

Detection of a Type II_n Supernova in Optical Follow-Up Observations of IceCube Neutrino Events

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The IceCube neutrino observatory pursues a follow-up program, which selects interesting neutrino events in real-time and issues alerts for electromagnetic follow-up observations. In March 2012, the most significant neutrino alert during the first three years of operation was issued by IceCube. In the follow-up observations performed by the Palomar Transient Factory (PTF), a Type II_n supernova (SN), PTF12csy, was found 0.2 degrees away from the neutrino alert direction, with an error radius of 0.54 degrees. It has a redshift of $z = 0.0684$, corresponding to a luminosity distance of about 300 Mpc, and the Pan-STARRS1 survey shows that its explosion time was many months before the neutrino alert, so that a causal connection is unlikely. The a posteriori significance of the chance detection of both the neutrinos and the SN at any epoch is 2.2σ within IceCube's 2011/12 data acquisition season. Also, a complementary neutrino analysis reveals no long-term signal over the course of one year. Therefore, the SN detection is considered coincidental and the neutrinos uncorrelated to the SN. However, the SN is unusual and interesting by itself: It is luminous and energetic, bearing strong resemblance to the SN II_n 2010jl, and shows signs of interaction of the SN ejecta with a dense circumstellar medium. High-energy neutrino emission is expected in models of diffusive shock acceleration, but at a low, non-detectable level. In this talk, the optical follow-up system is introduced, the neutrino and electromagnetic data gathered from the SN PTF12csy are presented, and the data analysis and possible interpretations are discussed.

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