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Phase diagram of QCD matter with magnetic field: domain-wall Skyrmion chain in chiral soliton lattice

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QCD matter in a strong magnetic field exhibits a rich phase structure. In the presence of an external magnetic field, the chiral Lagrangian for two flavors is accompanied by the Wess-Zumino-Witten (WZW) term containing an anomalous coupling of the neutral pion π_0 to the magnetic field via the chiral anomaly. Due to this term, the ground state is inhomogeneous in the form of either chiral soliton lattice (CSL), an array of solitons in the direction of the magnetic field, or domain-wall Skyrmion (DWSk) phase in which Skyrmions supported by $\pi_3[\mathrm{SU}(2)] \simeq \mathbb{Z}$ appear inside the solitons as topological lumps supported by $\pi_2(S^2) \simeq \mathbb{Z}$ in the effective worldvolume theory of the soliton. In this paper, we determine the phase boundary between the CSL and DWSk phases beyond the single-soliton approximation, within the leading order of chiral perturbation theory.

Author: NISHIMURA, Kentaro

Co-authors: Prof. ETO, Minoru (Yamagata University); Prof. NITTA, Muneto (Keio University)

Presenter: NISHIMURA, Kentaro

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