Domain Wall Formation from Level Crossing in the Axiverse

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We point out that domain wall formation is a more common phenomenon in the Axiverse than previously thought. Level crossing could take place if there is a mixing between axions, and if some of the axions acquire a non-zero mass through non-perturbative effects as the corresponding gauge interactions become strong. The axion potential changes significantly during the level crossing, which affects the axion dynamics in various ways. We find that, if there is a mild hierarchy in the decay constants, the axion starts to run along the valley of the potential, passing through many crests and troughs, until it gets trapped in one of the minima; the axion roulette. The axion dynamics exhibits a chaotic behavior during the oscillations, and which minimum the axion is finally stabilized is highly sensitive to the initial misalignment angle. Therefore, the axion roulette is considered to be accompanied by domain wall formation. The cosmological domain wall problem can be avoided by introducing a small bias between the vacua. We discuss cosmological implications of the domain wall annihilation.

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