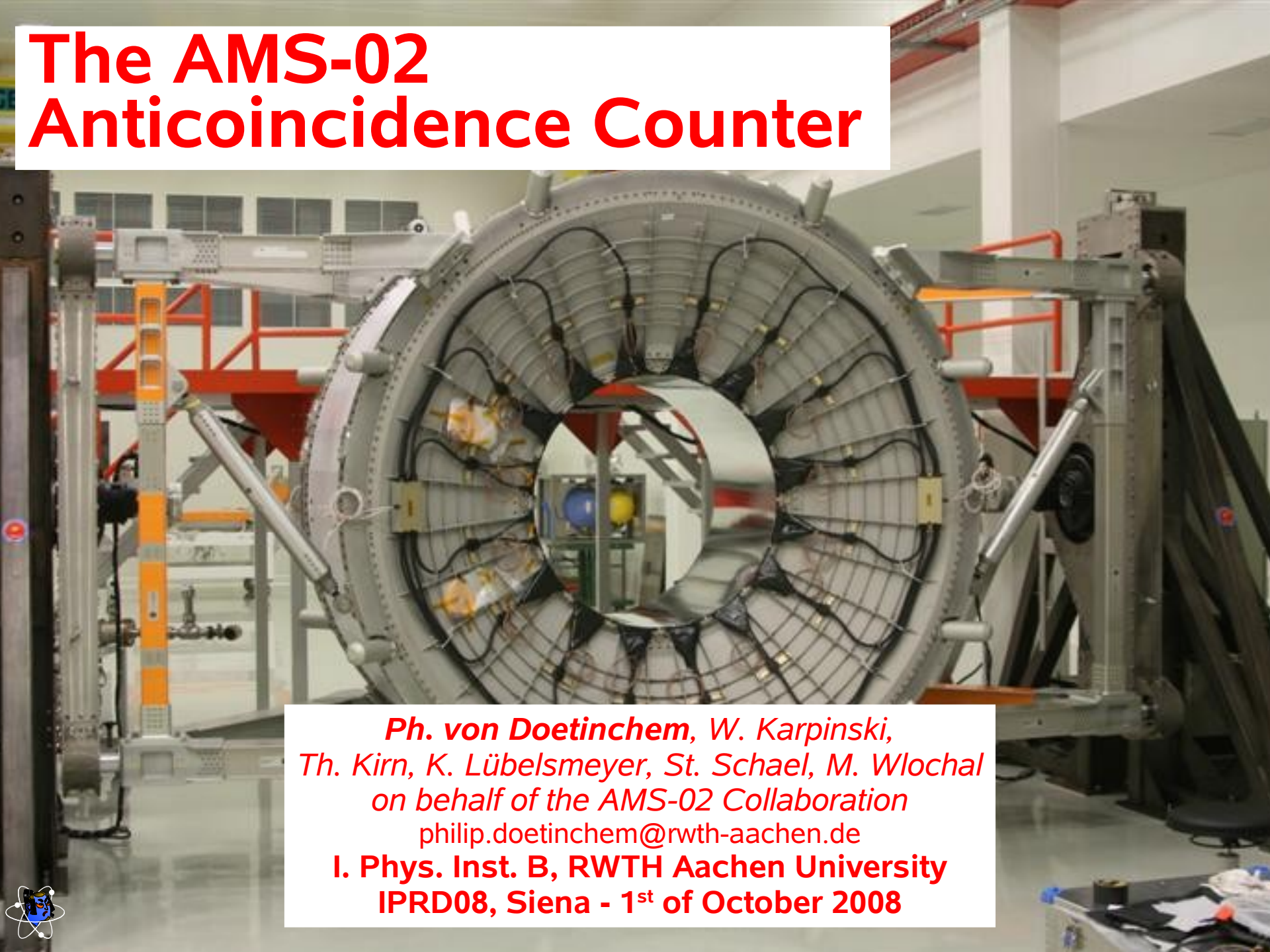


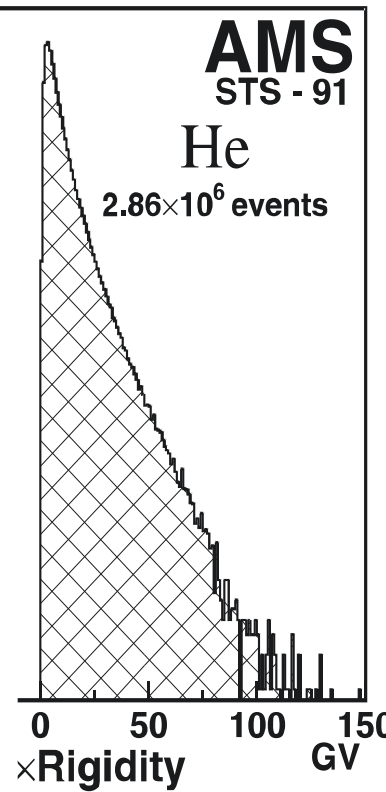
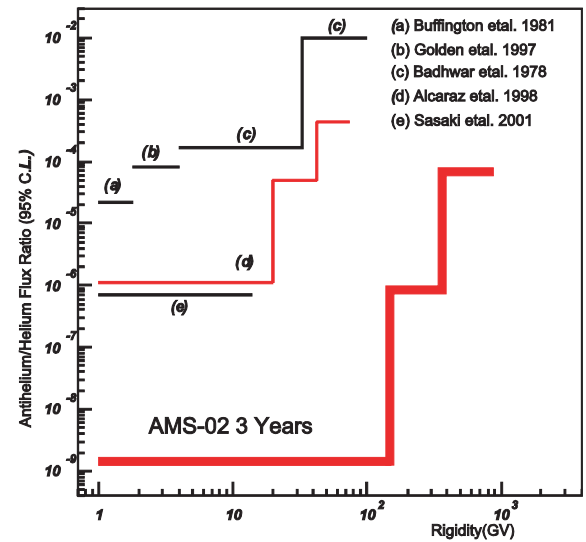
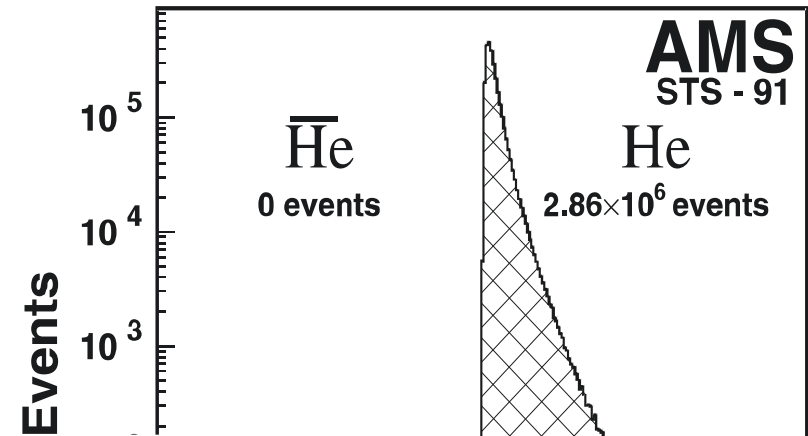
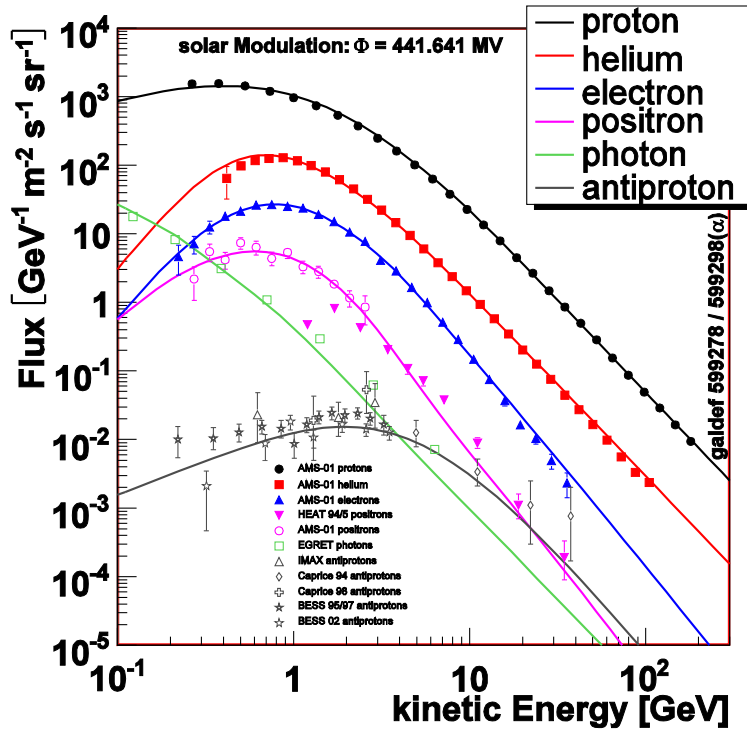
The AMS-02 Anticoincidence Counter



*Ph. von Doetinchem, W. Karpinski,
Th. Kirn, K. Lübelmeyer, St. Schael, M. Wlochal
on behalf of the AMS-02 Collaboration
philip.doetinchem@rwth-aachen.de
I. Phys. Inst. B, RWTH Aachen University
IPRD08, Siena - 1st of October 2008*



Cosmic-Ray Basics



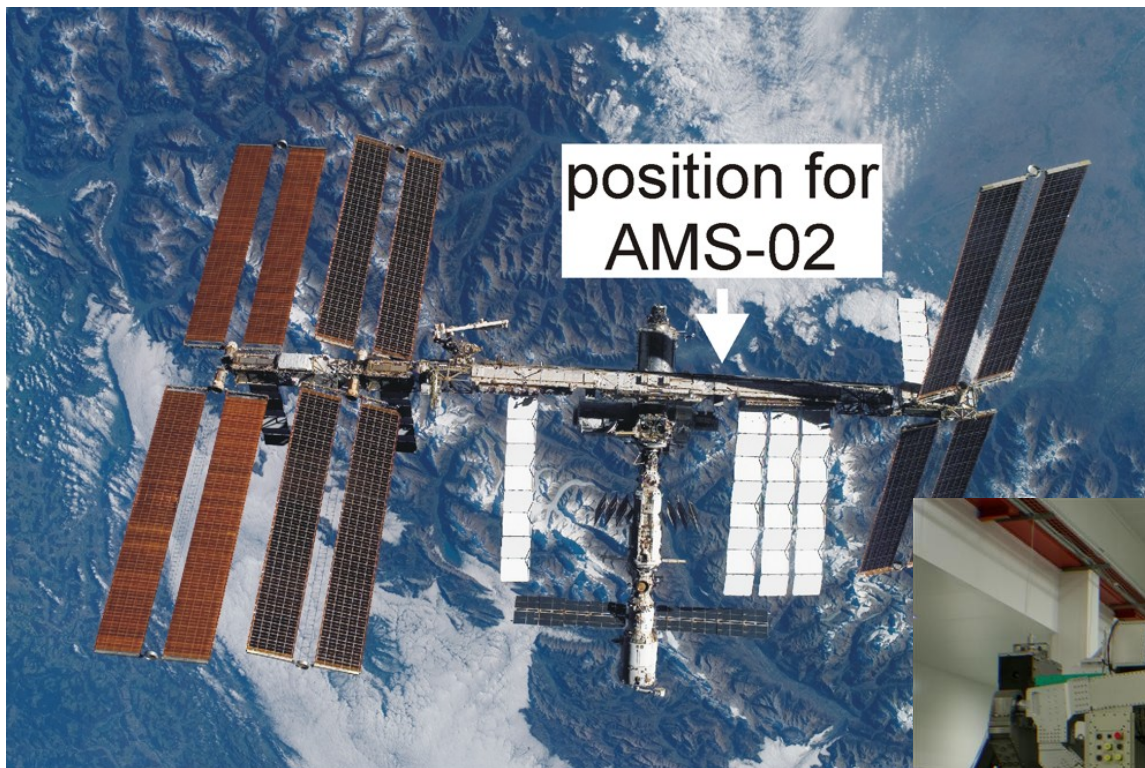
• **good agreement** of data and propagation models for particles, but unexplained features in antiparticles

• so far **no antimatter** was found in cosmic rays. Needs a very good determination between Helium and Antihelium



Veto by **Anticoincidence Counter**

The AMS-02 Detector

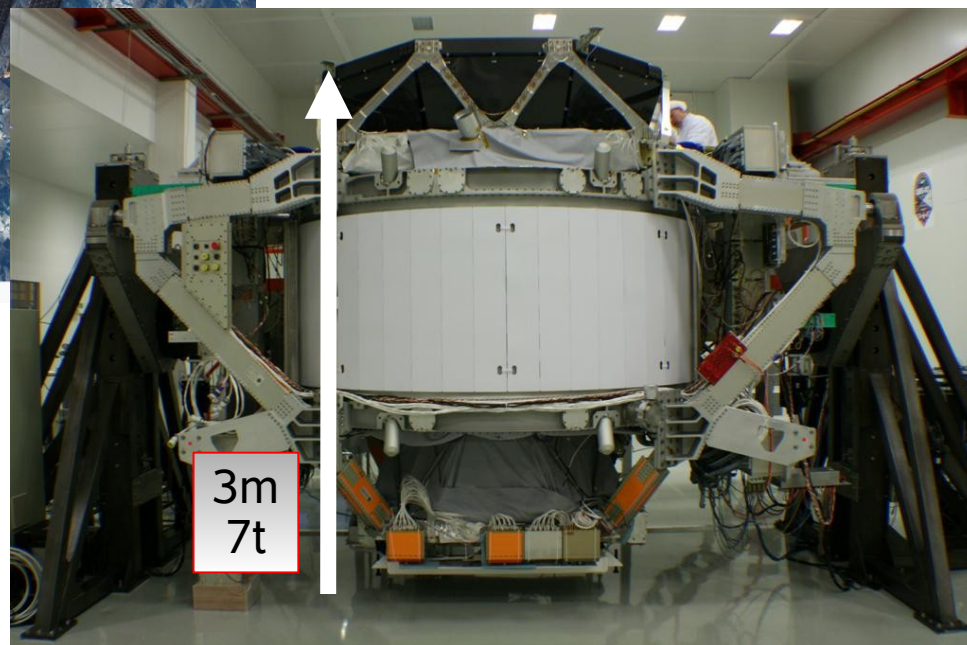


S120E008548

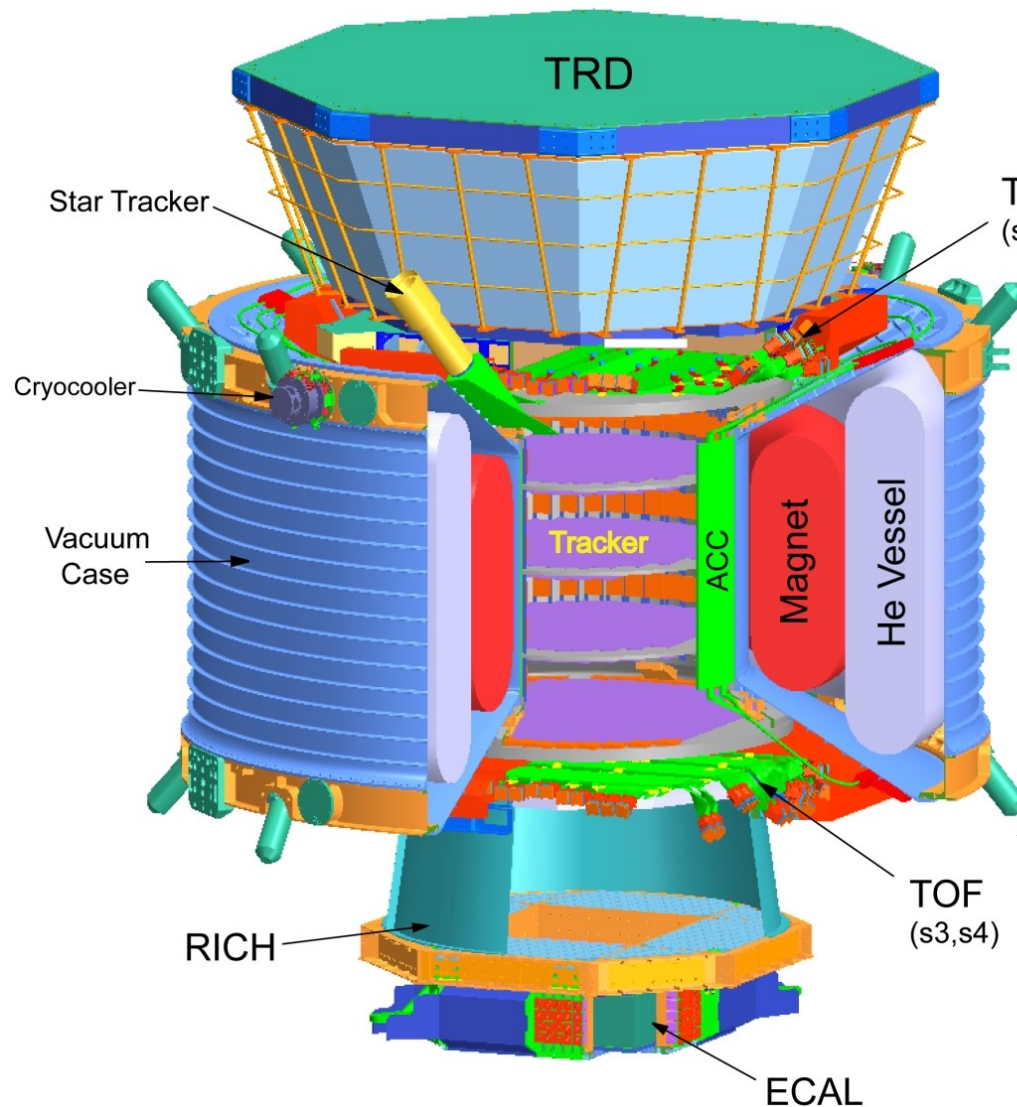
artist view of AMS-02
on the International Space Station

> 2010 operation for 3 years

AMS-02
in the clean room @ CERN



AMS-02 Overview



goals of AMS-02:

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

subdetectors:

Transition Radiation Detector (TRD)

- classify particles by $\gamma = E/m$

Time of Flight (ToF)

- trigger, velocity, dE/dx

Tracker + superconducting Magnet (1T)

- track reconstruction, momentum, dE/dx

Anti-Coincidence Counter (ACC)

- event selection → next slides

Ring Image Cherenkov Detector (RICH)

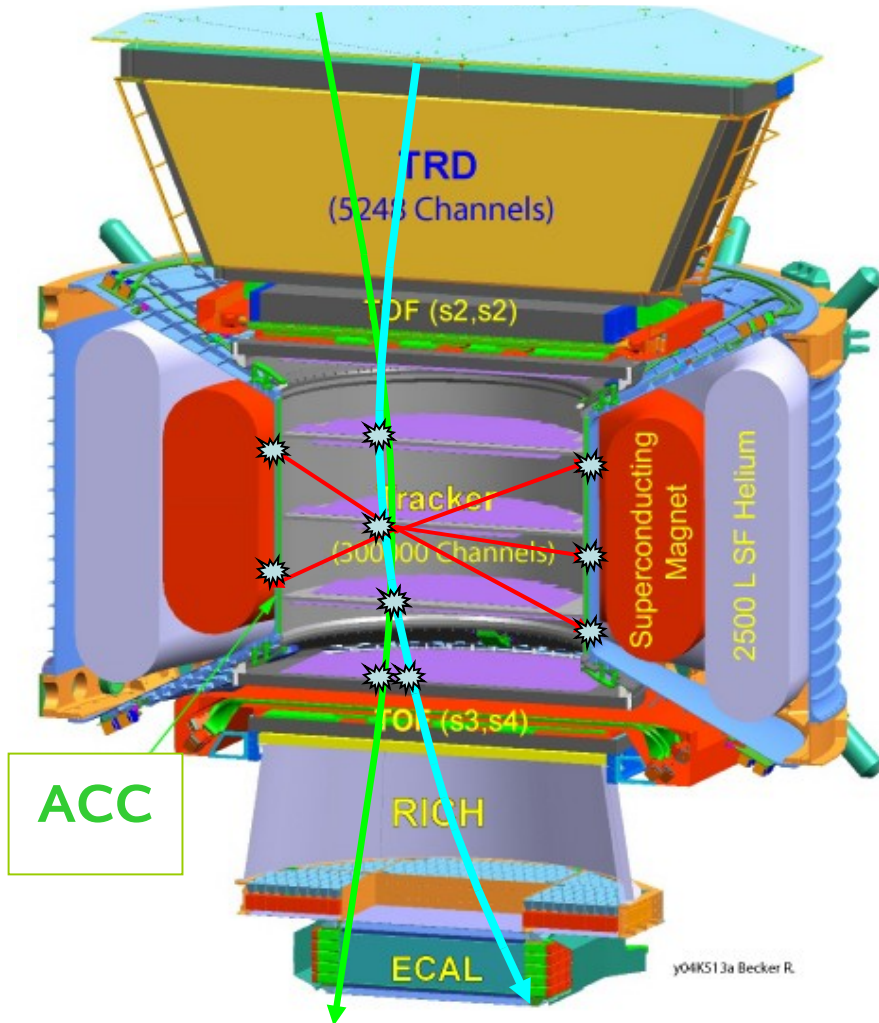
- precise velocity measurement

Electromagnetic Calorimeter (ECAL)

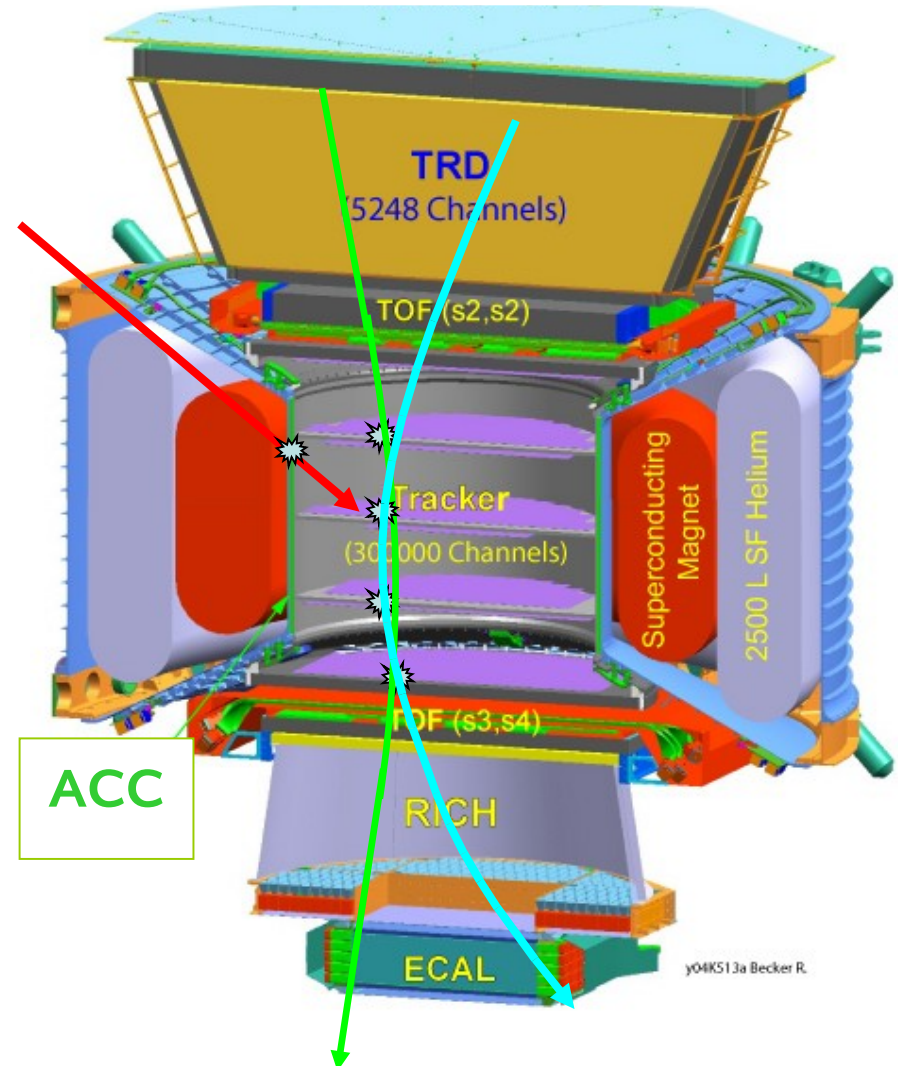
- shower shape and energy determination

Important Events for the ACC

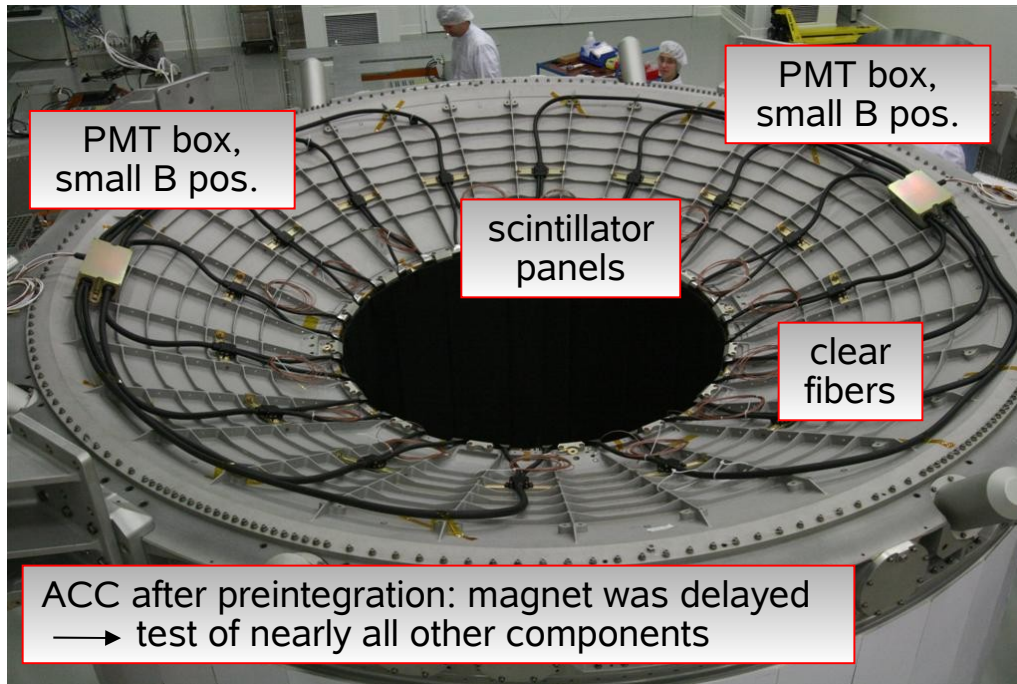
rejection of internal interactions



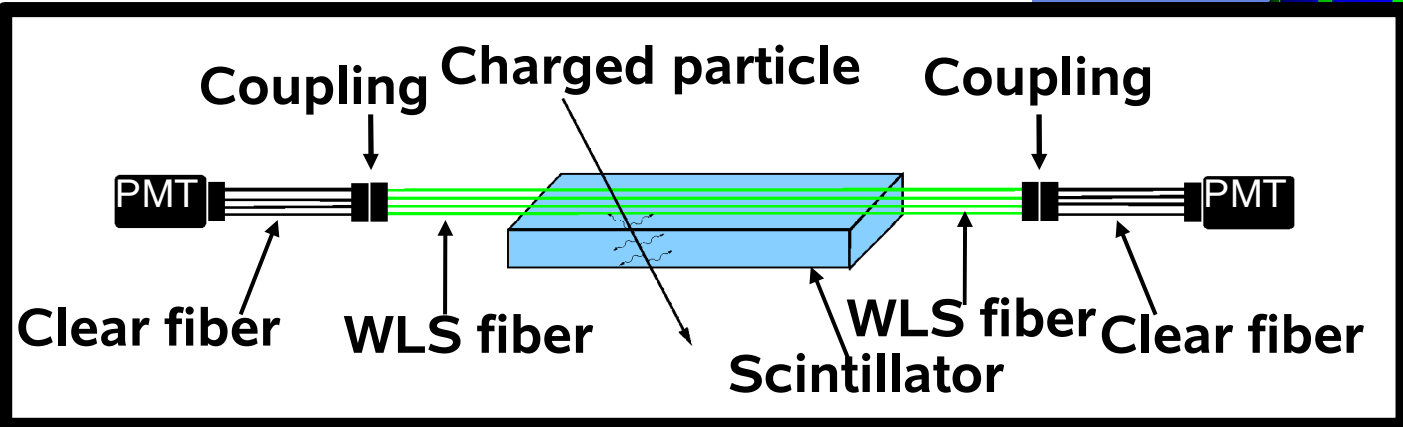
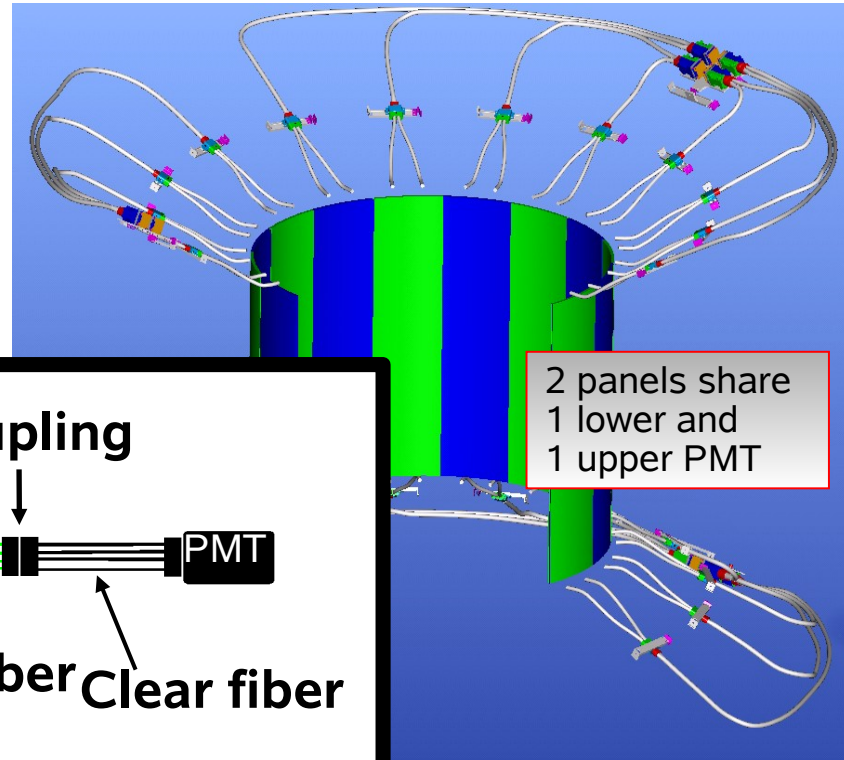
rejection of external particles



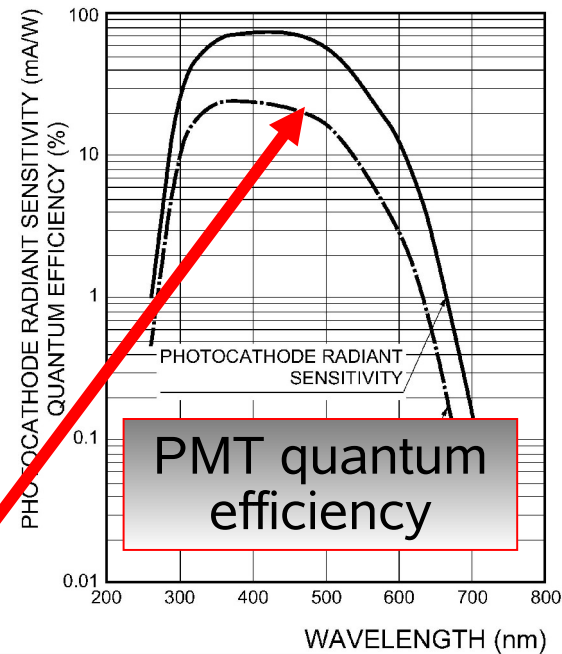
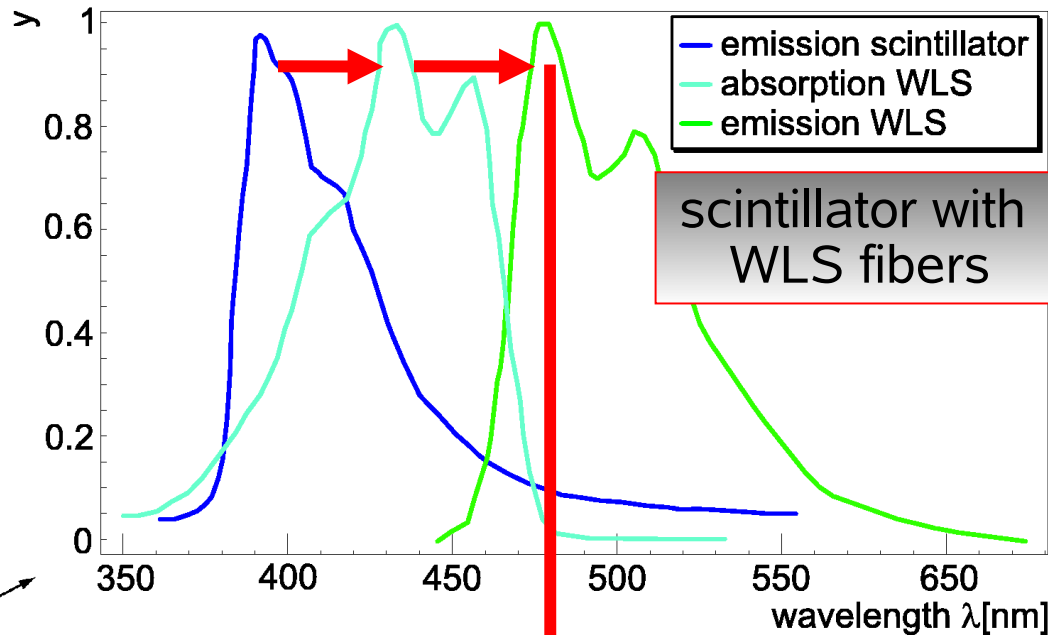
ACC System



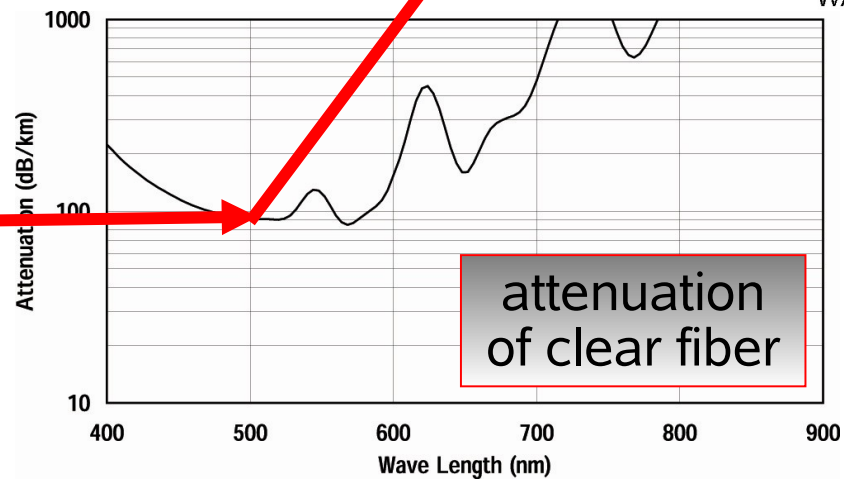
- small ACC inefficiency needed ($<10^{-4}$) for measurement of antimatter with very clean single tracks
- reduce trigger rate: fast detector (ns): e.g. South Atlantic Anomaly



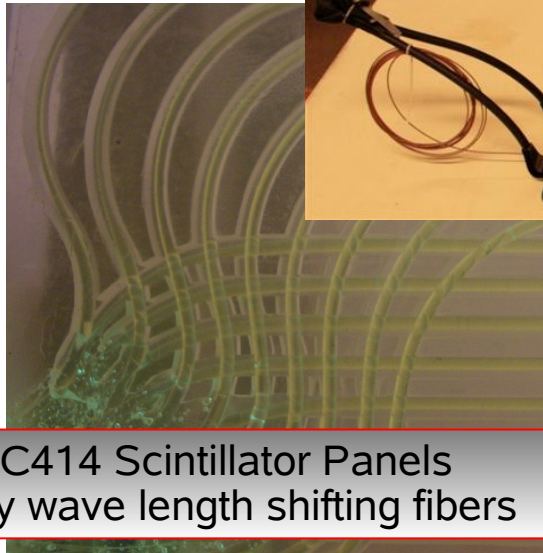
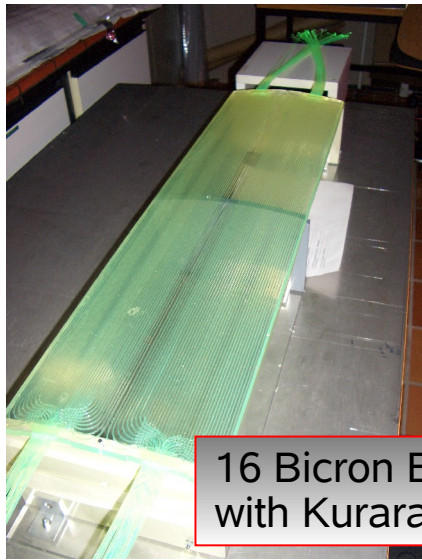
Light Signals



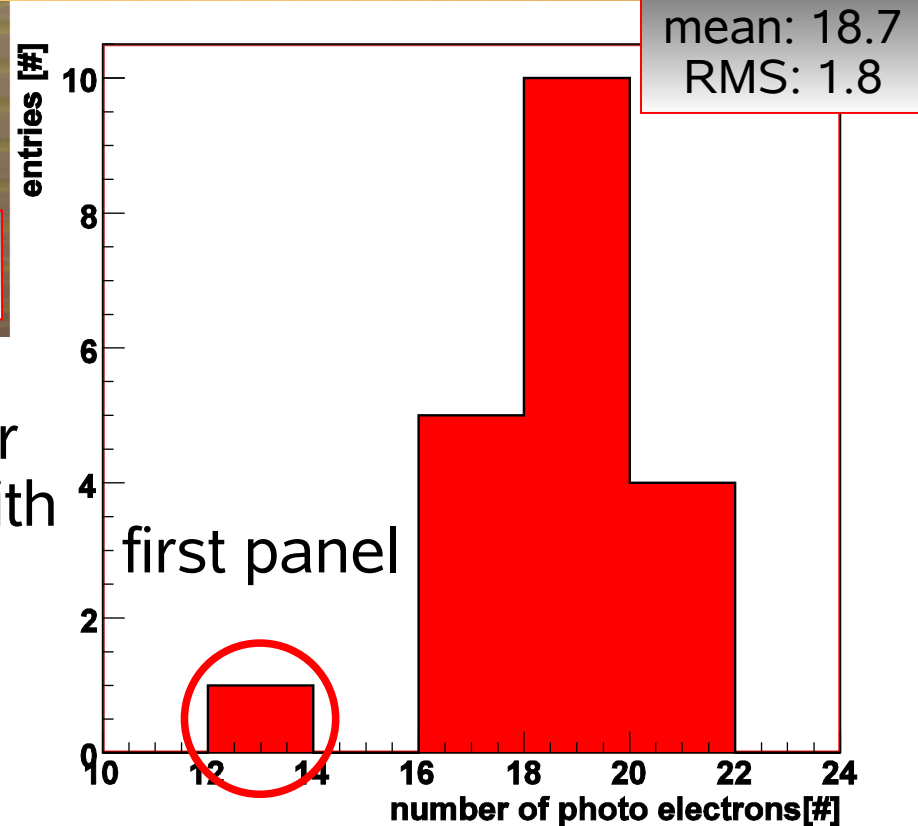
coupling to clear fiber



Panel Production



16 Bicron BC414 Scintillator Panels with Kuraray wave length shifting fibers

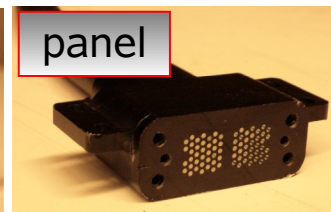
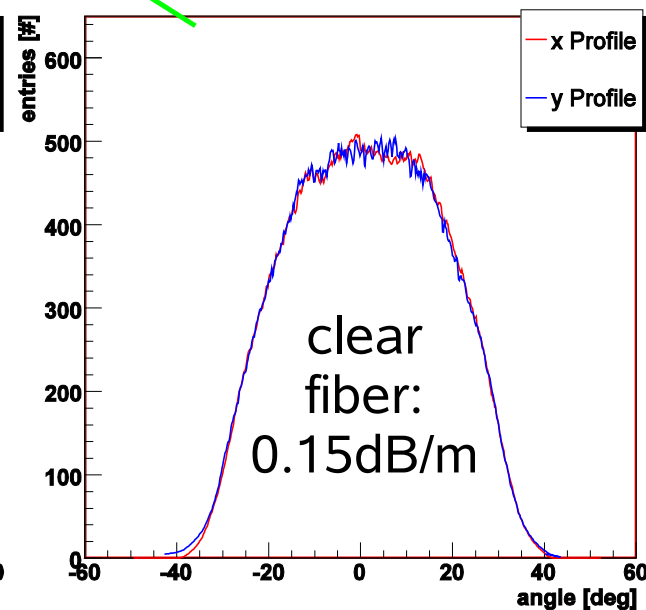
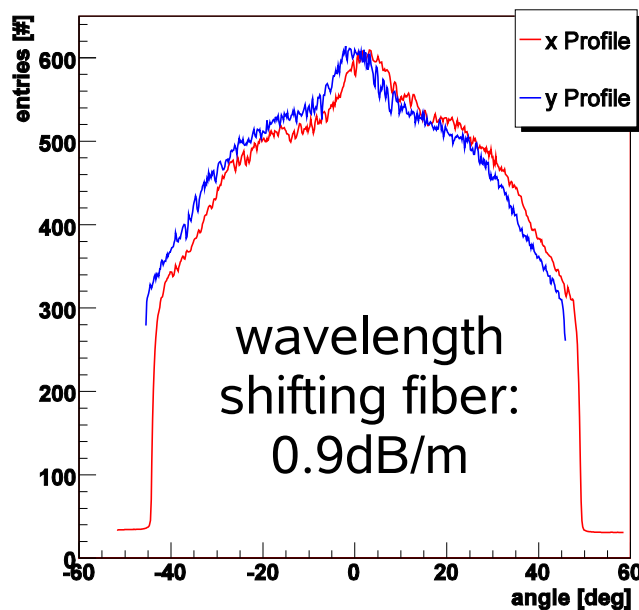
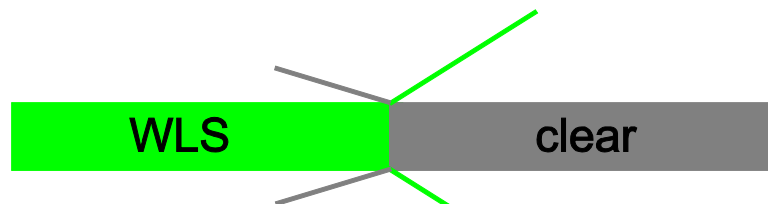
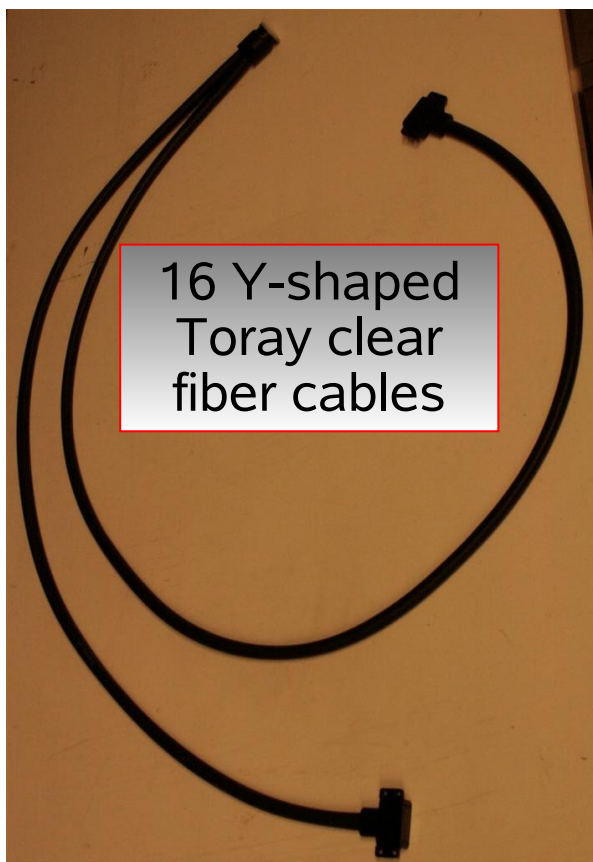


- measurement of MOP in number of photo-electrons, calibration with LEDs implemented in panels:

$$N_{pe} = \frac{Q_{CR} Q_{LED}}{\sigma_{LED}^2}$$

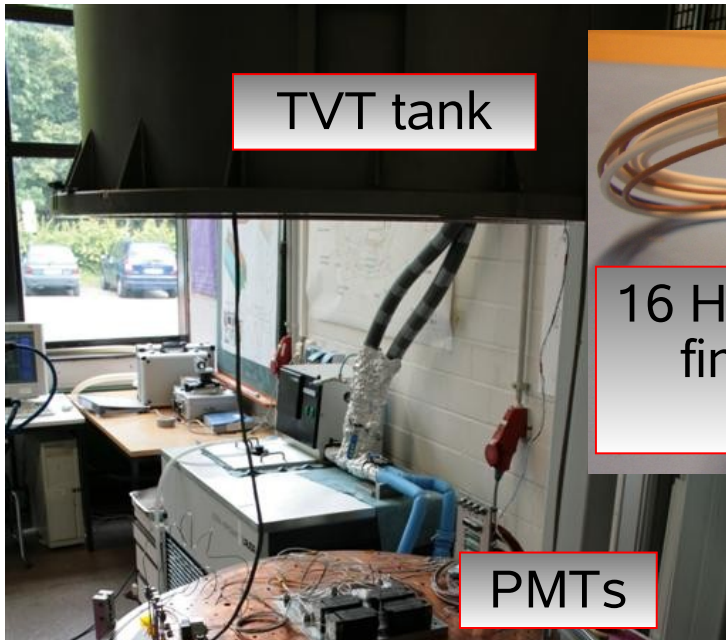
- AMS-01 average 20 p.e. with 20% more material

Coupling: WLS to Clear Fiber



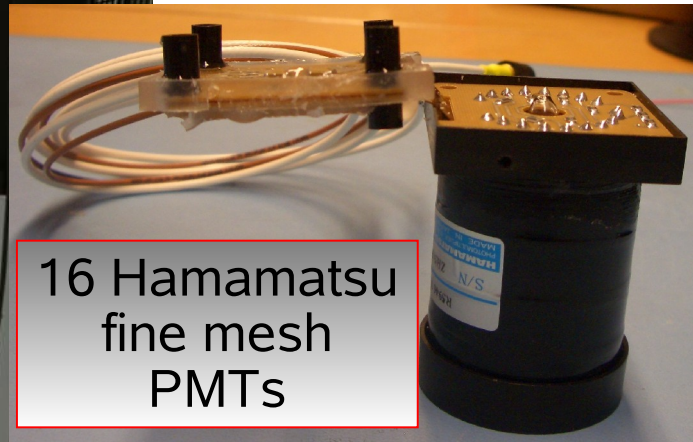
- acceptance angle matching of wavelength shifting fiber and clear fiber is important
- WLS: wide distribution due to reabsorption and non-ideal reflections also responsible for large attenuation

Space Qualification - PMTs

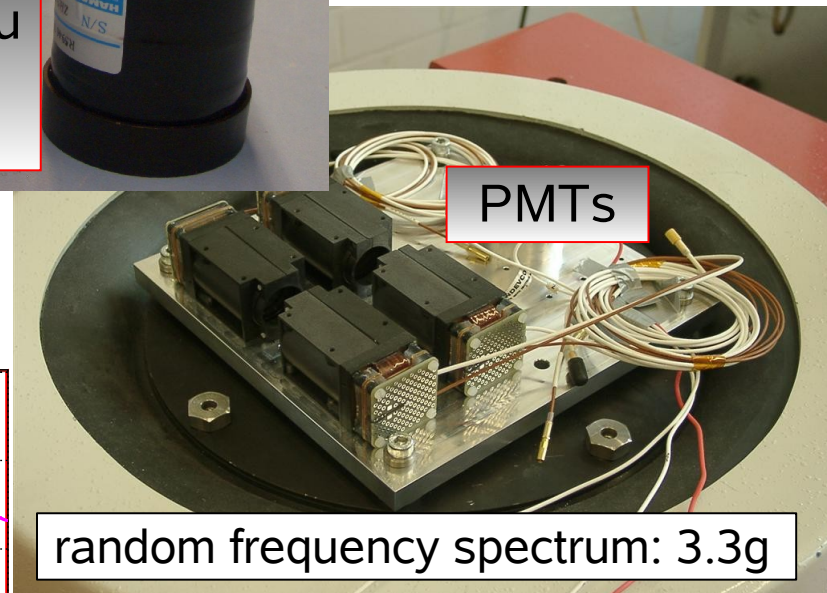


TVT tank

PMTs

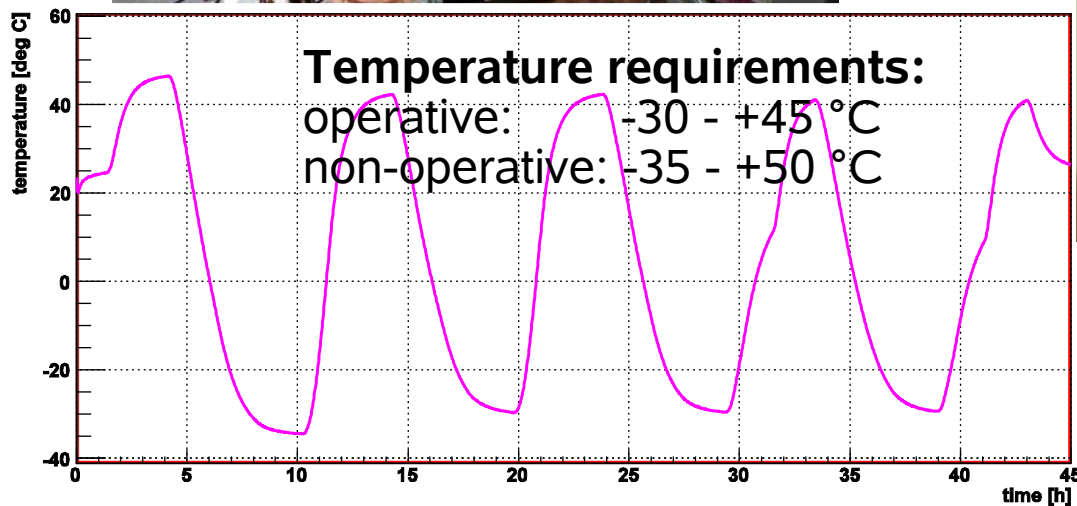


16 Hamamatsu fine mesh PMTs



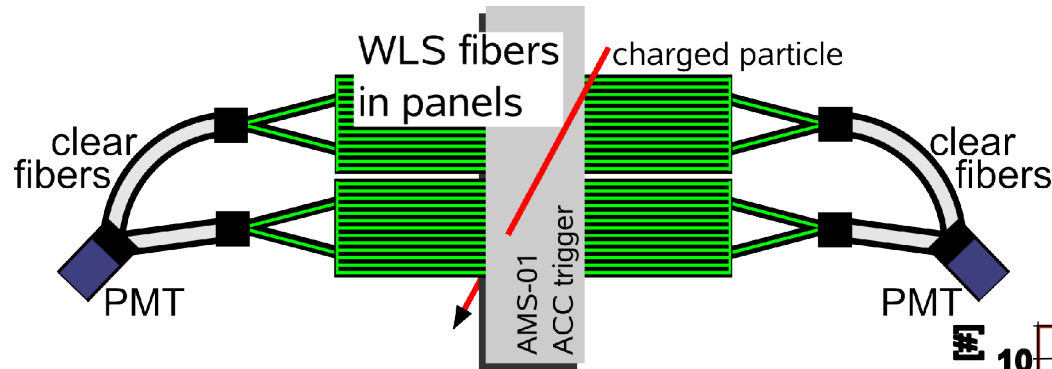
PMTs

random frequency spectrum: 3.3g

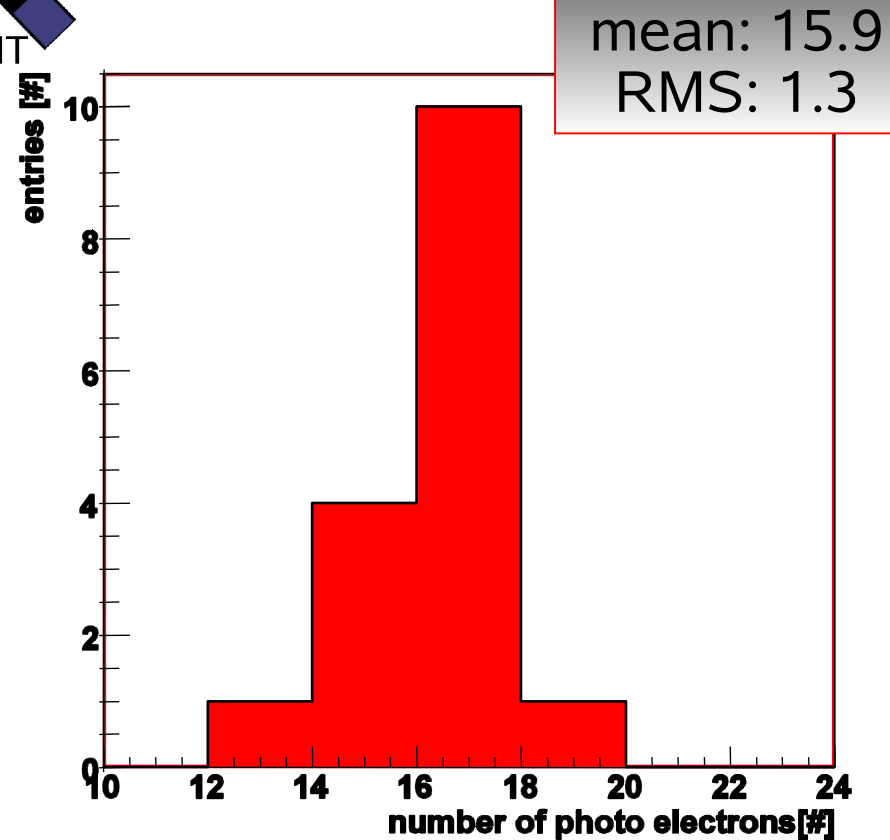
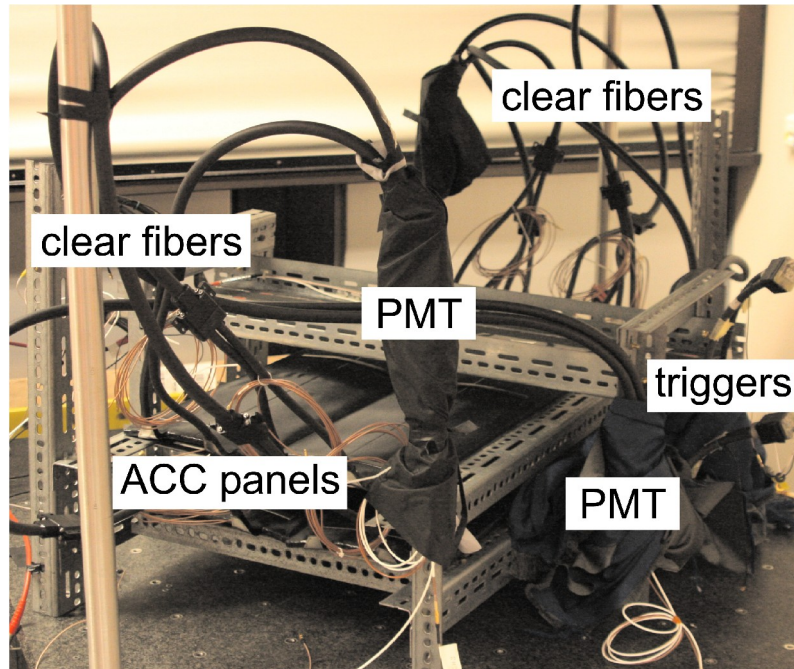


PMTs did not change in gain and photo-electron number within 5% after Space Qualification

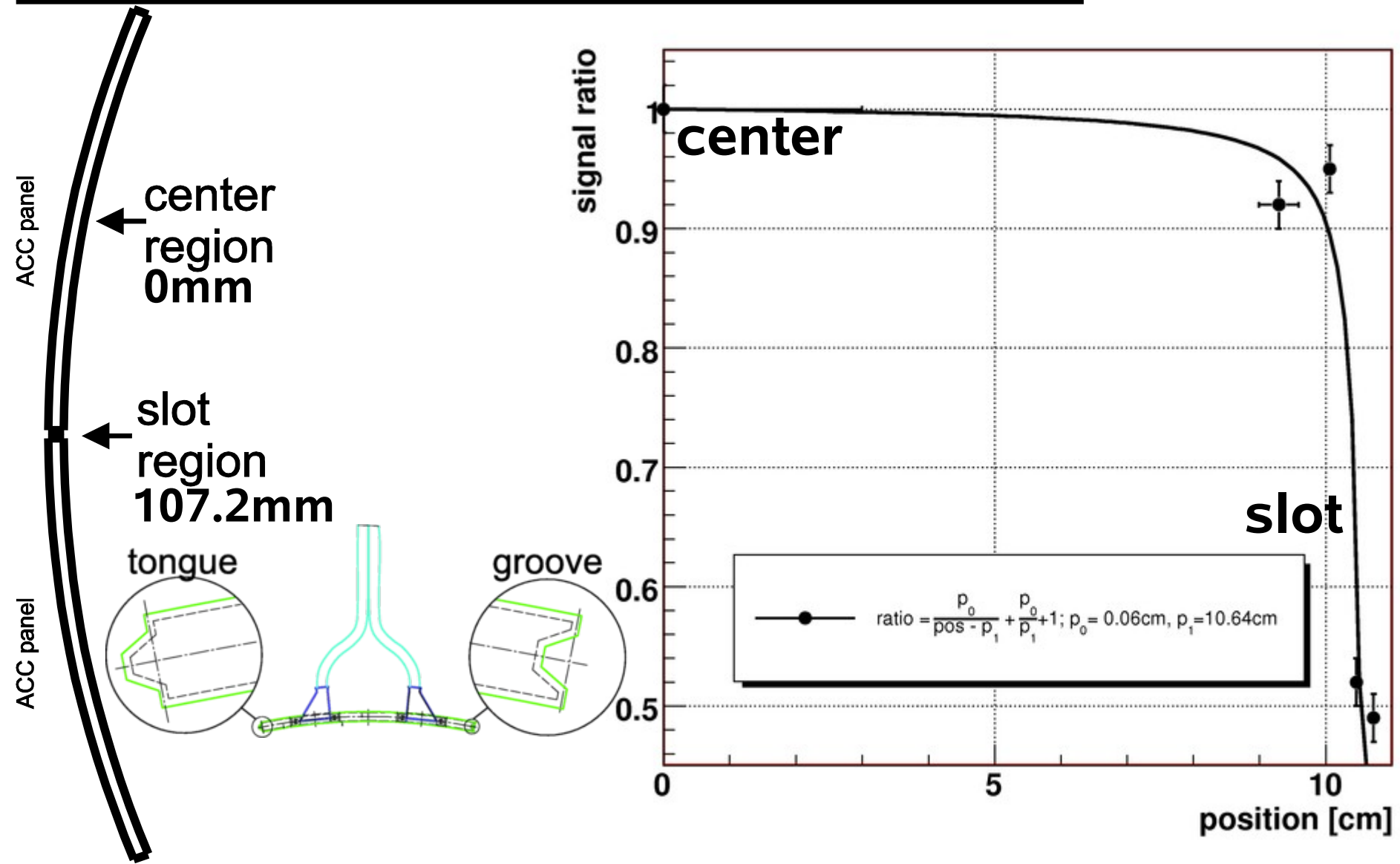
Complete System Test



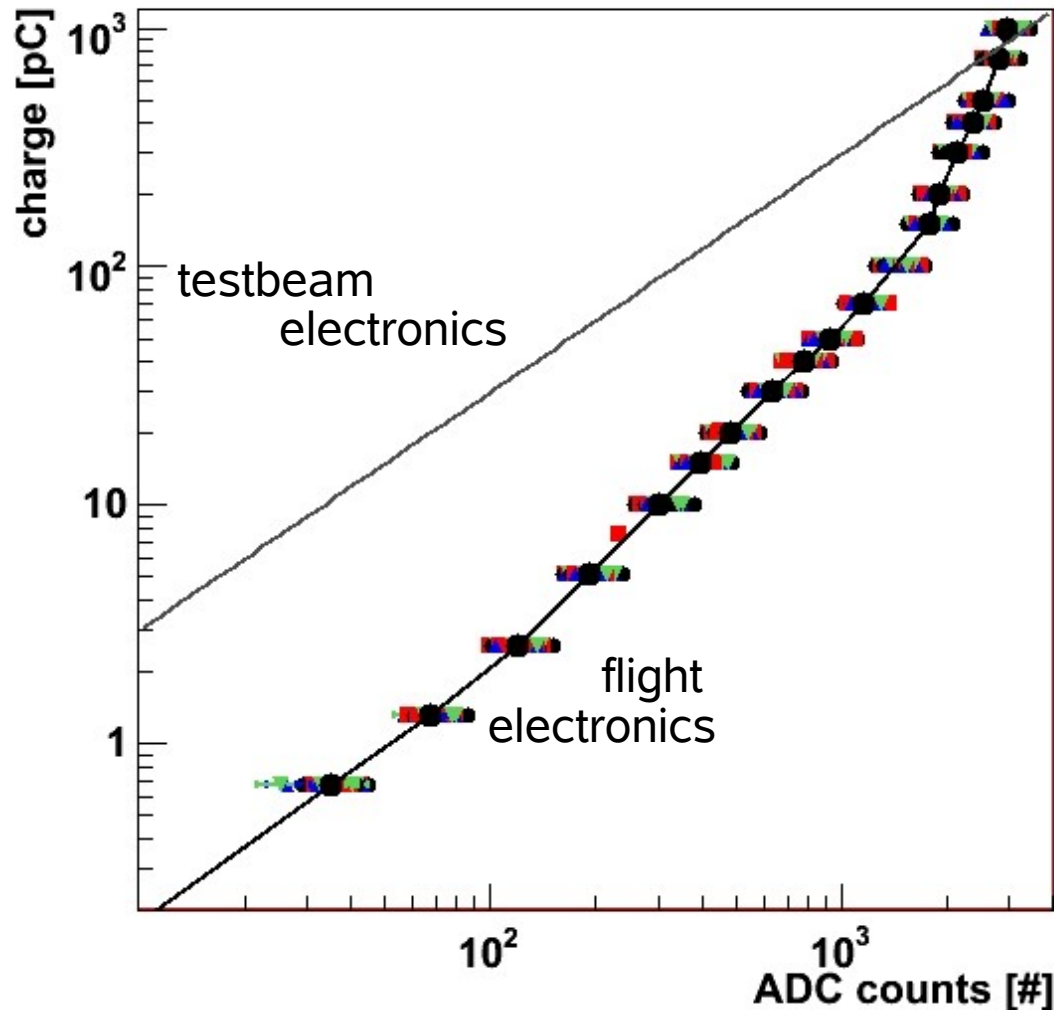
Test of complete chain:
panel + clear fiber + PMT
show good results!



Testbeam 2006



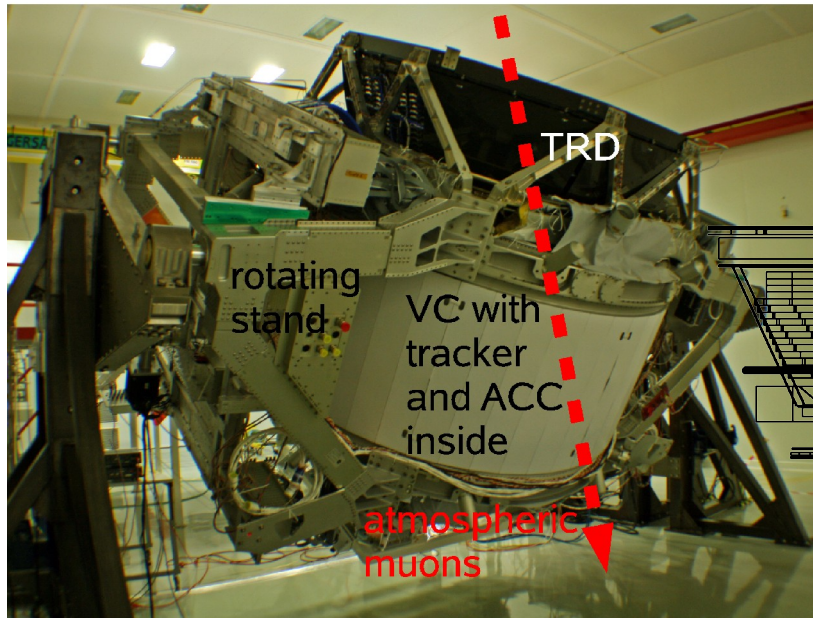
Flight Electronics



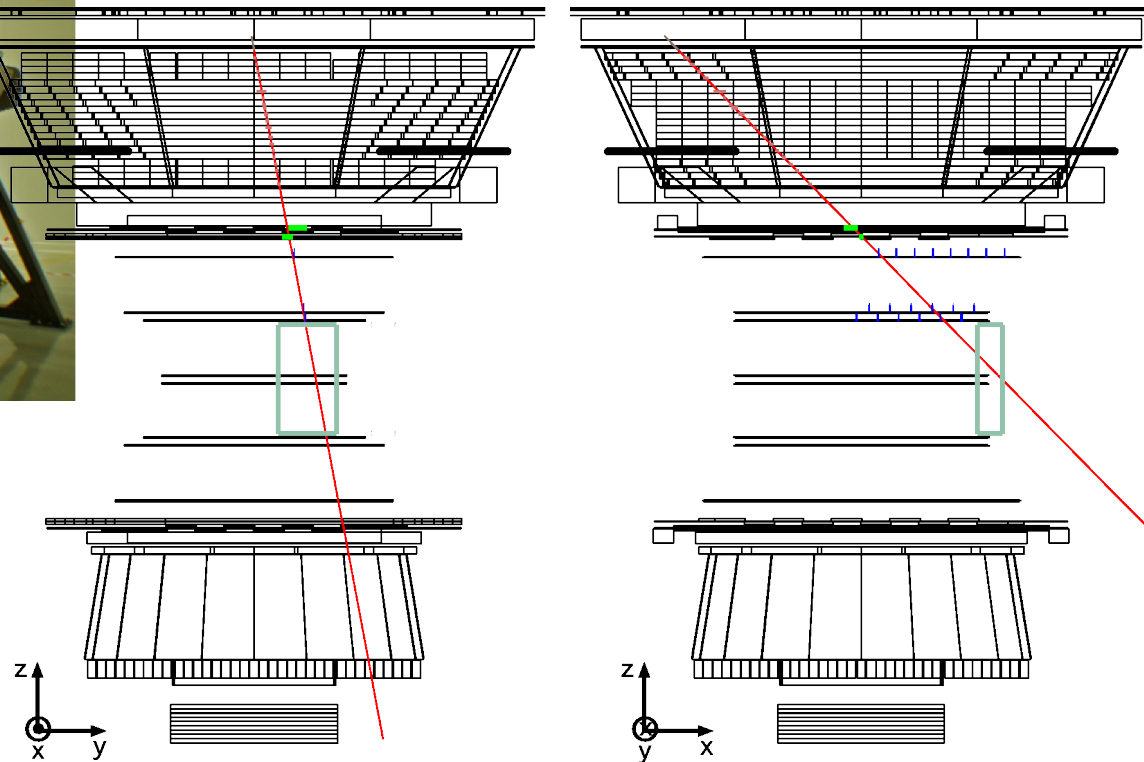
charge resolution:
testbeam: 3ADC counts for 1pC
flight: 50ADC counts for 0-1pC

**High resolution of small charges
is important for a reliable detection!**

AMS-02 Cosmics

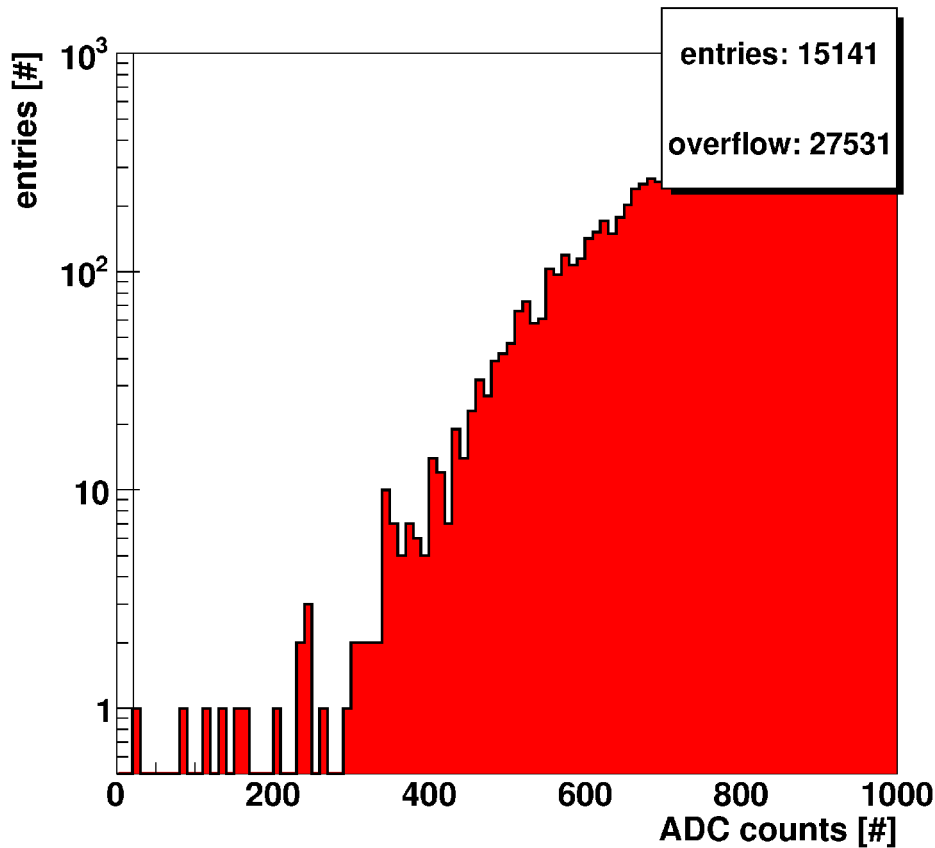


AMS-02 taking data after preintegration (all components, but magnet)

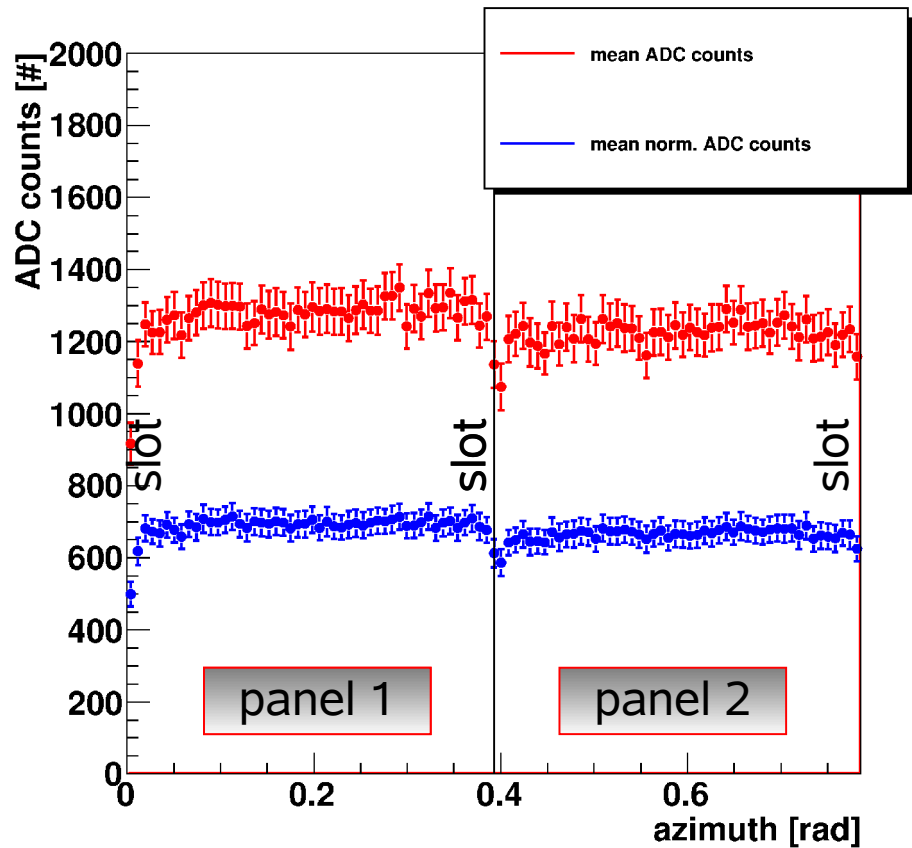


inefficiency study of ACC with TRD and tracker tracks

AMS-02 Cosmics



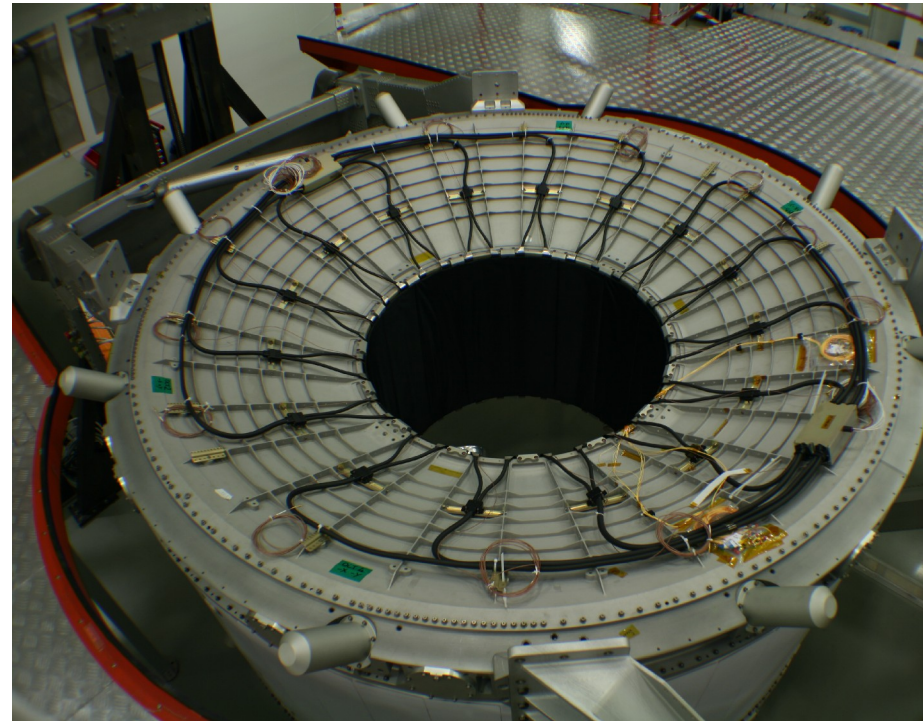
- use of very clean tracks in TRD and tracker
- **inefficiency** $< 3 \cdot 10^{-5}$ @ 68% C.L. for preintegration (design goal: $< 10^{-4}$)



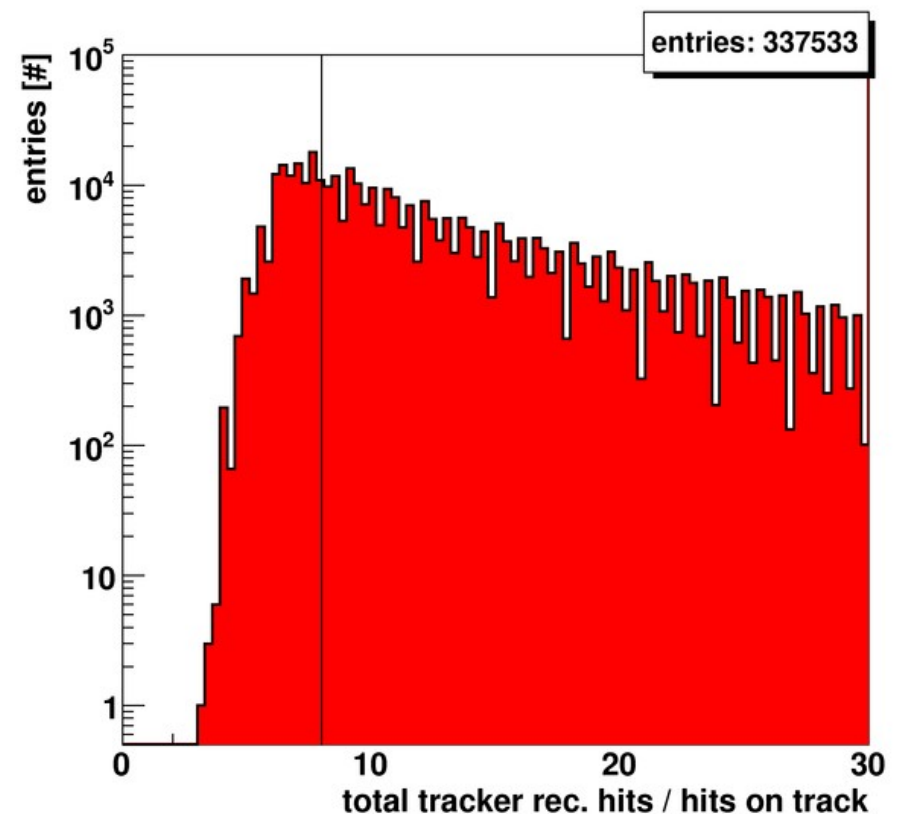
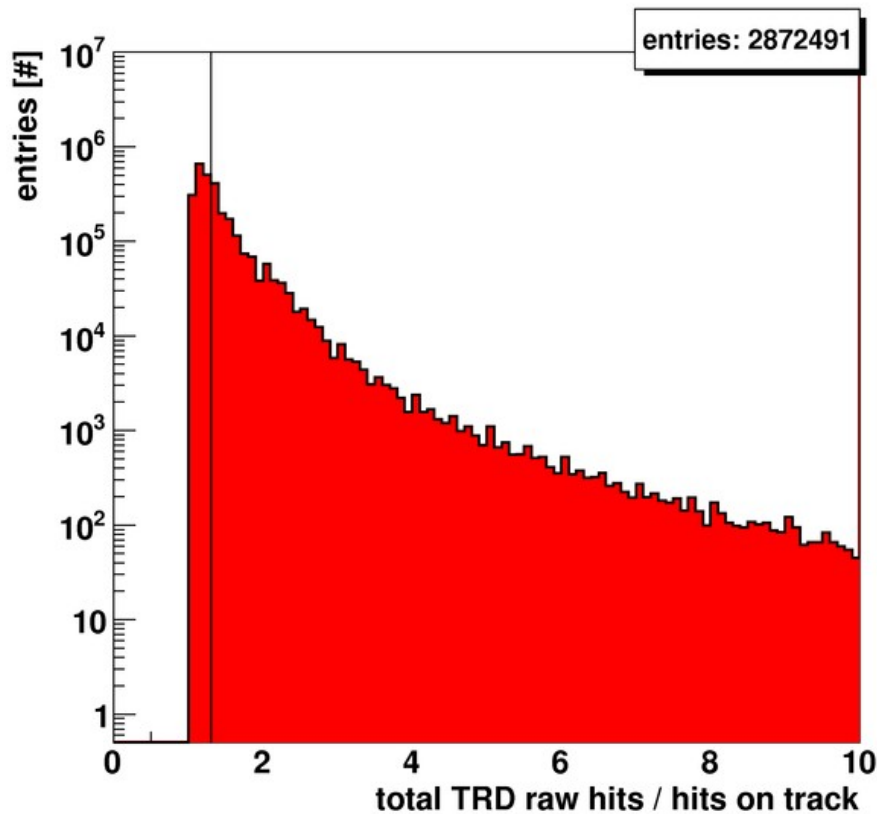
- average signal height across a sector of two ACC panels

Conclusion

- Preintegration of AMS-02 finished!
- ACC system works well!
 - scintillators: very good
 - clear fibers: very good
 - PMT: very good
 - electronics: very good
 - inefficiency is small!
- AMS-02 flight integration starts this year!

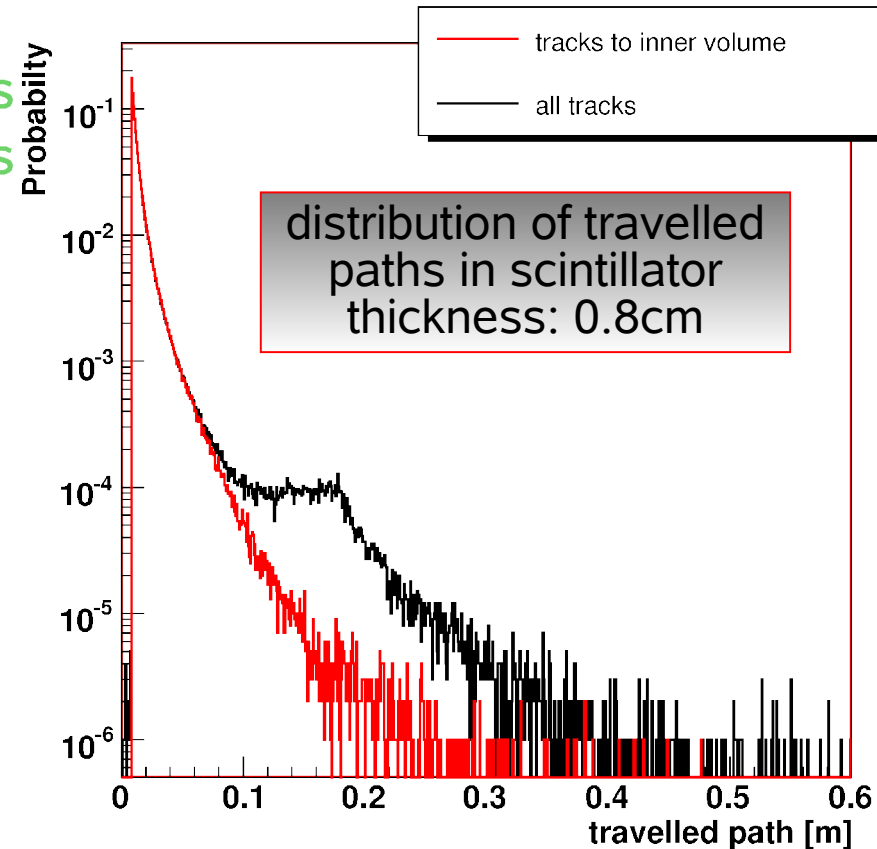
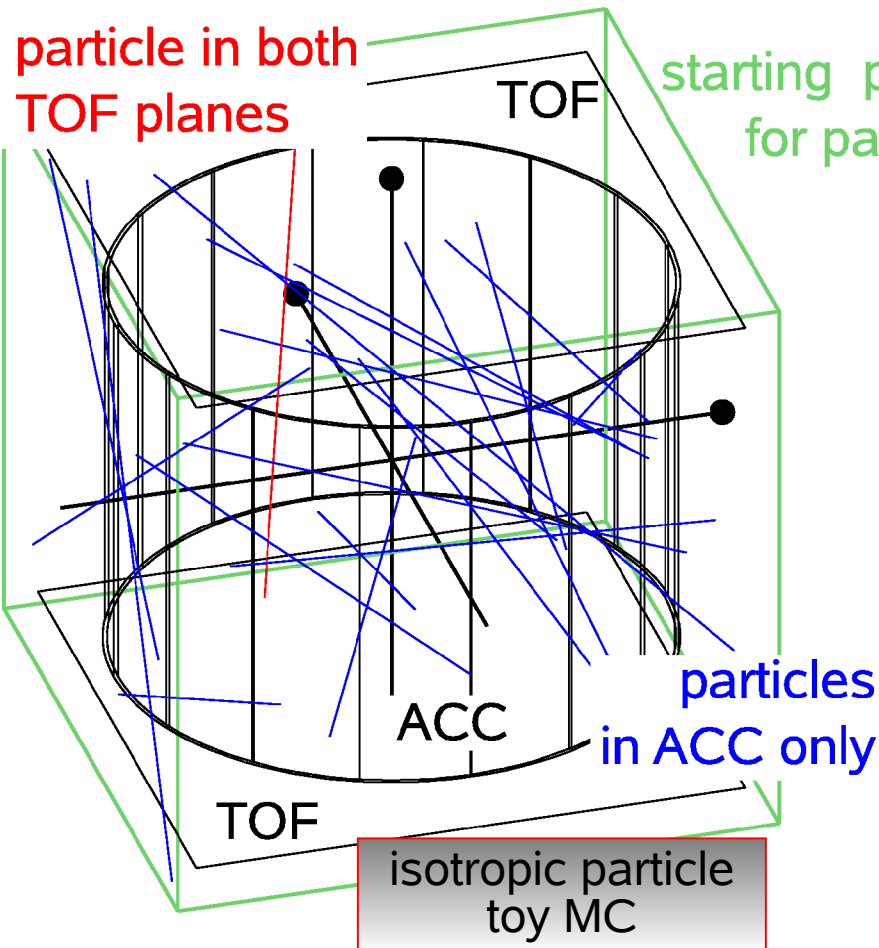


Preintegration Event Selection



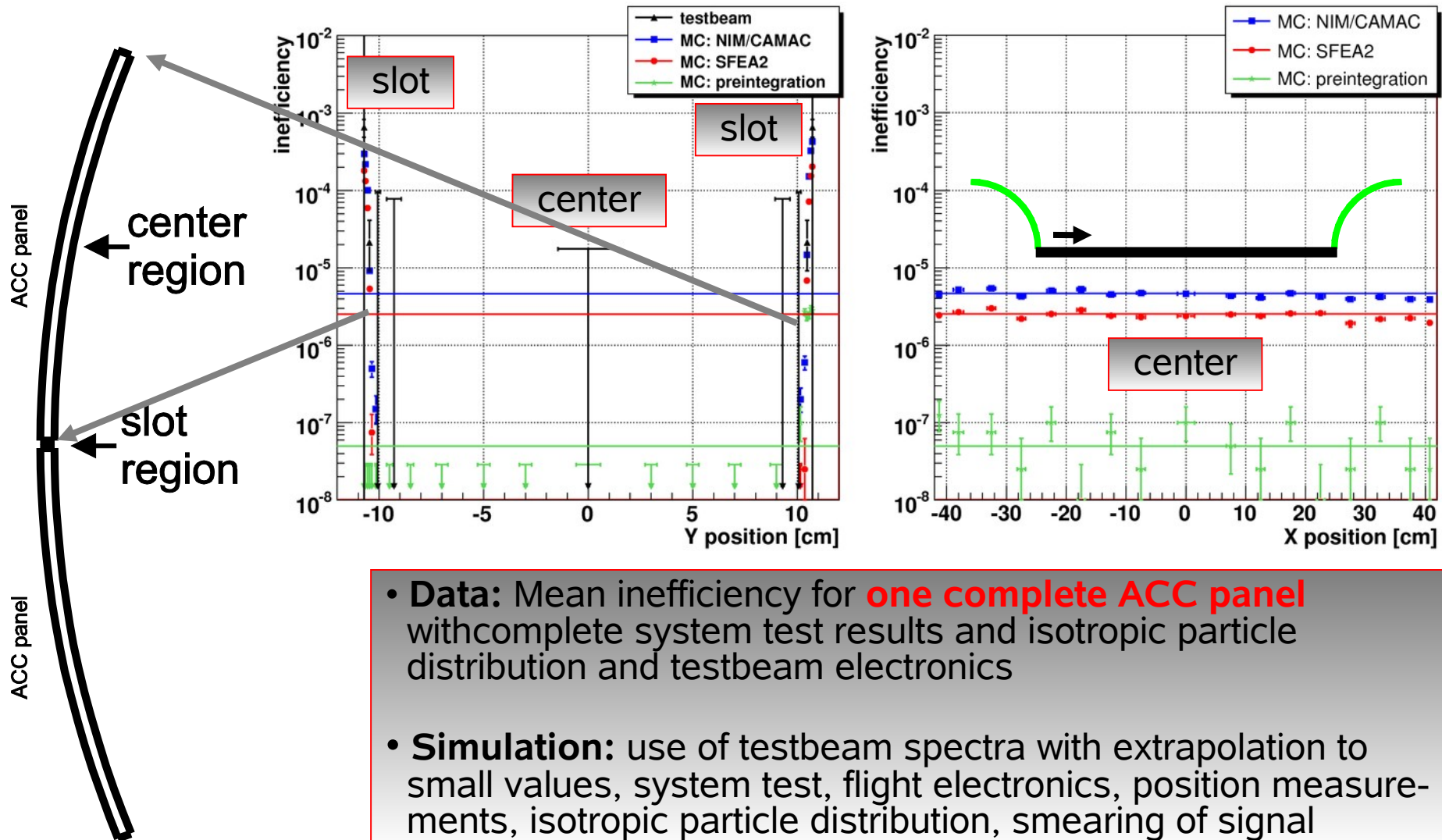
- short runs < 15min
- use clean tracks in TRD for extrapolation
- low noise in tracker (problems with cooling system)

Isotropic Particle Distribution



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

Inefficiency Model



- **Data:** Mean inefficiency for **one complete ACC panel** with complete system test results and isotropic particle distribution and testbeam electronics
- **Simulation:** use of testbeam spectra with extrapolation to small values, system test, flight electronics, position measurements, isotropic particle distribution, smearing of signal