Contribution ID: **41** Type: **not specified**

Domain wall evolution beyond quartic potentials: The Sine-Gordon and Christ-Lee potentials

Monday 14 April 2025 11:45 (15 minutes)

Domain walls are the simplest type of topological defects formed at cosmological phase transitions, and one of the most constrained. These analyses typically assume a quartic double well potential, but this model is not fully representative of the range of known or plausible particle physics models. Here we study the cosmological evolution of domain walls in two other classes of potentials. The Sine-Gordon potential allows several types of walls, interpolating between different pairs of minima (which demands specific numerical algorithms to separately measure the relevant properties of each type). The Christ-Lee potential parametrically interpolates between sextic and quartic behavior. We use multiple sets of simulations in two and three spatial dimensions, for various cosmological epochs and under various choices of initial conditions, to discuss the scaling properties of these networks. In the Sine-Gordon case, we identify and quantify deviations from the usual scaling behavior. In the Christ-Lee case, we discuss conditions under which walls form (or not), and quantify how these outcomes depend on parameters such as the energy difference between the false and true vacua and the expansion rate of the Universe. Finally, we briefly comment on the possible cosmological implications of our results.

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Session Classification: Session 2 - Phase Transitions & Topological Defects

Track Classification: Talk