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ALP Dark Matter from Kinetic Fragmentation: Opening up the parameter window and Observational Consequences

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Axion-like-particle (ALP) is a well-motivated candidate for dark matter, and it has been subject to extensive theoretical and experimental research in recent years. The most popular ALP production mechanism studied in the literature is the misalignment mechanism, where the ALP field has negligible kinetic energy initially, and it starts oscillating when its mass becomes comparable to the Hubble scale. Recently, a new mechanism called Kinetic Misalignment has been proposed where the ALP field receives large kinetic energy at early times due to the explicit breaking of the Peccei-Quinn symmetry. This causes a delay in the onset of oscillations so that the ALP dark matter parameter space can be expanded to lower values of the axion decay constant. At the same time, the ALP fluctuations grow exponentially via parametric resonance in this setup, and most of the energy in the homogeneous mode is converted to ALP particles. This process in known as fragmentation. In this talk, I will discuss the observational consequences of fragmentation for the axion miniclusters, and show that a sizable region of the ALP parameter space can be tested by future experiments that probe the small-scale structure.

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