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Towards future multi-messenger detections of core-collapse supernovae harbouring choked jets

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Over the last decade, the scenario of choked jets embedded in core-collapse supernovae (CCSNe) has attracted careful attention. The extended stellar envelopes of red supergiant (RSG) and blue supergiant (BSG) stars, both progenitors of Type II SNe, may constitute a challenge to the launch of a powerful jet able to burrow through their envelopes. As the jet carves its way through them, it dissipates its energy in a double-shock structure that forms at its head. The hot head material spills sideways, forming a cocoon that engulfs the jet and collimates it. If before choking the jet crossed a significant fraction of the stellar envelope, the cocoon is energetic enough to break out of the star, releasing ultraviolet (UV) and optical (O) emissions lasting over a few days. For a proper characterisation of RSGs and BSGs, the identification of both these electromagnetic signals is of paramount importance, because of the low probability for gamma rays to emerge.

I here discuss prospects in measuring UV emission, in view of the launch in 2026 of the satellite ULTRASAT which will operate in the UV band, complementing the performances of the currently active optical telescope ZTF. Furthermore, choked jets are also extremely interesting within the growing field of multi-messenger astronomy, being considered as possible contributors to the astrophysical diffuse neutrino flux, not yet associated with any existing source. In this regard, I discuss the possibility of exploiting multi-messenger detection on how to set multi-messenger observations among UV/O/neutrino telescopes optimising combined detections between different facilities.

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