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Isocurvature bounds on axion-like particle dark matter in the post-inflationary scenario

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Based on the work published in arXiv: 1903.06194. In collaboration with M. Feix (Univ. Heidelberg), J. Frank (KIT), R. Reischke (IIT, Haifa), B.M. Schaefer (Univ. Heidelberg), T. Schwetz (KIT).

We assume that dark matter is comprised of axion-like particles (ALPs) generated by the realignment mechanism in the post-inflationary scenario. This leads to isocurvature fluctuations with an amplitude of order one for scales comparable to the horizon at the time when the ALP field starts oscillating. The power spectrum of these fluctuations is flat for small wave numbers, extending to scales relevant for cosmological observables. Denoting the relative isocurvature amplitude at $k_* = 0.05$~Mpc^{-1} by $f_{\rm iso}$, Planck observations of the cosmic microwave background (CMB) yield $f_{\rm iso} < 0.31$ at the 2σ-level. This excludes the hypothesis of post-inflationary ALP dark matter with masses $m_a < 10^{-20}$-10^{-16}~eV, where the range is due to details of the ALP mass-temperature dependence. Future CMB stage IV and 21-cm intensity mapping experiments may improve these limits by 1-2 orders of magnitude in m_a.

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