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A multiple QCD axion

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The QCD axion is a well-motivated candidate for new physics and a primary focus of an ambitious global experimental program. It offers a compelling solution to both the strong CP and the dark matter problems within a narrow region of its parameter space, known as the QCD axion band. Nevertheless, rich theoretical frameworks lead us to expect that the axion is not the only exotic scalar produced in Nature, as it is often produced alongside several axion-like particles (ALPs).

In this talk, I will discuss the impact of a non-minimal scalar sector in the properties of the QCD axion and its role in addressing the strong CP problem. I will show that - due to an enlarged misalignment between the flavor and mass basis - the strong CP problem can be solved in a new displaced band, with the displacement determined by the number of ALPs in the theory. This setup can therefore open radically new regions of signal for QCD axions.

Motivated by these results, I will present a UV model that generates such multiple axions in the context of extra spacetime dimensions and I will discuss some implications to fifth force searches, cosmology and astrophysics.

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