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Simulations in large N gauge theories with finite chemical potential

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Using complex Langevin dynamics and stochastic quantization we examine the phase structure of a large N unitary matrix model at low temperature with finite quark chemical potential. This model is obtained as the low temperature effective theory of QCD with N number of colors and N_f number of quark flavors. We simulate several observables of the model, including Polyakov lines and quark number density, for large N and N f . The action is manifestly complex and thus the dominant contributions to the path integral come from the space of complexified gauge field configurations. For this reason, the Polyakov line eigenvalues lie off the unit circle and out in the complex plane. A distinct feature of this model, the occurrence of a series of Gross-Witten-Wadia transitions, as a function of the quark chemical potential, is reproduced using complex Langevin simulations.

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 (Hons, MSc,
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PhD

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