

Neutral Current Background Rejection for the Low-Energy Excess Analysis using Wire-Cell Reconstruction in MicroBooNE



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The MicroBooNE Experiment¹

Primary Physics Goals:

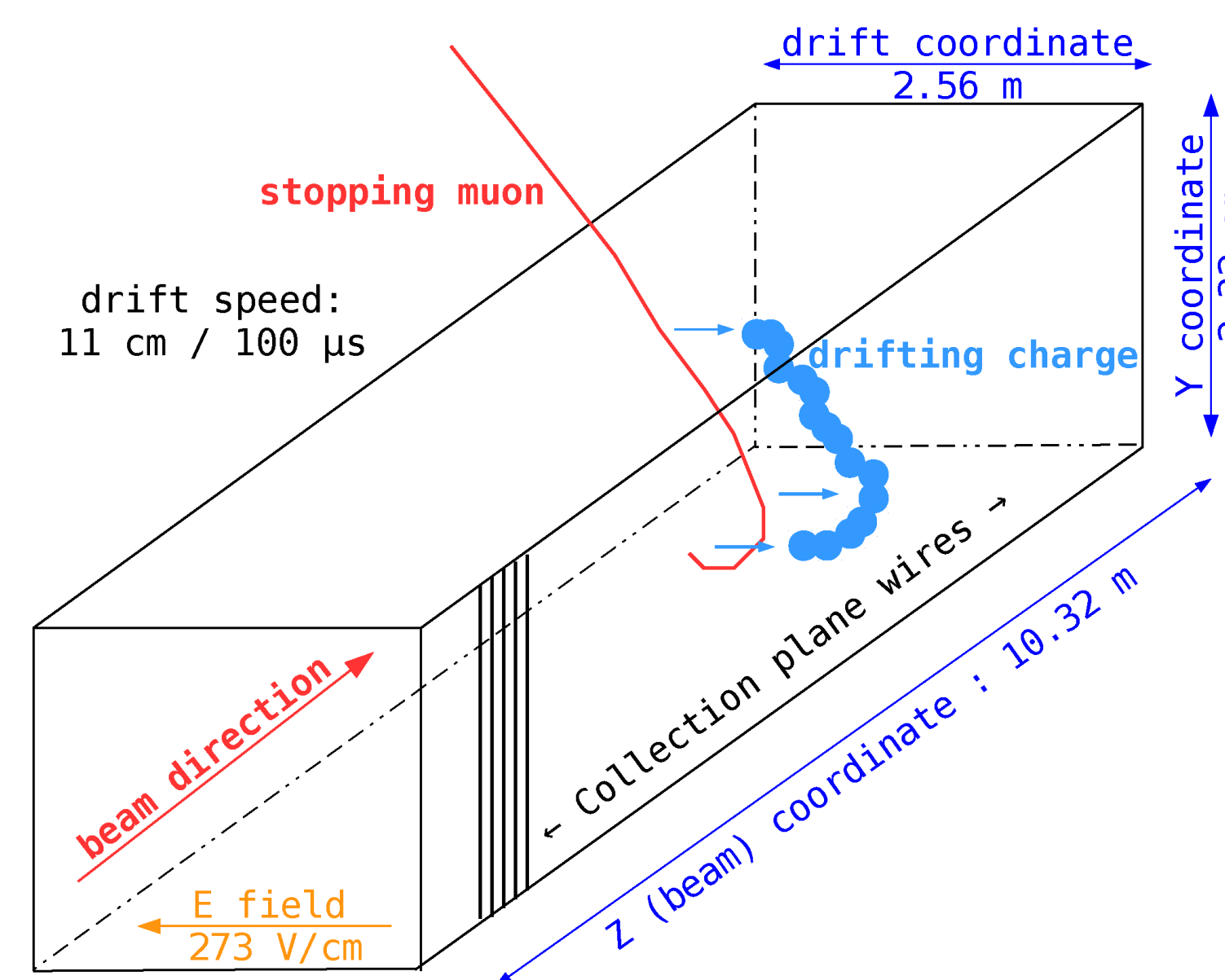
- Address Low Energy Excess (LEE) observed by MiniBooNE²
- ν -Ar cross sections
- Supernova ν

Detector:

- Surface LArTPC
- 170 ton (85 ton active mass)
- ν from BNB and NuMI beams
- 3 wire readout planes
- 32 PMTs

Advantages:

- Topological and calorimetric information
- Excellent electron/photon separation

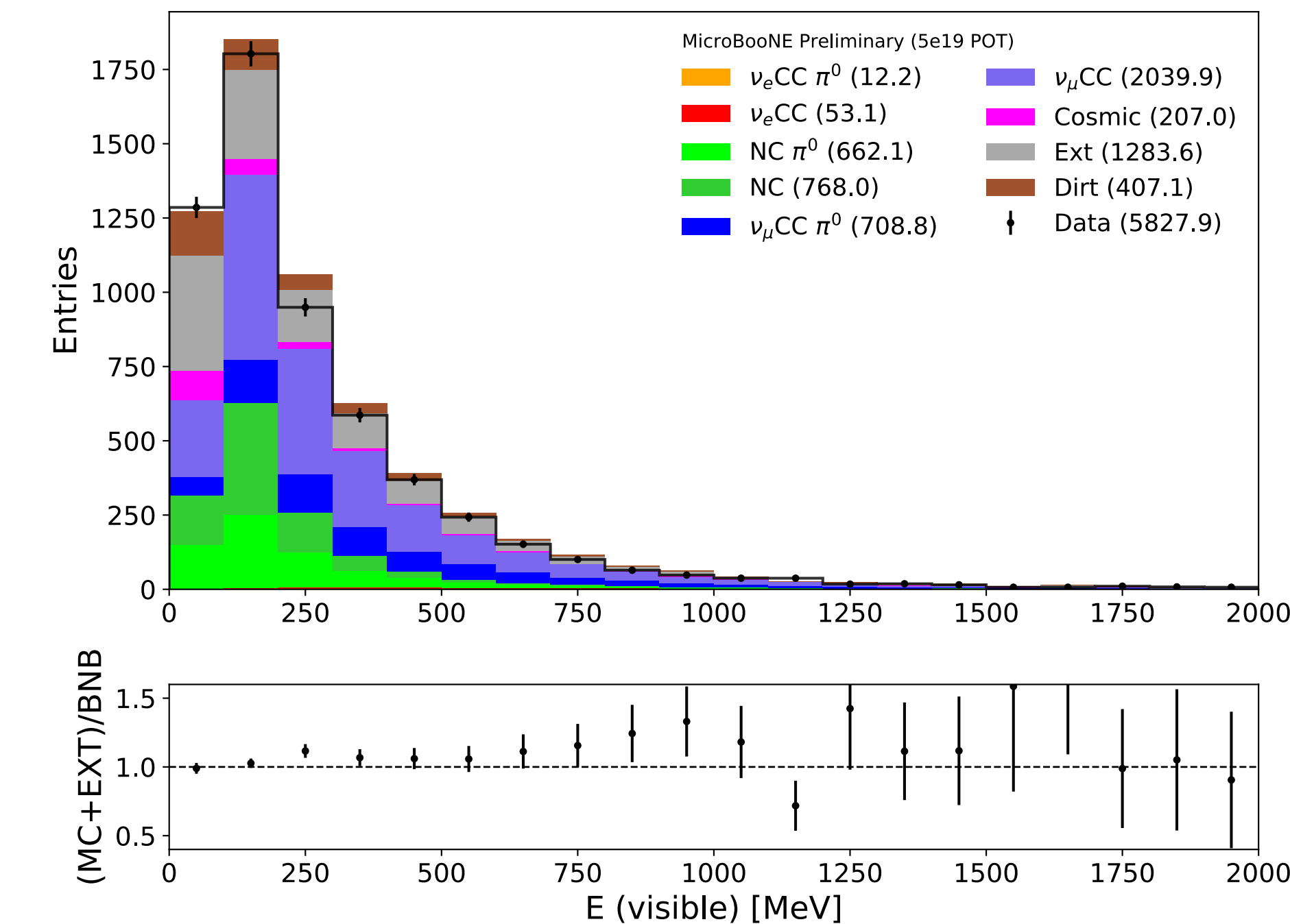


Wire-Cell

- Wire-Cell³ is a novel **tomographic imaging technique** for LArTPCs
- Creates 3D clusters of the TPC activity based on **charge readouts** and **light information**
- Trajectory fitting and dQ/dx measure identify cosmic backgrounds
- **High efficiency, high purity** generic neutrino events selection



Preselection



- The Wire-Cell cosmic background tagger helps rejecting stopping and crossing muons
- The implementation of a $\nu_{\mu}CC$ events filter removes the majority of the charged current events
- **~75% of the NC events are left** after preselection

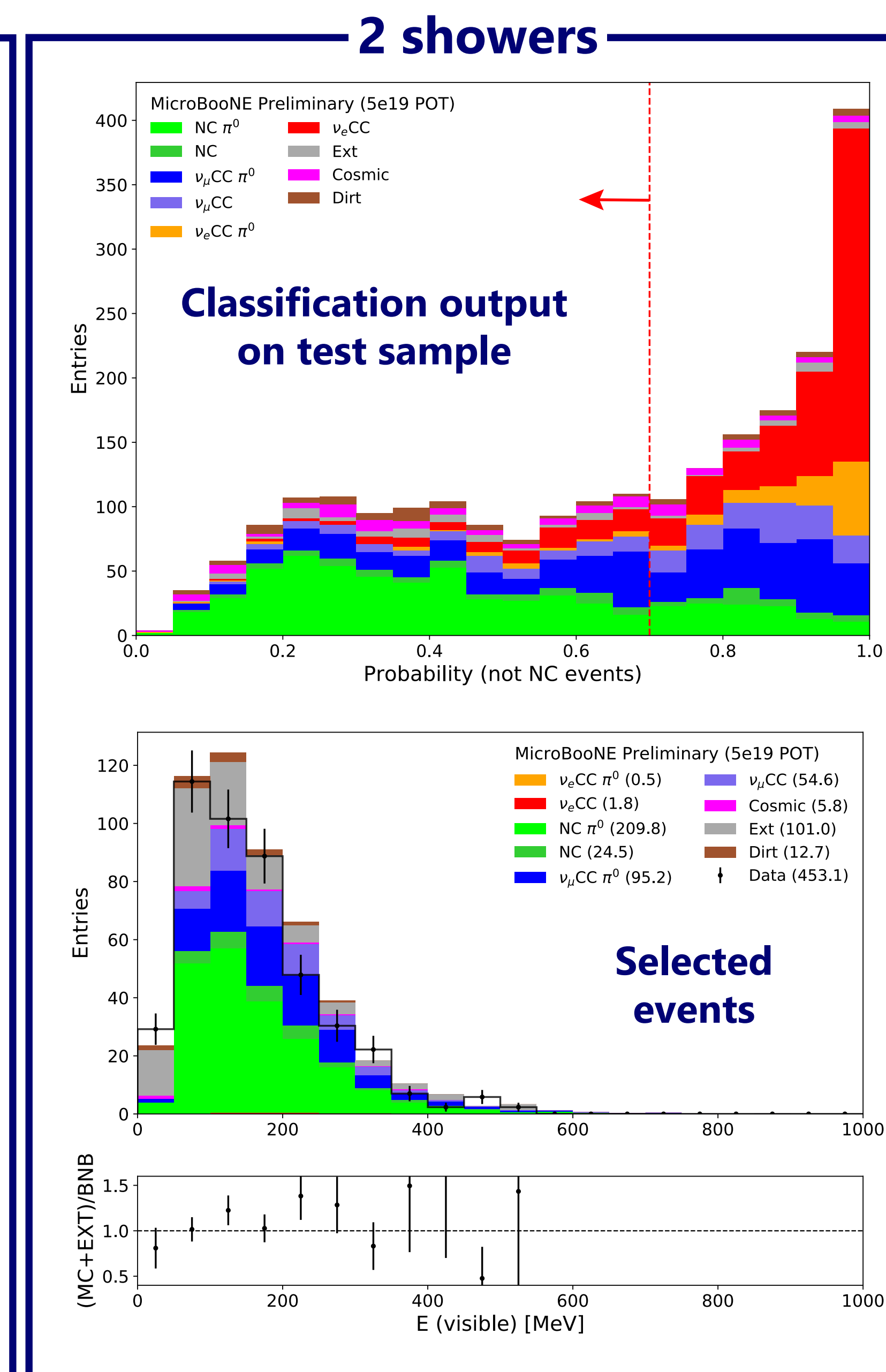
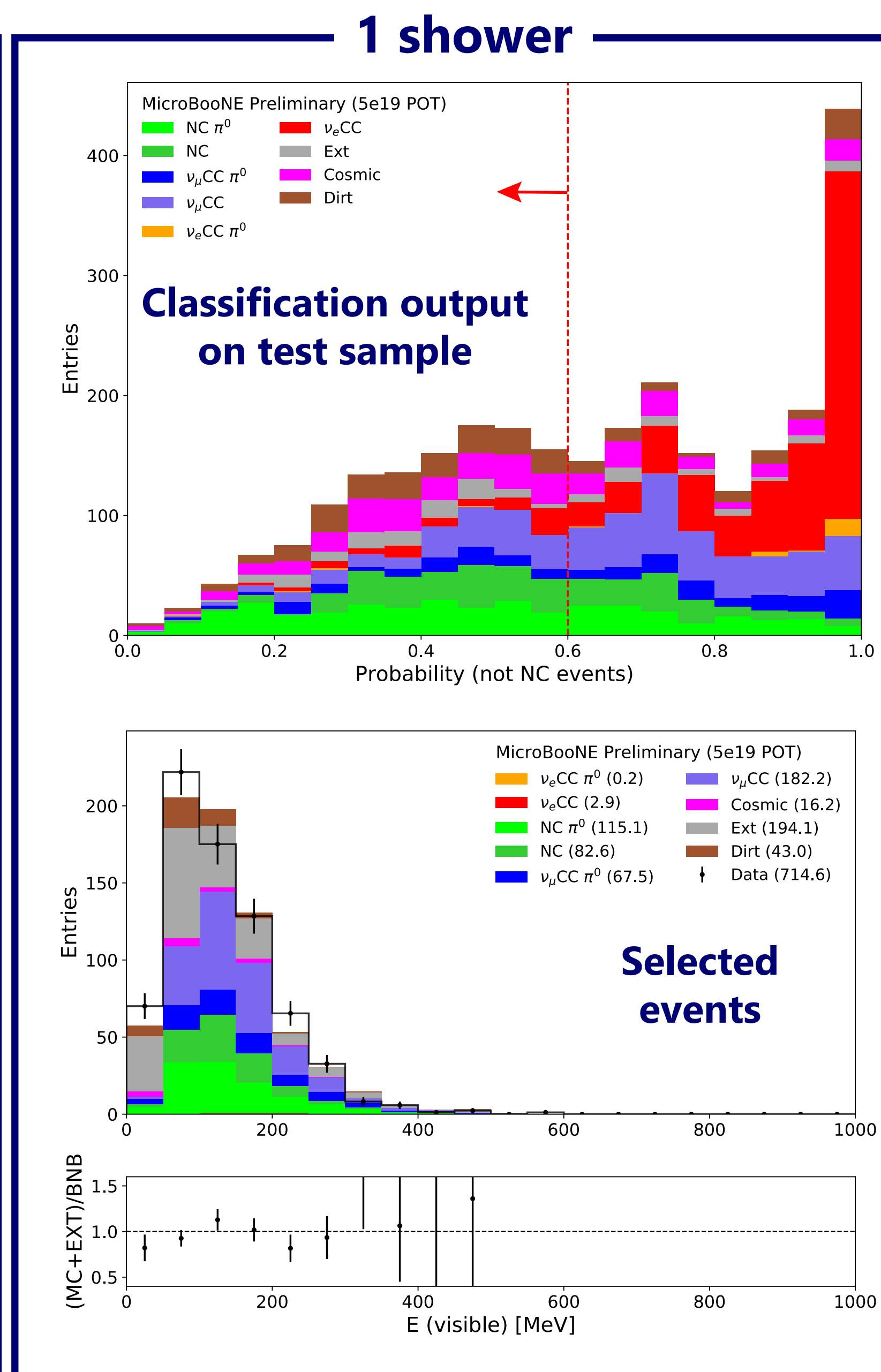
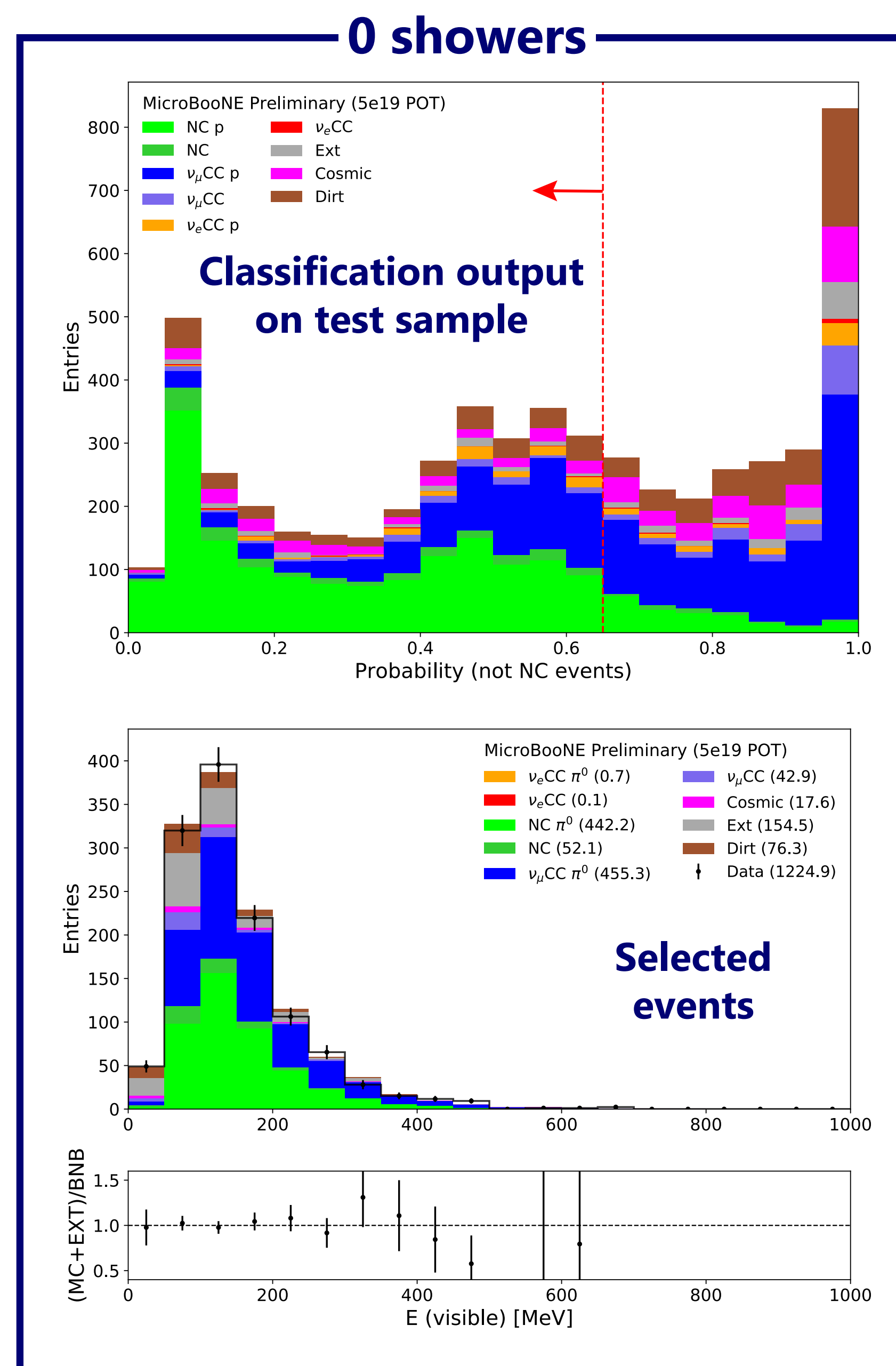
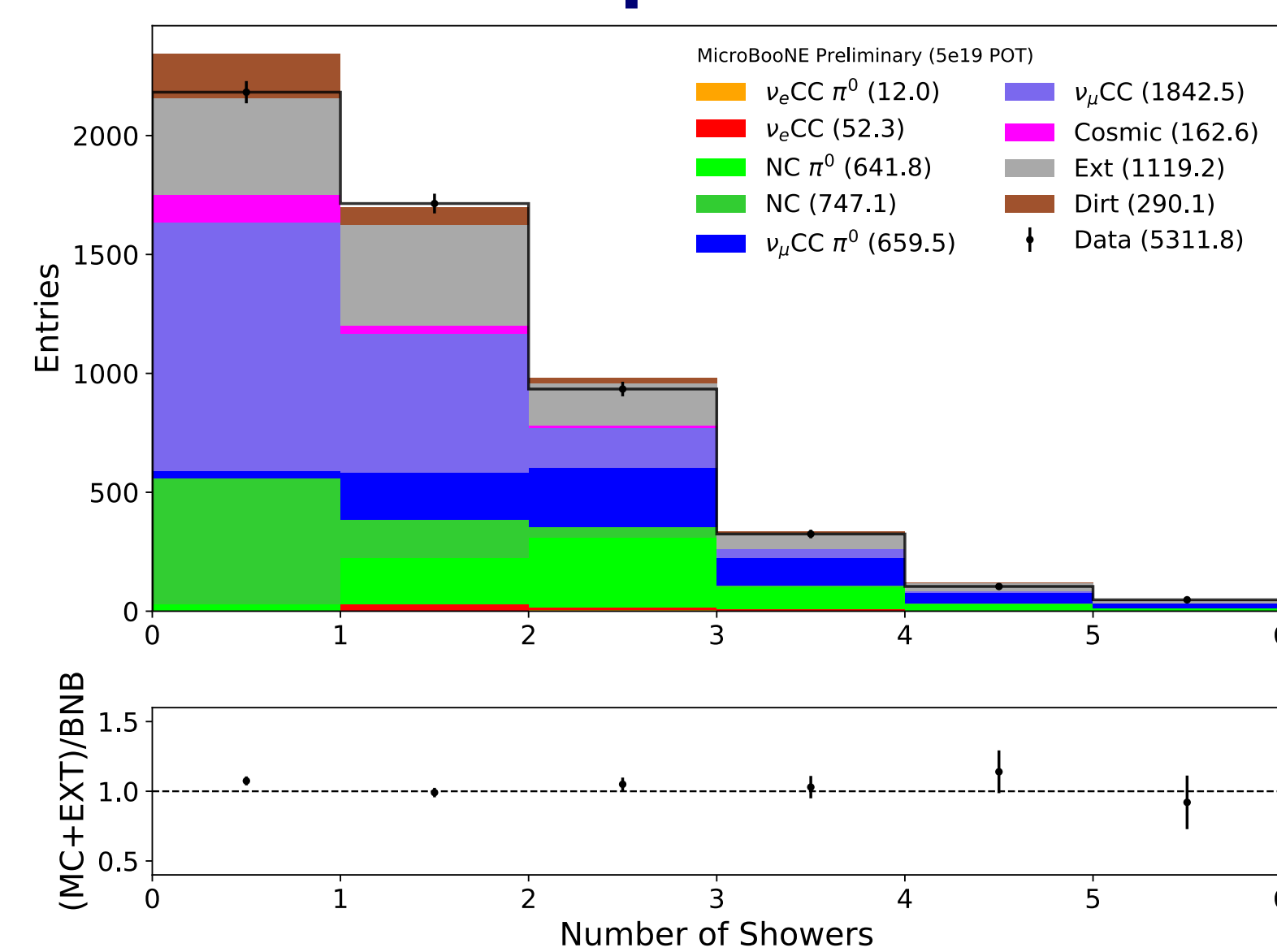
NC Events Selection

- After the $\nu_{\mu}CC$ events filter the events are divided based on the number of reconstructed showers

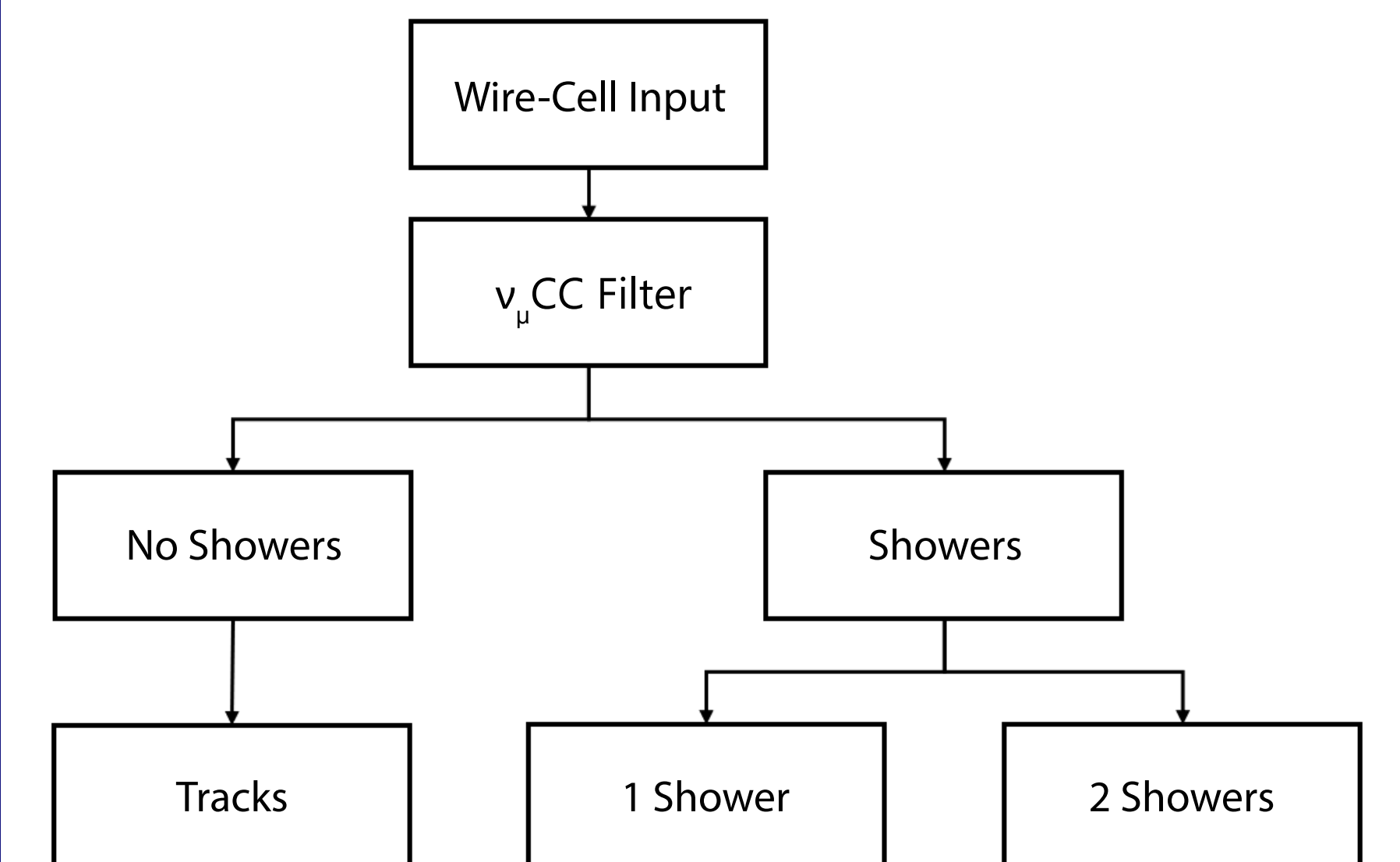
- A different (independent) selection is performed for each sample with 0, 1, and 2 showers

- A **neural network** is used to classify and select NC events

Showers per event



Pre-classification analysis workflow



Conclusions

- The current analysis only **focuses on events with 0, 1, and 2 showers**
- **Three different NC selections** are performed using neural networks for classification
- The **dominant background** is given by **charged current events** in the low energy region
- Other methods to discriminate NC and $\nu_{\mu}CC$ events will soon be explored
- The NC selection **will contribute to the charged current electron neutrino selection** as background rejection

Selection Performance

Combining the three selections:

- **Overall purity: ~38%**
- **Overall efficiency: ~50%**

Public Note: MICROBOONE-NOTE-1088-PUB
<https://microboone.fnal.gov/public-notes/>

References

- [1] <http://www-microboone.fnal.gov>
- [2] Phys. Rev. Lett. **98**, 231801 (2007)
- [3] JINST **13**, P05032 (2018)