Collision Muons Analysis on Tile-Calorimeter

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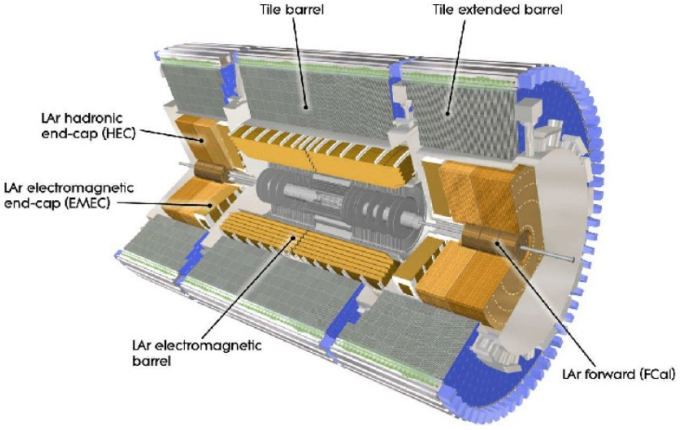
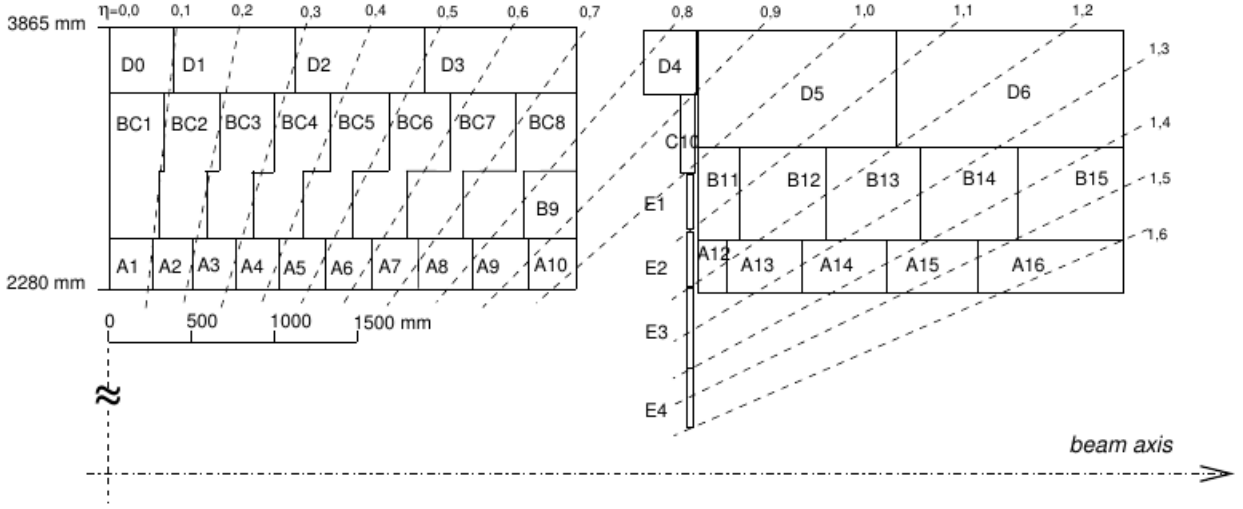
- Muons deposit energy via ionization following the well known *Bethe* formula, making them ideal for calorimeter response study.
- The Tile Calorimeter (TileCal) of ATLAS is a calorimeter system in the central region of the detector.
- Use muons from $W \rightarrow \mu \nu$ events to measure:
  - Cell energy deposit over path length *dE/dx* data-MC agreement
  - Cell response uniformity over azimuthal angle ϕ
- Motivation: Jet energy scale is calibrated assuming calorimeter's uniform response in ϕ.

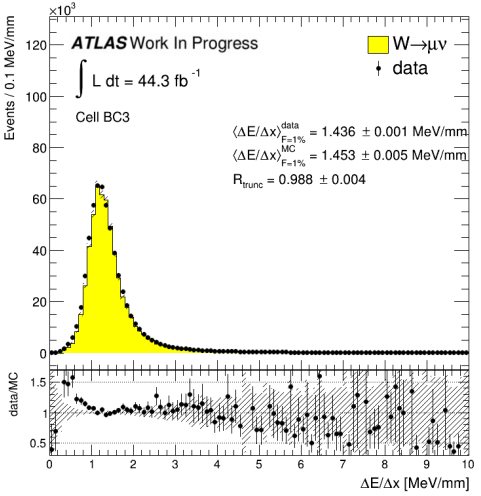


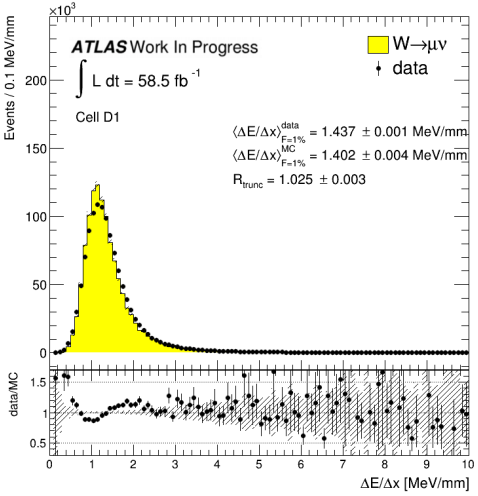


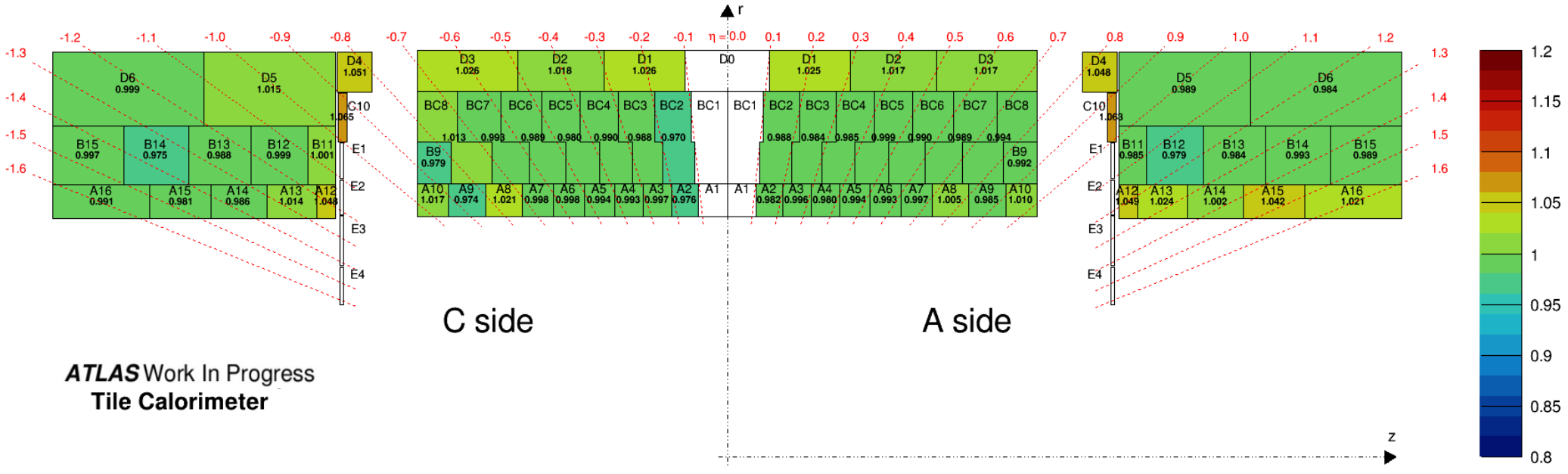
- Calculate the truncated mean of dE/dx distribution.
- Calculate the truncated mean data/MC ratio *R*.

$$R = \frac{< \Delta E/\Delta x >^{\mathrm{data}}_{F=1\%}}{< \Delta E/\Delta x >^{\mathrm{MC}}_{F=1\%}}$$

- Compare data from different data-taking year with the appropriate MC campaign that matches the pile-up conditions.







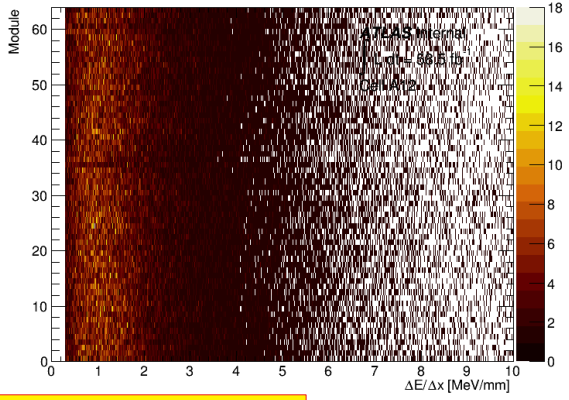
Cell response is defined of mean of dE/dX for cell *c* and module *m*,

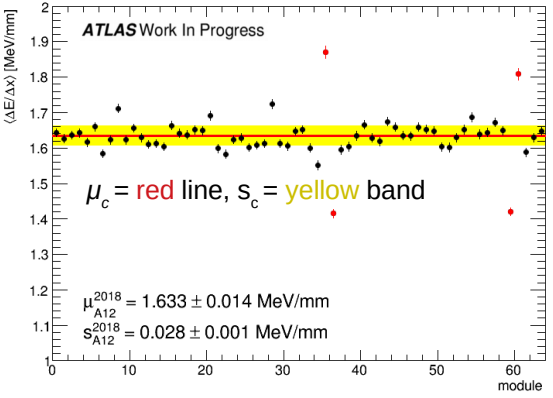
$$r_{m,c} \equiv \left\langle \frac{\Delta E}{\Delta x} \right\rangle_{m,c} = \frac{1}{N_{m,c}} \sum_{i}^{N_{m,c}} \left(\frac{\Delta E_i}{\Delta x_i} \right)_{m,c}$$

Likelihood function is defined and then maximized to solve for μ_c and systematics $s_{c,}$

$$L_c = \prod_{m=1}^{64} \frac{1}{\sqrt{2\pi}} \frac{1}{\sqrt{\sigma_{m,c}^2 + s_c^2}} \exp\left[-\frac{1}{2} \frac{(r_{m,c} - \mu_c)^2}{\sigma_{m,c}^2 + s_c^2} \right]$$

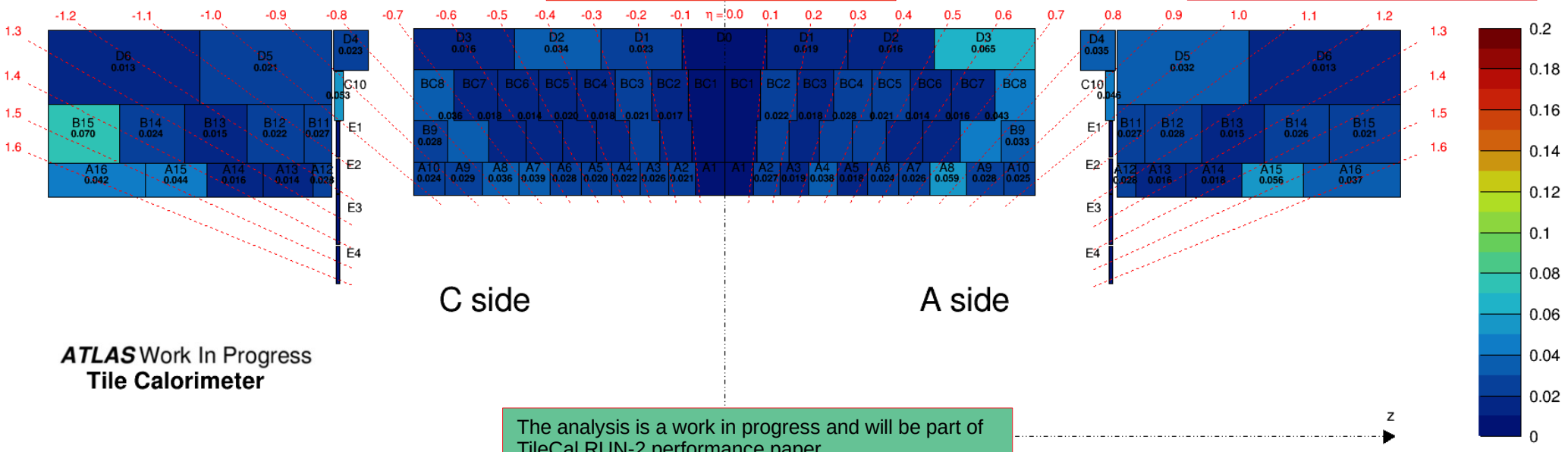
Special cells, to be excluded





s_c is the measure of non-uniformity in ϕ module

The method is sensitive enough to detect cells with special geometry.



ATLAS Work In Progress
Tile Calorimeter

The analysis is a work in progress and will be part of TileCal RUN-2 performance paper.