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A particle hypothesis based approach for energy estimation in muon neutrino charged current events at NOvA

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NOvA is a neutrino oscillation experiment which probes the neutrino CP-violating phase and mass ordering, as well as improve limits on current neutrino oscillation parameters, by measuring oscillations of muon neutrinos and muon anti-neutrinos produced in the NuMI beam at Fermilab. The muon neutrino disappearance analysis specifically focuses on the measurements of Δm^2_{32} and $\sin^2(\theta_{23})$. Choosing the right energy estimator is key to oscillation analyses; the estimator currently used by the muon neutrino disappearance analysis identifies the muon in an event, and labels all other energy depositions as hadronic energy. However, it is possible to use a version of NOvA's convolutional visual network (CVN) to separate the hadronic energy into its individual components. Once the particle is identified using CVN, we measure the energy of these tracks with a method called "Break Point Fitting" developed to track a scattering particle passing through a detector that takes measurements at discrete intervals. The track is fit under three assumptions: muons, protons, and pions, and the energy is calculated for each. The combination of tagging particles with CVN and more accurate energy calculation with BPF will allow for a more robust energy estimator, with a possibility for an improved energy resolution.

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