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How the dynamical properties of globular clusters impact their γ-ray and X-ray emission

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The X-ray and γ-ray emission of globular clusters (GCs) is attributed to their large fraction of compact binary systems, especially those with millisecond pulsars (MSPs). We analyze a population of 124 Galactic GCs to investigate how their dynamical properties affect the formation and evolution of compact binary systems and how this can be translated into the clusters' observed X-ray and γ-ray emission. We use mainly Chandra X-ray Observatory and Fermi Large Area Telescope observations to achieve our goals and start by detecting 39 GCs in γ rays, seven of which are not listed in previous Fermi-LAT catalogs. Additionally, we find that the total number of X-ray sources within a GC and its γ-ray luminosity are linearly correlated with the stellar encounter rate, indicating that compact binary systems are mainly formed via close stellar encounters. We also find an unexpected rise in the number of X-ray sources for GCs with low rates of stellar encounters, suggesting that there is a dynamical threshold where the formation of X-ray sources is dominated by stellar encounters. Furthermore, we use the Heggie-Hills law to find that subsequent stellar encounters in these compact binaries will, on average, make the binaries even harder, with basically no possibility of binary ionization. Finally, we find that all GCs are point-like sources in γ rays, indicating that the MSPs are concentrated in the clusters' cores, likely due to dynamical friction.

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