Dimensionally reduced SYM$_4$ at large-N: an intriguing Coulomb approximation

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We consider the light-cone (LC) gauge and LC quantization of the dimensional reduction of super Yang Mills theory from four to two dimensions. After integrating out all unphysical degrees of freedom, the non-local LC Hamiltonian exhibits an explicit ${\cal N}=(2,2)$ supersymmetry. A further SUSY-preserving compactification of LC-space on a torus of radius R, allows for a large-N numerical study where the smooth large-R limit of physical quantities can be checked. As a first step, we consider a simple, yet quite rich, "Coulomb approximation" that maintains an ${\cal N}=(1,1)$ subgroup of the original supersymmetry and leads to a non-trivial generalization of 't Hooft's model with an arbitrary --but conserved-- number of partons. We compute numerically the eigenvalues and eigenvectors both in momentum and in position space. Our results, so far limited to the sectors with 2, 3 and 4 partons, directly and quantitatively confirm a simple physical picture in terms of a string-like interaction with the expected tension among pairs of nearest-neighbours along the single-trace characterizing the large-N limit. Although broken by our approximation, traces of the full ${\cal N}=(2,2)$ supersymmetry are still visible in the low-lying spectrum.

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