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Dark photon production from axions with mildly large misalignment

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Dark photons can be resonantly produced in the early universe via their coupling to an oscillating axion field. However, this mechanism typically requires large axion–dark photon couplings or some level of fine-tuning. In this talk, I will present a new scenario in which efficient dark photon production arises from axion potentials shallower than quadratic. For moderately large initial misalignment values, the axion field can undergo either strong self-resonance or efficient dark photon production with
$gtrsim\mathcal{O}(1)$ couplings. When self-resonance dominates and disrupts the field's homogeneity, we show that oscillons naturally form and can sustain continued dark photon production. If the dark photon mass lies within three orders of magnitude below the axion mass, the resulting abundance can constitute a significant fraction of the present-day dark matter. We support this scenario with numerical lattice simulations of a benchmark model. Our results further motivate experimental searches for ultralight dark photon dark matter.

Collaboration you are representing

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