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Large N Volume Independence and an Emergent Fermionic Symmetry

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Large-N volume independence in circle-compactified QCD with Nf ≥ 1 adjoint Weyl fermions implies the absence of any phase transitions as the radius is dialed to arbitrarily small values. This class of theories are believed to possess a Hagedorn density of hadronic states. These properties are in apparent tension with each other, because a Hagedorn density of states typically implies a phase transition at some finite radius. This tension is resolved if there are degeneracies between the spectra of bosonic and fermionic states, as happens in the Nf=1 supersymmetric case. Resolution of the tension for Nf>1 then suggests the emergence of a fermionic symmetry at large N, where there is no supersymmetry. The Coleman-Mandula theorem can be escaped since the N=∞ theory is free, with a trivial S-matrix. I will show an example of such a spectral degeneracy in a non-supersymmetric toy example which has a Hagedorn spectrum.

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