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Muon Reconstruction in IceCube: Status and Future

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The IceCube neutrino observatory is a Cherenkov detector which is currently under construction at the South Pole. The glacier ice at the South Pole plays an important role as a target of neutrino-nucleon interaction and a super-transparent Cherenkov light propagator. Using the abundant natural ice, IceCube will be completed as the world's largest cubic kilometer neutrino observatory in 2011, with 4800 optical sensors (Digital Optical Modules, DOMs) deployed on 80 strings at depths of 1450m to 2450m from the surface of the ice. An earlier neutrino observatory (AMANDA) is now integrated into the IceCube volume.

Since the era of AMANDA our focus has been the search for extra-terrestrial neutrinos. One of the main detection channels for these neutrinos is from muons that are generated from muon-neutrinos via charged-current interactions [1] [2]. So far, we have not observed any excess beyond background for this process. However, our analyses have resulted in the reconstruction of a large number of muon events whose origin is atmospheric neutrinos. Unlike extra-terrestrial neutrinos, the statistics of muon events from atmospheric neutrinos are increasing everyday. Because of their large number, these atmospheric neutrinos can play a leading role in the analysis of neutrino absorption tomography of the Earth [3].

In order to utilize the atmospheric neutrino events as a probe of the Earth's core, we need to improve event reconstruction techniques, especially for muon energies in the range of ~10TeV to a few hundred TeV in IceCube. We also require a detailed understanding of the systematic uncertainties of reconstruction. For example, one of the main uncertainties may be induced by our limited knowledge of glacier ice. Several ongoing studies are trying to improve our understanding of the glacier ice properties. In this talk, I will give an overview of muon reconstruction and event selection in IceCube, with current status and future plans.

References

[1] A. Achterberg et al., *Phys. Rev.* D, **75**, 102001 (2007).

[2] A. Achterberg et al., *Phys. Rev.* D, **76**, 042008 (2007).

[3] Gonzalez-Garcia, M.C., Halzen, F., Maltoni, M., Tanaka, H.K.M. *Phys. Rev. Lett.*, **100**, 061802 (2008).