We studied the generation of heavy-meson synchrotron emission due to the acceleration of ultra-relativistic protons (and possibly nuclei) in the presence of strong magnetic fields ($H > \sim 10^{15}$ G) in transient astrophysical environments such as magnetar flares. We then discovered that, in addition to the well known pion synchrotron emission, heavy vector mesons like $\rho$, $D_S$, $J/\Psi$ and $\Upsilon$ could be generated with high intensity ($\sim 10^3$ times the photon intensity) through strong couplings to the ultra-relativistic nucleons in the strong magnetic field.

We propose in particular the synchrotron emission and subsequent cooling and decay of the heavy $\rho^0$ and $\Upsilon(1S)$ mesons by the burst of energetic neutrinos, via $p \rightarrow p' + \Upsilon(1S)$, $\Upsilon(1S) \rightarrow \tau^+ + \tau^-$, $\tau^+ \rightarrow \mu^+ + \nu_\mu + \nu_\tau$ and $\tau^- \rightarrow \mu^- + \bar{\nu}_\mu + \bar{\nu}_\tau$. We evaluate the spectra of escaping $\nu_\tau$, $\nu_\mu$ and $\nu_\tau$ due to the decay of short lived $\tau$-mesons.

We conclude the possible event rate in a terrestrial PeV neutrino detector like ICECUBE [2]. We estimate that neutrinos produced from the heavy vector-meson synchrotron radiation from a strong magnetar SGR burst will only be detectable with the current generation of detectors if the source is very nearby (< 30 pc). Nevertheless, if ever detected, the existence of heavy meson synchrotron emission might be identifiable by the unique signature of energetic tau neutrinos.

References