**Physics Seminar**

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“Exploring the mysteries of the Universe with the IceCube neutrino detector at the South Pole”

**Abstract**

IceCube is a cubic kilometre neutrino detector, consisting of over 5000 optical sensors, embedded in the deep ice at the South Pole. The primary goal of detecting high energy neutrinos from the Universe was reached after two years of full operation - heralding the birth of neutrino astronomy. In this talk I will review how an idea from the 1960s became
a reality decades later, culminating with the observation of the first cosmic neutrinos. These neutrinos, with energies up to 2 PeV, may come from exotic objects such as active galaxies, or gamma-ray bursts, where some sort of acceleration mechanism would be at work, boosting cosmic ray particles to energies millions of times greater than achieved at the LHC. IceCube's neutrino observations are helping in the quest to understand how such particle acceleration could be possible. At lower energies, IceCube is searching for neutrinos from many potential dark matter annihilation sites - including our Sun, and the centre of the galaxy. The background flux of atmospheric neutrinos is also providing a beam for particle physics - allowing for precision measurements of neutrino oscillation mixing parameters, and for searches for sterile
neutrinos. Finally, I will describe plans to expand the high and low energy reach of the array - and some of the physics that will be explored, including attempts to determine the neutrino mass hierarchy.

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