Inclusive Search for Anomalous Single-Photon Production in MicroBooNE

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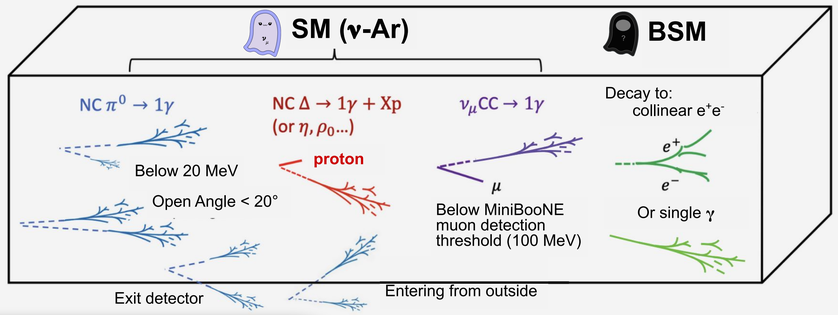
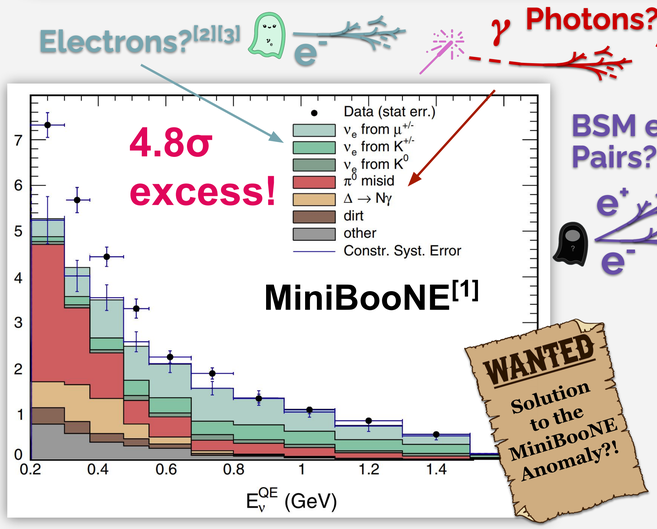
MicroBooNE

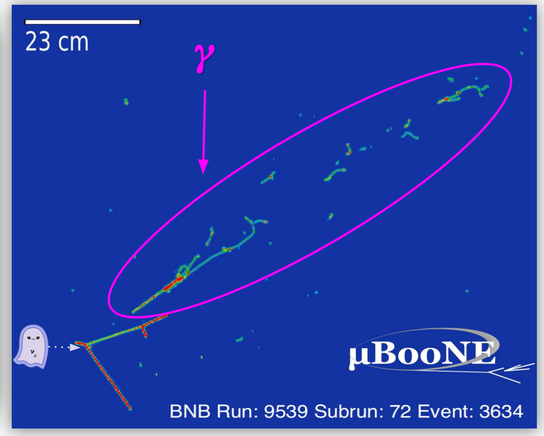
- Liquid Argon Time Projection Chamber neutrino detector
- Sits in the Booster Neutrino Beam (BNB) at Fermilab just upstream of MiniBooNE
- **Primary design goal: to understand the MiniBooNE anomaly**





Inclusive Single Photon Search

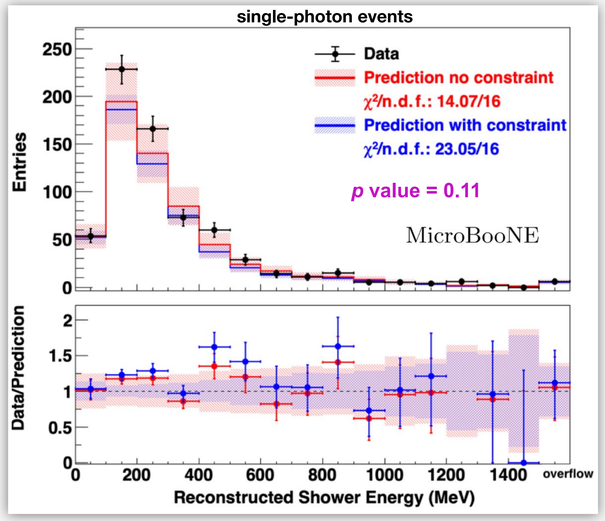
- Goal: search the **whole photon-like phase-space** for signs of an excess
- Targets any final state consistent with what would be observed as a single-photon in MiniBooNE
- Selection using Wire-Cell reconstruction[4] tools and targeted BDTs achieves an **efficiency of 7.0% and a purity of 40.2%**.



Inclusive Results

IN SINGLE PHOTON SIGNAL REGION

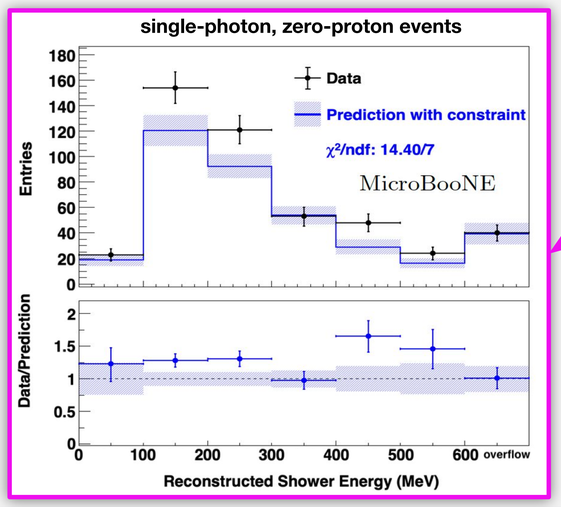
- **678 data events**
- Constrained prediction = 564 ± 24(stat) ± 51(syst)
  - Constrained with NC π^0 and ν_μCC data
- Below 600 MeV: mild data excess (*p* value = 0.03)

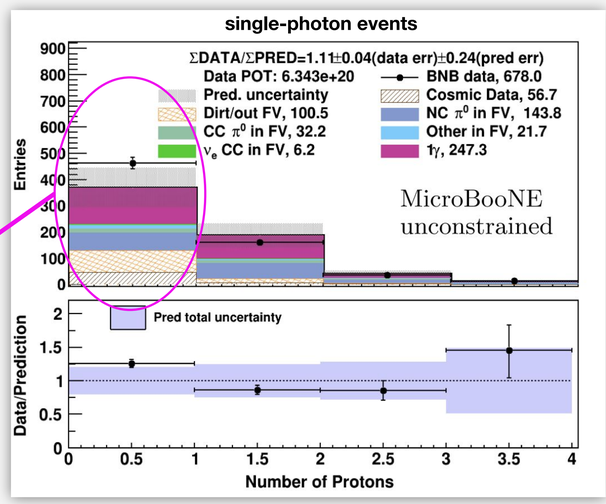


Digging Deeper: 1γ0p

ZERO PROTON SUBSAMPLE RESULTS

- Prior analyses[2][3][5] have noted proton content, which was undetectable by MiniBooNE, may be of interest to the LEE
- Subset of selected inclusive single-photon events
- Contain **no reconstructed protons** above 35 MeV KE in the final state (0p)
- Have reconstructed shower energy ≤ 600 MeV
- Local significance of data excess: **2.2σ**





Next Steps

- These hints of a MiniBooNE-like excess require further study of 1γ0p events
- In-progress MicroBooNE follow-up with more data and new tools to tag protons and neutrons: **See Diego Andrade's Poster on Thursday**
- All SBN program[6] detectors now have data: investigations with SBND and ICARUS underway

References

[1] MiniBooNE, Phys. Rev. D 103, 052002 (2021)
[2] MicroBooNE, Phys. Rev. Lett. 128, 241801 (2022)
[3] MicroBooNE, Phys. Rev. Lett. 135, 081802 (2025)
[4] MicroBooNE. JINST, vol. 17, no. 01, p. P01037, 2022
[5] MicroBooNE, Phys. Rev. Lett. 128, 111801 (2022)
[6] R. Acciarri et al. arXiv:1503.01520 [hep-ex]

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