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Long-Term Stability of Backgrounds in the IceCube Neutrino Observatory

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The IceCube Neutrino Observatory is a cubic-kilometre-scale neutrino telescope completed in the Austral summer of 2010/2011. The detector forms a lattice of 5,160 photomultiplier tubes (PMTs) installed in the South Polar ice cap at depths from 1450 to 2450 m. IceCube is designed to detect astrophysical neutrinos upward of 100 GeV and to study neutrino oscillations with atmospheric neutrinos down to about 10 GeV thanks to the DeepCore infill array. In addition to this, the special environment of the Antarctic ice makes it possible to detect neutrinos of much lower energies (˜10 MeV) from galactic core-collapse supernovae by measuring a correlated increase in PMT background rates. Especially these studies very close to the detector threshold require multi-year data samples to achieve statistically significant results. Investigating the long-term behavior of the backgrounds, mainly PMT noise and atmospheric muons, is therefore important to estimating the sensitivity and understanding variations in the background between different data samples. We find that the noise rate of the IceCube PMTs decays over multiple years and observe a yearly sinusoid-like variation in the atmospheric muon background. The decay can be attributed to changes conditions of the surrounding ice in which the PMT is embedded. Variations in the atmospheric muon background can be attributed to changes in the conditions of the upper atmosphere.

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