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THE SPIDER STELLAR ENGINE: A SHOCKING EXTRATERRESTRIAL DESIGN?

Abstract

An advanced civilization is likely to use the energy of its home star to control its motion in the galaxy. The motivations include avoiding supernovas, engaging in interstellar life spreading, or migrating towards a nearby star as its home star fades away. For these reasons, the search for non-communicative technosignatures includes the search for stellar engines. On the observational side, hypervelocity stars have been the target of such searches, but have not led to promising candidates [1]. On the theoretical side, stellar engine concepts have been proposed [2–4] but they have not been linked to observable technosignatures. We propose to interpret the complex phenomenology of spider pulsars as a stellar engine. To do so, we confront the fundamental constraints and results of stellar engine concepts with current models of spider binaries. A spider pulsar irradiates its companion star with highly relativistic winds, leading to mass-loss. If this mass-loss is then somehow channeled toward one direction or another outside the system, this creates a thrust, as the fundamental physics of thrust is to expel matter. More precisely, we argue that the *intrabinary shock* geometry [5–8] might play a crucial role for channeling mass-loss, and thus for controlling thrust and direction. Building on the stellivore hypothesis [9-10], looking for evidence of spider pulsar engines constitutes a unique and previously unexplored type of potential technosignature.

References:

(1) Lingam and Loeb, Constraints on the Abundance of 0.01 c Stellar Engines in the Milky Way doi:10.3847/1538-4357/abc69c.
(2) Badescu and Cathcart, Stellar Engines and the Controlled Movement of the Sun. doi:10.1007/1-4020-4604-9
(3) Caplan, Stellar engines: Design considerations for maximizing acceleration doi:10.1016/j.actaastro.2019.08.027.
(4) Svoronos, The Star Tug: An active stellar engine capable of accelerating a star to relativistic velocities doi:10.1016/j.actaastro.2020.07.005.
(5) Romani and Sanchez, Intra-binary Shock Heating of Black Widow Companions doi:10.3847/0004-637X/828/1/7.
(6) Wadiasingh, et al. Constraining Relativistic Bow Shock Properties in Rotation-powered Millisecond Pulsar Binaries doi:10.3847/1538-4357/aa69bf.
(7) Wadiasingh, et al. Pressure Balance and Intrabinary Shock Stability in Rotation-powered-state Redback and Transitional Millisecond Pulsar Binary Systems doi: 10.3847/1538-4357/aaed43.
(8) van der Merwe, et al. X-Ray through Very High Energy Intrabinary Shock Emission from Black Widows and Redbacks doi: 10.3847/1538-4357/abbdfb.
(9) Vidal, The Beginning and the End - The Meaning of Life in a Cosmological Perspective. Springer, 2014.
(10) Vidal, Stellivore Extraterrestrials? Binary Stars as Living Systems doi:10.1016/j.actaastro.2016.06.038.