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# Instanton-dyon ensembles reproduce deconfinement and chiral restoration phase transitions

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Paradigm shift in gauge topology at finite temperatures, from the instantons to their constituents – instanton-dyons – has recently lead to studies of their ensembles and very significant advances. Like instantons, they have fermionic zero modes, and their collectivization at sufficiently high density explains the chiral symmetry breaking. Unlike instantons, these objects have electric and magnetic charges. Simulations of the instanton-dyon ensembles have demonstrated that their back reaction on the Polyakov line modifies its potential and generate the deconfinement transition. For Nc=2 gauge theory the transition is second order, for Nc=2 Nf=2 QCD both transitions are weak crossovers at happening at about the same condition. Introduction of quark-flavor-dependent periodicity phases (imaginary chemical potentials) leads to drastic changes in both transitions. In particulaly, in the so called $Z(N_c) - QCD$ model the deconfinement transforms to strong first order transition, while the chiral condensate does not disappear at all. The talk will also cover more detailed studies of correlations between the dyons, effective eta' mass and other screening masses. We also studied fluctuations of topological and magnetic charges in sub-volume: those should be compared to corresponding lattice studies.

**Author:** Prof. SHURYAK, Edward (Stony Brook)

**Presenter:** Prof. SHURYAK, Edward (Stony Brook)

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