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Axion streams and implications for haloscopes

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A consequence of QCD axion dark matter being born after inflation is the emergence of ultra-small-scale substructures known as miniclusters. Although miniclusters merge to form minihalos, their intrinsic granularity is expected to remain imprinted on small scales in our galaxy. However, encounters with stars will tidally strip mass from the miniclusters, creating pc-long tidal streams that act to refill the axion voids left in between the miniclusters.

We investigate whether or not this stripping rescues experimental prospects from the worst-case scenario in which the majority of axions remain bound up in unobservably small miniclusters. We find that the density sampled by the Earth on mpc-scales will be around 70-90% of the known local DM density, and at a typical point in the solar neighbourhood, we expect most of the dark matter to be comprised of debris from $\mathcal{O}(10^2 - 10^3)$ overlapping streams. The latter are a unique prediction that constitutes a way for haloscopes to distinguish between pre and post-inflationary axion cosmologies.

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