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Inhomogeneous phases in the chiral Gross-Neveu model on the lattice

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Understanding of the QCD phase diagram is one of important topics in nuclear and hadron physics.
In particular, various possible phase structures are proposed from analyses of effective theories in low temperature and high density region. One of them is inhomogeneous chiral condensate which exhibits characteristic space structures. Since there is no general established method for determination of the structure of the chiral condensate, usually some solutions such as chiral spiral and kink solutions are assumed. On the other hand, the Monte Carlo method in lattice QCD does not work in the low temperature and high density region, because of existent of the notorious sing problem. However, the usual lattice calculation is applicable to the 1+1 Gross-Neveu (GN) model and chiral GN model that have similar property of QCD, since they do not have the sign problem at finite density. Recently the interesting phase structure of the inhomogeneous chiral condensate in the 1+1 dimensional GN model on the lattice has been presented [1].

Here we study the phase structure of the 1+1 dimensional chiral GN model, performing the lattice simulation. Advantage of using the Monte Carlo method is that one can investigate the general space structure of the sigma and pion condensates without any assumption of it. We will discuss the phase diagram of the chiral GN model with finite number of flavors, comparing that of the GN model with finite number of flavors.

[1] J. Lenz, L. Pannullo, M. Wagner et al., Phys. Rev. D 101, no.9, 094512 (2020).

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