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Gravity waves from ALP dark matter fragmentation

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Axion-like particles (ALP) are appealing candidates for dark matter if produced non-thermally via the vacuum misalignment mechanism. In certain cases, such as in the presence of a monodromy, the self-interactions of ALPs can be sufficiently strong and lead to the fragmentation of the homogeneous field soon after the onset of oscillations. We investigate numerically the dynamics of fragmentation, as well as of the subsequent turbulent regime, and calculate the stochastic gravitational wave (GW) background that is produced from this process. We find that a particularly strong background can be produced when ALPs exhibit an extended intermediate phase of ultra-relativistic dynamics, which can be induced by a small mass at the bottom of the potential. Such background can partially be explored with future GW detectors, offering an important probe of the properties of dark matter.

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