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# Quarks in a finite volume and deconfinement as percolation of center-electric fluxes in QCD

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In order to understand the puzzle of the free energy of an individual quark in QCD, we explicitly construct ensembles with quark numbers ⊠⊠≠0mod3, corresponding to non-zero triality in a finite subvolume ⊠ on the lattice. We first illustrate the basic idea in an effective Polyakov-loop theory for the heavy-dense limit of QCD, and then extend the construction to full Lattice QCD, where the electric center flux through the surface of ⊠ has to be fixed at all times to account for Gauss's law. This requires introducing discrete Fourier transfroms over closed center-vortex sheets around the spatial volume ⊠ between all subsequent time slices, and generalizes the construction of 't Hooft's electric fluxes in the purge gauge theory. Moreover, clusters of the same center-electric fluxes are shown to undergo a percolation phase transition in the effective theory in which we can follow the corresponding Kertesz line through the Z3-crossover region, from the endpoint of the first-order line all the way to the massless limit. The best we can offer to study the same deconfinement phase transition in full QCD, at the moment, is the gauge-invariant definition of clusters of electric flux and their spanning probabilities which appear prohibitively expensive to measure, however.

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