Contribution ID : **8** Type : **not specified**

Parametric-Resonance Production of QCD Axions

The QCD axion remains one of the most compelling dark matter candidates, yet its mass window is tightly constrained by the standard misalignment mechanism. We identify a generic new production channel: primordial temperature fluctuations during the QCD phase transition periodically modulate the axion mass, driving parametric resonance in the axion field. This resonance amplifies the axion abundance beyond the misalignment prediction and opens a new mass window for dark matter at $10^{-4} - 10^{-3}$ eV—a regime previously unexplored but now accessible to next-generation haloscopes. Our mechanism is model-independent, relying only on the thermal history of the universe, and provides a sharp new target for axion dark matter experiments.

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