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Do Dark Matter Axions Form a Condensate with Long-Range Correlation? CHANDA PRESCOD-WEINSTEIN, MARK HERTZBERG, ALAN GUTH, Massachusetts Inst of Tech-MIT — Recently there has been significant interest in the claim that dark matter axions gravitationally thermalize and form a Bose-Einstein condensate with cosmologically long-range correlation. This has potential consequences for galactic scale observations. Here we critically examine this claim. We point out that there is an essential difference between the thermalization and formation of a condensate due to repulsive interactions, which can indeed drive long-range order, and that due to attractive interactions, which can lead to localized Bose clumps (stars or solitons) that only exhibit short range correlation. While the difference between repulsion and attraction is not present in the standard collisional Boltzmann equation, we argue that it is essential to the field theory dynamics, and we explain why the latter analysis is appropriate for a condensate. Since the axion is primarily governed by attractive interactions – gravitation and scalar-scalar contact interactions – we conclude that the claim of long-range correlation is unjustified.

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