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Fine-grained dark matter substructure and axion haloscopes

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The small-scale distribution of dark matter is expected to feature fine-grained substructure on solar-system scales, arising from the gravitational folding of an initially smooth phase-space sheet into many overlapping streams. For axions—especially in the post-inflationary scenario—early-Universe clustering can further amplify these densities. While such substructure is typically considered irrelevant for direct detection, it may significantly affect axion searches. We present several models of axion substructure and evaluate their impact on detectability. Our results show that high-frequency-resolution analyses can reveal these features, potentially enhancing axion discovery prospects even without reaching standard sensitivity thresholds.

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