Contribution ID: **50** Type: **not specified**

Ultra-High Energy Neutrinos and the Glashow Resonance

We study the signatures of the Glashow resonance process $\bar{\nu}_e e \to W$ in the high-energy astrophysical neutrino observatory IceCube.
We note that in addition to the standard hadronic and electromagnetic showers produced by an incoming neutrino at the resonance energy of $E_\nu \approx 6.3$ PeV, there are two clear signals of the process: the pure muon" from $\bar{\nu}_e e \to \bar{\nu}_\mu \mu$ and thecontained lollipop" from $\bar{\nu}_e e \to \bar{\nu}_\tau \tau$.
The event rate and the signal-to-background ratio (the ratio of the resonant to concurrent non-resonant processes) are calculated for each type of interaction, based on current flux limits on the diffuse neutrino flux.
Because of the low background in the neighborhood of the resonance, the observation of only one pure muon or contained lollipop event essentially signals discovery of the resonance, even if the expected event numbers are small.
We also evaluate the total event rates of the Glashow resonance from the extra-galactic diffuse neutrino flux and emphasize its utility as a discovery tool to enable first observations of such a flux.
We find that one can expect 3.6 (0.65) events per year for a pure pp ($p\gamma$) source, along with an added contribution of 0.51 (0.21) from non-resonant events.
We also give results as a function of the ratio of pp vs $p\gamma$ sources.

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