Charge PDF generator network

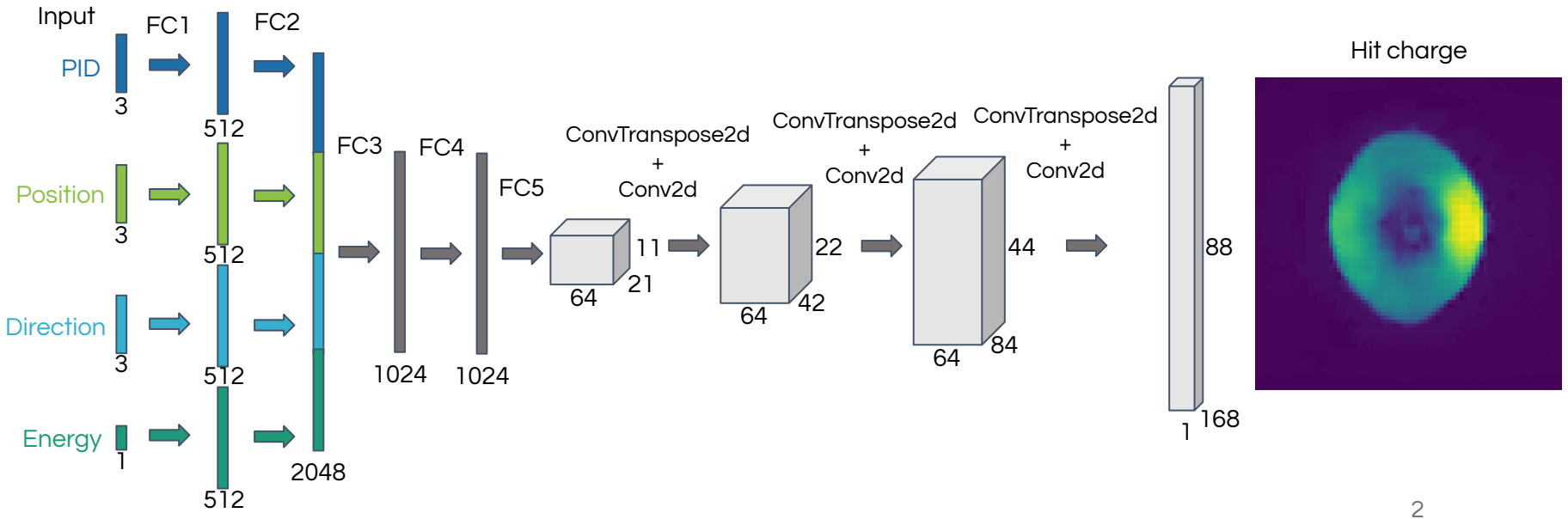
SBU water Cherenkov

August 16 2019

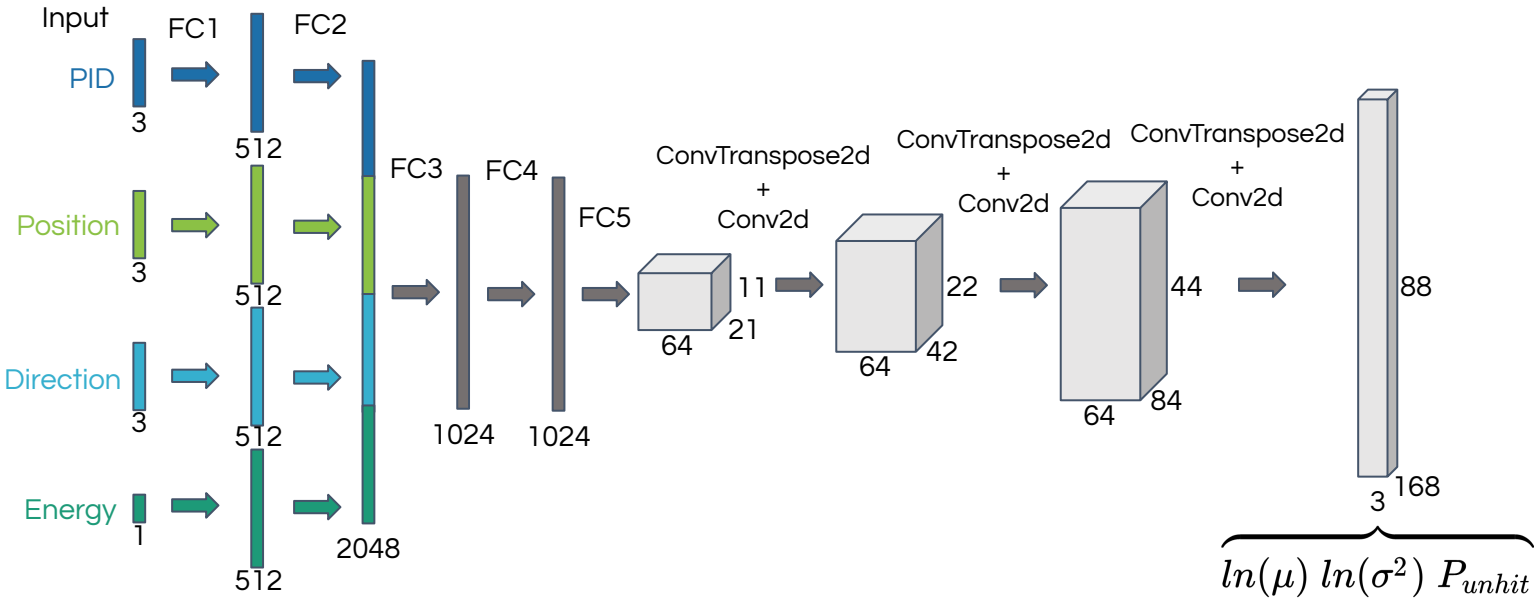
Cristóvão Vilela

Reminder

- Follow network architecture described in arXiv:1411.5928 as close as possible, output is the observed (mean) charge at each PMT in the barrel.
- Train with Huber loss on observed charges.

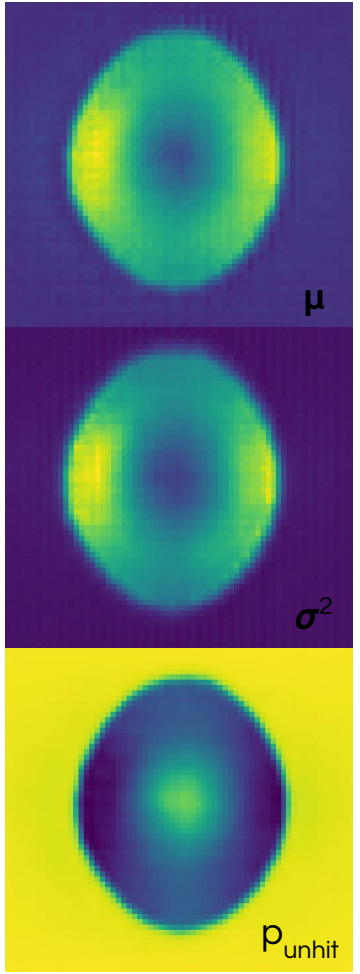


Predicting pdfs

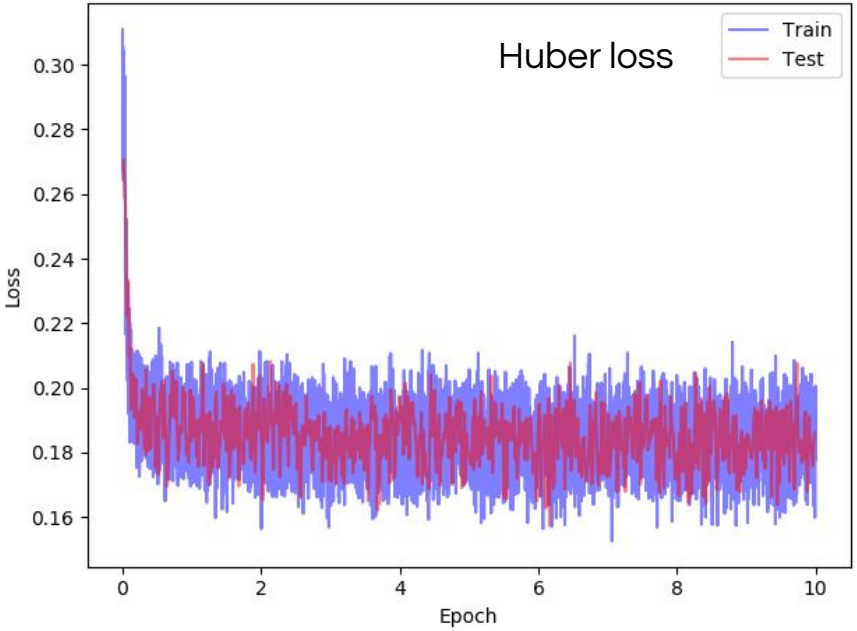


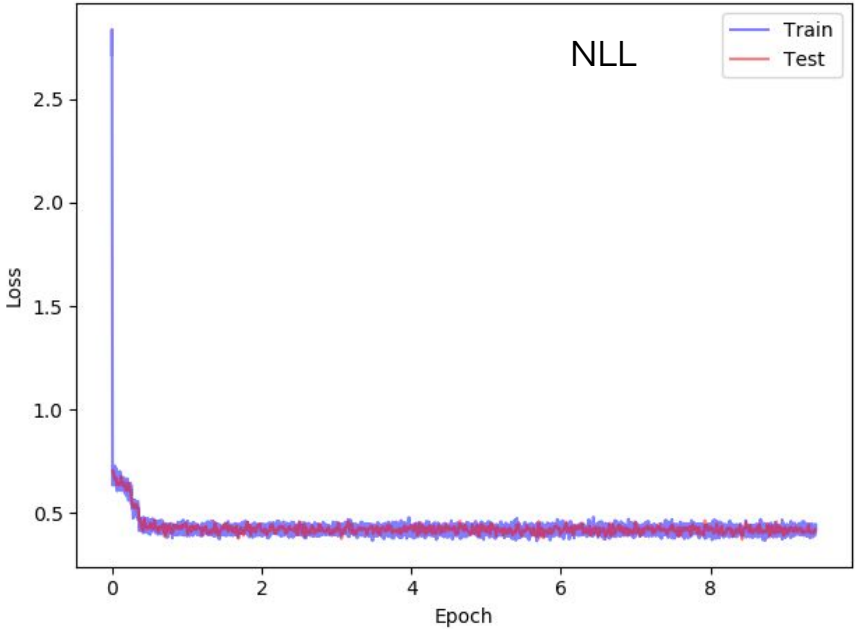
$$\text{Loss} = -ln(\mathcal{L}) = -\sum_{unhit} ln(P_{unhit}) - \sum_{hit} ln(1 - P_{unhit}) - \sum_{hit} \frac{1}{2}\left[ln(2\pi\sigma^2) + \frac{(q_{obs}-\mu)^2}{\sigma^2}\right]$$

- Prediction is a (Gaussian) charge pdf and hit probability for each PMT.
- Basic building block for FiTQun-like MLE reconstruction!



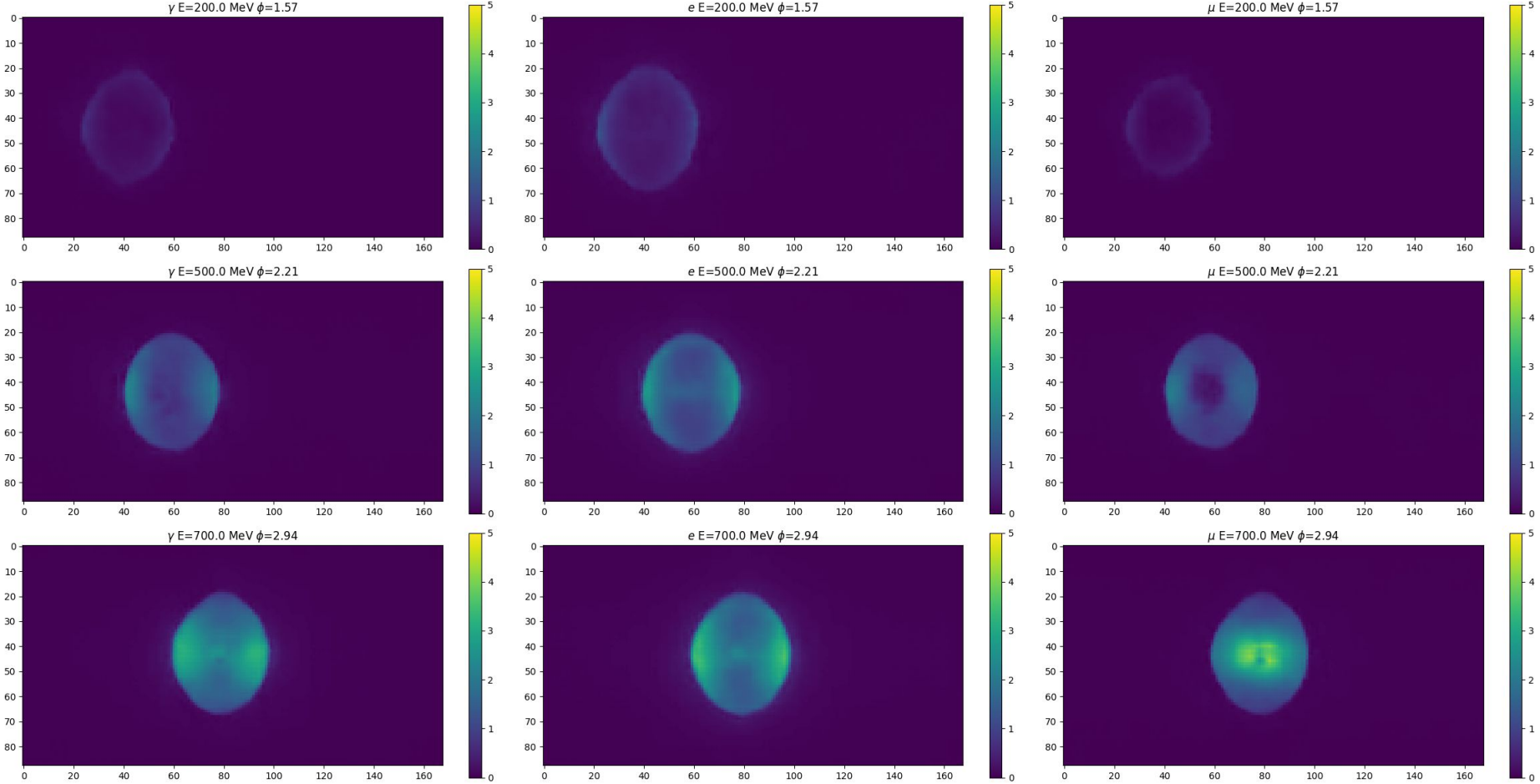
Training





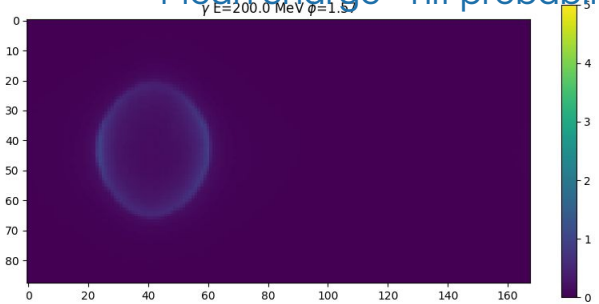
- Still no improvement after ~1 epoch

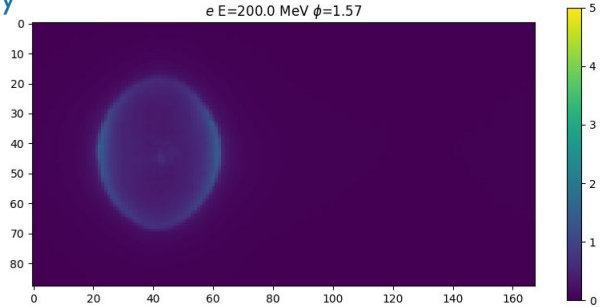
CNN-generated rings: **Huber** loss

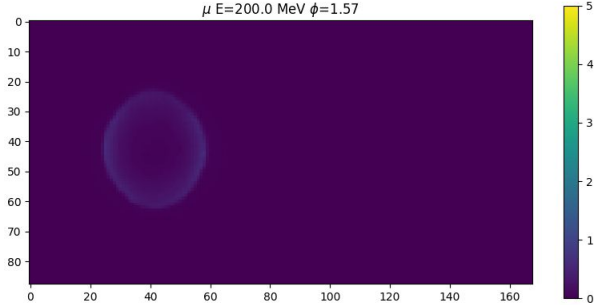


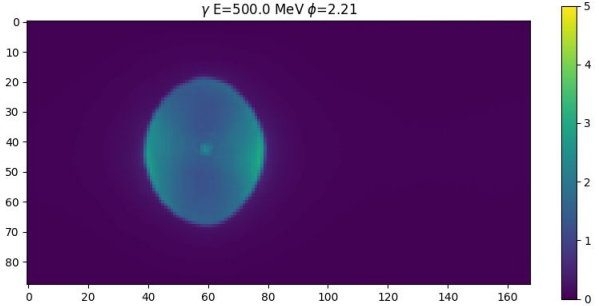
CNN-generated rings: NLL loss

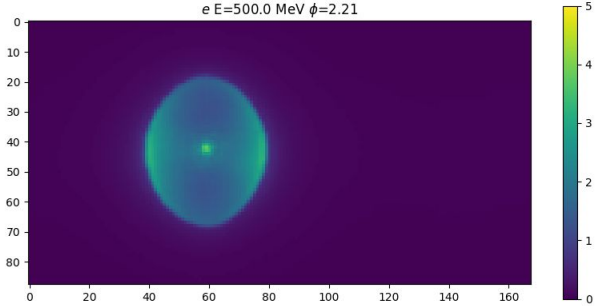
Mean charge * hit probability

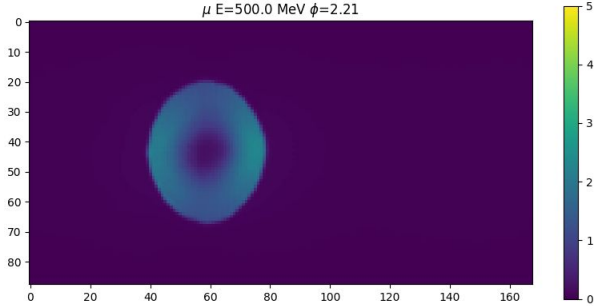


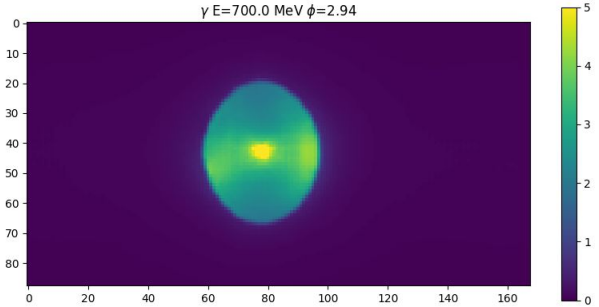


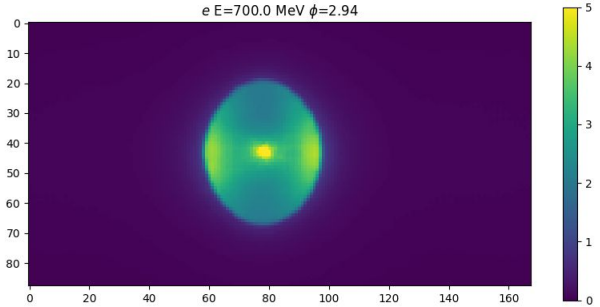


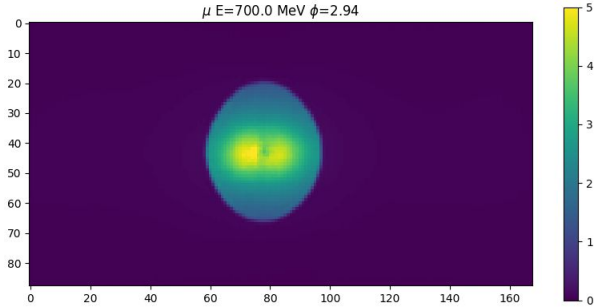






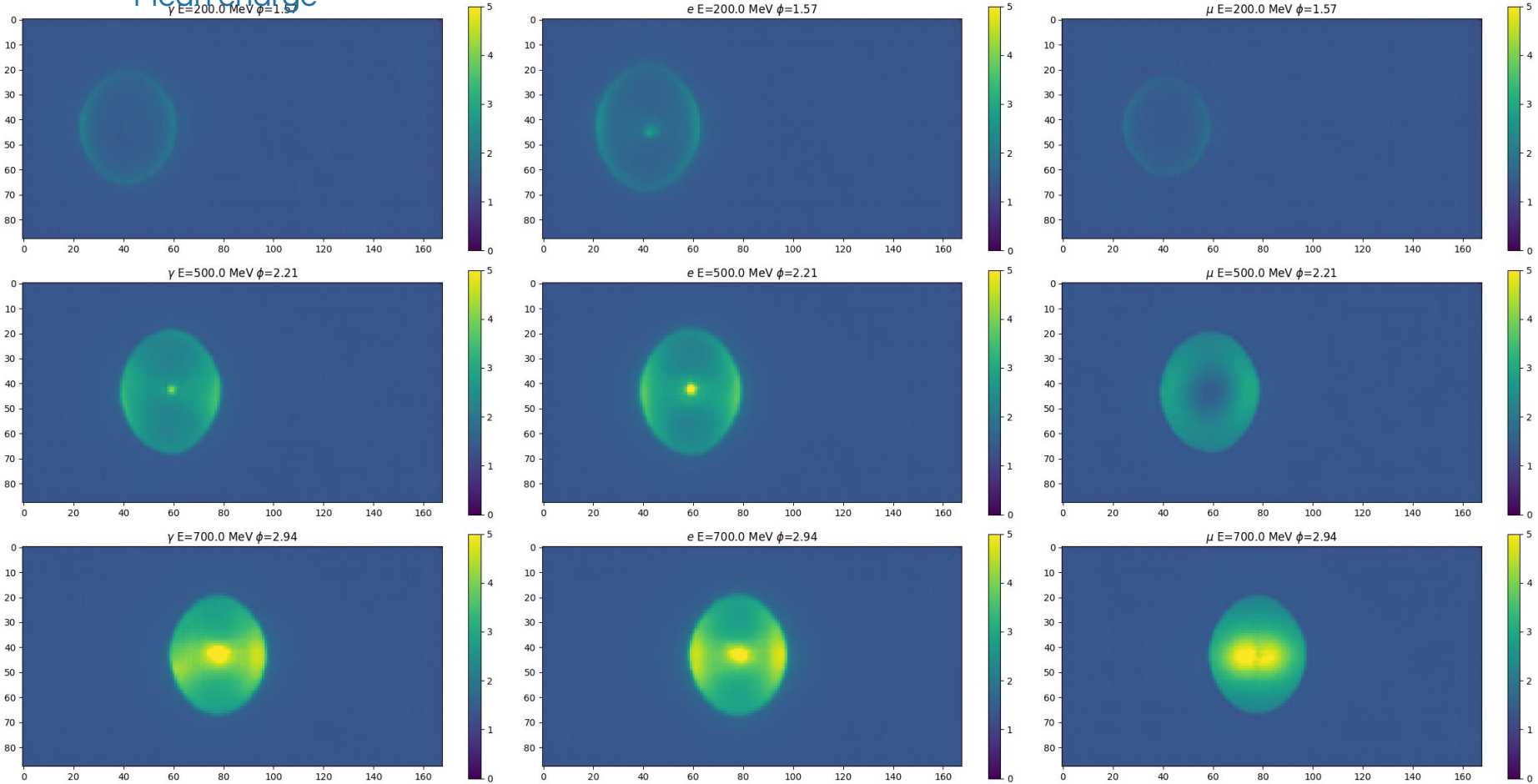






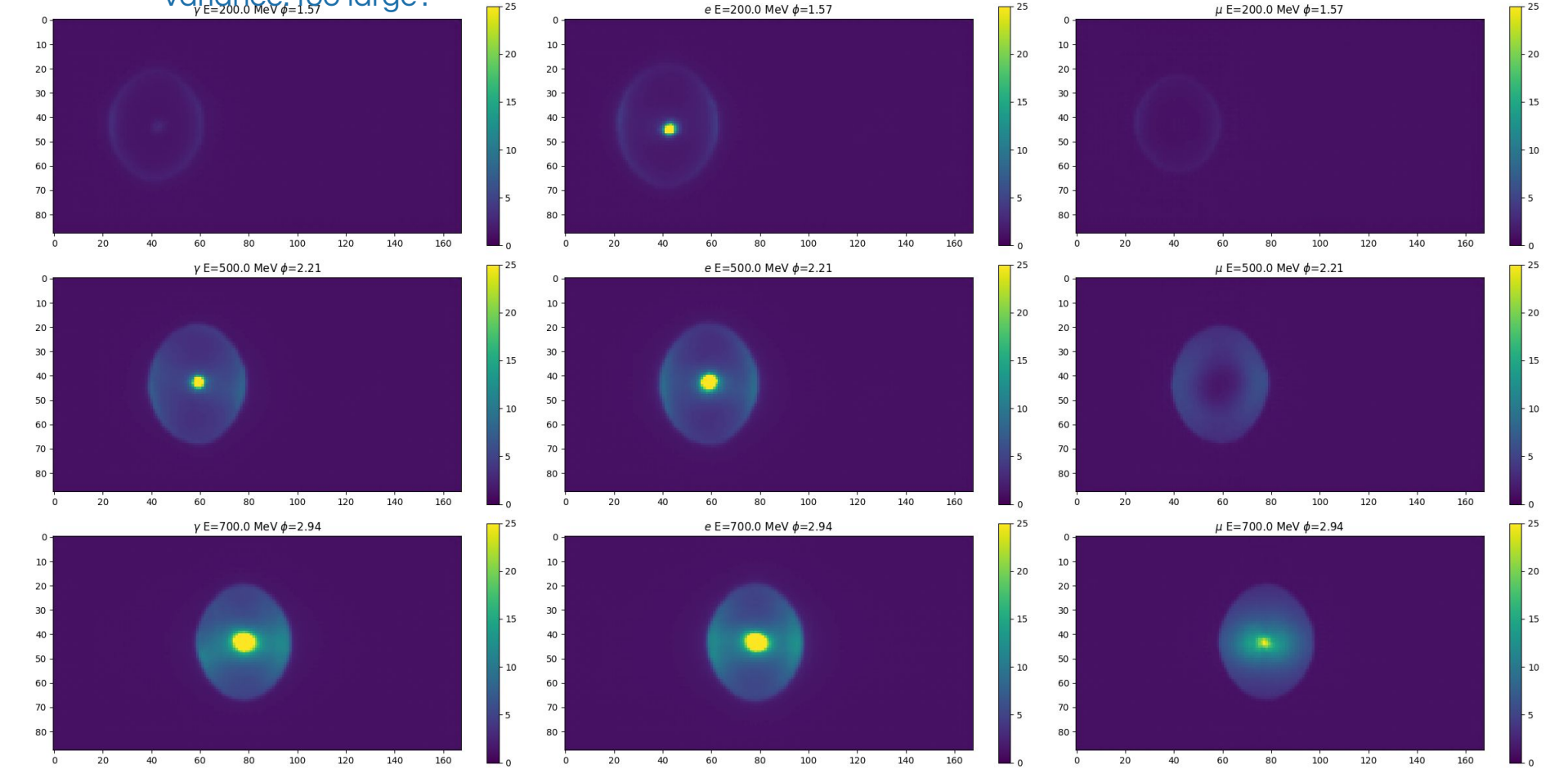
CNN-generated rings: NLL loss

Mean charge



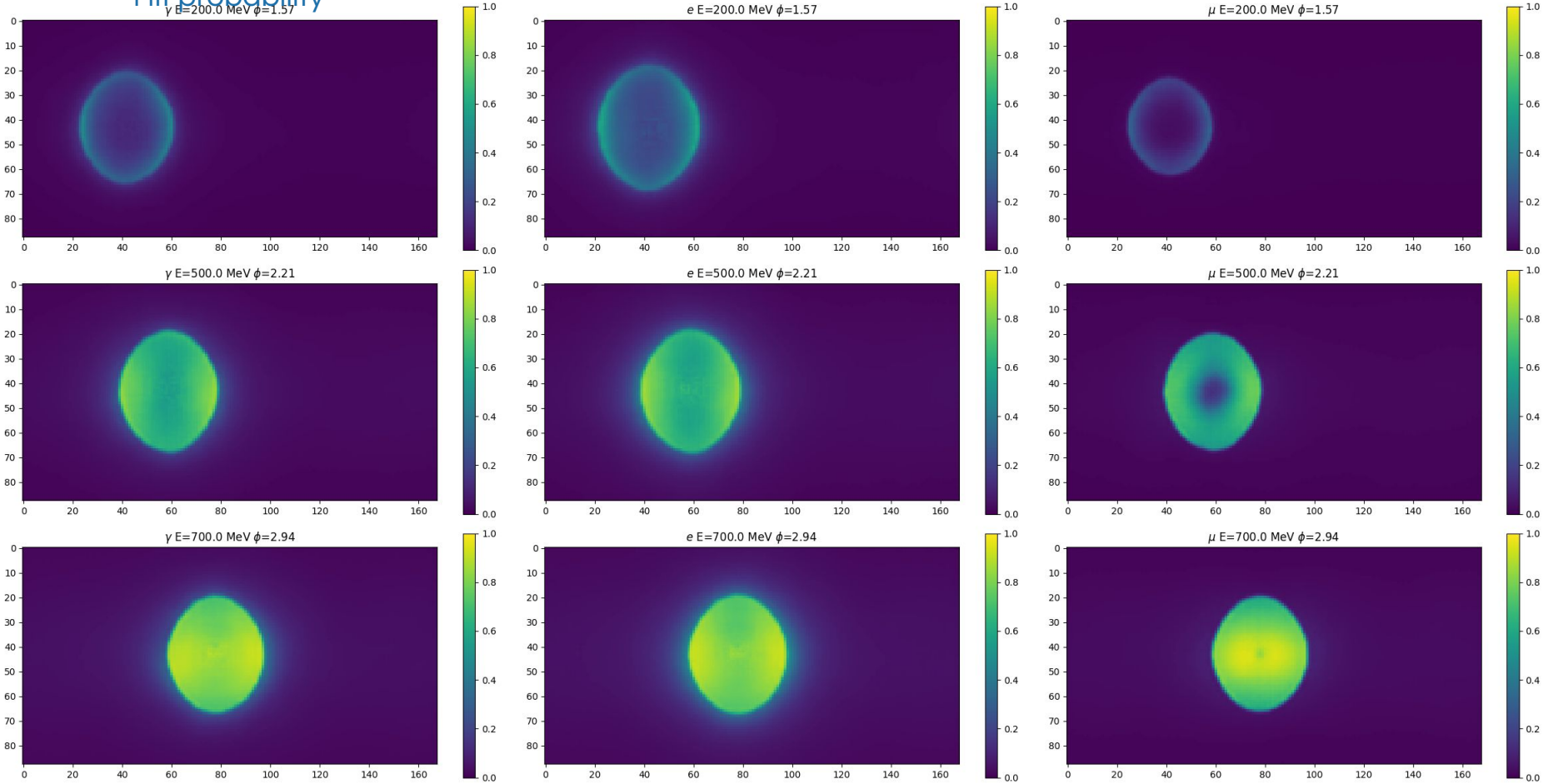
CNN-generated rings: NLL loss

Variance: too large?

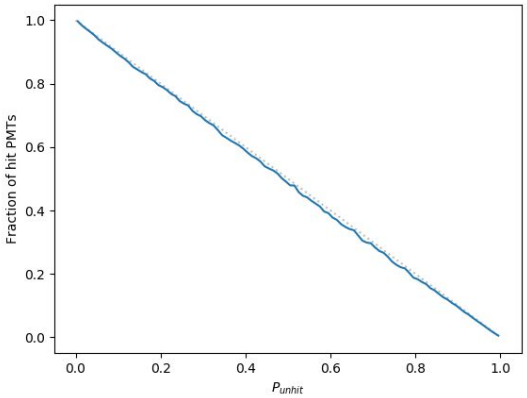


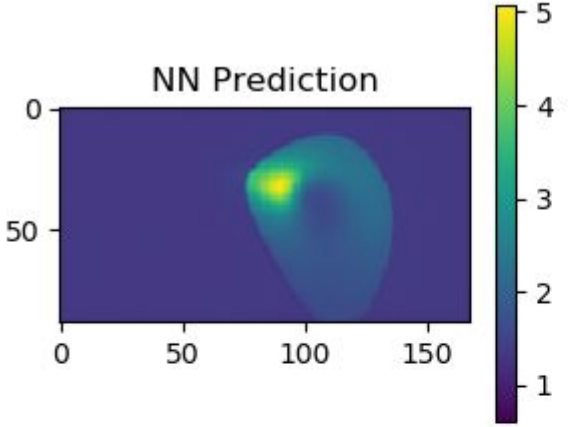
CNN-generated rings: **NLL** loss

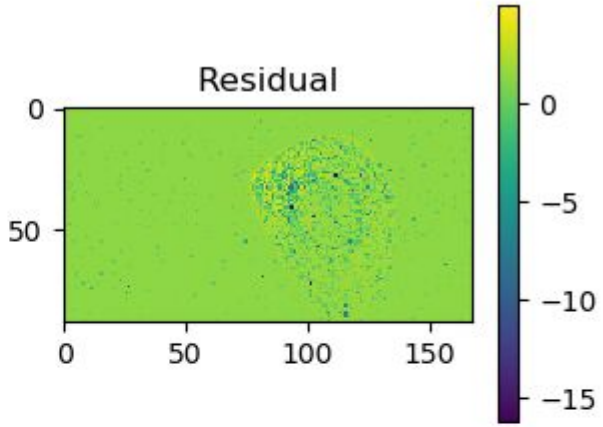
Hit probability

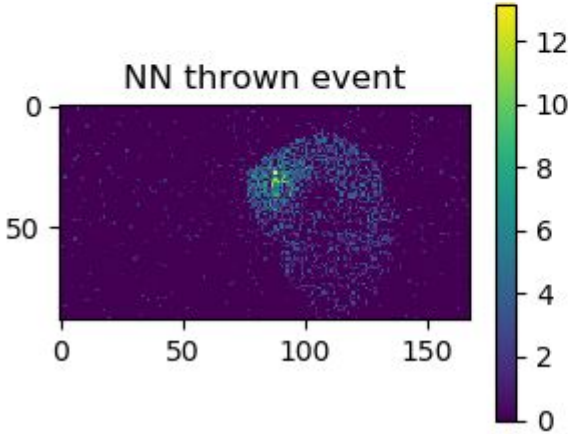


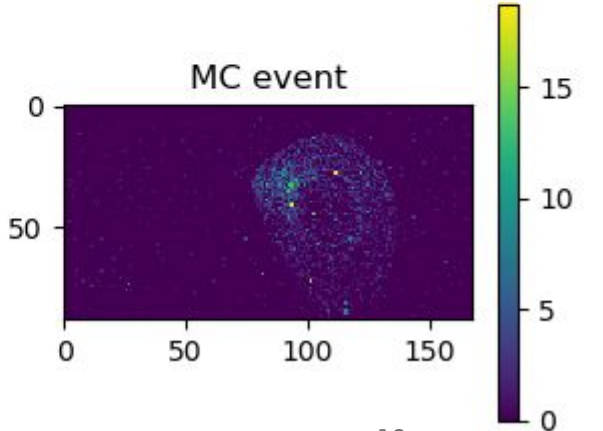
Inspecting the PDF



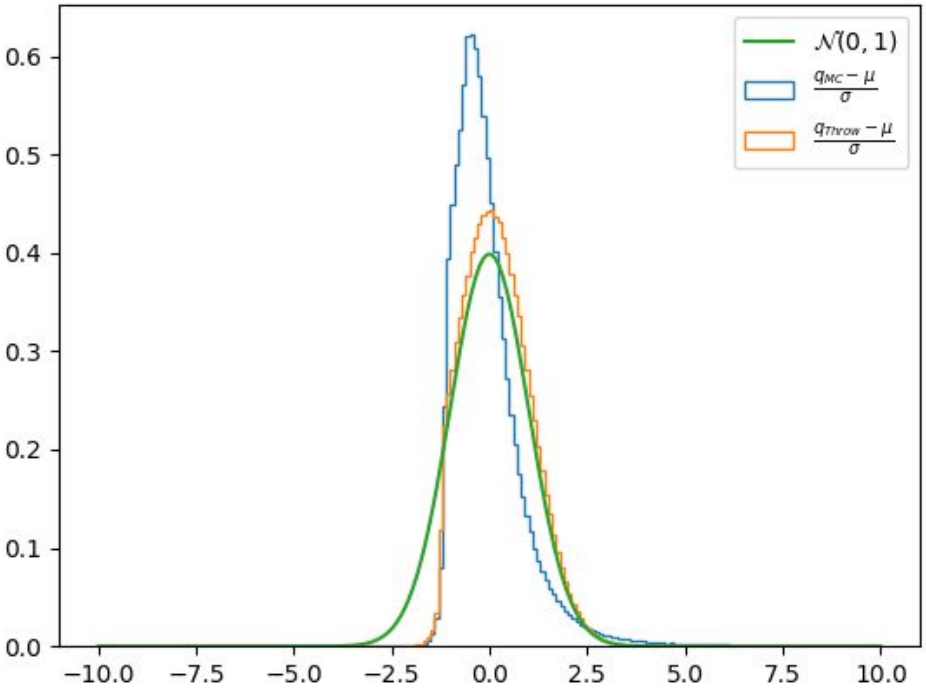




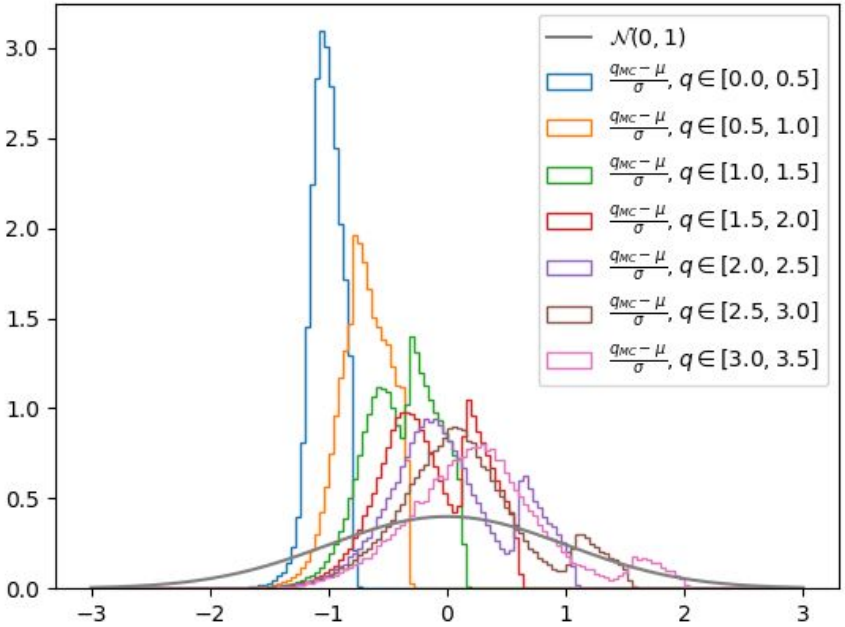


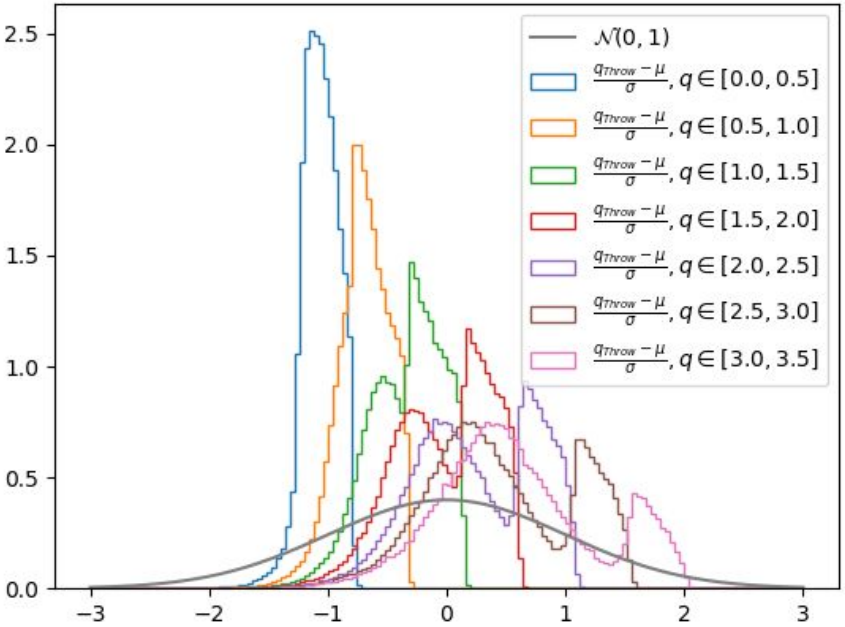


Inspecting the PDF

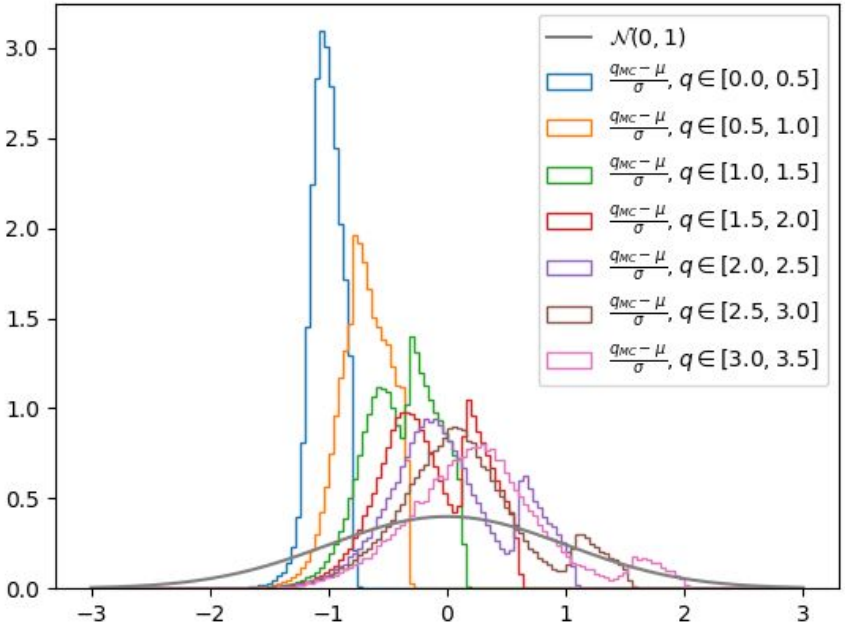


Inspecting the PDF

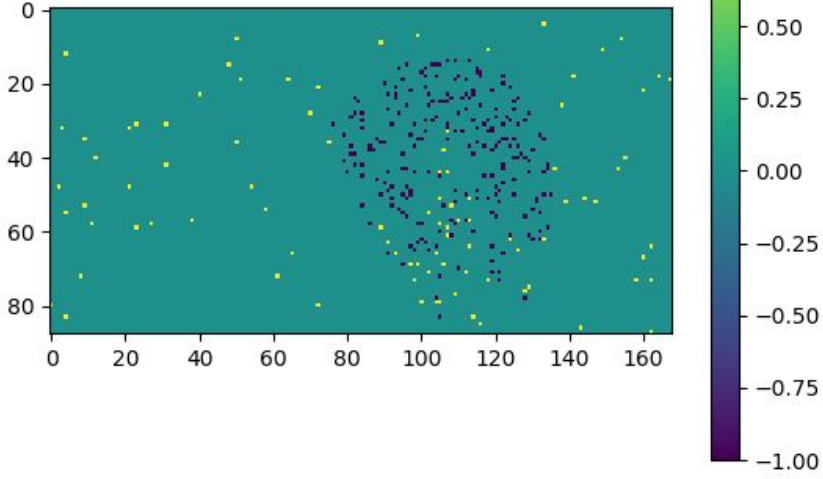




Inspecting the PDF



- Only hits with q in [1.5, 2.0]
- Positive side of the pull distribution: 1
- Negative side of the pull distribution:-1



Exponentially modified gaussian

- Gaussian distribution doesn't seem sufficient to model charge distribution
- In particular, see two modes, one mostly for hits outside of the ring, the other for hits in the ring
  - Do we need a more taily distribution