

Constraints on the astrophysical flux and the dark matter decay with IceCube HESE data

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The IceCube detection of High Energy Starting Events (HESE) and the upward muon track events (6 year data) are presently hard to explain with the single power-law astrophysical flux for energies above 30 TeV. We investigate the possibility that a significant component of the additional neutrino flux originates due to the decay of a very heavy dark matter particle via several possible channels into standard model particles. We perform a full 5 parameter fit to IceCube data in which we vary astrophysical flux normalization, power-law index, dark matter mass, dark matter lifetime and dark matter decay mode. We show that that dark matter with mass in the range 200-400 TeV, lifetime around 10^{27} s and soft-channel decay mode ($DM \rightarrow W^+ + W^-, b \bar{b}$, etc) provides much better fit to IC data than the best-fit astrophysical flux alone. For hard decay channels such as $DM \rightarrow \nu_e + \bar{\nu}_e$, the best fit gives mass of few PeV, thus contributing only to the highest energy events. We have also done analysis by using the prior that would fix power-law index to the best fit value for upward muon track events ($\gamma \sim 2.13$), and we find that in this case, all dark matter decay channels contribute substantially, but the fit overall is not as good as without the prior.

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