

'Lopsided' supernova could be responsible for rogue hypervelocity stars

February 11 2015, by Dan Majaess



Tauris 2015 argues that supernova explosions occurring in tight binary systems can help eject stars from the Galaxy at hypervelocities. Credit: IsiacDaGraca

Hypervelocity stars have been observed traversing the Galaxy at extreme velocities (700 km/s), but the mechanisms that give rise to such phenomena are still debated. Astronomer Thomas M. Tauris argues that lopsided supernova explosions can eject lower-mass Solar stars from the Galaxy at speeds up to 1280 km/s. "[This mechanism] can account for the majority (if not all) of the detected G/K-dwarf hypervelocity candidates," he said.

Several mechanisms have been proposed as the source for [hypervelocity stars](#), and the hypotheses can vary as a function of stellar type. A

simplified summary of the hypothesis Tauris favors begins with a higher-mass star in a tight binary system, which finally undergoes a [core-collapse supernova](#) explosion. The close proximity of the [stars](#) in the system partly ensures that the orbital velocities are exceedingly large. The binary system is disrupted by the [supernova explosion](#), which is lopsided (asymmetric) and imparts a significant kick to the emerging [neutron star](#). The remnants of supernovae with massive progenitors are [neutron stars](#) or potentially a more exotic object (i.e., black hole).

Conversely, Tauris noted that the aforementioned binary origin cannot easily explain the observed velocities of all higher-mass hypervelocity stars, namely the B-stars, which are often linked to an ejection mechanism from a binary interaction with the supermassive black hole at the Milky Way's center. Others have proposed that interactions between multiple stars near the centers of star clusters can give rise to certain hypervelocity candidates.

There are several potential compact objects (neutron stars) which feature extreme velocities, such as B2011+38, B2224+65, IGR J11014-6103, and B1508+55, with the latter possibly exhibiting a velocity of 1100 km/s. However, Tauris ends by noting that, "a firm identification of a hypervelocity star being ejected from a binary via a [supernova](#) is still missing, although a candidate exists (HD 271791) that's being debated."



Some astronomers argue that certain hypervelocity stars can stem from interactions in dense star clusters. Credit: NASA, ESA, and E. Sabbi (ESA/STScI)

Tauris is affiliated with the Argelander-Institut für Astronomie and Max-Planck-Institut für Radioastronomie. His findings will be published in the forthcoming March issue of the *Monthly Notices of the Royal Astronomical Society*.

The interested reader can find a preprint of Tauris' study on arXiv.

Surveys of hypervelocity stars were published by Brown et al. 2014 and Palladino et al. 2014.

More information: "Maximum speed of hypervelocity stars ejected from binaries." *arXiv:1412.0657* [astro-ph.SR] arxiv.org/abs/1412.0657

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Source: [Universe Today](#)

Citation: 'Lopsided' supernova could be responsible for rogue hypervelocity stars (2015, February 11) retrieved 5 May 2026 from <https://phys.org/news/2015-02-lopsided-supernova-responsible-rogue-hypervelocity.html>

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