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Impacts of electroweak symmetry breaking on axion-like particles as dark matter

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Axion-like particles (ALPs), the pseudo Nambu-goldstone bosons arising from the spontaneous breaking of global symmetry, are promising candidates for dark matter. The most extensively studied ALP production mechanism is known as the misalignment mechanism, where ALP is presumed to remain frozen at a point in the field space until it begins oscillating around the potential minimum and behaves as cold dark matter (CDM). The oscillation initiates once the universe Hubble expansion rate falls below the ALP mass, defining the oscillation frequency. Here, we examine how electroweak symmetry breaking (EWSB) affects ALP evolution, specifically through a global symmetry breaking Higgs portal operator at dimension-6. The interaction is observed to contribute partially to ALP's mass during EWSB, thus altering oscillation frequency and influencing the correlation between the scale of symmetry breaking and its mass. The novelty of this study lies in broadening the parameter space satisfying correct CDM relic density, facilitating future exploration through a diverse range of experimental avenues.

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