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Semiclassics for QCD vacuum structure via T^2 compactification

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We explore the QCD vacuum structure, using a novel semiclassical method on $\mathbb{R}^2 \times T^2$ with 't Hooft and baryon magnetic fluxes. In this setup, it is conjectured that no phase transition occurs when the size of T^2 is varied (adiabatic continuity). If this holds true, the analysis at small T^2 can predict qualitative features of the QCD vacuum structure on $\mathbb{R}^4$.
At small T^2, through semiclassical analysis, we derive a 2D effective theory, where the confining vacuum is described as a dilute gas of center vortices. This 2D effective theory yields a plausible θ-dependence of the QCD vacuum. Moreover, the resulting 2D effective theory is analogous to the chiral Lagrangian with a periodicity-extended η' meson. This periodicity extension arises from incorporating the gluonic multi-branch structure into the η' degrees of freedom, and it improves the consistency of global aspects of the chiral Lagrangian.

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