# Three Great Reasons to Use MeV-Scale Reconstruction in Single-Phase LArTPCs

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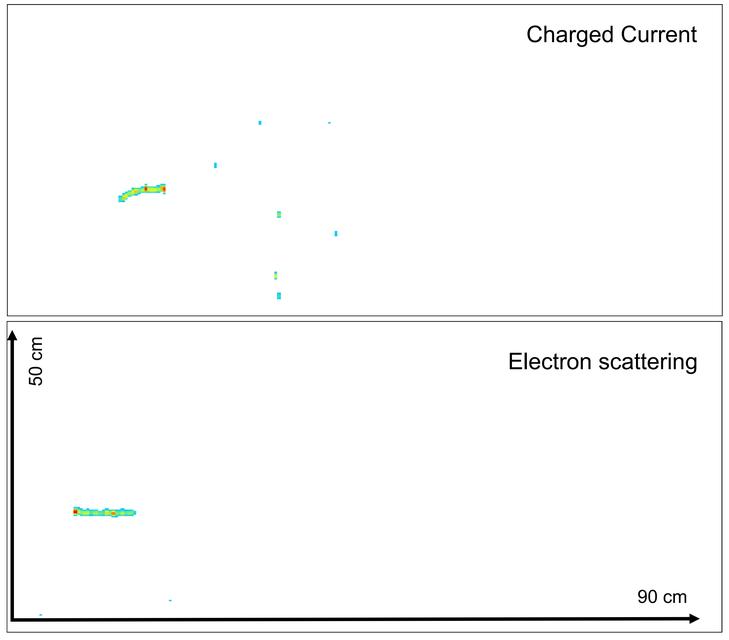
## The MeV Scale in LArTPCs

- LArTPCs have excellent calorimetry and position resolution.
- LArTPCs  have also demonstrated MeV-scale capabilities. [1]
  - Thresholds < 300 keV
- What can MeV-scale reconstruction be used for?

## Supernova Neutrinos

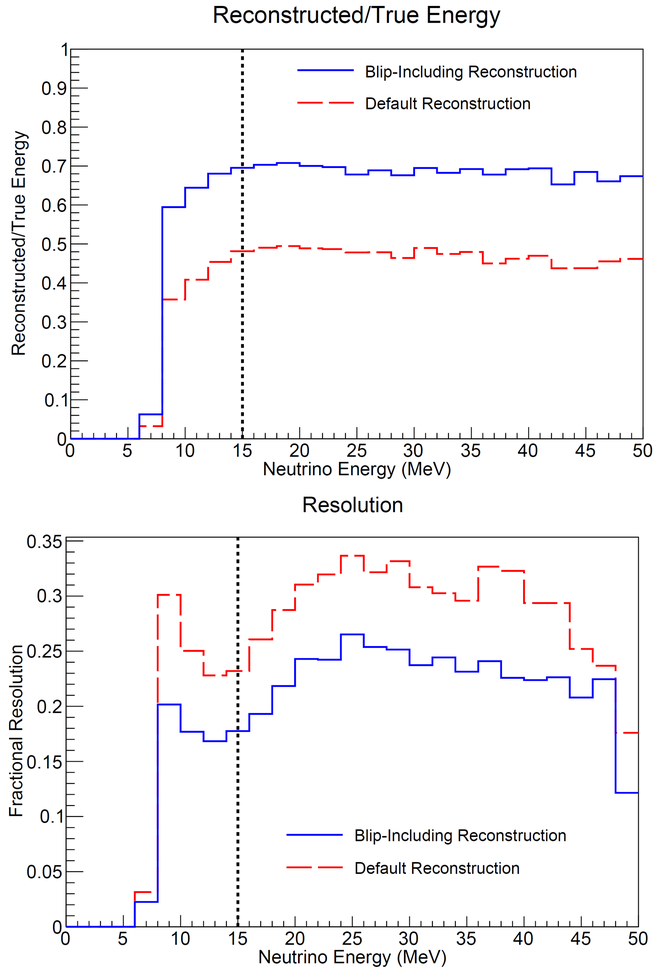
- Supernova neutrinos are low energy (< 60 MeV).
- Charged current interactions often produce 1-10 MeV de-excitation photons.
- Reconstructing these photons helps us distinguish between charged current and electron scattering events.




**Top: MARLEY simulation of a supernova electron neutrino charged current interaction in argon. Bottom: Simulation of an electron scattering event. Both are viewed as raw data ArgoNeuT event displays. Both events contain a 20 MeV electron, however the top event display also shows low energy (MeV-scale) isolated activity (“blips”) near the main electron track.**

## Improved Calorimetry

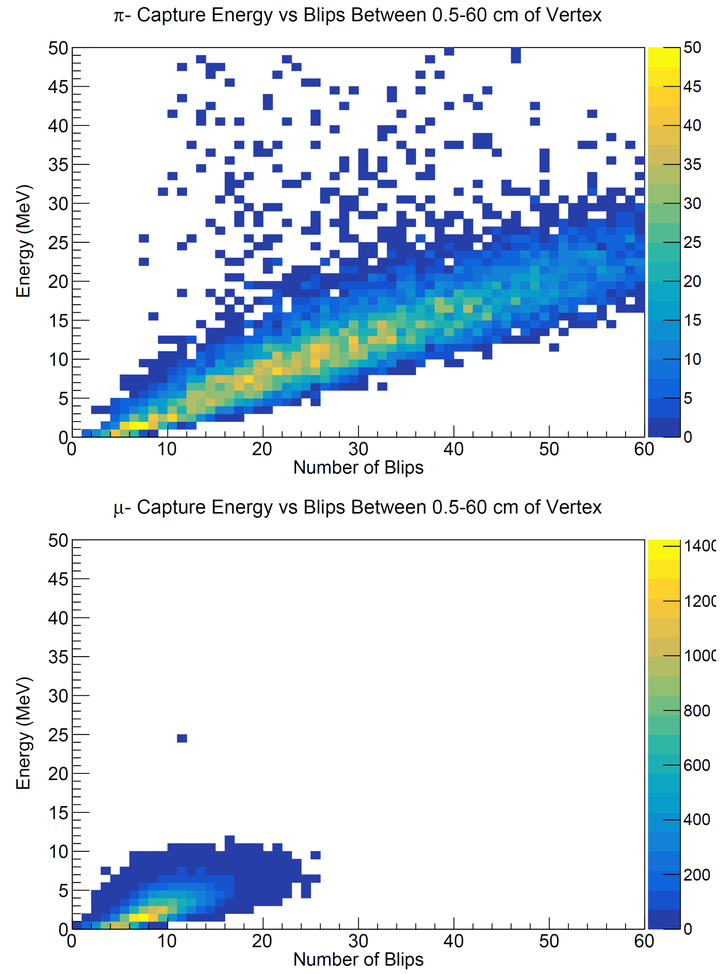
- Supernova neutrino interactions produce low-energy photons from nuclear de-excitation and bremsstrahlung.
- These photons produce electrons with energies at or below the MeV-scale which will be lost by common shower reconstruction methods.
- Adding in MeV-scale reconstruction greatly improves reconstruction.




**Top: Ratio of average reconstructed and true neutrino energy versus neutrino energy with (blue solid line )and without (red dashed line) blip reconstruction Bottom: Fractional RMS resolution. The vertical black dotted line at 15~MeV denotes the approximate endpoint of the $^{8}$B solar neutrino spectrum.**

## Particle Identification

- MeV-scale activity from nuclear effects should allow for pion/muon discrimination.
  - e.g. final-state neutrons, protons and de-excitation gammas from pion/muon capture
- We find that blip activity near the capture point differs for pions and muons.




**Summed blip energy versus blip multiplicity within 0.5 and 60 cm of the capture-point for pion  captures at rest (top), and muon captures at rest (bottom).**

[1] Phys. Rev. D **99** 012002 (2019)