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Neutrino Radiography of the Earth's Core with the IceCube neutrino observatory

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In spring of 2011, the world's largest neutrino observatory, IceCube, was completed within deep glacial ice at the South Pole.
IceCube is designed to detect Cherenkov light emitted by secondary charged particles generated from high-energy neutrinos.
The primary mission of IceCube is to discover the origin of cosmic neutrinos, while detailed studies of the atmospheric neutrino background have been performed in the last five years. For example, we observed ~35 atmospheric neutrino events per day in 2008 with a half-size detection volume of completed IceCube.

From the point of view of geosciences, using atmospheric neutrinos seen by IceCube is currently the unique solution to perform neutrino radiography for the Earth's core.
This is the direct measurement of Earth's core density, while the body-wave and the free oscillation studies based on seismic wave measurements cannot reduce substantial uncertainties that depend on geophysical models of Earth.
Two challenges to be overcome for IceCube are sufficient event statistics and improved energy resolution.

Our current knowledge about Earth's density profile, the Preliminary Reference Earth Model (PREM), indicates sensitivity to neutrino energies above 10TeV. However, the atmospheric neutrino energy spectrum decreases steeply with increasing energy.
This constraint results in a requirement of long-term measurement even with a cubic kilometer neutrino observatory.
Using 10 years of full-size IceCube data, we currently expect at least 3-sigma separation in averaged density between core and mantle.

On the other hand, the energy resolution of event reconstruction affects separation efficiency of neutrinos with energy over 10TeV.
With a better energy resolution and detailed understandings of systematic errors, the required measurement period is minimized.
Our short-term goal is thus understanding systematic errors and improving our energy reconstructions.

In this talk we present the current status of neutrino radiography of the Earth's Core with IceCube one year data.
The talk will contain results performed with data obtained in 2008 or later.

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