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Phase Diagram of QCD in Three Dimensions

QCD in three dimensions allows for a Chern-Simons term resulting in non-standard spontaneous symmetry breaking patterns. In three dimensions the standard breaking pattern for $2N_f$ flavors is $U(2N_f) \to U(N_f) \times U(N_f)$. However, in the presence of a Chern-Simons term at level k the breaking pattern changes to $U(2N_f) \to U(N_f + k) \times U(N_f - k)$.
In this talk we will discuss the phase diagram of this theory in the chemical potential —temperature plane using an effective four-fermion interaction that also include the effect of a Chern-Simons term.
We analyze this theory for different regimes of the coupling constants, and find a rich phase diagram with a cascade of phase transitions as a function of the temperature or chemical potential, which correspond to the breaking patterns induced by the Chern-Simons term. The phase transitions can be either first or second order and we also find a tricritical point. In addition, we observe exotic patterns of chiral symmetry breaking in a small region of the parameter space, such as for example $U(3) \to U(1)^3$ and $U(4) \to U(2) \times U(1)^2$. Implications of these results will be discussed. Based on https://arxiv.org/abs/2102.09089 with Takuya Kanazawa and Mario Kieburg.

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