First Deep Learning based Event Reconstruction for Low-Energy Excess Searches with MicroBooNE

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- Investigate low energy $\nu_e$ excess seen by MiniBooNE in the [200-600] MeV range.
- Focus on 1lepton-1proton final states, dominant at low energy.
- Use $\nu_\mu$ sample as normalization of intrinsic $\nu_e$ background.

- Deep Learning and Computer Vision tools to identify and reconstruct interesting events:
  - LArTPC read-outs are "pictures" of the interactions: signal of each wire in time,
  - Semantic Segmentation Network identifies tracks and EM showers at the pixel level,
  - Computer Vision algorithm identifies vertex as kinks in tracks for $\nu_\mu$ candidates,
  - Spatial resolution for vertex finding ~0.3 cm is equivalent to 1 wire spacing.
Main challenge of track reconstruction: un-responsive wires.
- Tracks grow by stochastic search in 3D space around the current end point
  - small region to search => low resource consumption,
  - 3D consistency across planes => robustness to un-responsive wires and crossing cosmic tracks.
- 4% energy resolution on 1μ1p events.