



Contribution ID: 123

Type: 20 minutes talk

Chiral models of composite axions and accidental Peccei-Quinn symmetry

Thursday, 16 December 2021 17:30 (30 minutes)

The QCD axion, based on the existence of the anomalous Peccei-Quinn (PQ) symmetry, realizes a remarkably simple and elegant solution to the strong CP problem, and is also a well-motivated dark matter candidate. However, hiding behind the apparent simplicity, explicit realizations are extremely sensitive to PQ-violating effects in the UV, which can destabilize the axion potential and spoil the original mechanism. Since global symmetries are always expected to be broken by Quantum Gravity, such effects appear rather generically: this is known as the axion quality problem. In this talk, we introduce a class of composite axion models where the PQ symmetry is not only accidental, but also naturally protected from higher dimensional operators by the gauge dynamics. The axion emerges as the NGB of a strongly-interacting, chiral sector with no fundamental scalars, where all mass scales are generated dynamically. The models can be easily embedded in a Grand Unified Theory; we shall discuss the case of non-supersymmetric SU(5), and possibly SO(10). From a wider perspective, we also clarify the selection-rules under which higher dimensional PQ violating operators can generate a potential for the axion in the IR, which can be of general interest for composite axion models based on a QCD-like confining gauge group.

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Phenomenology

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Session Classification: Full-length talks