Contribution ID: **339** Type: **Poster**

# Neutrino Burst-Generated Gravitational Radiation from Collapsing Supermassive Stars

*Friday, 1 June 2018 18:30 (1 hour)*

We estimate the gravitational radiation signature of the $e^+e^-$ annihilation-driven neutrino burst accompanying the asymmetric collapse of an initially hydrostatic, radiation-dominated supermassive object suffering the Feynman-Chandrasekhar instability. An object with a mass $5 \times 10^4\ \mathrm{M_{sun}} < M < 5 \times 10^5\ \mathrm{M_{sun}}$, with primordial metallicity, is an optimal case with respect to the fraction of its rest mass emitted in neutrinos as it collapses to a black hole: lower initial mass objects will be subject to scattering-induced neutrino trapping and consequently lower efficiency in this mode of gravitational radiation generation; while higher masses will not get hot enough to radiate significant neutrino energy before producing a black hole. The optimal case collapse will radiate several percent of the star's rest mass in neutrinos and, with an assumed small asymmetry in temperature at peak neutrino production, produces a characteristic linear memory gravitational wave burst signature. The timescale for this signature, depending on redshift, is ∼1 s to 10 s, optimal for proposed gravitational wave observatories like DECIGO. Using the response of that detector, and requiring a signal-to-noise ratio SNR $> 5$, we estimate that collapse of a $5 \times 10^4\ \mathrm{M_{sun}}$ supermassive star could produce a neutrino burst-generated gravitational radiation signature detectable to redshift $z < 7$. With the envisioned ultimate DECIGO design sensitivity, we estimate that the linear memory signal from these events could be detectable with SNR $> 5$ to $z < 13$.

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**Session Classification:** Poster Session

**Track Classification:** PNA