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Axion monodromy dark matter and fluctuations

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Axion-like particles (ALP), produced via the misalignment mechanism are interesting candidates for cold dark matter, both from the theoretical as well as the experimental perspective. The standard potential of ALPs is periodic and bounded from above.

Recently interest has grown towards situations where the periodicity is broken, giving rise to a potential with many non-degenerate minima.
For example in string theory such scenario can be realized using the phenomenon of monodromy. Importantly, this extends the range of viable ALP dark matter models towards larger experimentally more accessible couplings. At the same time the structure of the potential with many minima results in a non-trivial time evolution and a growth of fluctuations.

In this talk we consider the case of breaking with a quadratic monomial, which corresponds to the massive Sine-Gordon model. We perform an analysis of the full nonlinear dynamics and discuss how the instabilities of the coherent oscillations trigger the growth of quantum fluctuations, which can lead to significant deviations from an expected matter-like equation of state. We discuss the effects of the complex structure of the potential, such as the averaging out of the interactions and the transitions between local minima.

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