

# Charge particle identification

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# Classification of particle type from a reaction

- Our detector, a time projection chamber, can detect the energy lost per unit length ( $dE/dX$ ) and momentum vector ( $\vec{P}$ ) of reaction fragments.
- At a constant momentum, different types of particle lost different amount of energy and we can classify they can be easily classified by plotting  $dE/dX$  vs  $|\vec{P}|$  as shown

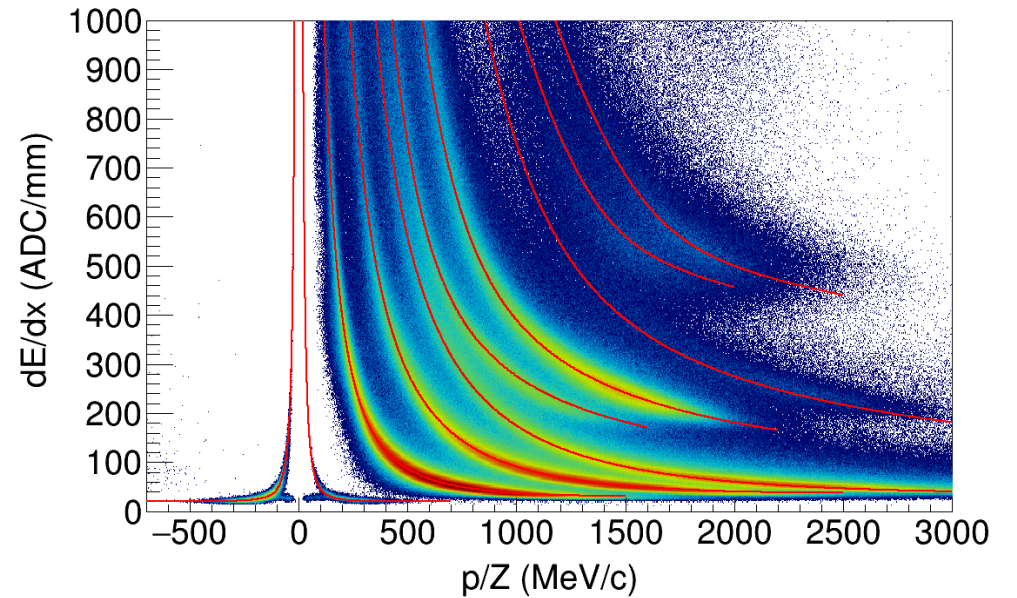


Figure courtesy G. Jhang

# Why AI

- Currently we draw graphical cuts from the aforementioned 2D plots, but we know the shape of those line changes depending on emission angle.
- Hope is instead of making selection in 2D feature space ( $dE/dX$  and  $|\vec{P}|$ ), we increase the dimensionality to 4D ( $dE/dX$ ,  $p_x$ ,  $p_y$ ,  $p_z$ ) and hope for better results.
- Machine learning algorithm should excel at higher dimensional classification.

# Current result and challenges

- Confusion matrix shows that fully connected neural network did do better than graphical cut on simulated data.
- Challenges:
  - Simulated data will not be identical to experimental data
  - Difficult to incorporate the python library into FairROOT framework

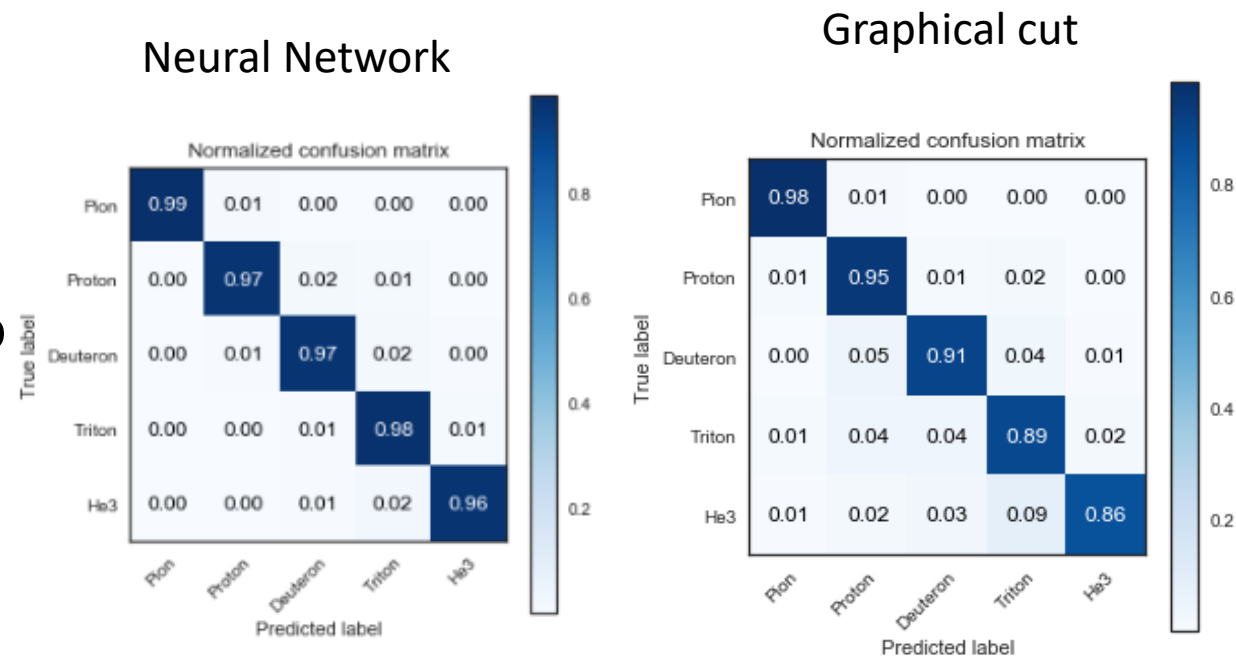


Figure courtesy T. Ladouceur