High Energy Neutrinos via Upsilon Synchrotron Emission in Strong Magnetic Field

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We propose that the acceleration of ultra-relativistic protons and nuclei in the presence of strong magnetic fields in such environments as AGNs, Magnetars, or GRB central engines could be a viable site for strong meson synchrotron emission. We show that charged scalar mesons like $\pi^{\pm}$, vector mesons like ρ, and even heavier mesons like D_S, J/Ψ and Υ, can be emitted with high intensity (~ 103 times the photon intensity) through strong couplings to ultra-relativistic nucleons. These processes for meson synchrotron emission would eventually produce a burst of three flavors of high-energy neutrinos. We estimate the difference of energy spectra of e-, μ- and τ-neutrinos by taking account of the measured branching ratios of Υ to charged leptons, the energy loss during propagation of these leptons before decay due to the synchrotron radiation, and the matter effect (MSW effect) of neutrino oscillations during the propagation through the supernova matter and the vacuum. We can predict the ratio $\nu_e : \nu_\mu : \nu_\tau$ at very high-energies emerging from the production and decay of Υ, which would be testable in Ice-Cube, Auger, and Zeus neutrino detection facilities.

[1] T. Kajino, A. Tokuhisa, K. Kojima, T. Yoshida, M.A. Famiano, and G.J. Mathews, submitted to ApJ (2009).