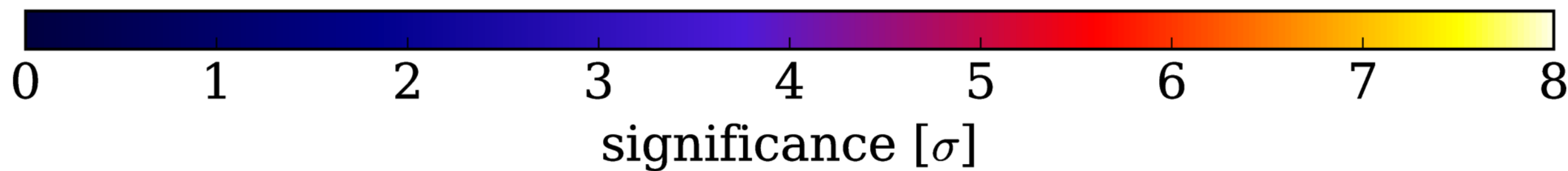
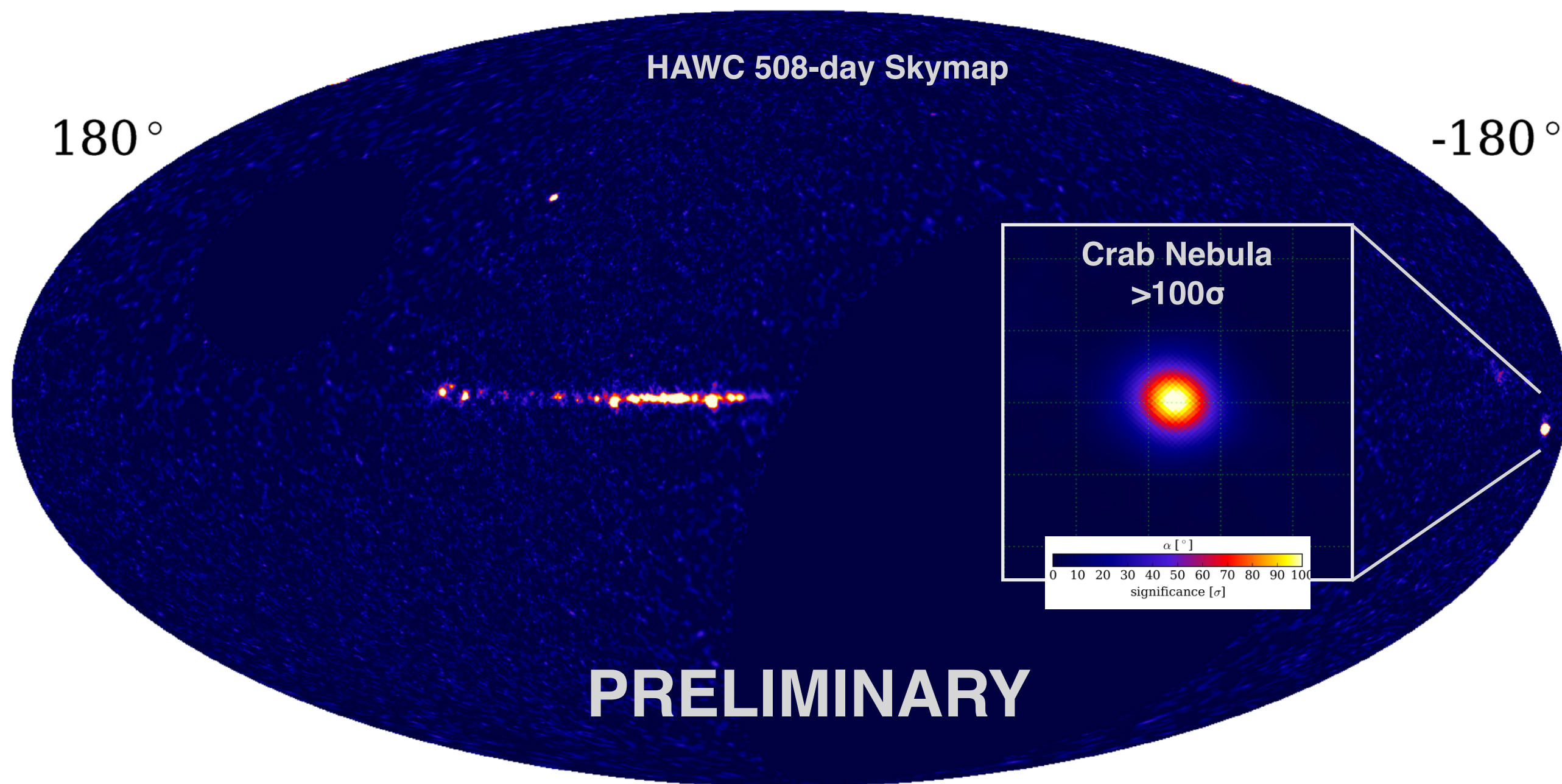


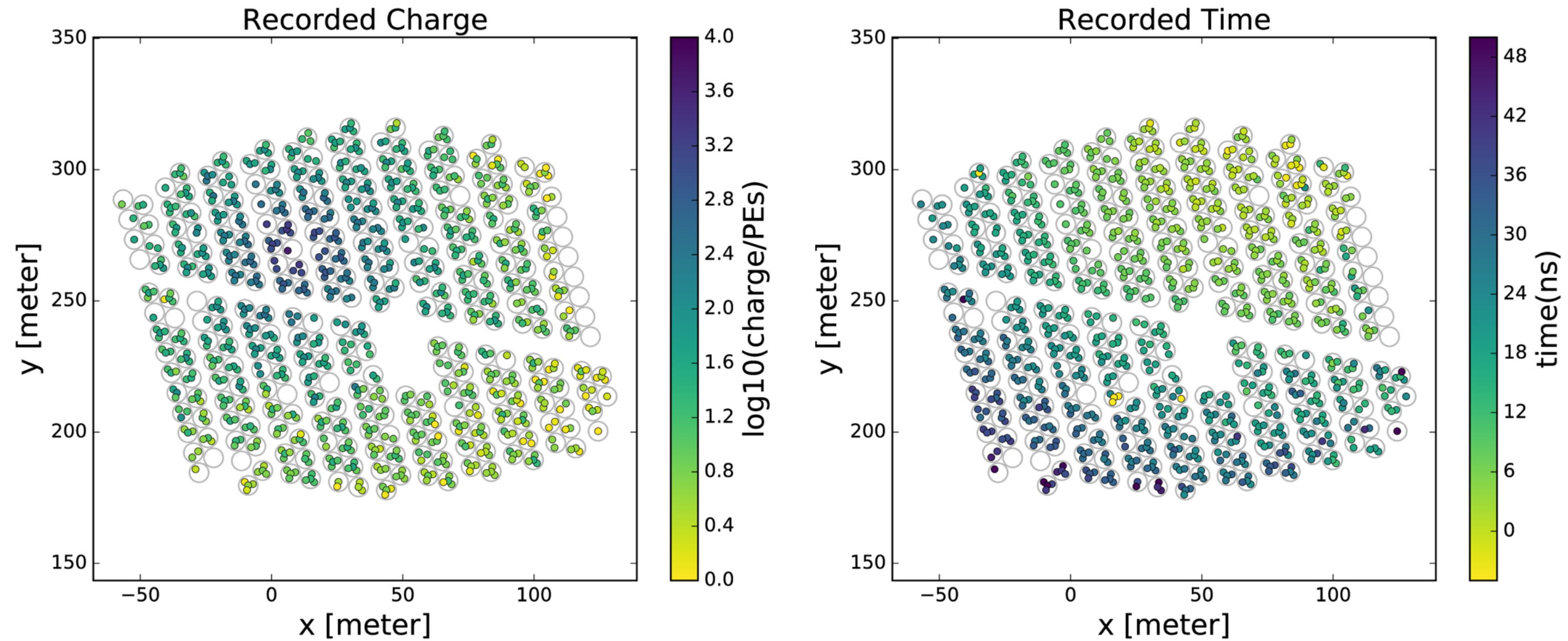
Performance of HAWC in First Data

John Pretz - Penn State
November 11, 2016



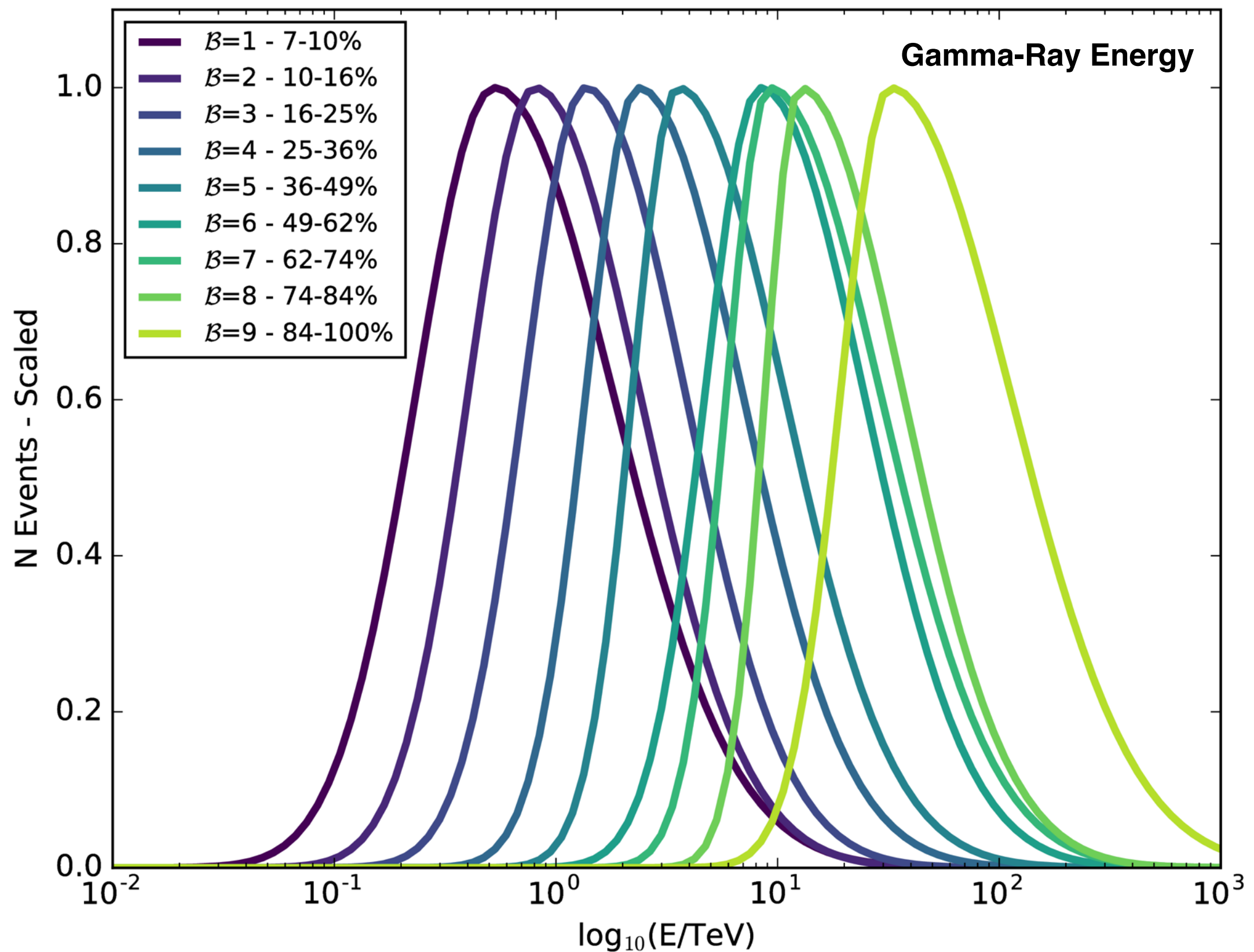


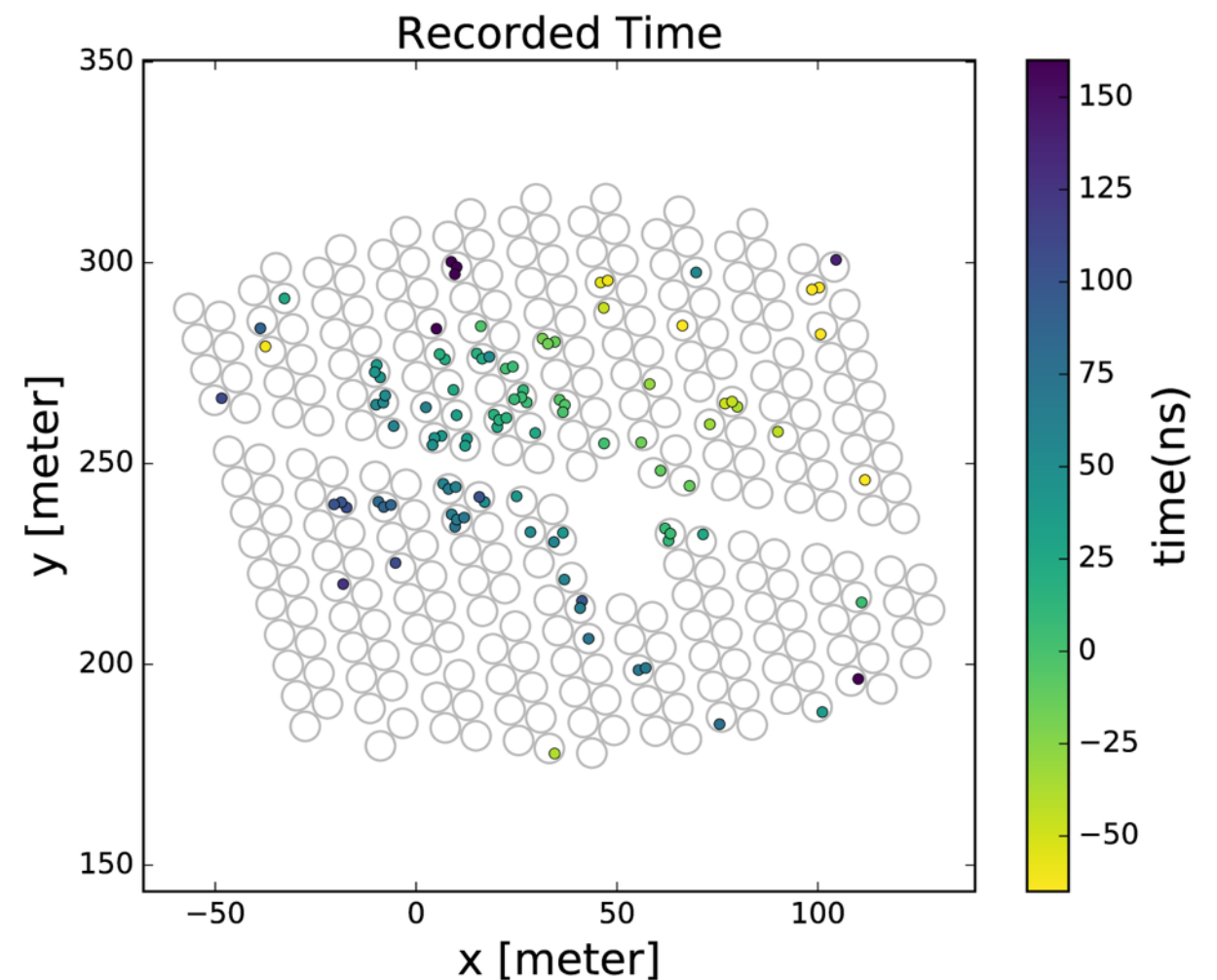
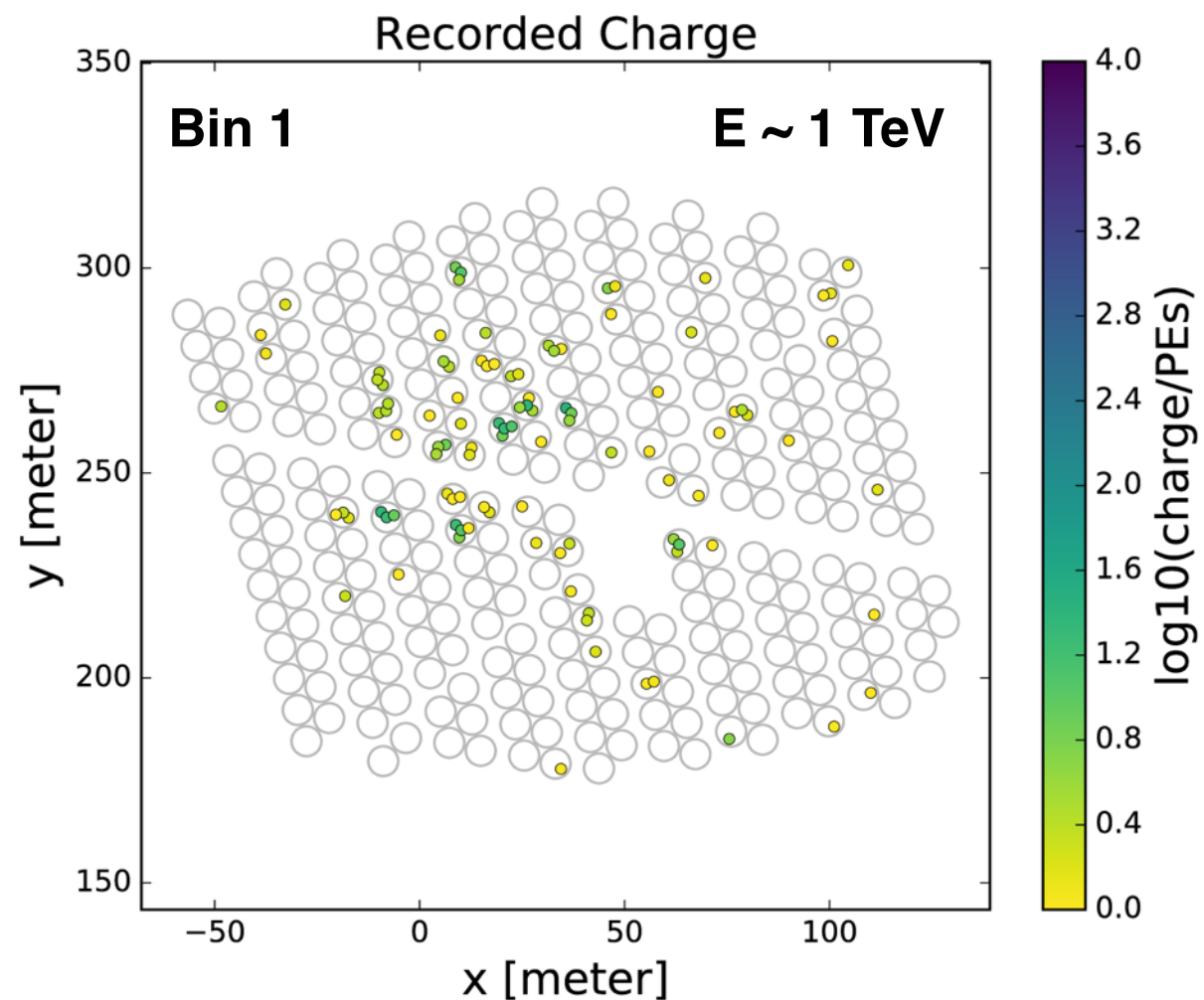
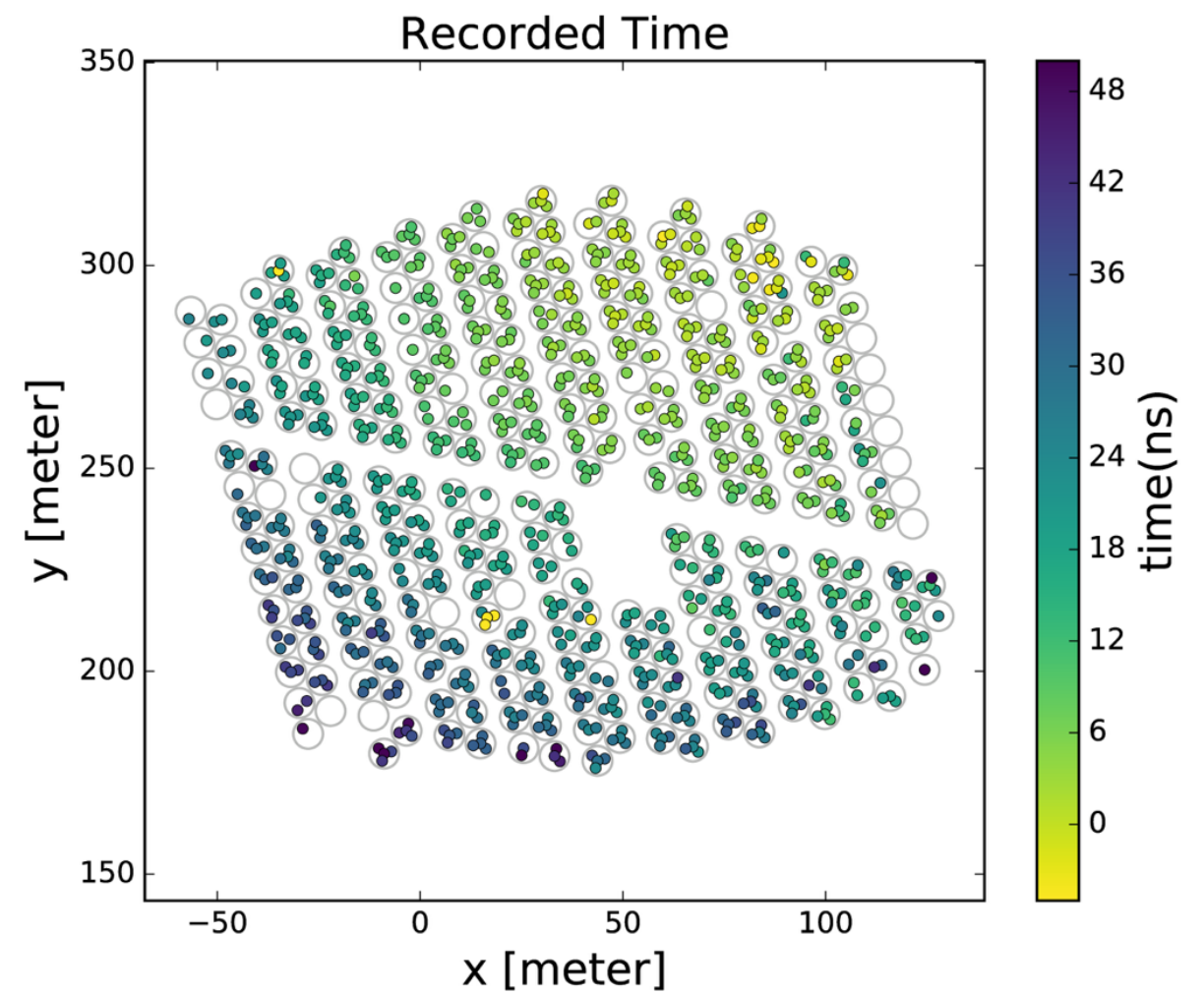
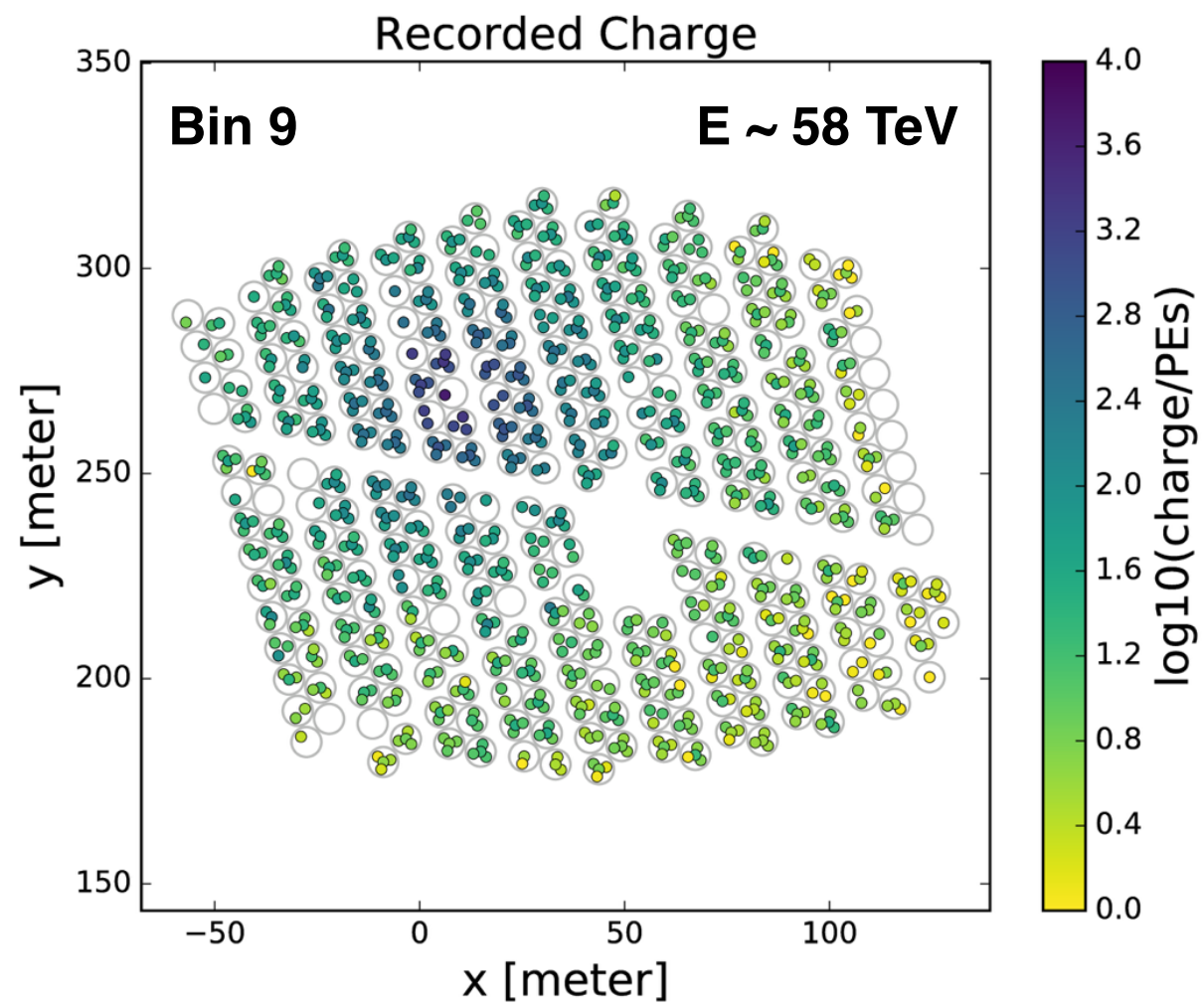
Sample Event



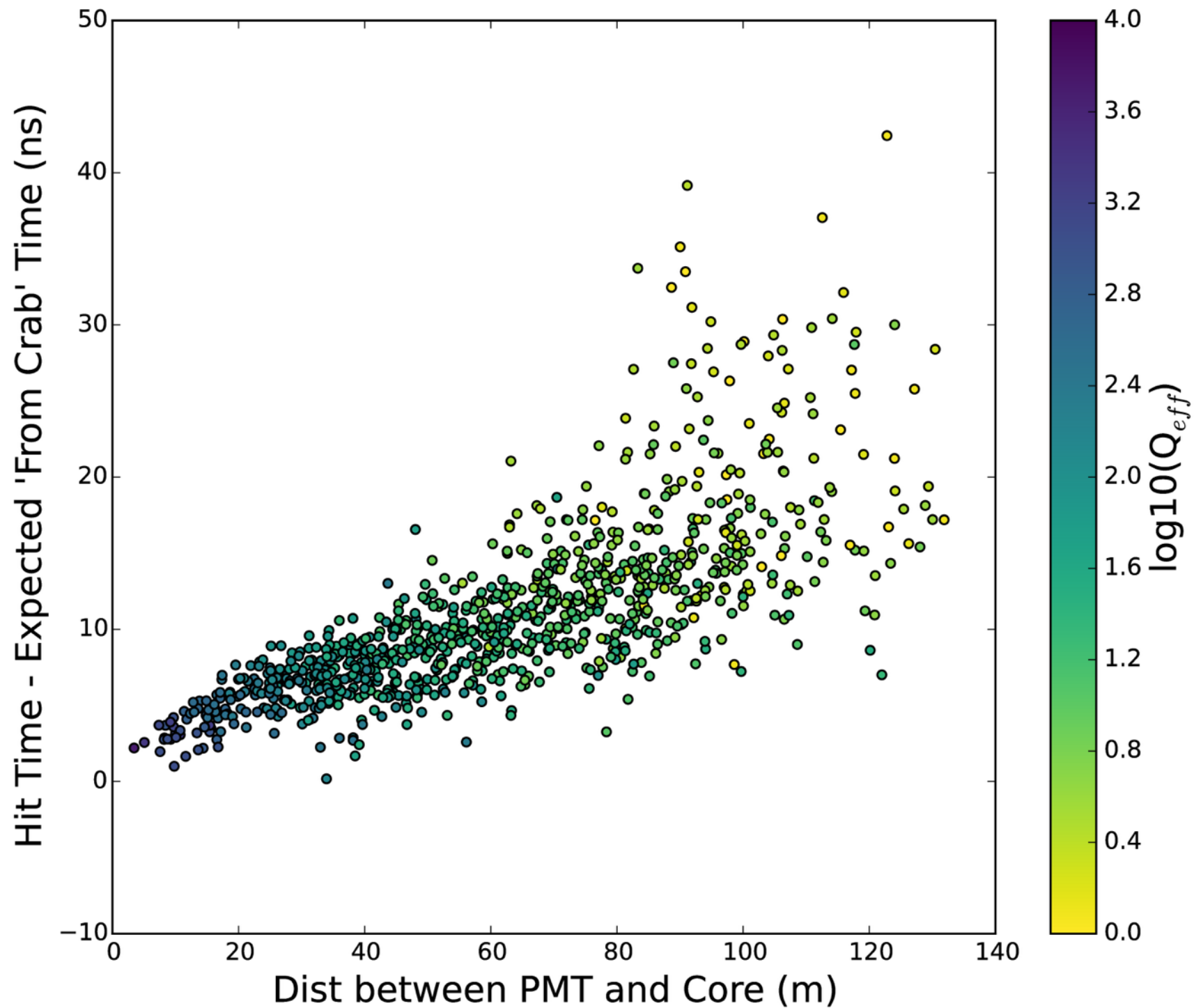
Trigger Rate ~ 25 kHz / 30 PMT Threshold

Events Categorized by Fraction of PMTs Hit



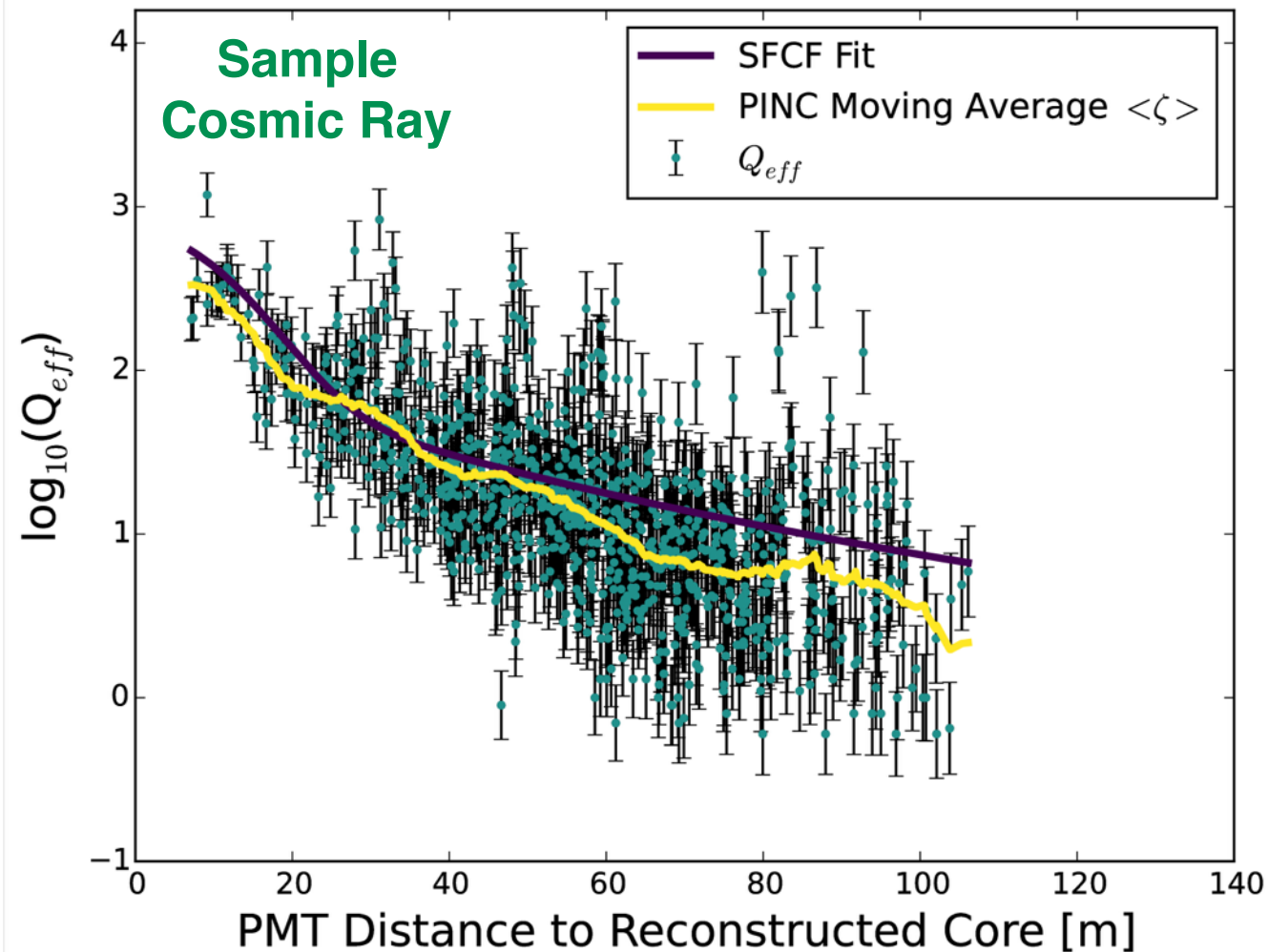


Air Shower Curvature & Sampling



Direction reconstruction is a simple plane fit, after this correction.

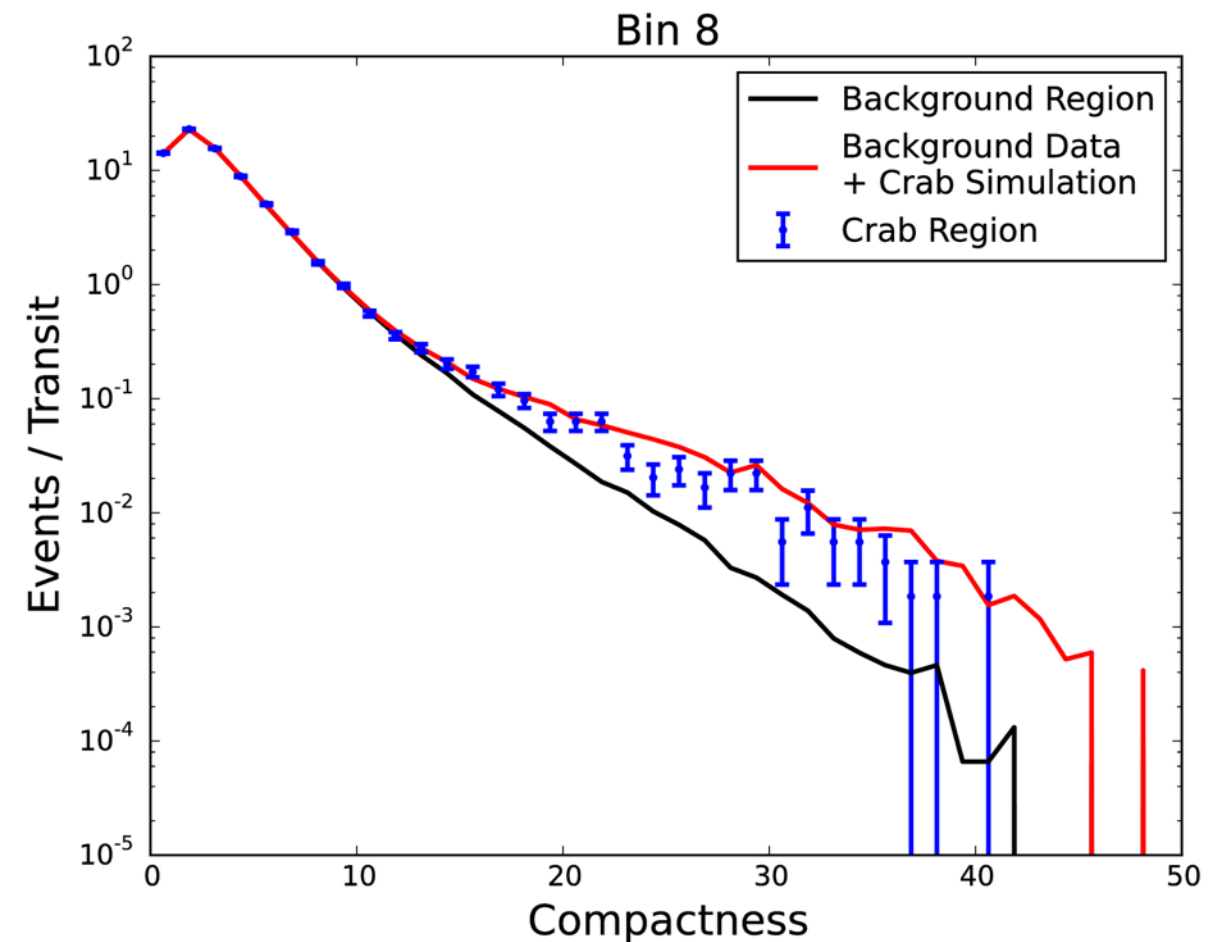
Photon/Hadron Discrimination: Compactness



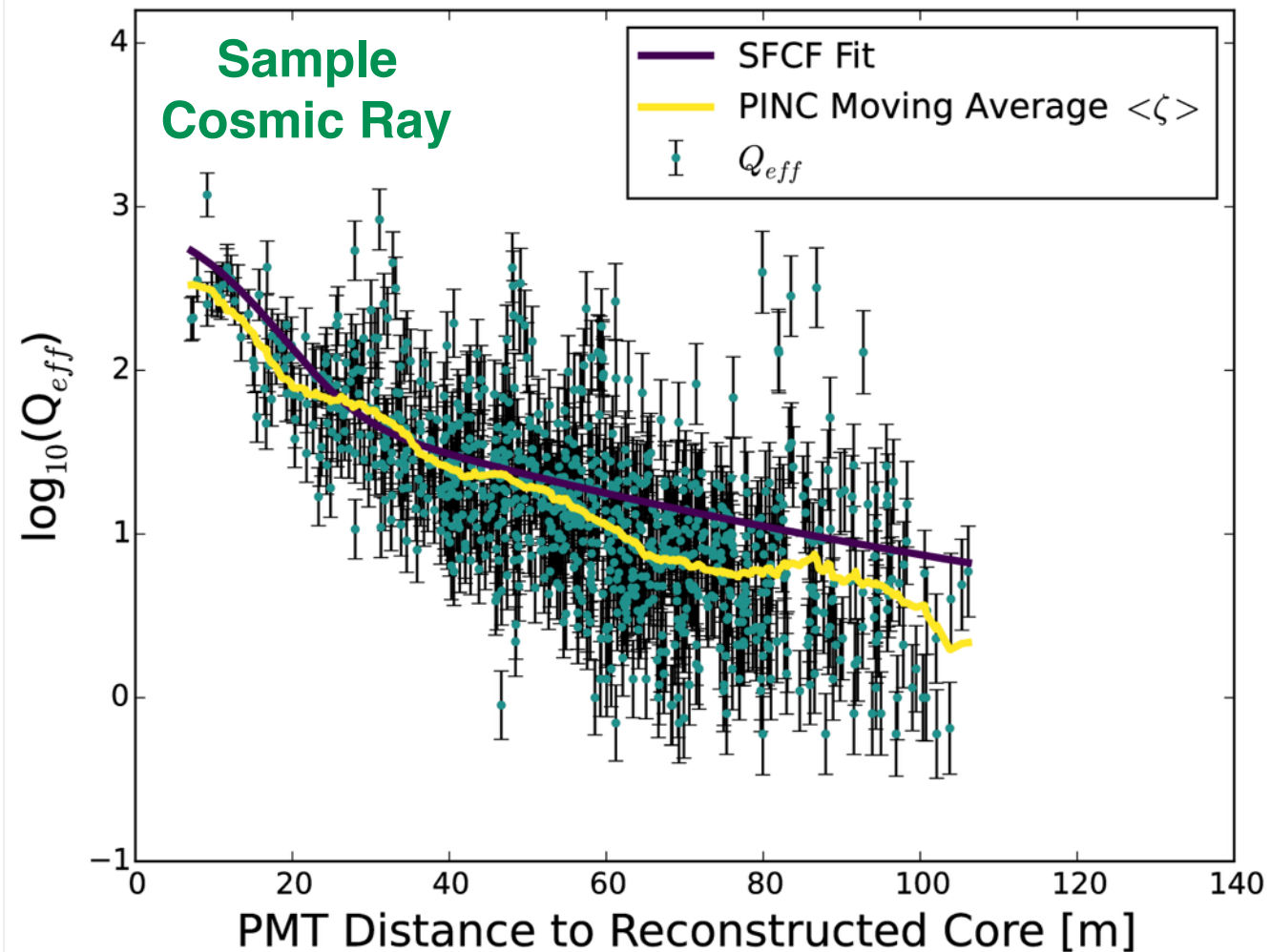
Number of PMTs in
the Event

$$\mathcal{C} = \frac{N_{hit}}{C_{xPE_{40}}}$$

Charge in hardest-hit
PMT outside 40 meters.



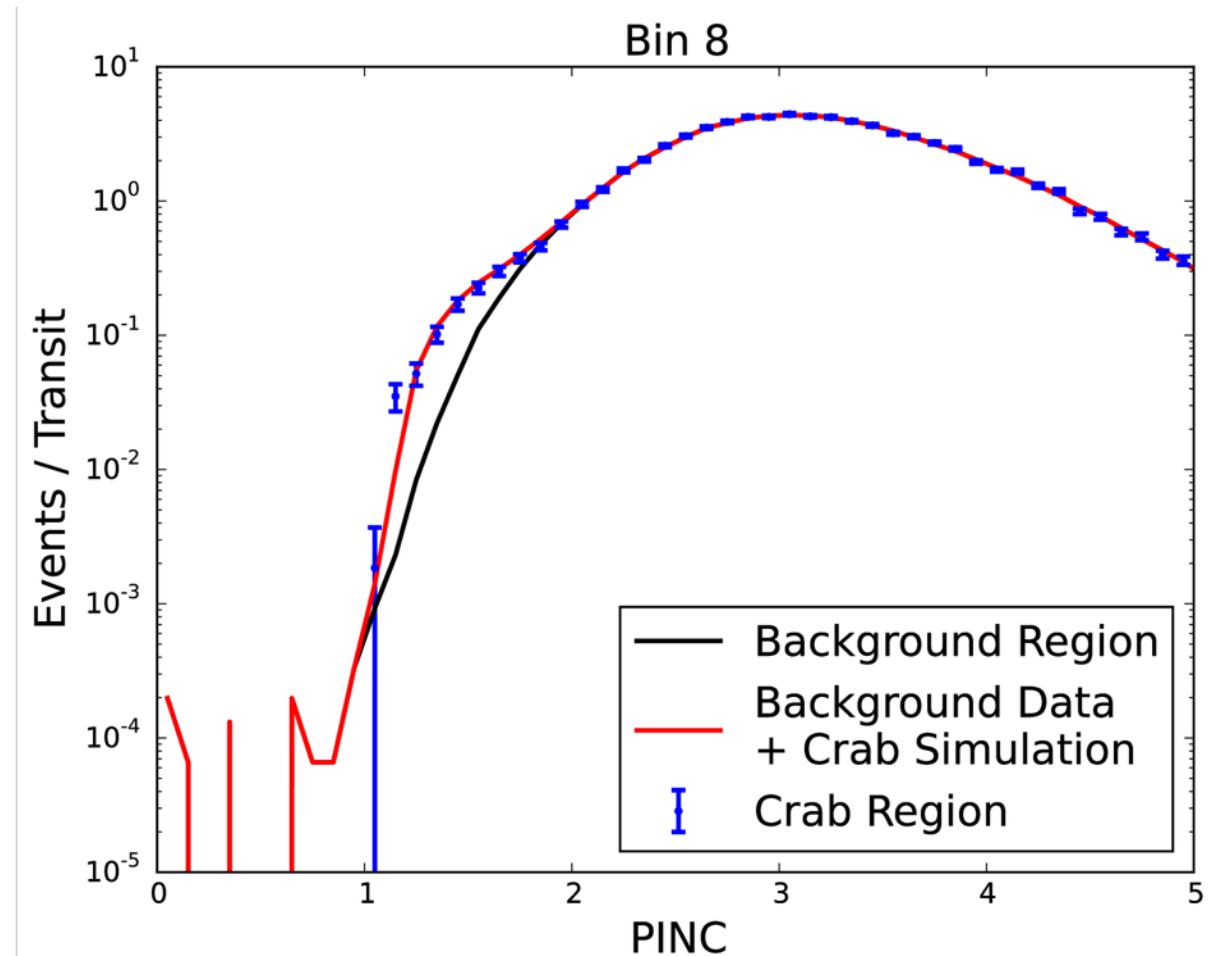
Photon/Hadron Discrimination: PINCness



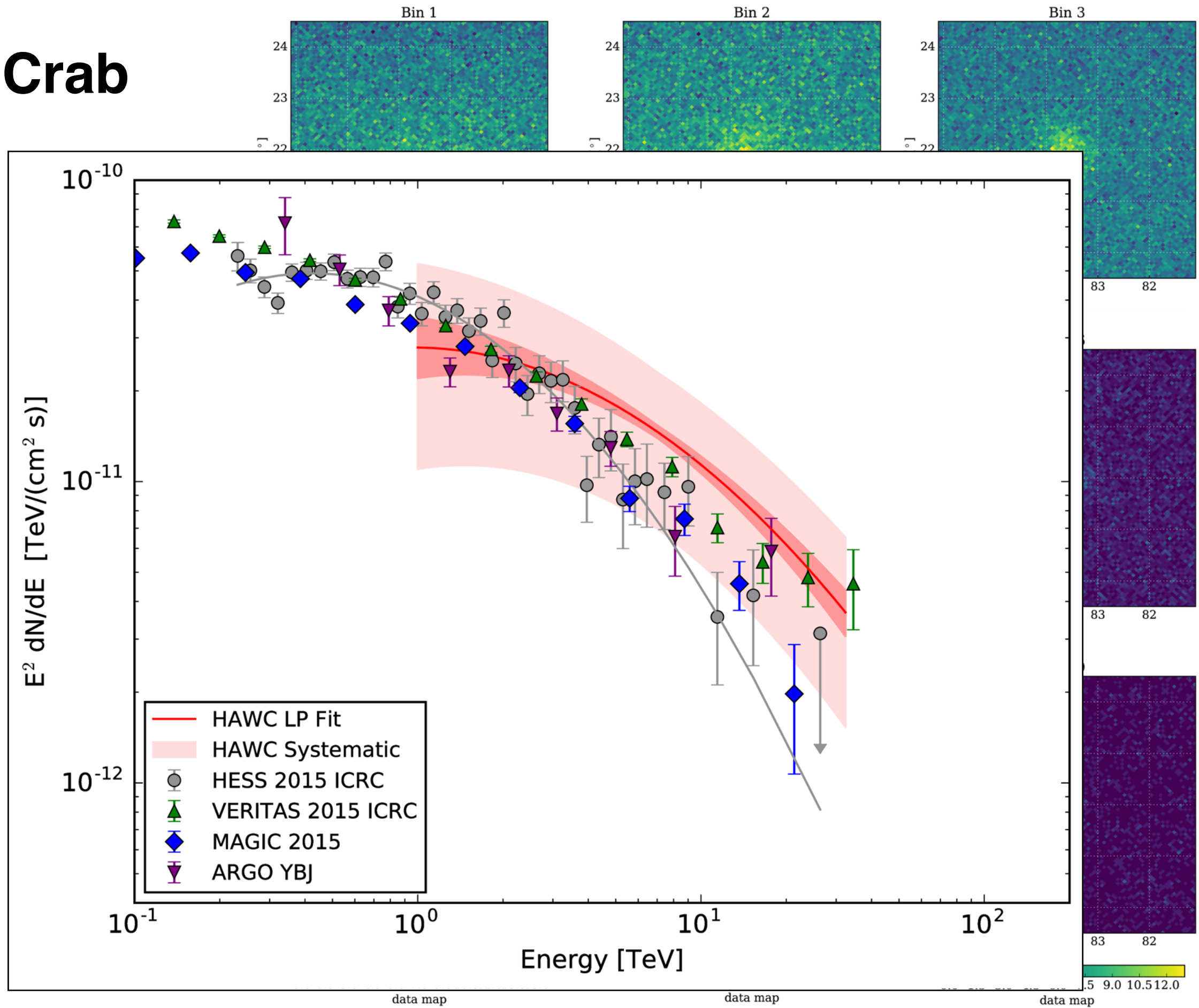
$$\zeta_i = \log_{10}(q_i)$$

$$\mathcal{P} = \frac{1}{N} \sum_{i=0}^N \frac{(\zeta_i - \langle \zeta_i \rangle)^2}{\sigma_{\zeta_i}^2}$$

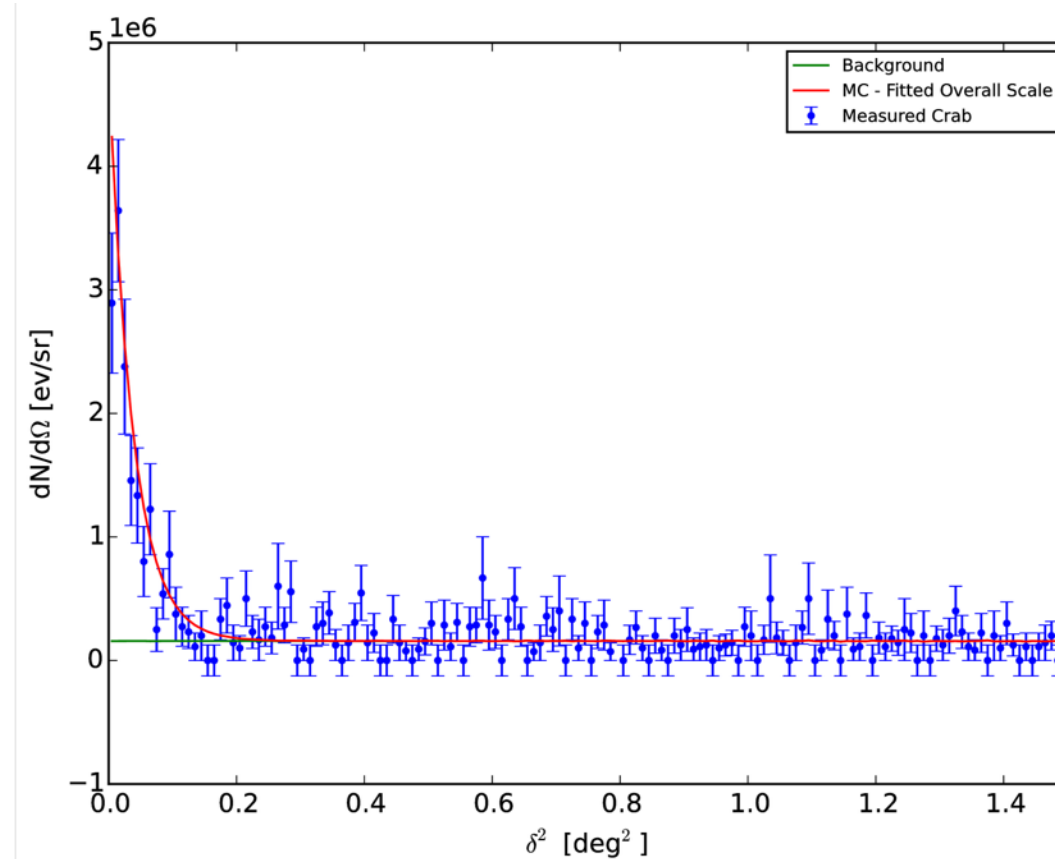
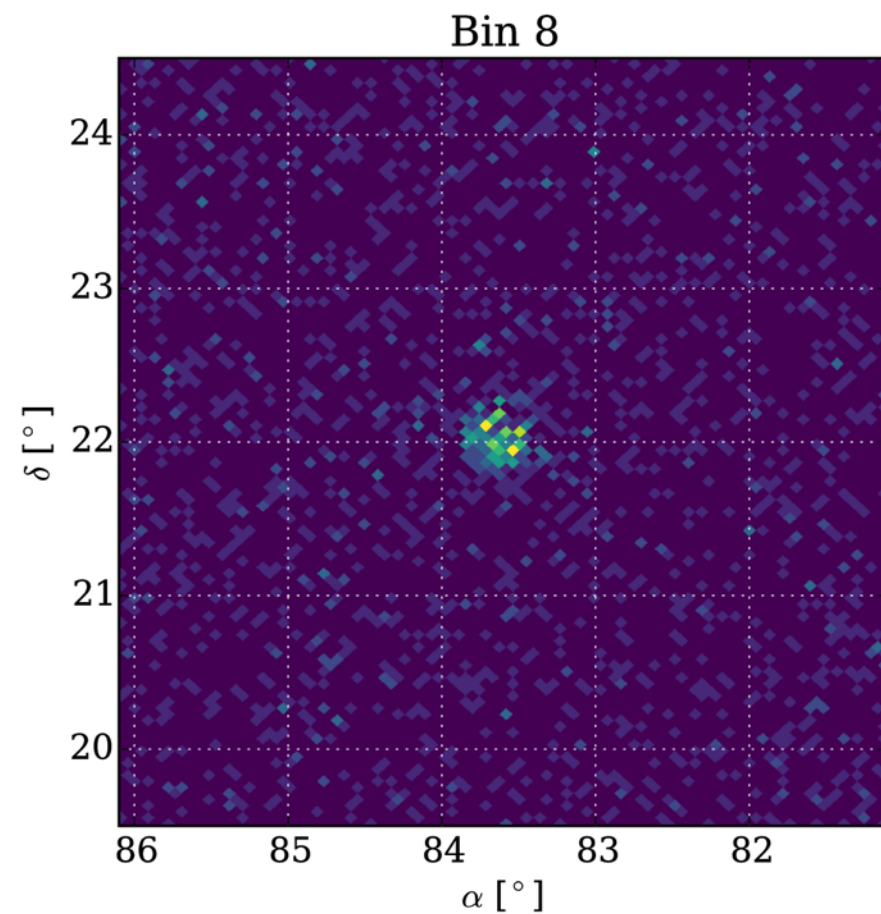
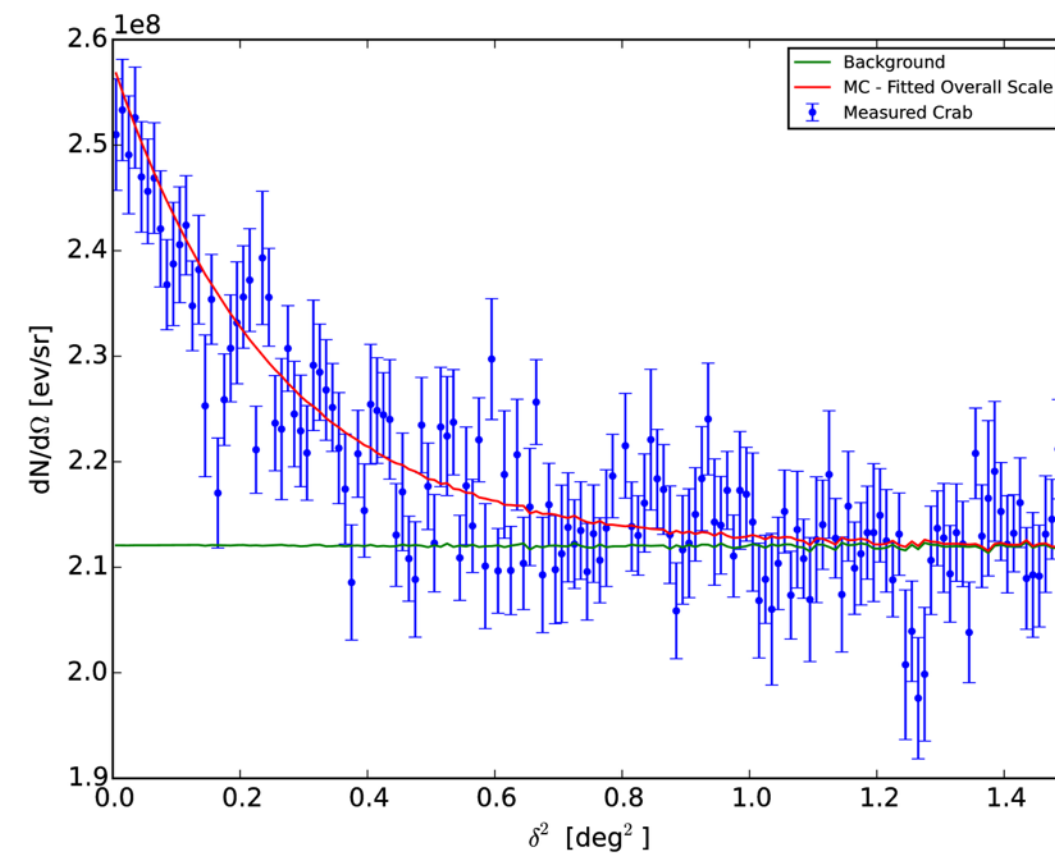
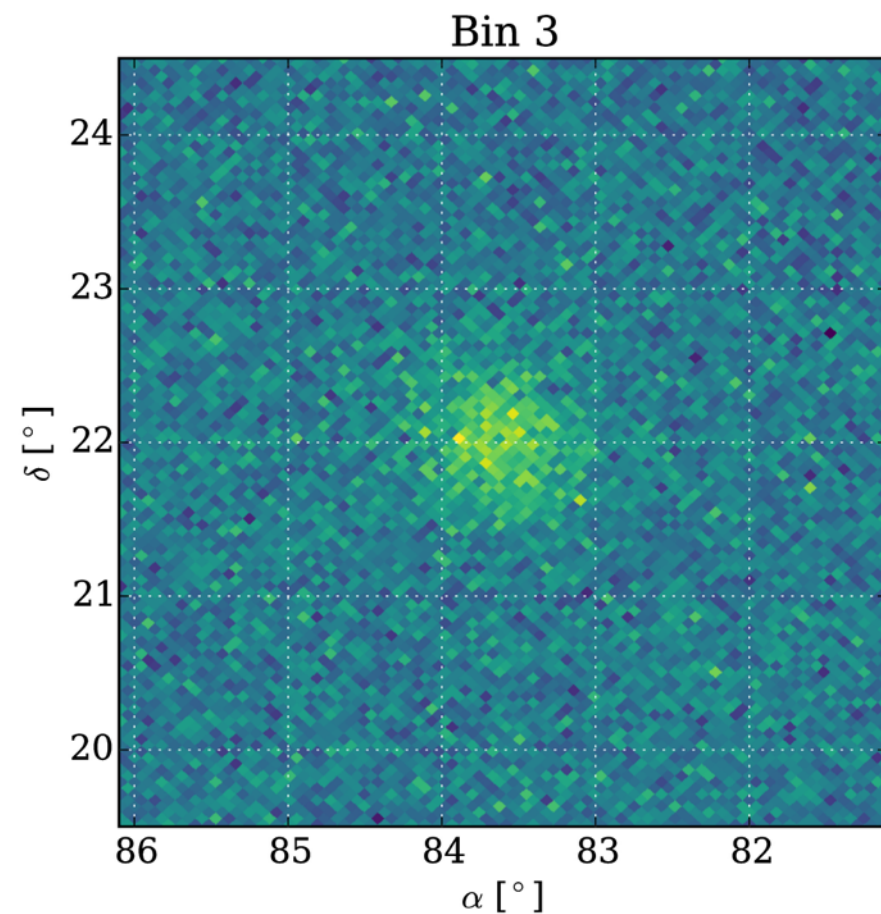
χ^2 -like quantity to quantify “smoothness”



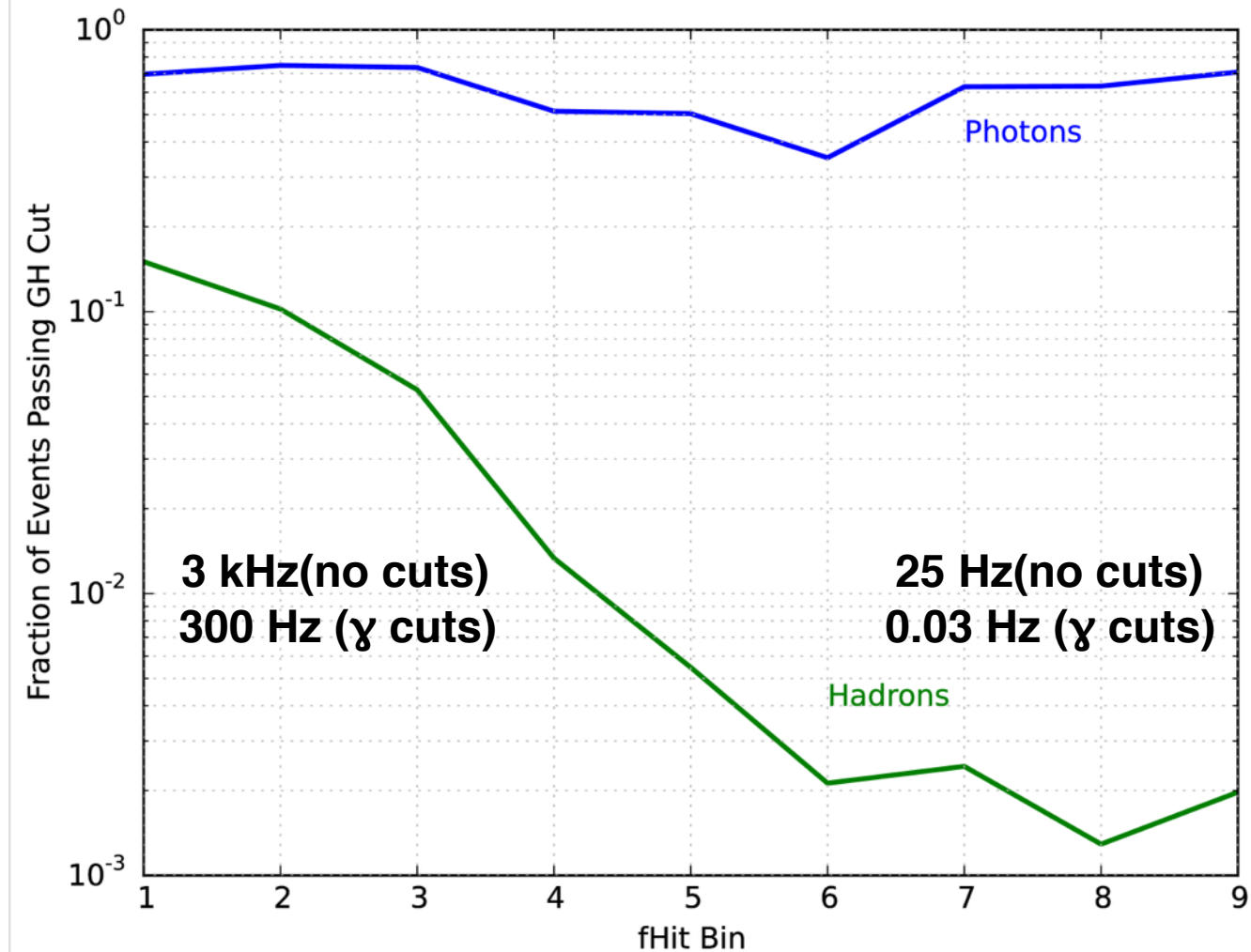
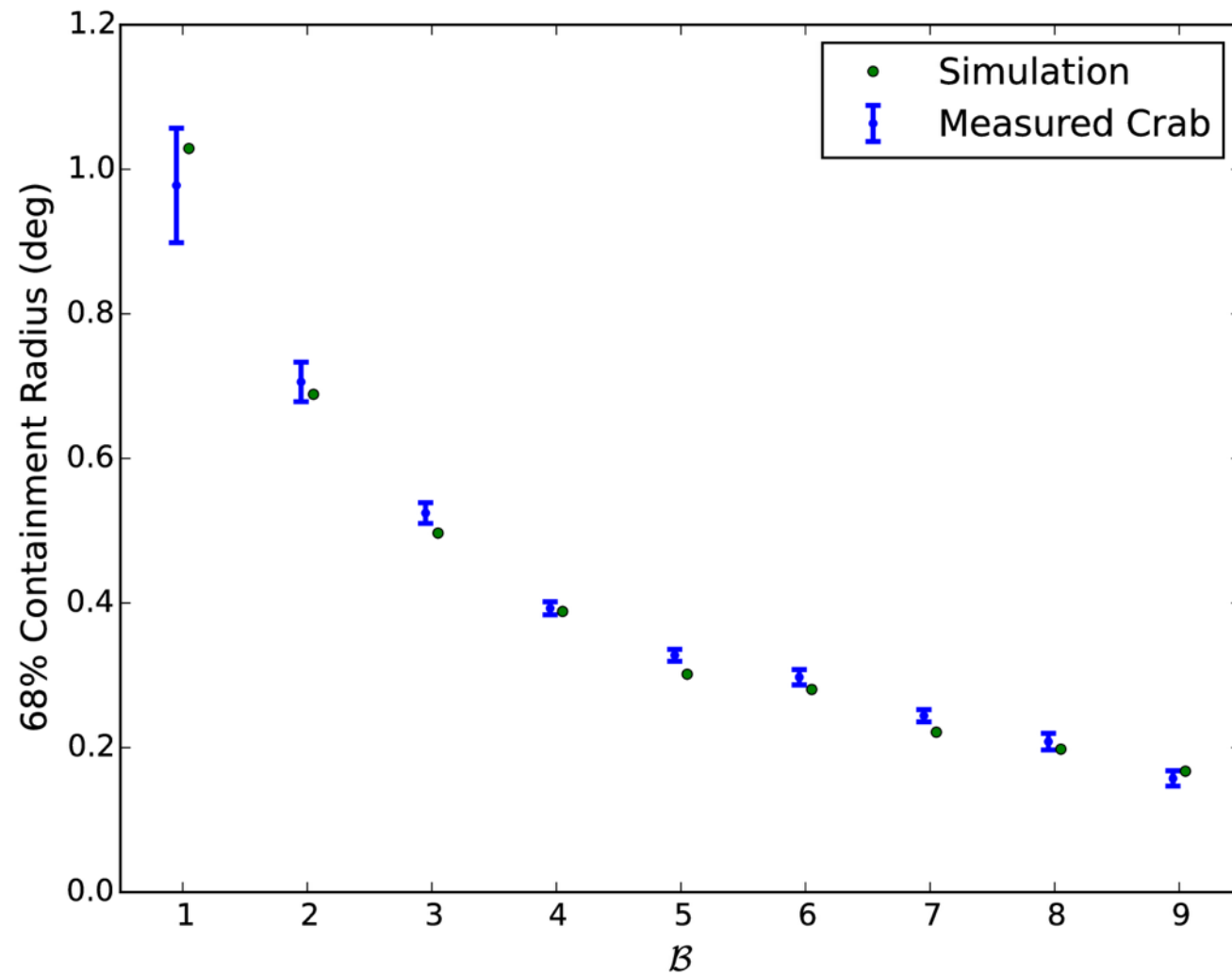
The Crab



Angular Resolution & Photon/Hadron Rejection



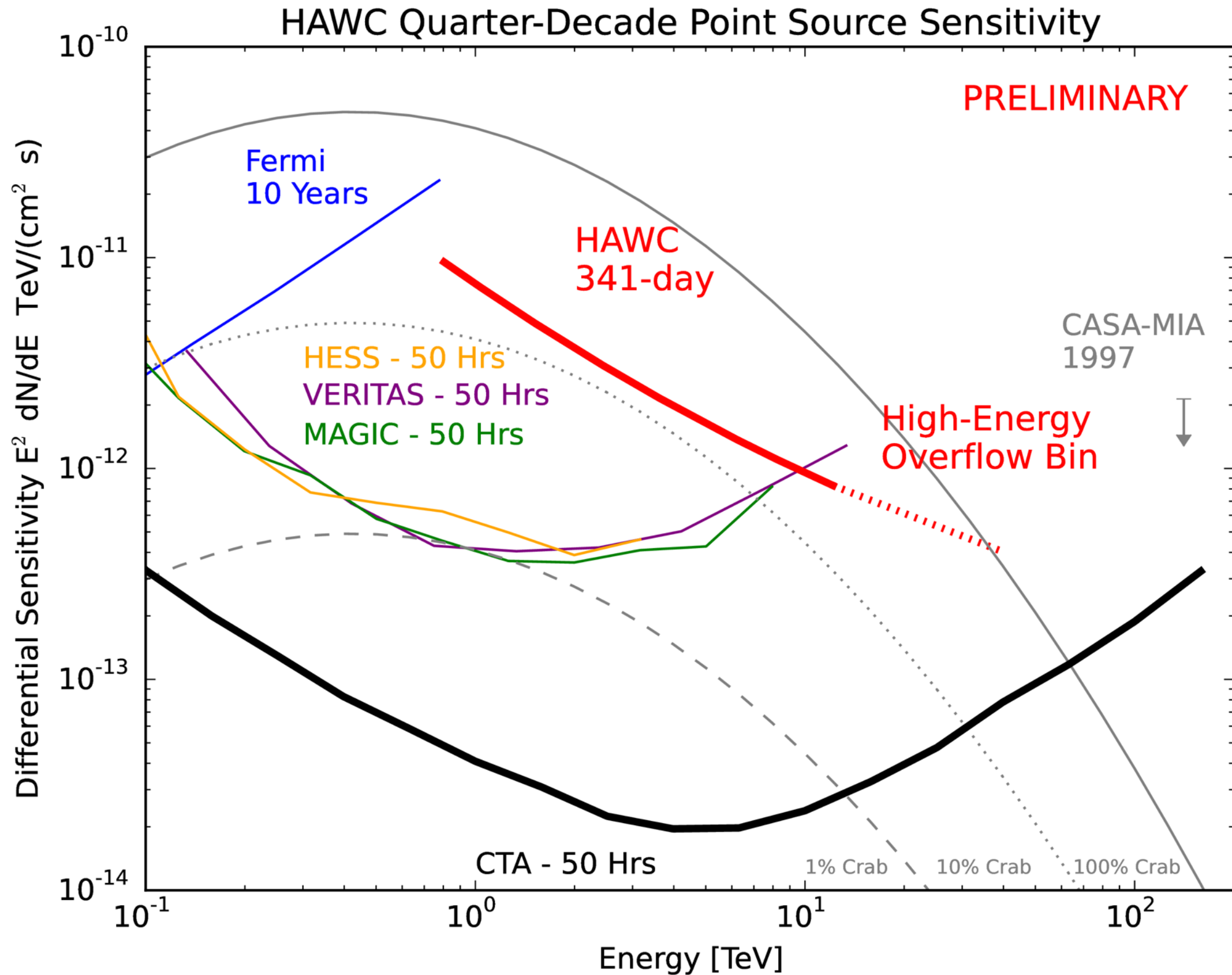
Angular Resolution & Photon/Hadron Rejection



Take-away

- Angular Resolution (68% containment) $< 0.2^\circ$
- 2×10^{-3} background efficiency with good gamma-ray efficiency.

Differential Sensitivity



Summary

- The Crab Nebula is a strong source in HAWC (100σ) and provides an excellent test beam.
- Reconstruction and photon/hadron separation sketched.
- Angular resolution demonstrated down to 0.2° .
- Gamma/hadron separation keeps $>30\%$ of photons while only keeping 2×10^{-3} hadrons.
- Unprecedented sensitivity above 10 TeV.
- Energy reconstruction above 10 TeV coming soon.

