Exploring End-to-End Deep Learning for Event & Object Classification

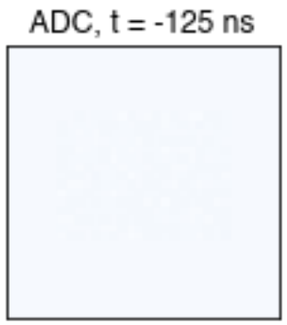
Michael Andrews[1,2], Manfred Paulini[1,2], Sergei Gleyzer[1,3], Barnabas Poczos[4]

[1]CMS, [2]Carnegie Mellon University-Physics, [3]University of Florida, [4]Carnegie Mellon University-ML

S2I2 HEP/CS Workshop, 2017-MAY-02

Motivation

The Current State of Affairs



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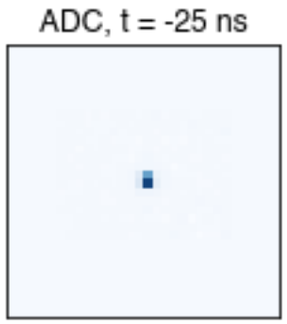

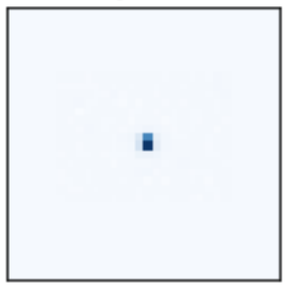

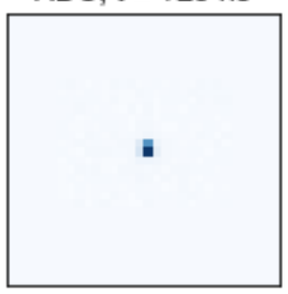

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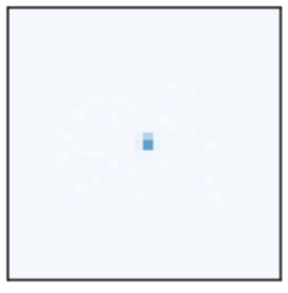
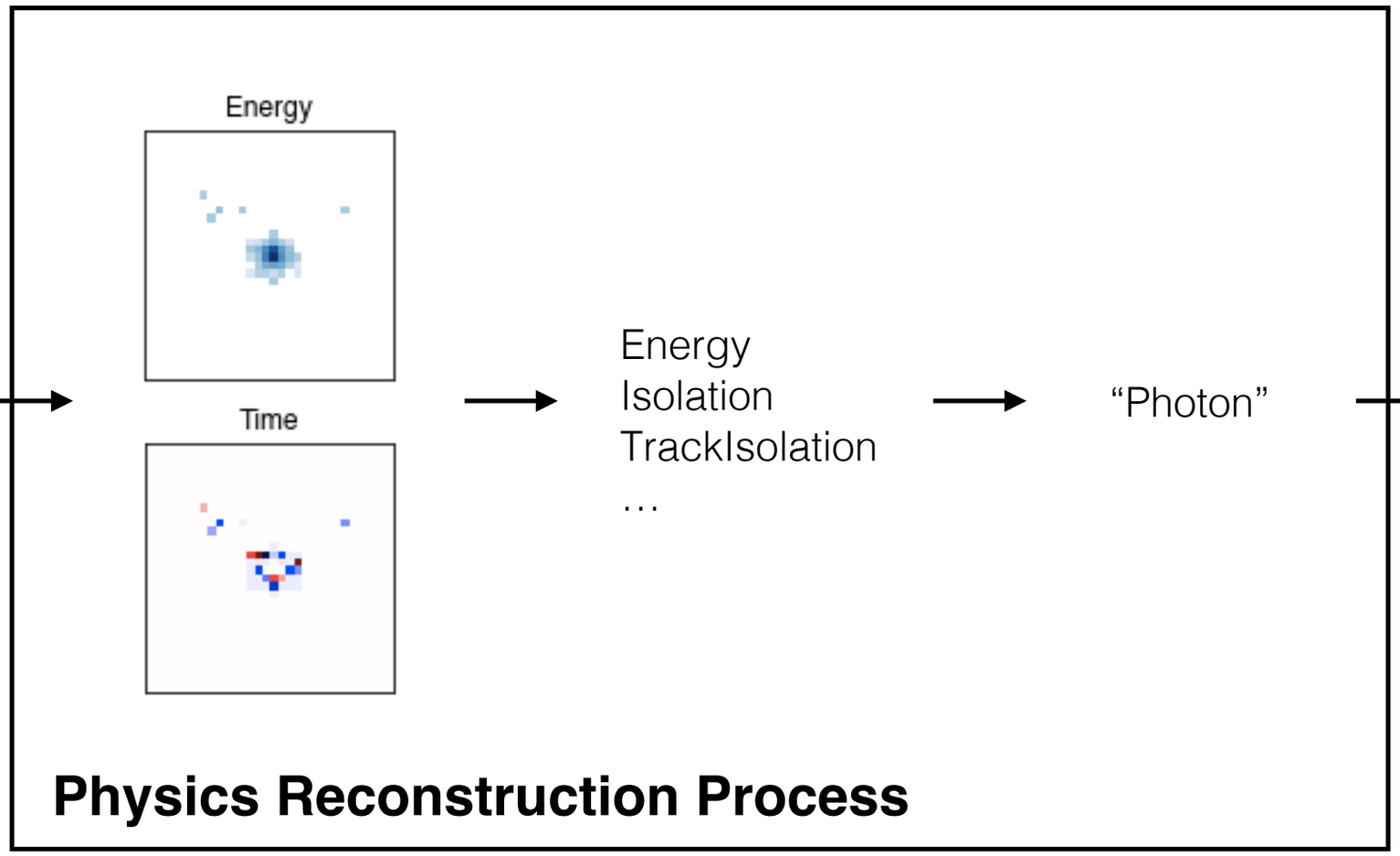
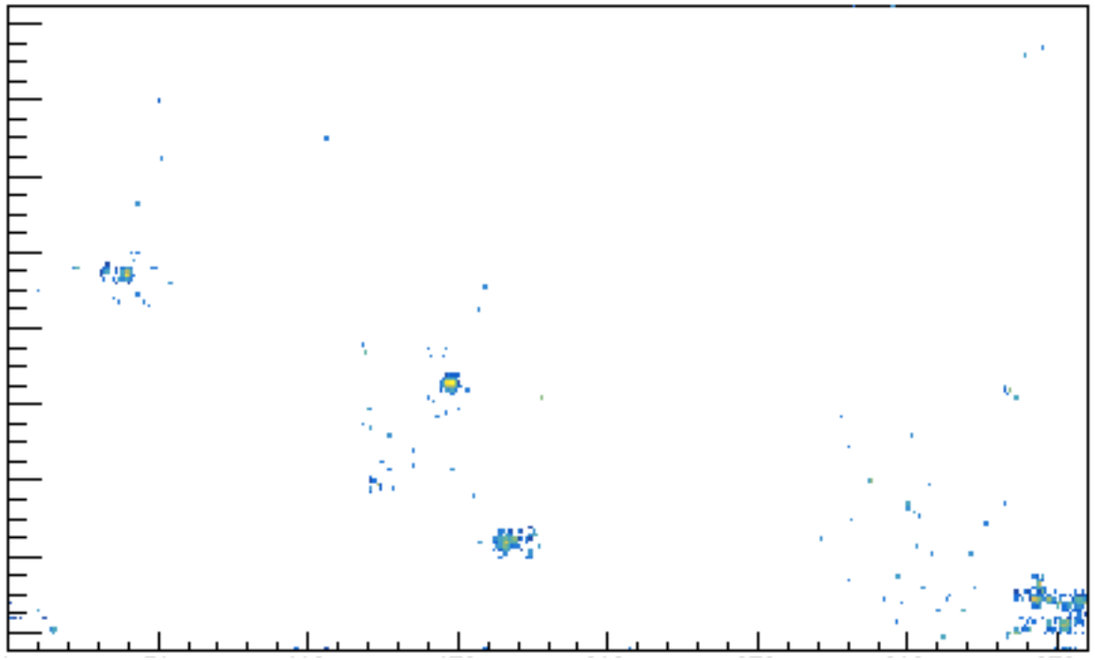




Q: *Are we throwing away information?*
Should this be done before or after event classification?

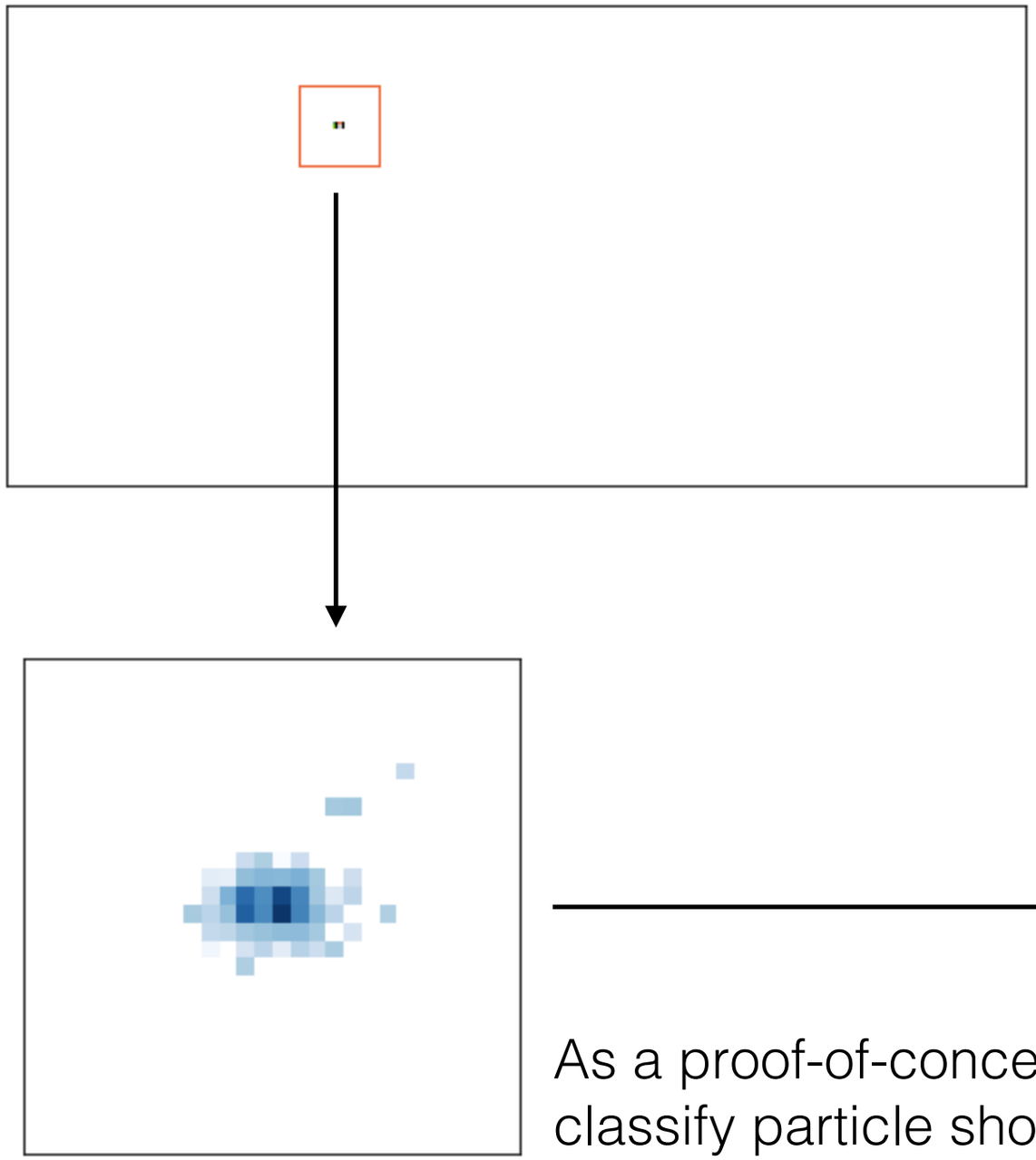
End-to-End Approach



Event Class Prediction

Take detector-level inputs and directly output event class without bothering with reconstruction

Proof Of Concept



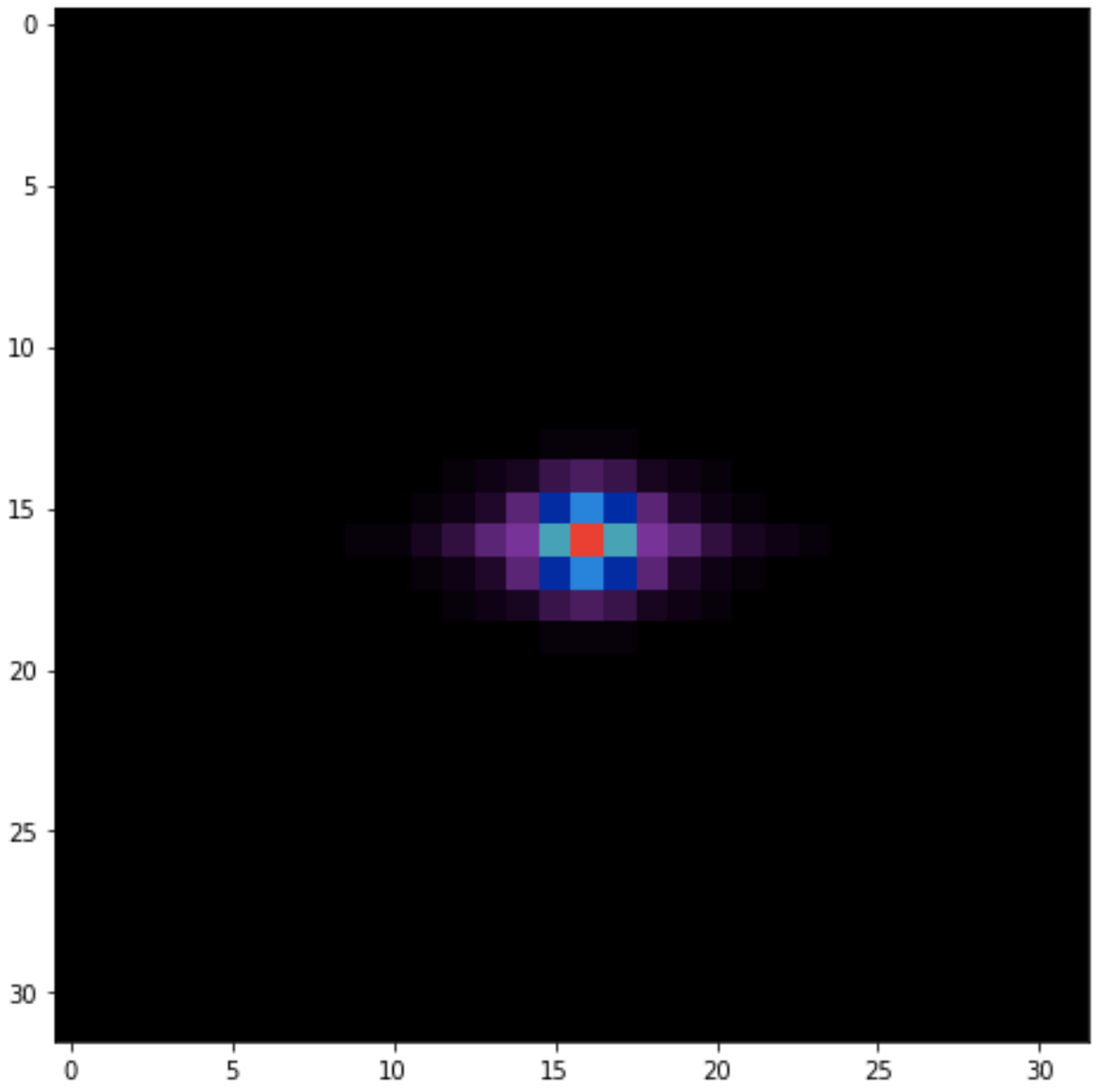
Particle ID
Prediction

As a proof-of-concept,
classify particle showers in ECAL

Shower Visualization

Photon-Induced EM Shower

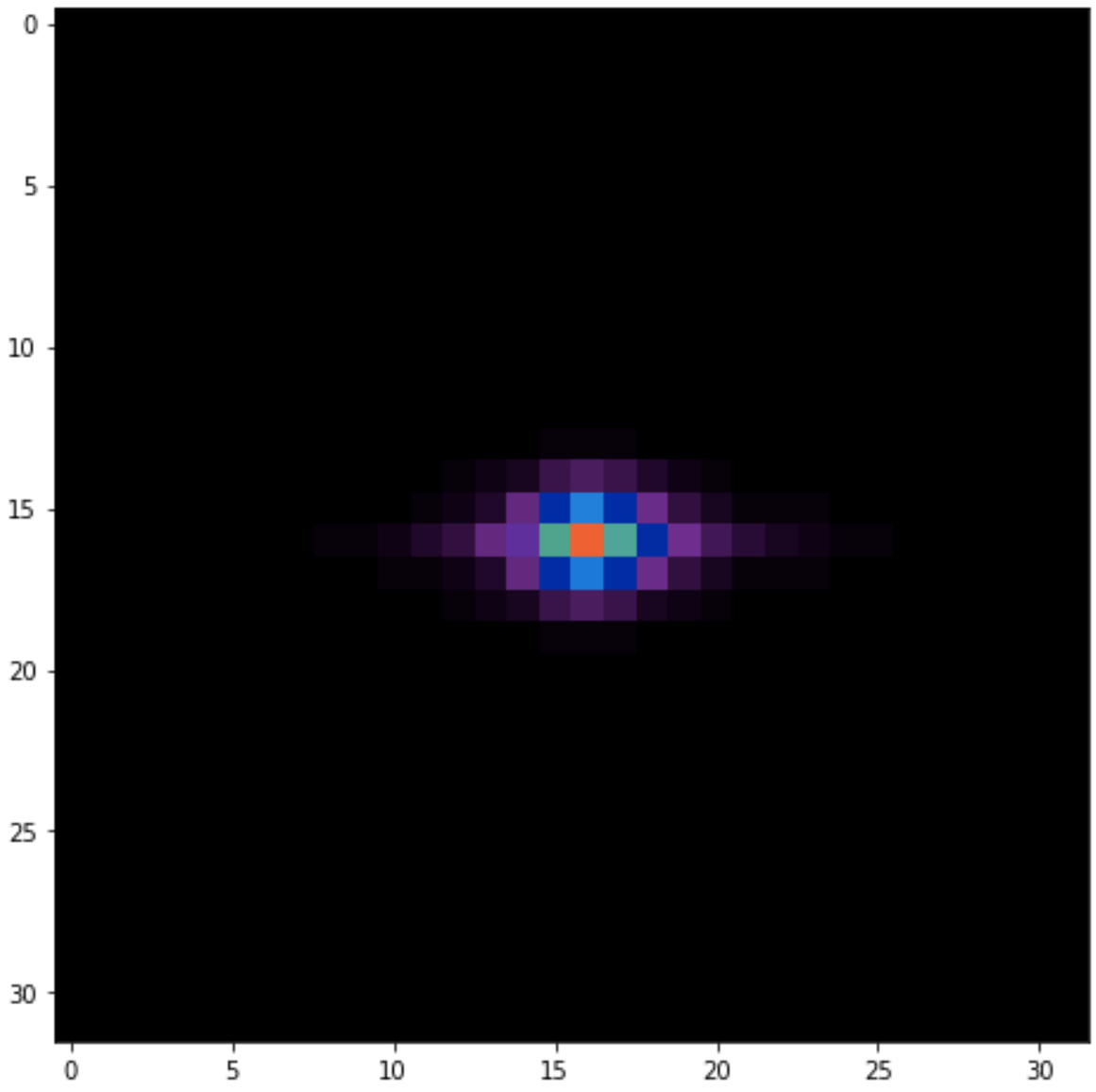
mean energy distribution over 10k events



Shower Visualization

Electron-Induced EM Shower

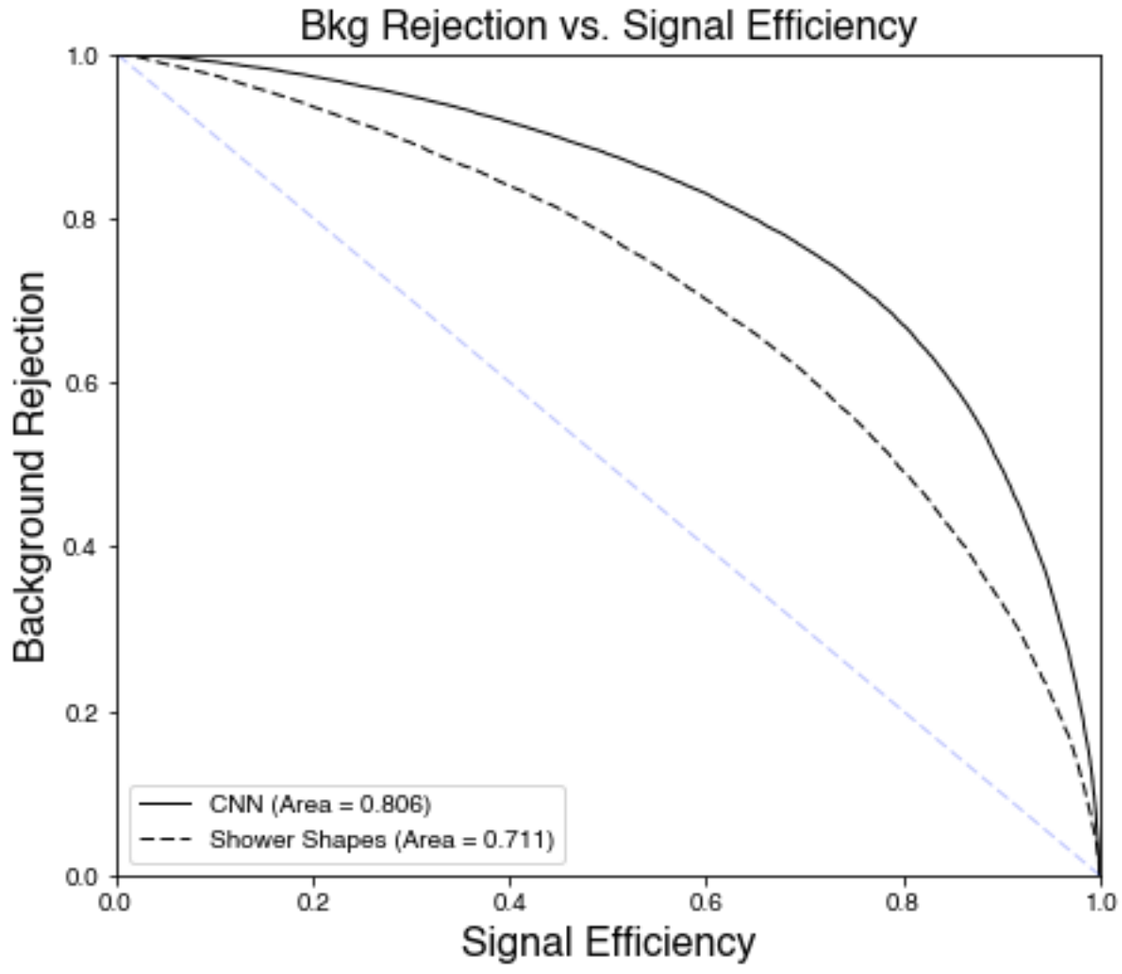
mean energy distribution over 10k events



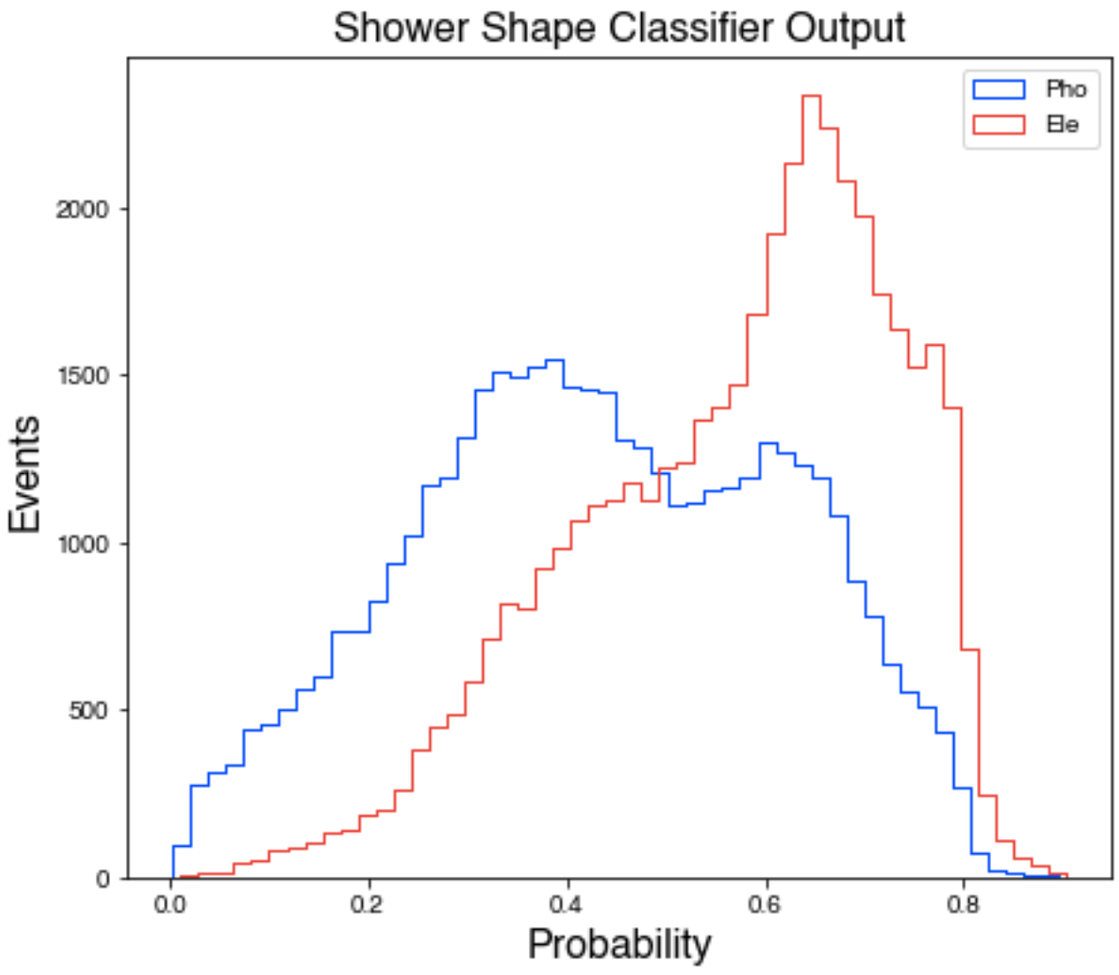
Preliminary Results

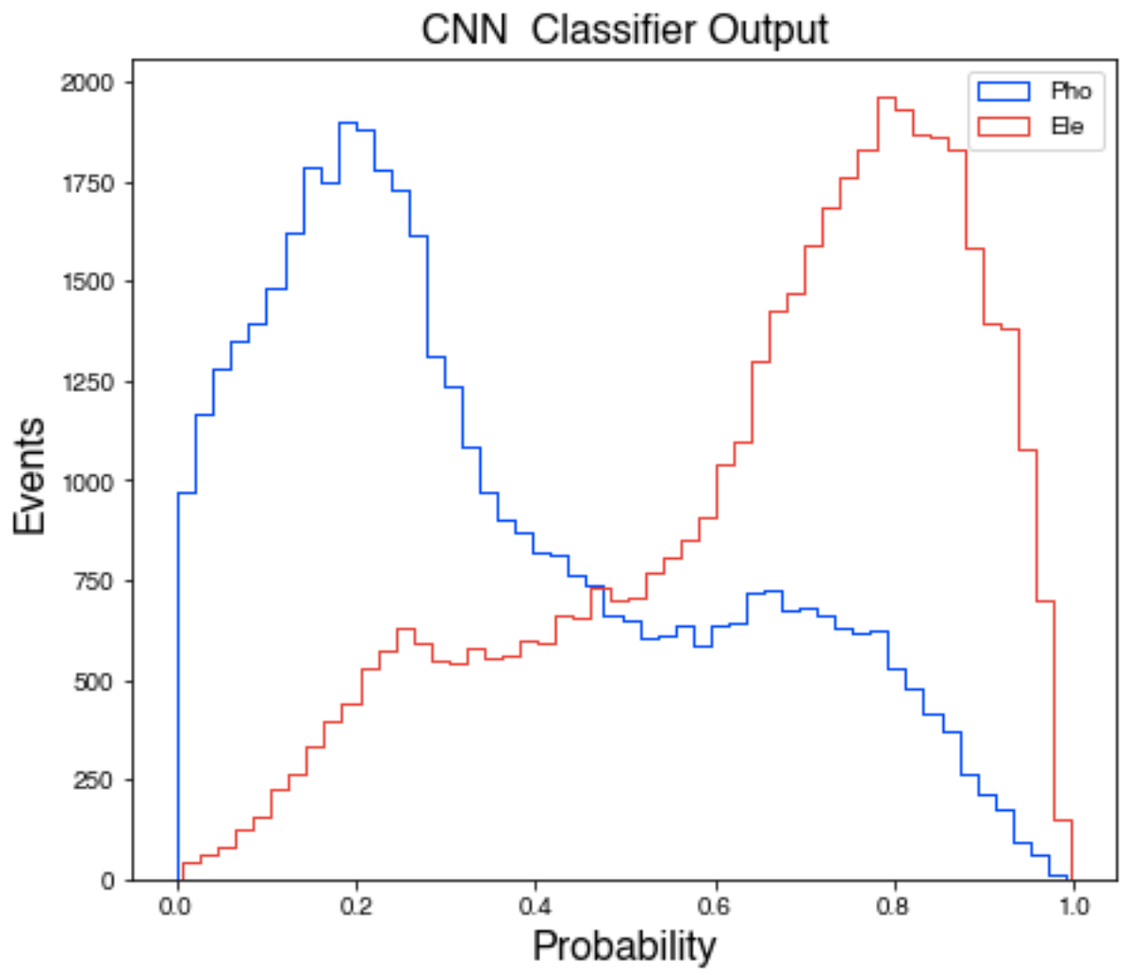
Network Type Inputs	**Fully-Connected** Shower Shape Variables	**Fully-Connected** Flattened Image	**CNN** Stacked Images	**CNN+LSTM** Image Sequence
ROC AUC	0.708	0.770	0.806	0.799

Preliminary Results



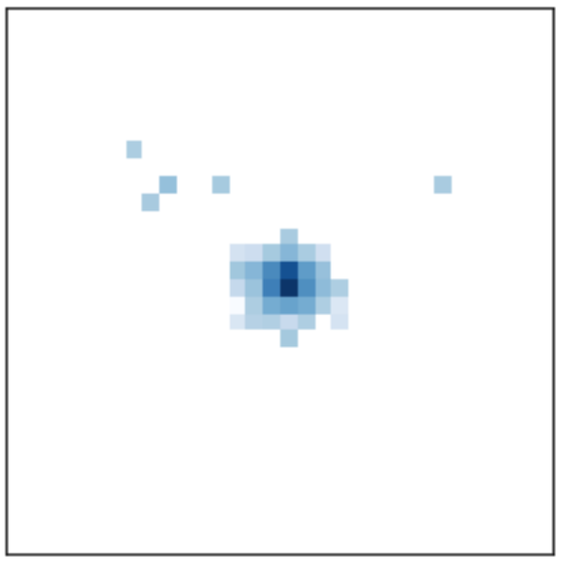
Preliminary Results



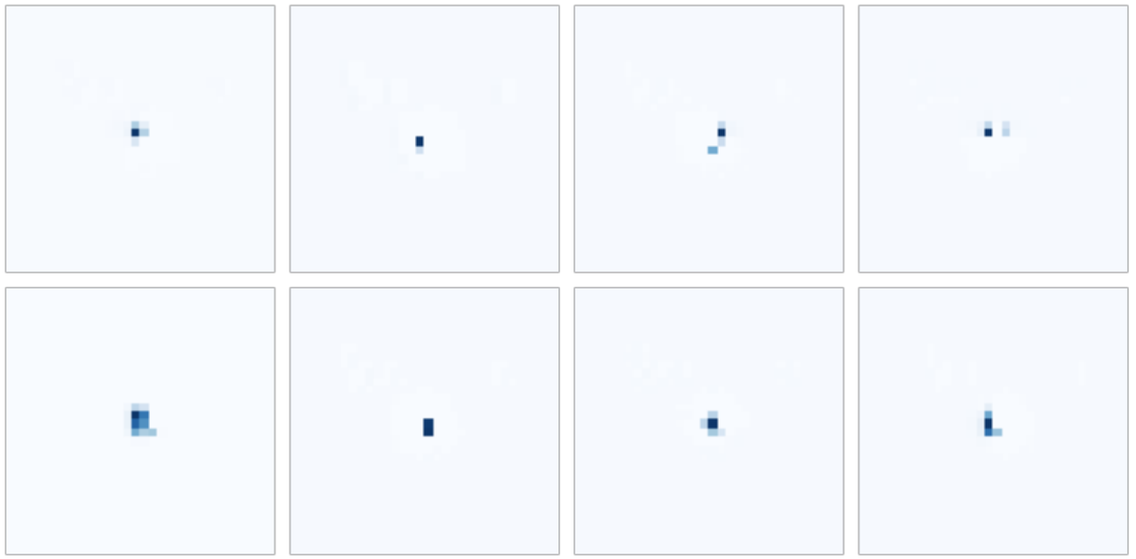


Visualizing CNN Layers

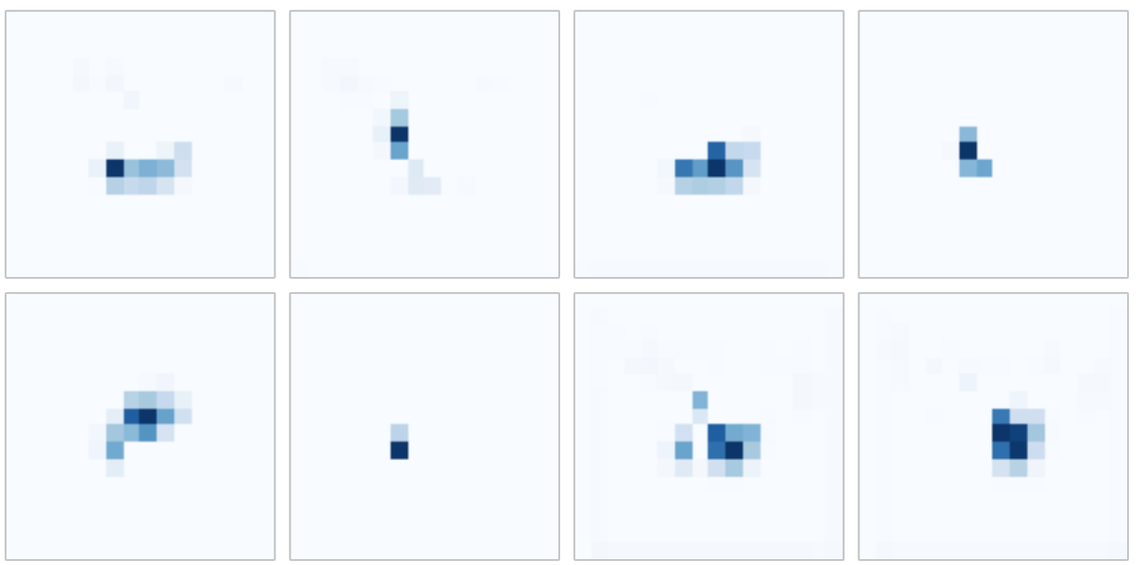
Input



Convolutional Layer 1



Convolutional Layer 3



Output

88%
Photon
(correct!)