Charge identification in RICH

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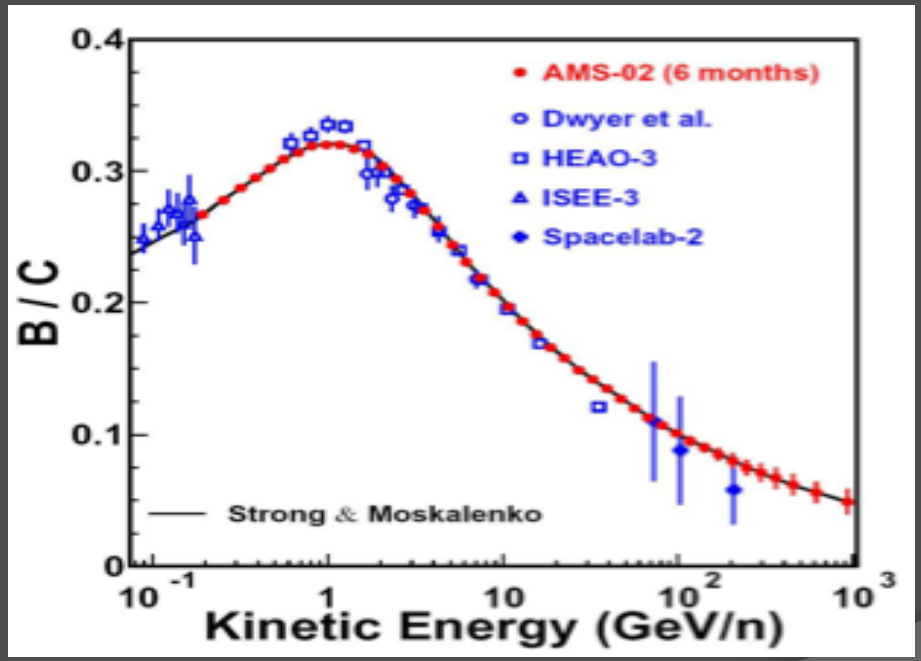
Main goals

- Light nuclei selection ($Z \leq 6$)
  - Check the charge reconstruction made with RICH
  - Evaluating of charge performance in RICH detector
- Determination of nuclei ratios: $\frac{B}{C}$ $\frac{He}{H}$
- Comparison with data using Propagation Models : parameters determination

These implies a detailed study of the charge determination by the RICH detector (LIP algorithm) .

Current B/C measurements

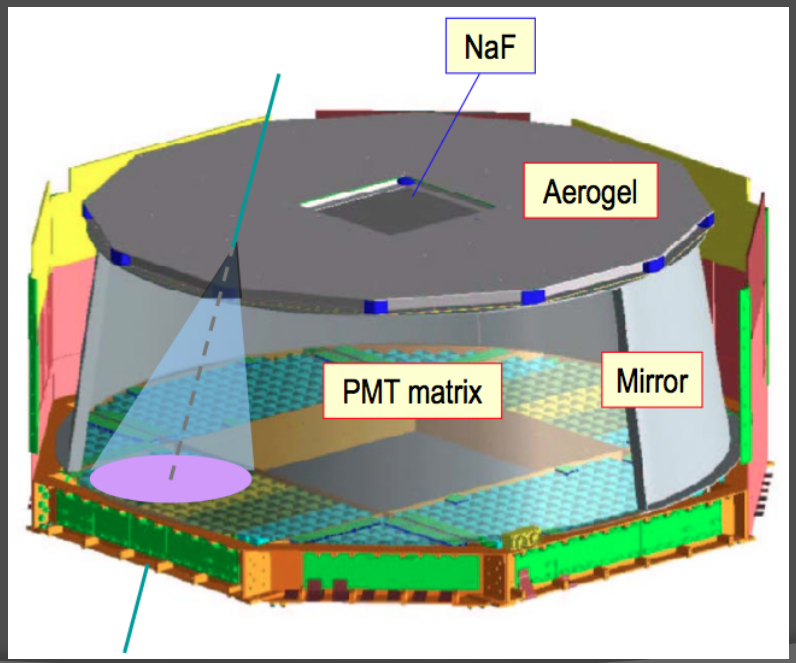
- The plot below show the status of $\frac{B}{C}$ measurements compared to the AMS-02 estimations as derived from the Strong-Moskalenko model
- This shows the great performance of charge identification that we aim to achieve with RICH detector

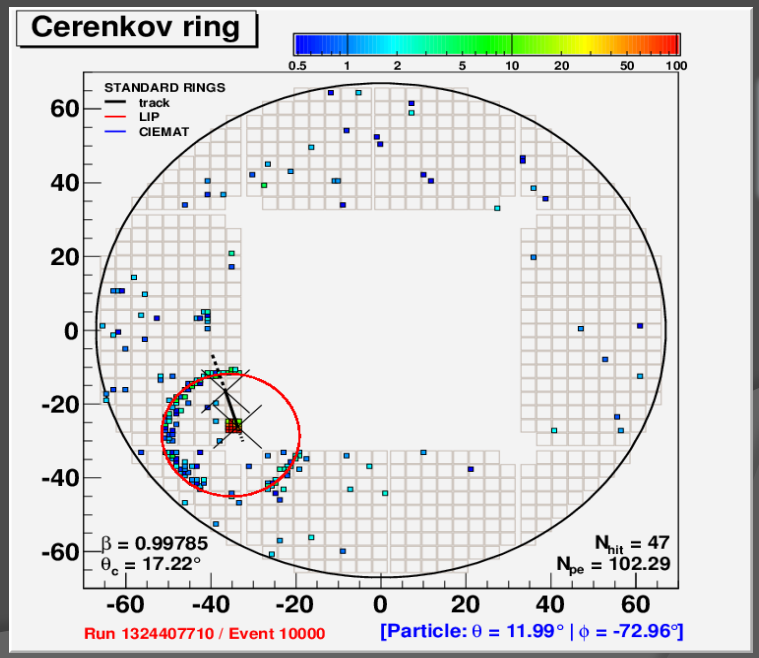


RICH detector and Z measurement

- ✓ Cerenkov photons are radiated giving information about charge
- ✓ The photons that hit the photo-detector matrix are converted into photoelectrons
- ✓ The number of photoelectrons depends on the charge

$$Z^2 \propto \frac{N_{p.e} \sin^2(\theta_c)}{\epsilon}$$

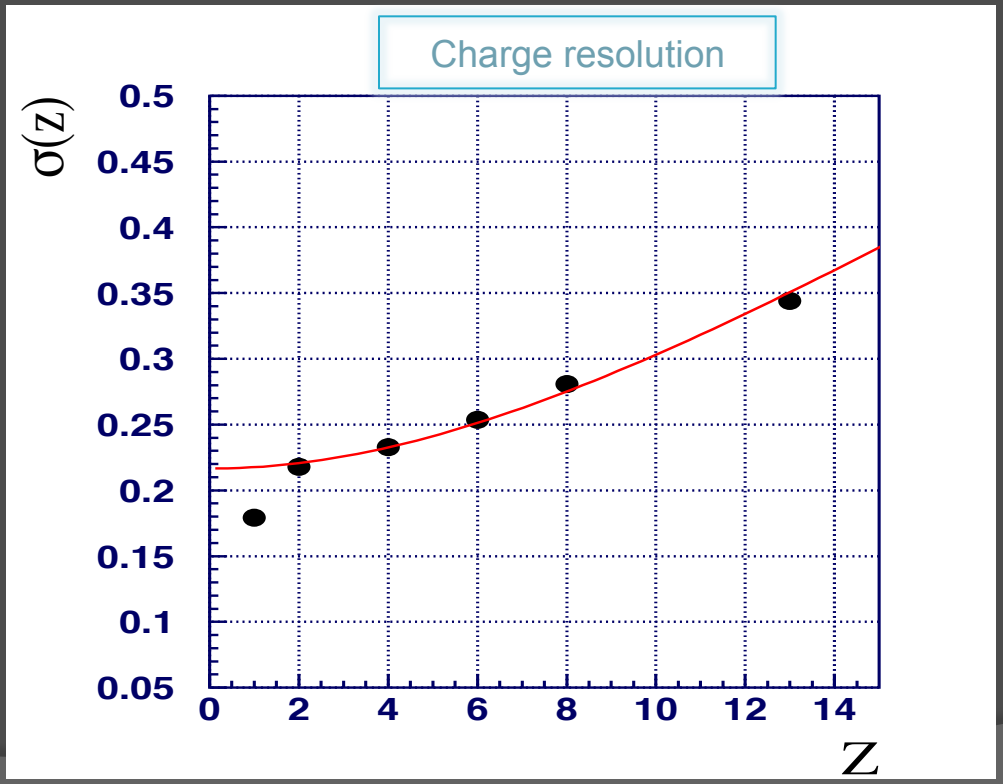


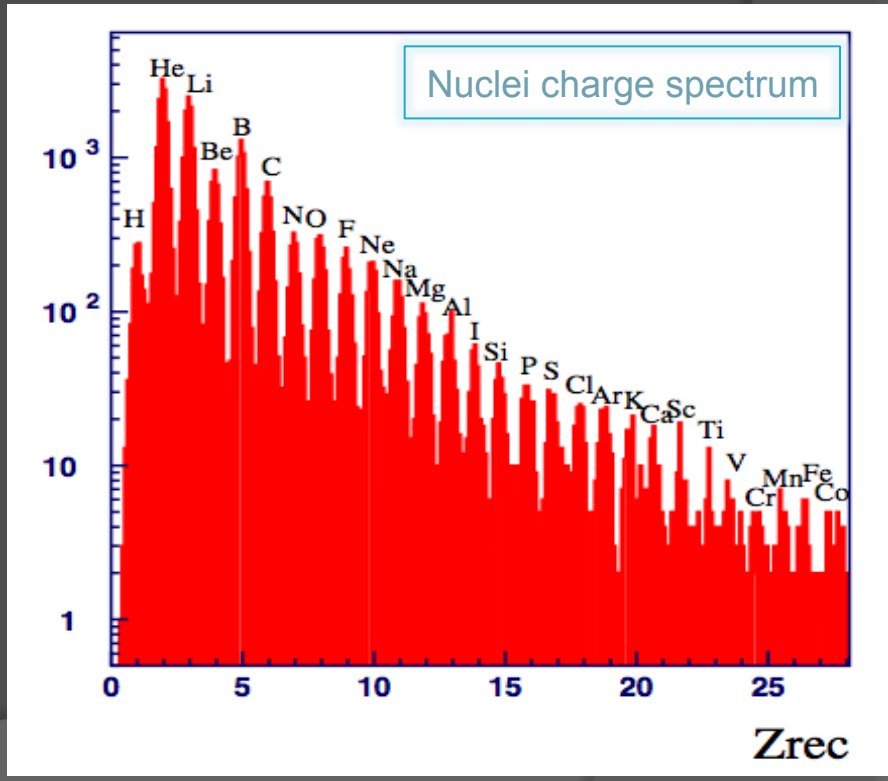


Carbon event

RICH Charge at Test Beam

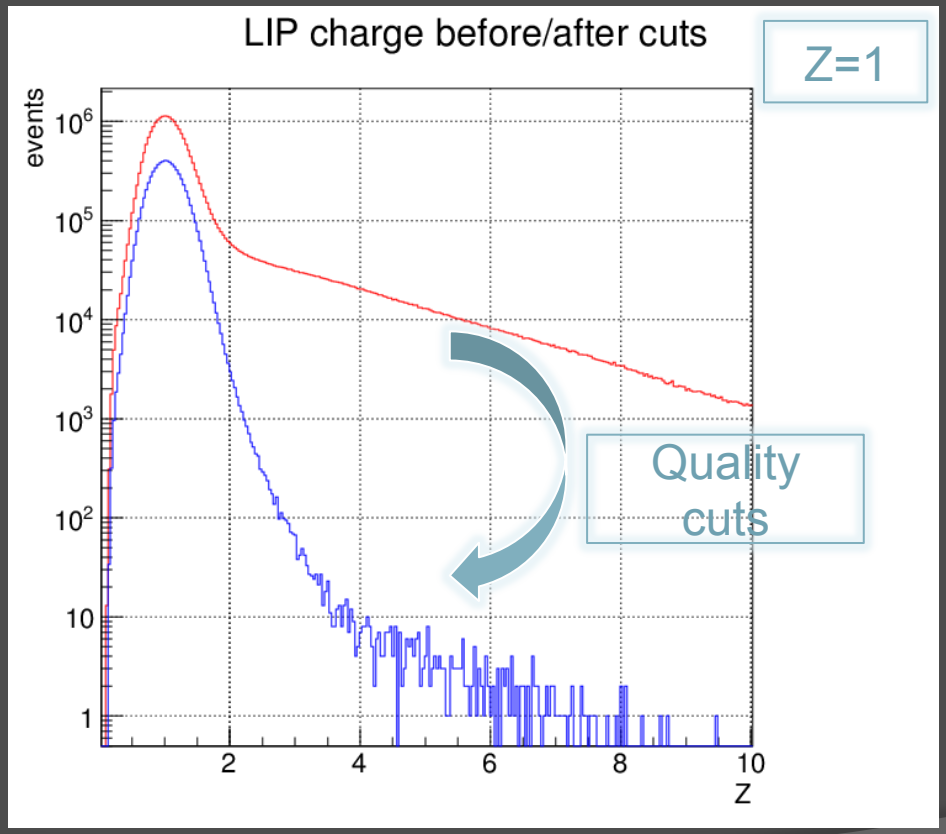
- ✓ We obtain from the the left plot charge resolution of 0.2 for Z=2
- ✓ The right side plot shows us the nuclei charge spectrum with a good resolution
- ✓ This shows the great potential of charge detection in RICH

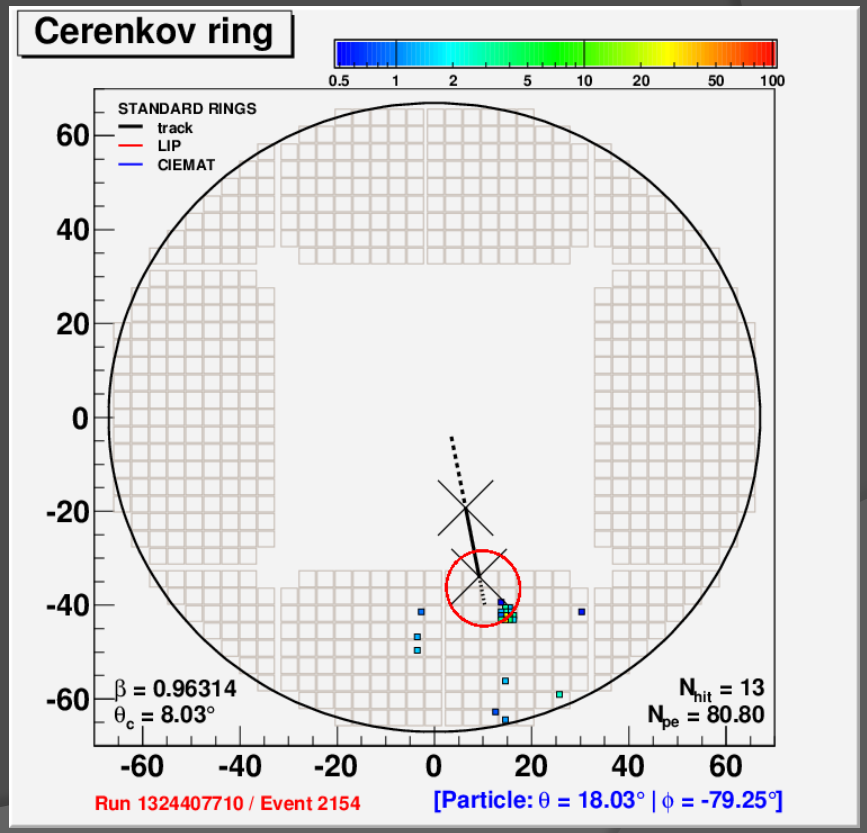




Event Selection

- ✓ If we look careful to the charge detection using AMS-02 data, we realize that the charge resolution need to be improved
- ✓ The right side picture shows a clustered event that will imply a poor charge reconstruction





What to do to improve Z rec

- ✓ A fine tuning of charge is required
- ✓ We will proceed to the study of performance of charge detection in PMT matrix . In particular, we will study the following aspects:
  - Occupancy of each PMT
  - Correlation between PMT gain and temperature
  - Uniformity of charge over the PMT matrix

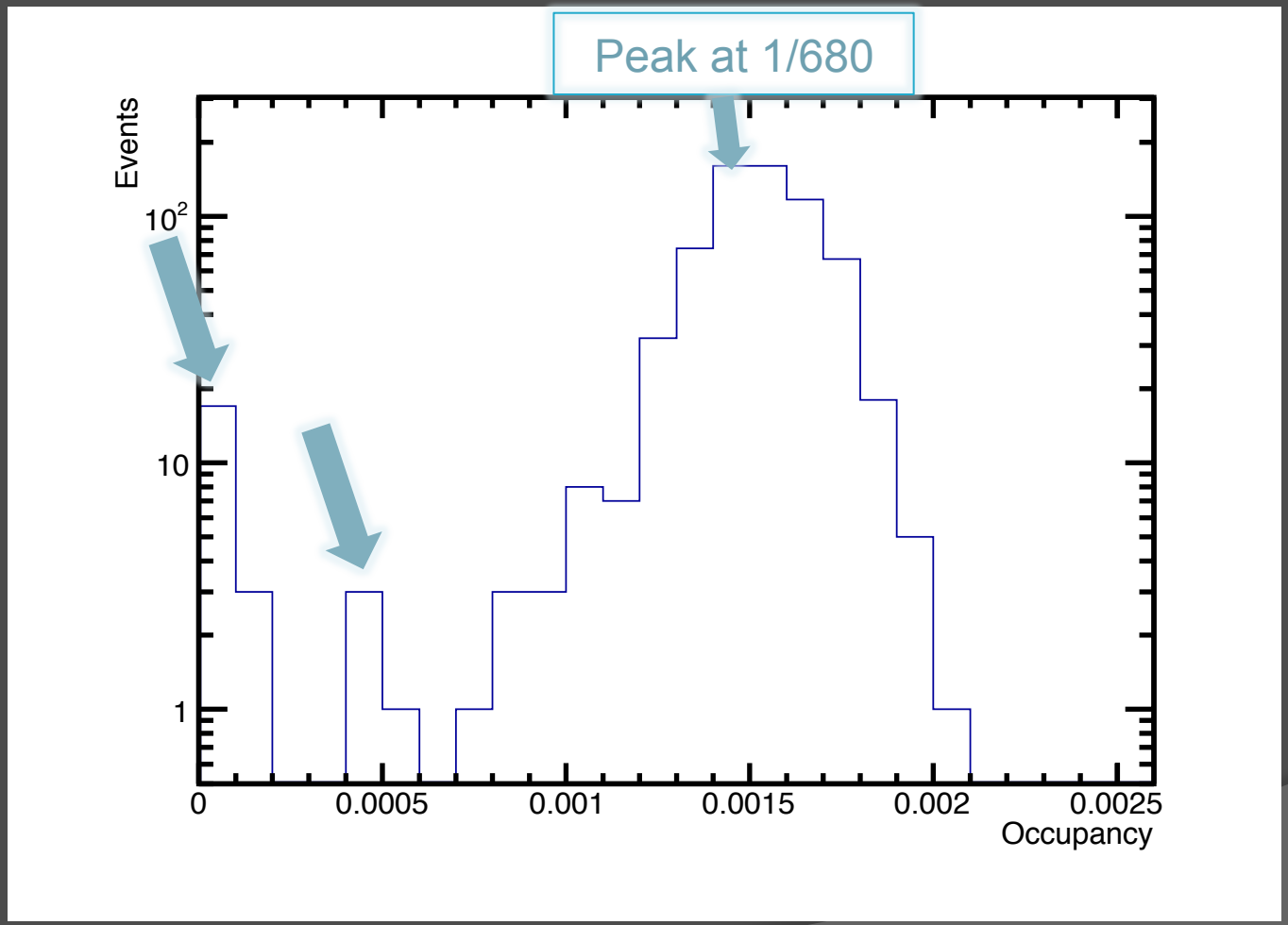
Time dependent factors

- ✓ Main Concepts:

- PMT gain: number of photoelectrons produced by each photon that hits the PMT matrix
- PMT Occupancy: Fraction of hits falling on every PMT
- Uniformity of charge: Same charge value for all PMT matrix regions

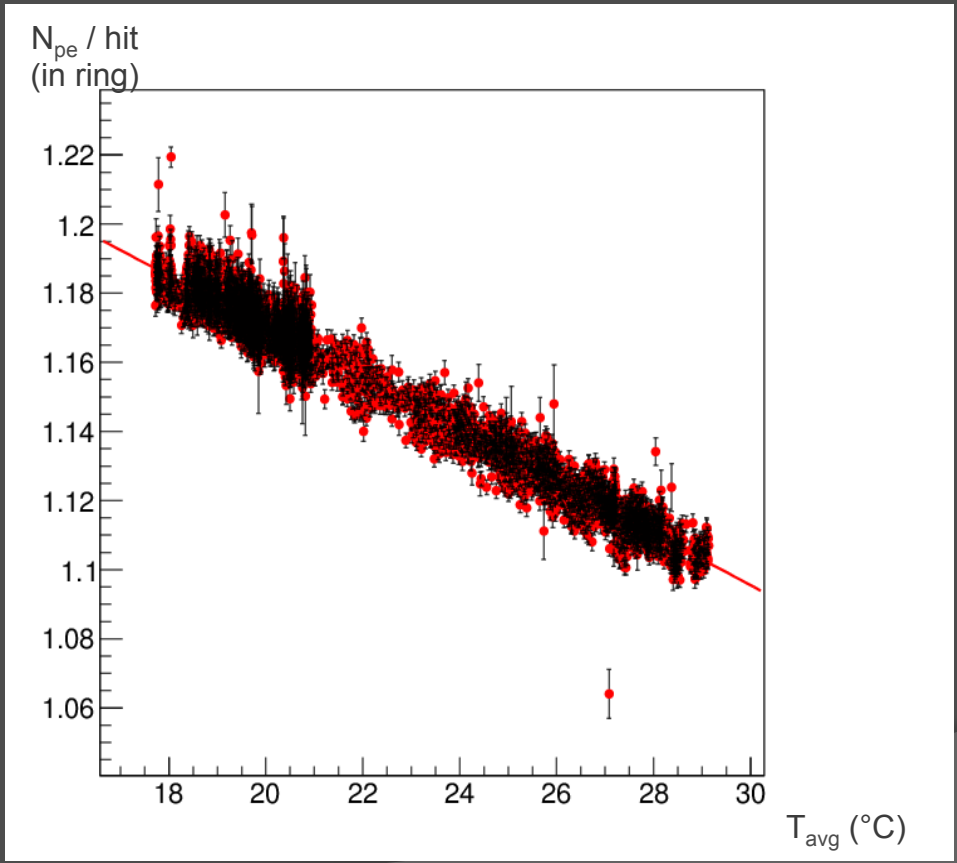
Occupancy

- ✓ Check PMT occupancy and eliminate the low occupancy ones



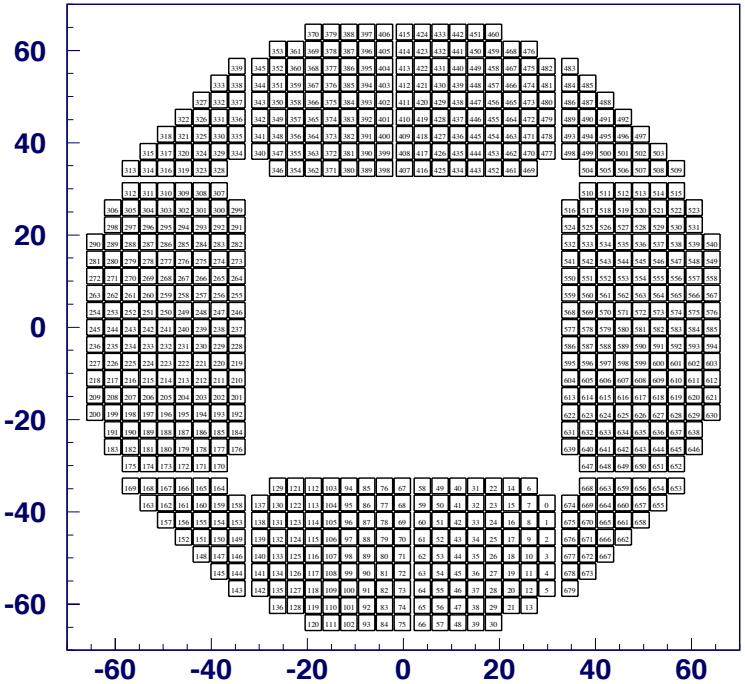
PMT gain vs Temperature

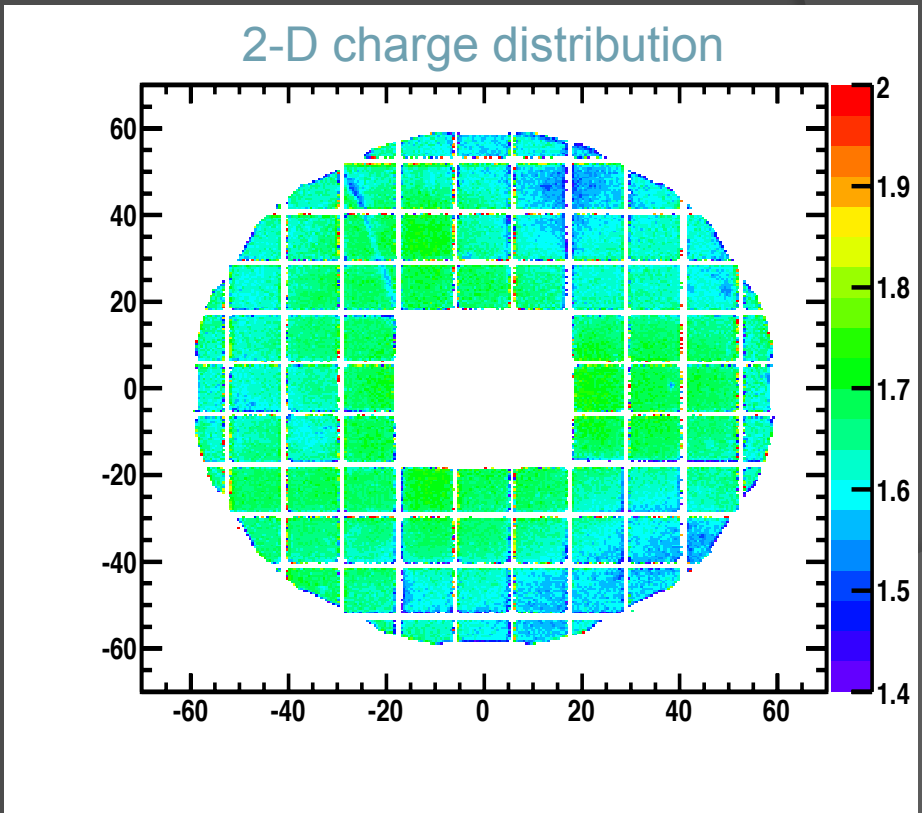
- There is a clear correlation between the detected signal and the temperature of the PMTs
- This shows that the PMT gain decreases with temperature



Charge uniformity

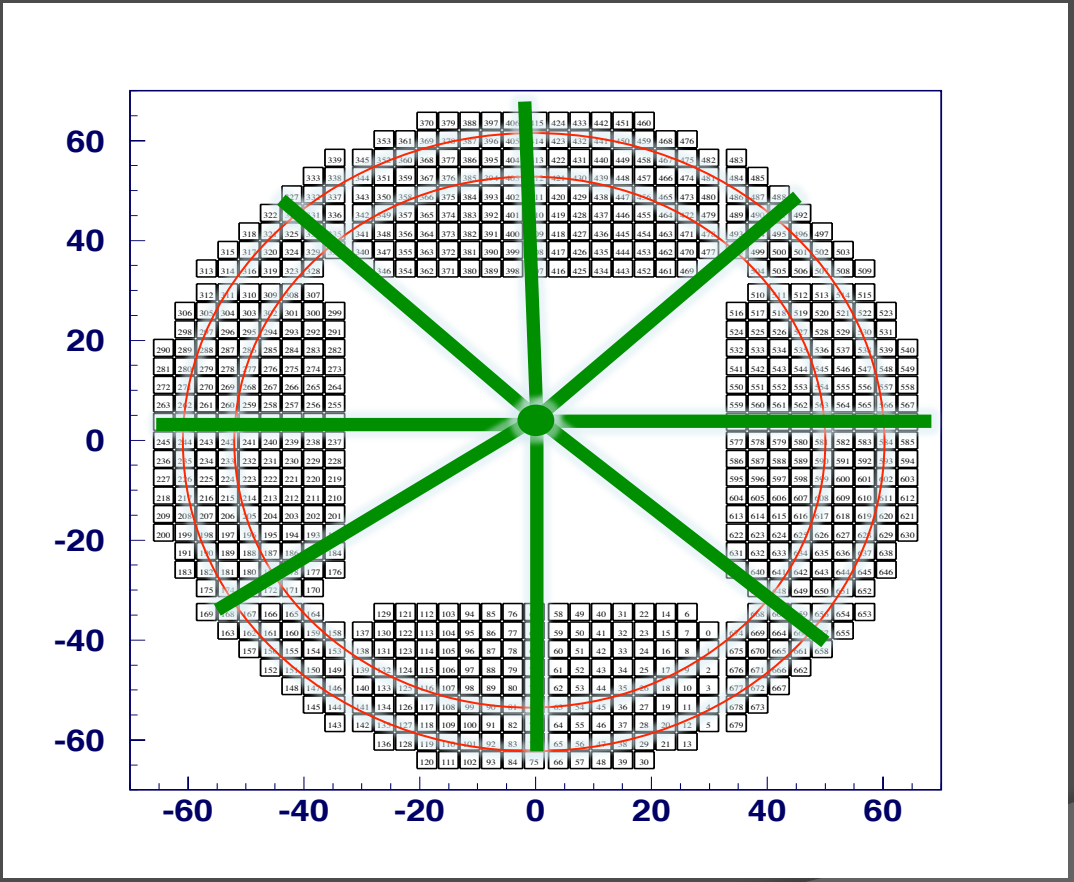
- ✓ We aim to evaluate the uniformity of charge over the PMT matrix
- ✓ In this plots, we show the helium nuclei





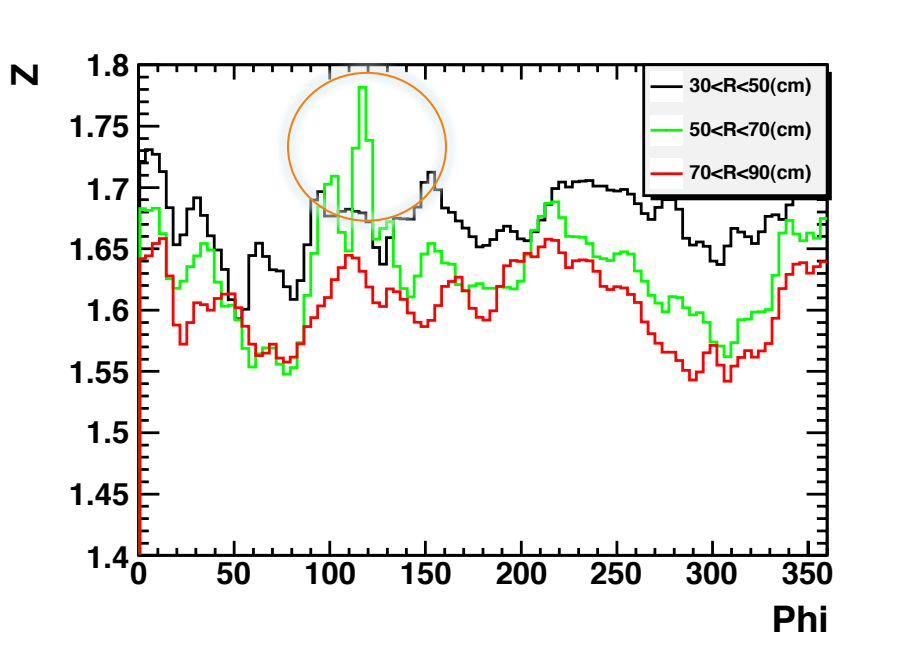
Charge uniformity

- To understand better the uniformity of charge showed in the previous slide, we proceed to the radial and axial uniformity study.

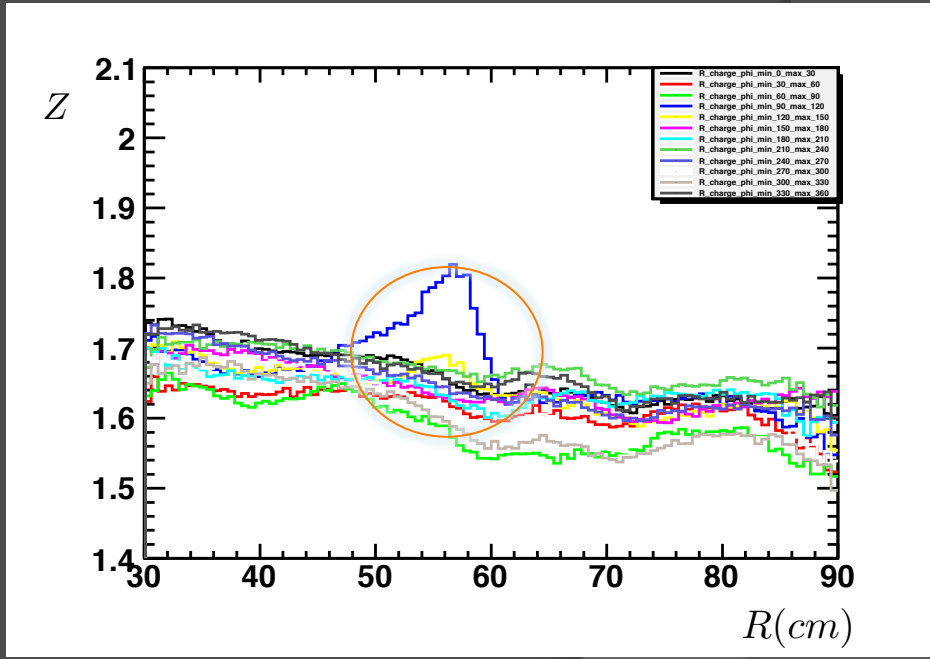


Charge uniformity

- ✓ The profile plots on r and phi show non uniformities that should be corrected
- ✓ This will imply a careful study of the efficiency factors per PMT

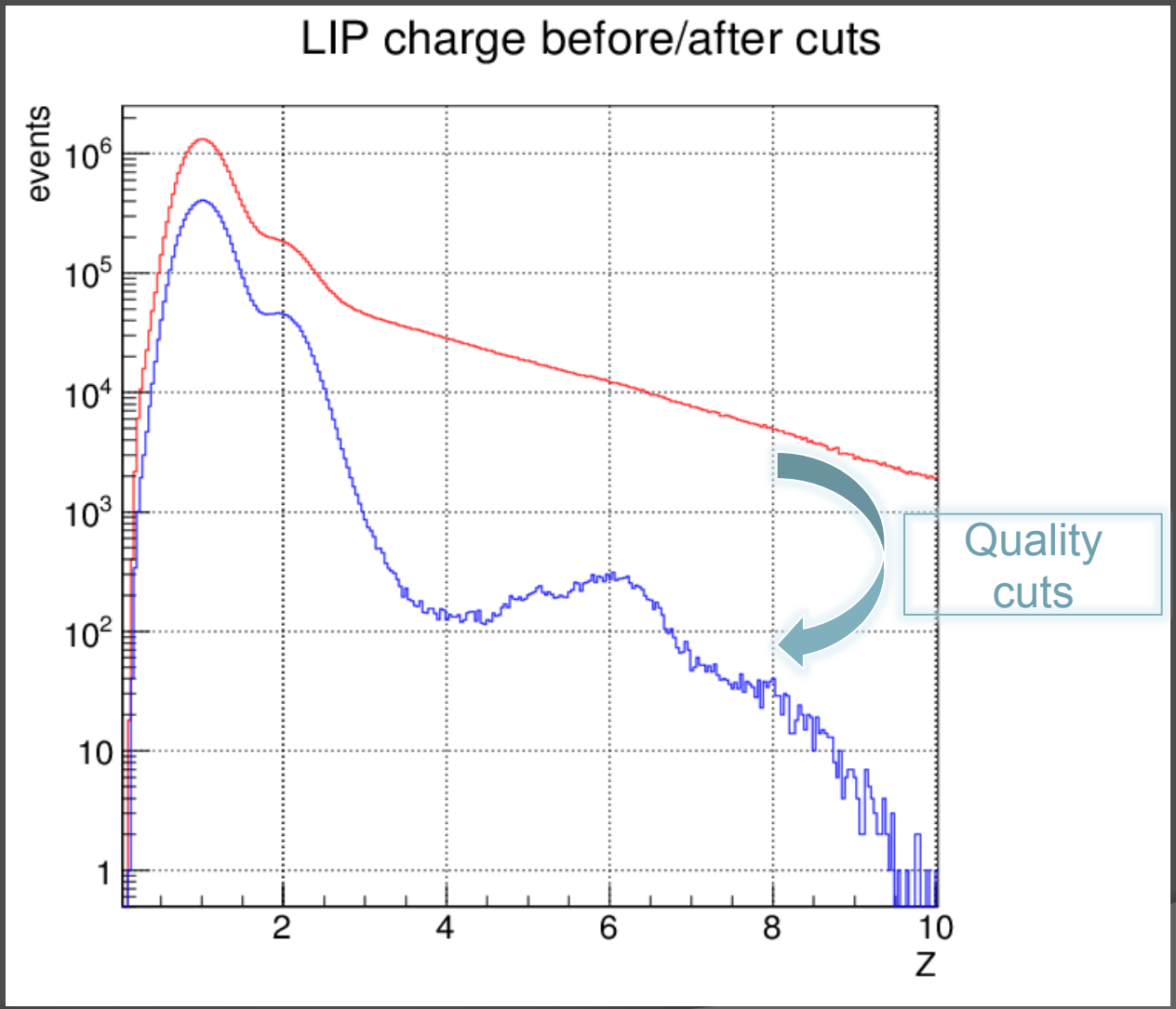


Charge vs. Phi distribution



Charge vs. Radii distribution

AMS-02 charge performance



Lot of work to do!