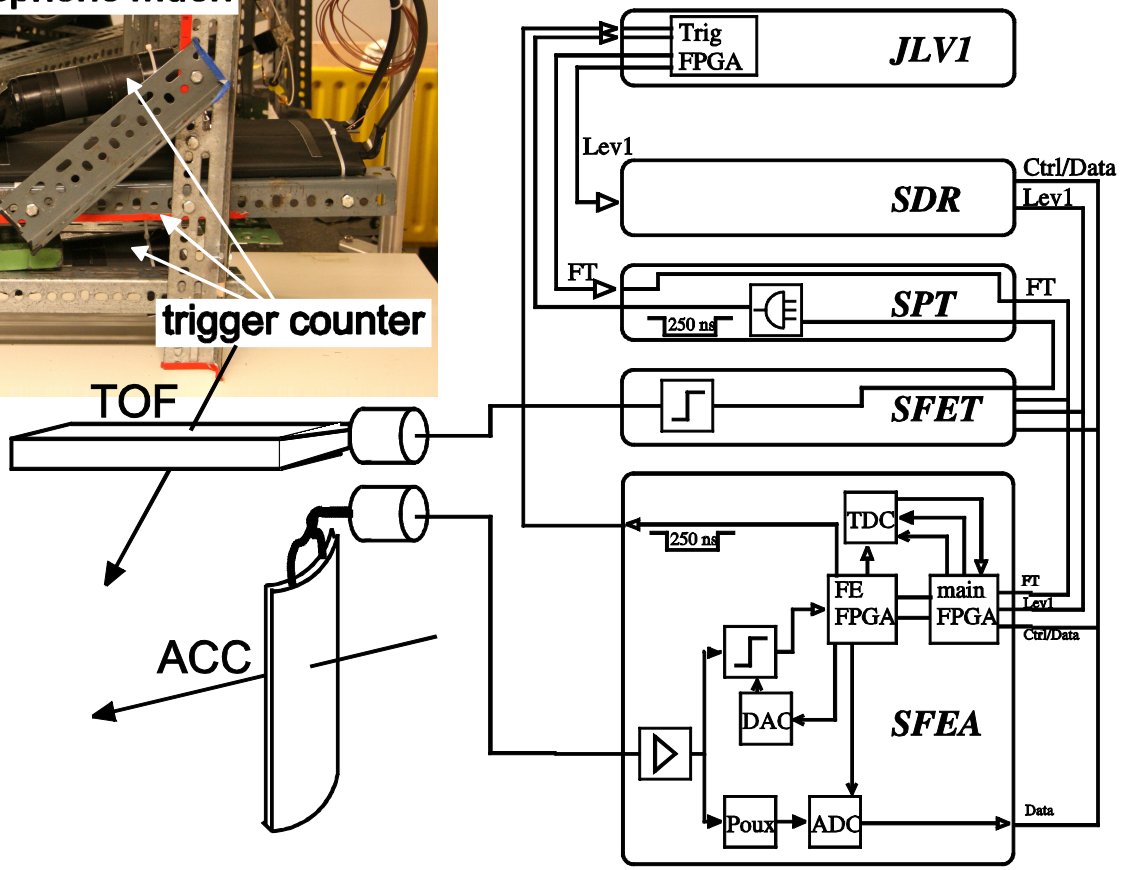


Estimated mean inefficiency of **one complete ACC panel** with complete system test results and isotropic particle distribution (20% effect), but with testbeam elec.: **$5.1 \cdot 10^{-5}$**

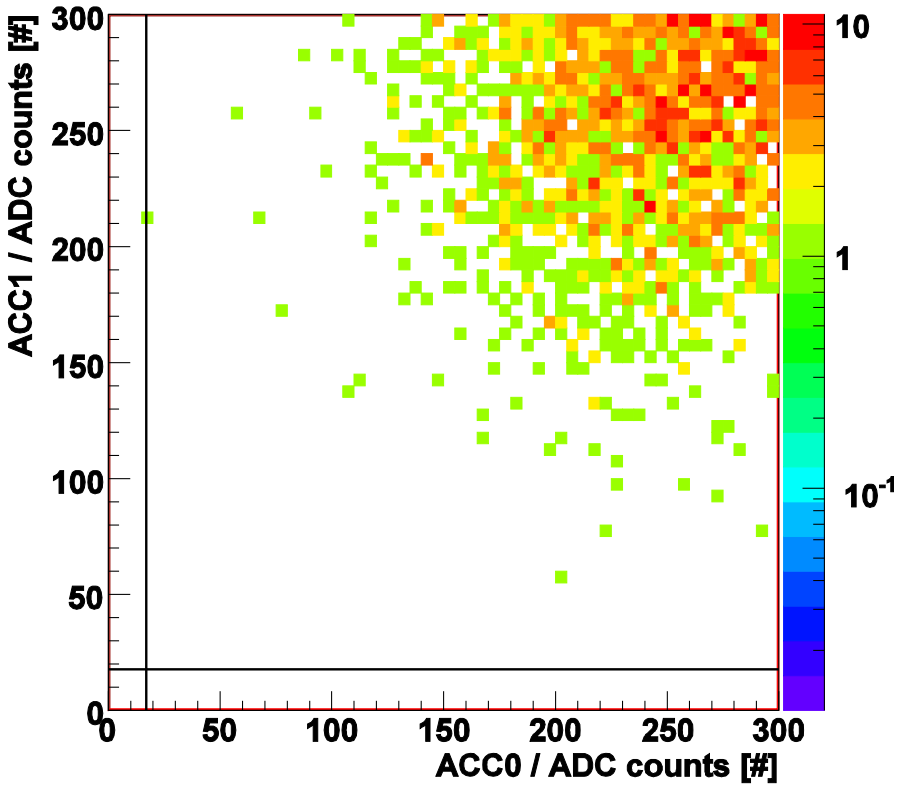
Flight Electronics

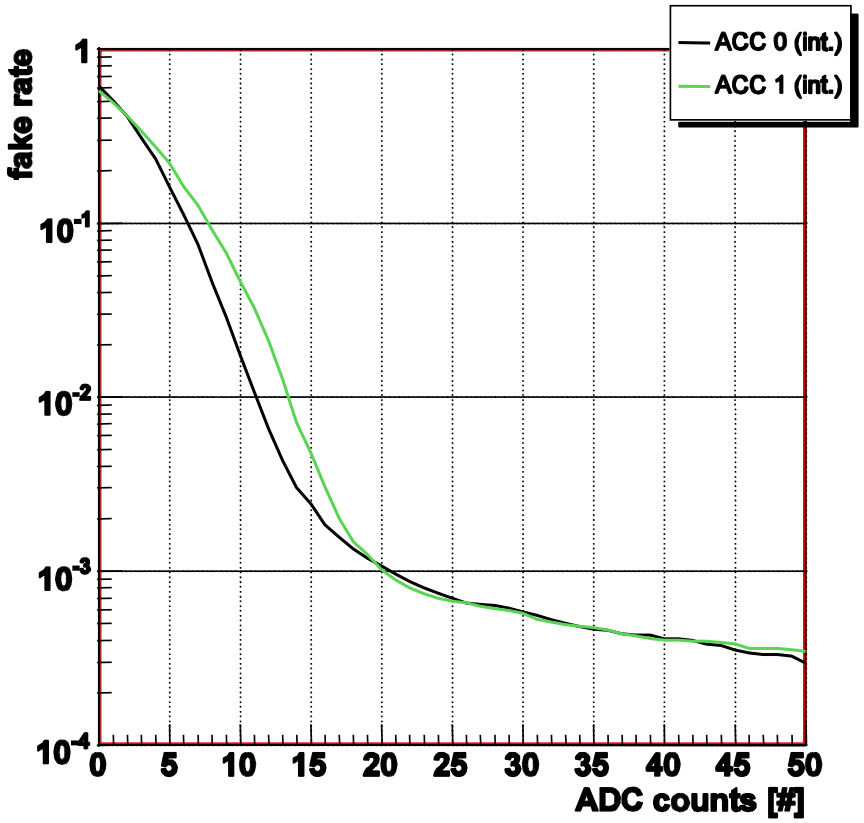






Flight Electronics

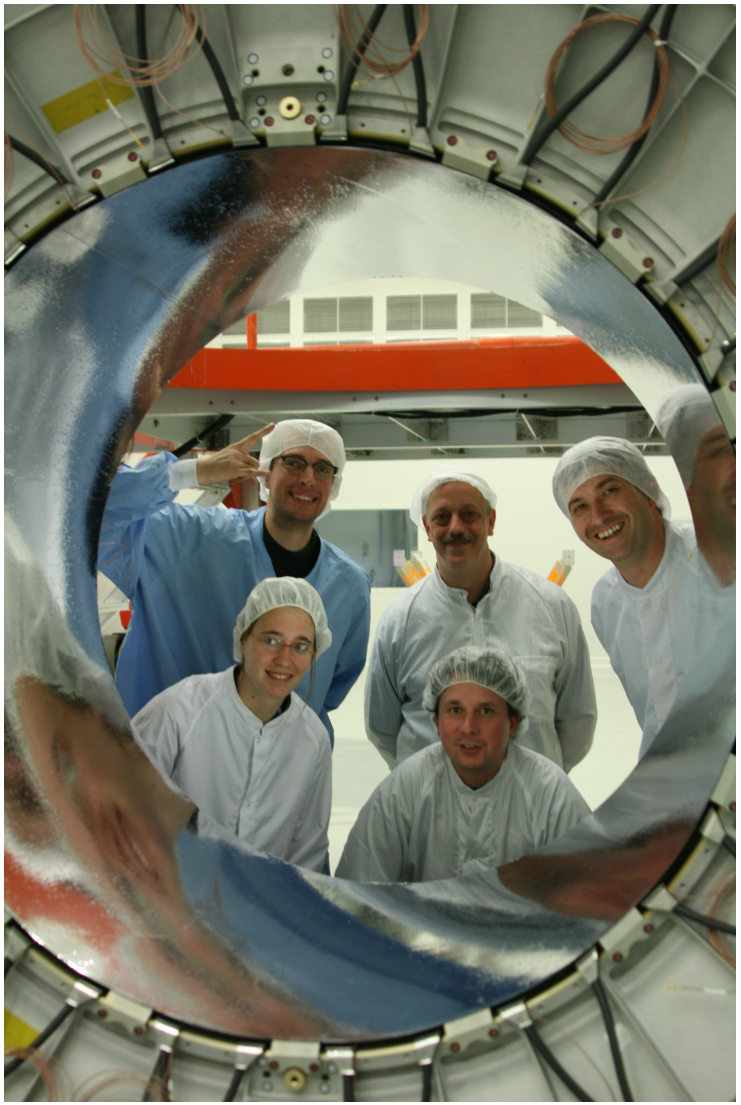


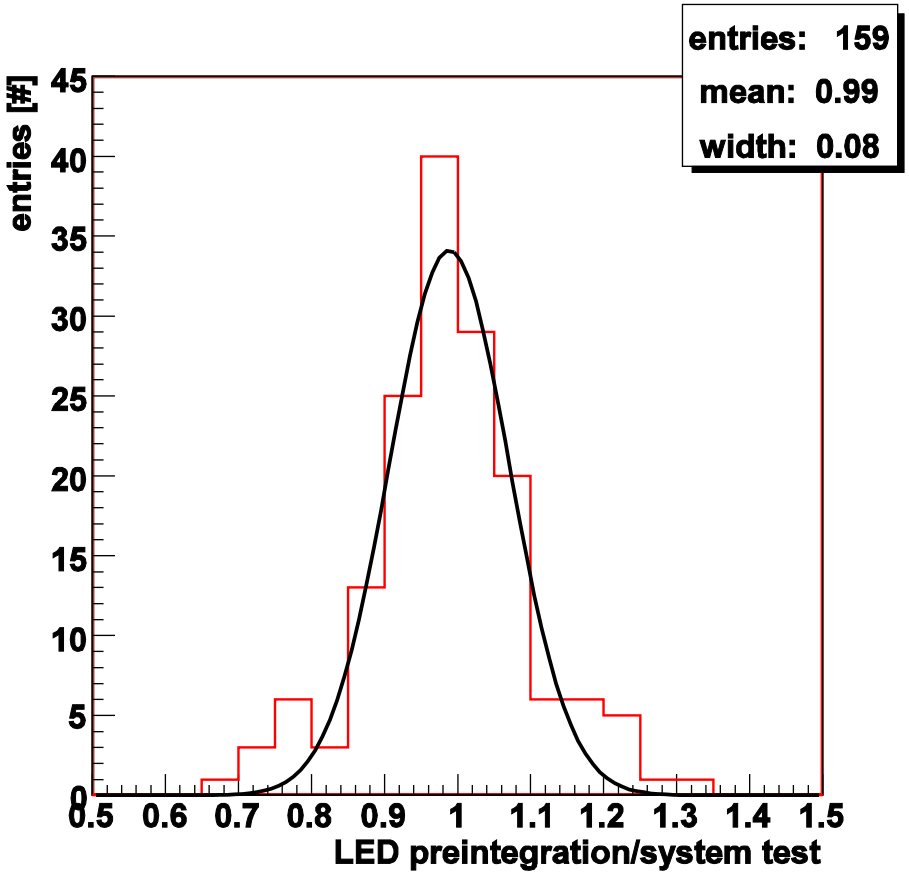


- good resolution for small charges
- small pedestal width
- ⇒ small inefficiency

- rate of fake hits caused by PMTs vs. used cut: ca. 10^{-4}

Preintegration





successful preintegration: 99 ± 8 %

LED test comparison (after/before)

Conclusion

- **ACC system for AMS-02 is ready!**
  - scintillators, clear fibers, PMTs: good
  - flight electronics: good
  - preintegration done!
- flight integration May/June
- more studies
  - ineff. along panel
  - vary incidence angle