

Single-species non-reciprocal phase transitions: phenomenology, renormalization group and entropy production

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(Dated: July 8, 2025)

Abstract: Non-reciprocal interactions are typically present in a large number of out-of-equilibrium systems, such as active matter, social and ecological. They are believed to be responsible for non-equilibrium phase transitions and still leave open fundamental questions of major interest. We introduce a generalization of the Ising model that includes non-reciprocal interactions based on vision-cones. The model exhibits rich phenomena such as the coexistence of a first order and a second order phase transition, as well as metastability. We compare analytical results obtained from both a mean-field approximation and performing dynamic renormalization group transformations with simulations in a $d = 2$ square lattice, highlighting the impact of non-reciprocity on the universality class of the 2D Ising model. Finally, we study the breakdown of detailed balance by studying entropy production of the coarse grained description of the model.

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