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Statistical Inference of Fast Radio Burst Environments Using Galaxy Number Density: Similarities Between CHIME Repeaters and Non-Repeaters

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Fast radio bursts (FRBs) are short-duration, bright radio emission pulses with energies. The exact origin of FRBs remains a mystery. However, FRBs are classified into two types depending on their repetition: repeaters and non-repeaters. Different progenitor types, such as magnetars for repeaters and cataclysmic events for non-repeaters, might explain their distinct behaviors. Therefore, understanding the difference between these two populations is a key to constraining their origins. However, due to the difficulty in precisely localizing FRBs, it is challenging to confirm if their progenitors differ. In this study, we attempt to estimate the galaxy number density associated with FRBs in the CHIME catalog using the galaxy catalog WISE × PS1. Since our method focuses on large-scale galaxy environments around FRBs, it is independent of the localization problem, allowing us to use samples of 26 repeaters and 238 non-repeaters, about two times larger than localized FRBs at present. If repeaters and non-repeaters originate in distinct galactic environments, it could imply different host and progenitor types. Conversely, similar environments might suggest a common progenitor. Here, we present our findings by comparing the density increments of both repeaters and non-repeater sources. The Kolmogorov-Smirnov (KS) test for the distributions of galaxy number densities around the FRB sources indicates no significant difference between repeaters and non-repeaters with a p-value of 0.405. Our finding suggests that repeaters and non-repeaters could share similar galactic environments and, hence, similar host and progenitor types. In addition to this, we find the majority of FRBs occur in underdense galactic environments compared to randomly selected regions, exhibiting a mild preference for young stellar populations.

Section

High Energy

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