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Multi-messenger signatures from choked delayed jets in TDEs

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Recent radio observations of tidal disruption events (TDEs) show that some TDEs exhibit late time emission, which may be due to delayed jet launch from the central engine. The multi-messenger observations of several TDEs (AT2019dsg, AT2019fdr, and AT2019aalc) by IceCube and optical telescopes also provide evidence for the possibility of late time engine activity. In this work, we address this scenario where the jet is launched with a delay time $t_{\rm lag} \sim$ days - months, to examine whether choked jets can explain the late time emission in TDEs. In our model, we consider the interaction of the relativistic jet with the spherically symmetric debris expanding with velocity $v_{\rm w}$. This eventually decides whether the jet breaks out or not, and also leads to cocoon formation which can eventually collimate the jet. We discuss the effects of $t_{\rm lag}$ and $v_{\rm w}$ on the outcomes of jet breakout and collimation, in particular, for the ranges of jet luminosity where we find choked jets. We find that for $t_{\rm lag} \sim 10^7$ s, jets with $L_{\rm j,iso} \leq 10^{46}\,{\rm erg\,s^{-1}}$ would be choked. Finally, we study the observational signatures of such delayed choked jets in the EM and neutrino channels, where we find that optical and X-ray observations can be possible for a nearby TDE ($z = 0.05$) with current detectors like LSST and Chandra respectively, but radio observations are less optimistic.

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