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# U(1)A anomaly effects on phase diagrams in chiral random matrix model

Incorporating the background instanton effects, we extend the chiral
random matrix model to include the anomaly effect.
The anomaly effect appears naturally as the flavor mixing determinant interaction terms,
which are missed in the conventional random matrix models.
Due to the determinant interaction terms, the model shows
the second-order phase transition for two massless-quark flavors and
the first-order for three light-quark flavors at finite temperatures.
We investigate the phase diagram of this model at finite T/mu and furthermore
at finite isospin and hypercharge chemical potentials.
We find that the critical point exists on T-mu plane with physical quark masses.
We also find that the determinant terms cause the mixing not only between
the chiral condensates but also between the chiral and meson condensates,
which results in an enlargement of the region where, for example,
both of the pion and the strange-quark chiral condensates have finite values.
The anomaly effects enrich the phase structure and
we expect that this is also the case in QCD.

References:
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