Non-periodic ground states of one-dimensional, non-frustrated, two-body interactions

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Since the discovery of quasicrystals, one of the problems in statistical mechanics is to construct microscopic models of interacting atoms or molecules in which all ground-state configurations minimizing energy are non-periodic.

We construct for the first time examples of one-dimensional classical lattice–gas models with non-frustrated, two-body, infinite-range interactions and without periodic ground-state configurations. Ground-state configurations of our models are Sturmian sequences defined by irrational rotations on the circle. We present minimal sets of forbidden patterns which define Sturmian sequences in a unique way. Our interactions assign positive energies to forbidden patterns and are equal to zero otherwise. We illustrate our construction by the well-known example of the Fibonacci sequences.

We will also discuss stability of one-dimensional non-periodic ground-state configurations with respect to finite-range perturbations of interactions. We will show that they are not stable for fast-decaying interactions.

Reference

Aernout van Enter, Henna Koivusalo, and Jacek Miękisz, Sturmian Ground States in Classical Lattice–Gas Models, Journal of Statistical Physics 178: 832–844 (2020).