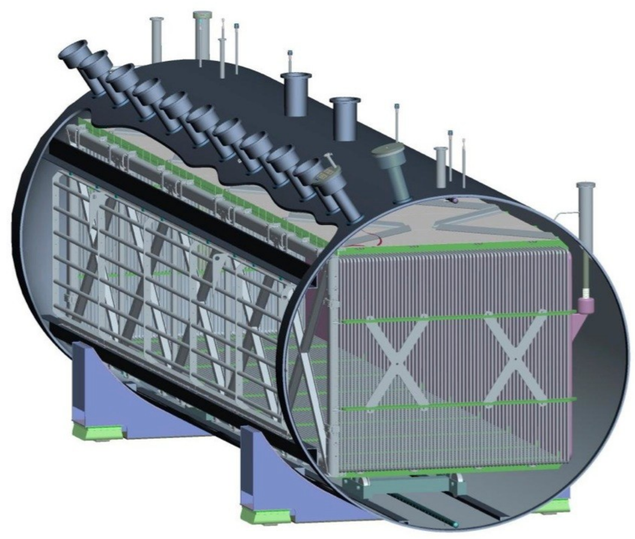
The MicroBooNE Search for Single Photon Events

Robert Murrells - University of Manchester on behalf of the MicroBooNE Collaboration

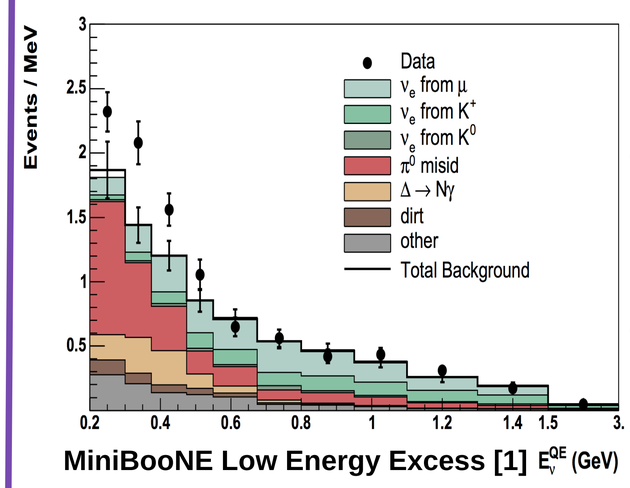
1 The MicroBooNE Experiment

Primary physics goals:
- Study of neutrino cross-sections in liquid argon.
- Investigation of the excess of low energy events observed by MiniBooNE [1].

Detector:
- 85 ton (active mass) liquid argon time projection chamber (LArTPC).
- Situated on the Booster Neutrino Beam (BNB) at Fermilab.

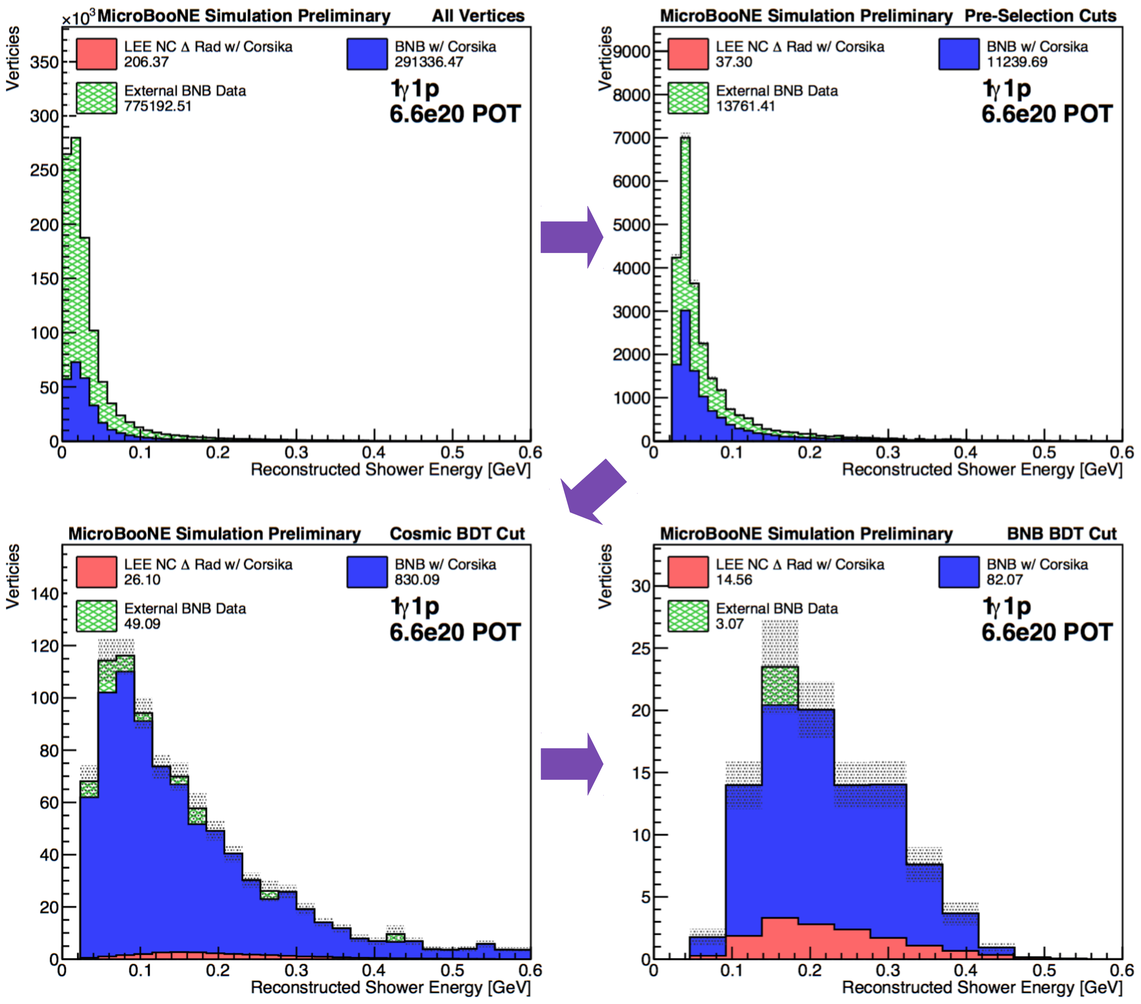


2 The MiniBooNE Low Energy Excess



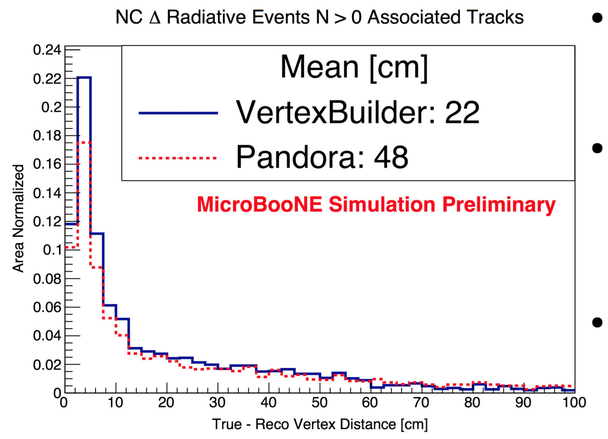
- An excess of events was seen in the low energy region [1].
- MiniBooNE was unable to distinguish between e^- and γ events.
- This search focuses on a NC $\Delta \rightarrow N+\gamma$ interpretation scaled x3 to match the low energy excess (LEE) [2].

3 Analysis Overview



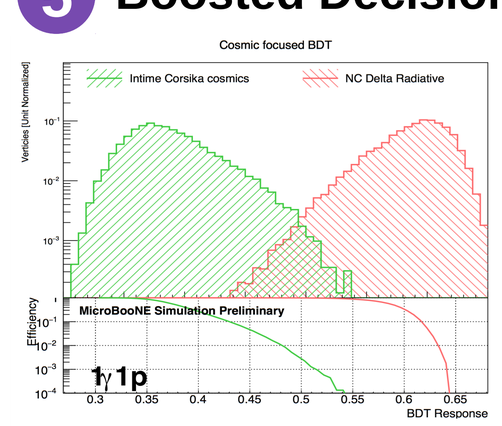
- Event selection is split into four sections: vertex reconstruction, pre-selection cuts and BDT background rejection for cosmic and BNB related backgrounds [3].
- Cosmic background is almost completely removed by selection.

4 Vertex Reconstruction



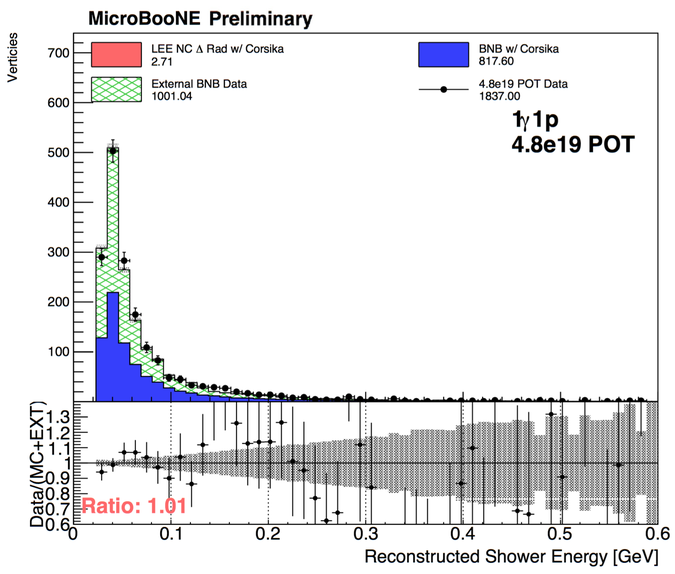
- Designed and optimized for NC $\Delta \rightarrow N+\gamma$ events.
- Backwards-projects showers to associate with tracks and other showers.
- Reconstructs vertices with at least one shower and N≥0 tracks.

5 Boosted Decision Tree Background Rejection



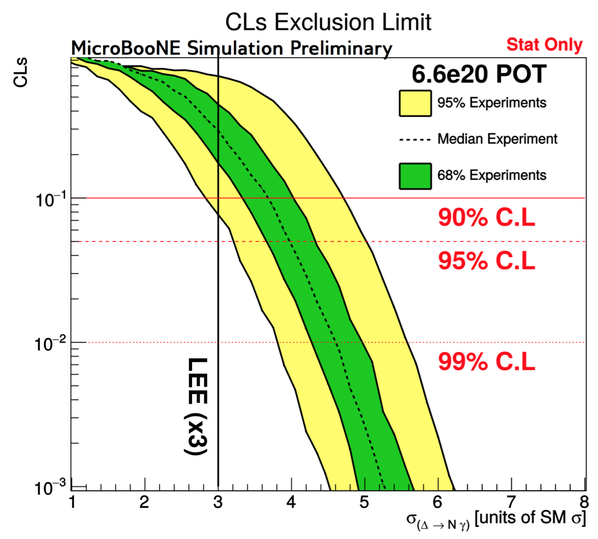
- Separate boosted decision trees (BDTs) are trained for rejection of cosmic and BNB related backgrounds.
- Variables used to train BDTs include reconstructed shower energy, vertex position and track length.

6 Data to Monte Carlo Comparison

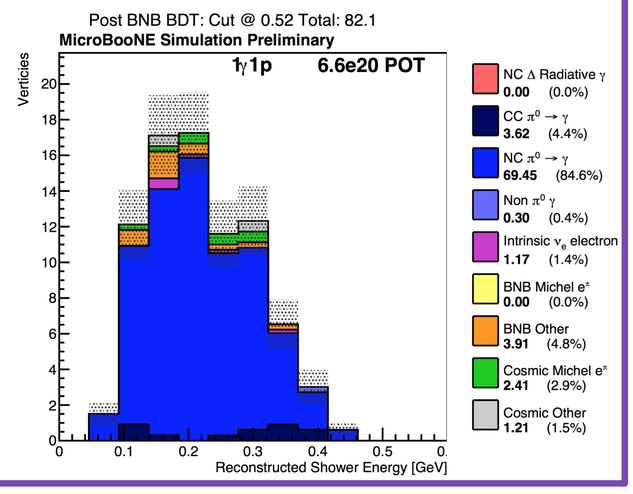


- Important check for the viability of the analysis.
- Comparison made using the first data collected by MicroBooNE.
- Good agreement between data and MC for total number of vertices and spectrally for the variables used to train the BDTs.

7 Final Selection



- MicroBooNE's sensitivity to the NC $\Delta \rightarrow N+\gamma$ cross-section.
- Projected stats-only sensitivity on the 6.6e20 POT dataset would exclude a 4.6xSM cross-section at 99 % C.L.
- Need to improve selection to be sensitive to a photon-like LEE anomaly.
- Vast majority of remaining background comprised of NC $\pi^0 \rightarrow 2\gamma$ decay.
- Projected stats-only sensitivity to the 3xSM LEE cross-section can be improved to 99 % C.L. if background is further reduced by a factor of 2.2.



References:
[1] MiniBooNE Collaboration, Phys. Rev. Lett. 102, 101802.
[2] MicroBooNE Public Note 1043
[3] MicroBooNE Public Note 1041

μBooNE

MANCHESTER 1824
The University of Manchester