Contribution ID: **4** Type: **not specified**

Gamma Ray Constraints on New Physics Interpretations of IceCube Data

Saturday 30 September 2017 09:35 (20 minutes)

We use the multi-messenger method to test various interpretations of the PeV neutrino events at Icecube. We find that a purely astrophysical interpretation with a single power-law flux is incompatible with the existing gamma ray constraints. However, a new physics interpretation in terms of a heavy dark matter decay to neutrinos and Standard Model Higgs is found to be still compatible, provided the dark matter lifetime is larger than $\sim 10^{28}$ sec for masses in the 2-4 PeV range. We also study the gamma ray constraints on a simple Z' model, which is a good candidate to explain the anomalous gap feature in the IceCube data. With more data, if these anomalous features become statistically significant, the multi-messenger method can be used as an effective probe of the new physics interpretations.

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Session Classification: Neutrinos and Dark Matter