Neutrino Astronomy and Astroparticle Physics at the South Pole

Juan Carlos Díaz Vélez
IceCube Collaboration
University of Wisconsin-Madison

Abstract

The electron neutrino was discovered in 1956 by Frederick Reines and Clyde Cowan of Los Alamos National Laboratory 26 years after it was originally postulated by Wolfgang Pauli in order to explain an apparent violation of energy conservation in β-decay. Since then, two other neutrino flavors associated with charged leptons have been discovered. The neutrino is an elusive particle with no electric charge and very little mass. As such, it rarely interacts with matter and can travel large distances unhindered through the Universe. For this reason, high-energy neutrinos are considered to be ideal messengers from the most interesting, violent, and least understood phenomena in the Universe.

In 1993, the first working high-energy neutrino detector was deployed deep in the waters of Lake Baikal, Russia. Originally conceived at the University of Wisconsin and completed in 2000, the Antarctic Muon and Neutrino Detector Array (AMANDA) uses natural ice as a Cherenkov detector of charged particles produced in neutrino interactions. AMANDA represents a proof-of-concept for larger scale detectors and current efforts are underway to construct IceCube, a second generation neutrino telescope encompassing a full cubic kilometer of ice. When completed, IceCube will be the largest and most sensitive telescope of its kind.