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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 astophysical flux for energies above 30TeV. 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 10^27s and soft-channel decay mode (DM –> 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 –> nu_e + \bar nu_e, the best fit is for the dark matter 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 decay channels contribute substaintially, but the fit overall is not as good as without the prior.

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