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The stochastic gravitational wave background from close hyperbolic encounters of primordial black holes in dense clusters

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The inner part of dense clusters of primordial black holes is an active environment where multiple scattering processes take place. Some of them give rise from time to time to bounded pairs, and the rest ends up with a single scattering event. The former eventually evolves to a binary black hole (BBH) emitting periodic gravitational waves (GWs), while the latter with a short distance, called close hyperbolic encounters (CHE), emits a strong GW burst. We make the first calculation of the stochastic GW background originating from unresolved CHE sources. Unlike the case for BBH, the low-frequency tail of the SGWB from CHE is sensitive to the redshift dependence of the event rate, which could help distinguish the astrophysical from the primordial black hole contributions. We find that there is a chance that CHE can be tested by third-generation ground-based GW detectors such as Einstein Telescope and Cosmic Explorer.

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