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The Generalized Neutrino Self-Veto for Neutrino Telescopes

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Searches for astrophysical neutrinos have to contend with a large background of atmospheric neutrinos. In searches for up-going neutrinos, this background is irreducible. In veto-based searches, however, down-going atmospheric neutrinos are removed when the veto is triggered by muons produced in the same air shower, leaving only astrophysical neutrinos at high energies and small zenith angles. However, this veto is only guaranteed for muon neutrinos. There is a possibility for muons from other branches of the shower to contribute and offer a veto for atmospheric electron neutrinos and atmospheric neutrinos from prompt decays. To verify the veto probability for these neutrinos an analytic formula was derived from lepton yields and modifications to CORSIKA were made. The modification to CORSIKA improves upon the simulation's speed and file size by actively determining when showers are not interesting to the analysis and stopping the showers simulation and moving on to the next one.

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