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How Can Astrophysical Events Resolve the Fermi Paradox?

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This study explores a possible solution to the Fermi paradox, which questions why we have not observed alien civilizations despite the vastness of the universe. Previous simulations by Zackrisson et al. (2015) suggested that a Kardashev-III type civilization, capable of harnessing the energy of an entire galaxy, could expand across 50% of the Milky Way (MW) in just 25 Myr. Similarly, Wright et al. (2021) proposed that galactic rotation could accelerate the transition from Kardashev-II to Kardashev-III civilizations. However, these models have not been confirmed by observations, and the paradox remains unresolved. This study investigates whether extreme astrophysical phenomena, such as supernova explosions and dense Giant Molecular Clouds (GMCs), could prevent alien civilizations from reaching a Kardashev-III level, thus explaining their apparent absence. Using simulations based on Wright et al. (2021), the researchers analyze the impact of supernova explosions in MW-like galaxies. The research findings show that with a supernova rate of 0.3 events per year, the effect on alien expansion is minimal, aligning with Burns & Parsons (2022). However, in galaxies with a much higher supernova rate (300 events per year), the time required to colonize 50% of the galaxy is delayed from 35 Myr to 70 Myr. Additionally, previous research by Burns & Parsons (2022) suggests that dense GMCs could have an even greater impact on hindering extraterrestrial expansion. This study aims to test and confirm that hypothesis as well. By considering these astrophysical barriers, this research suggests that extreme cosmic events may significantly slow down or even prevent the emergence of Kardashev-III civilizations, offering a potential resolution to the Fermi paradox.

Section

Galaxy/Extragalactic

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