

Department of
Theoretical Physics

Some Quantum Field Theories with Ghost Matter
(Towards dS/CFT)

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The zoom link will be sent separately.



Large N vector models, such as the critical $O(N)$ vector model, are exactly solvable (when N is large) and provide what may be the "simplest" example of holographic duality, as they are believed to be dual to higher-spin gauge theories in anti-de Sitter space. Several authors (Strominger and others) have generalized vector models to vector models in 3-dimensions with ghost matter -- i.e., matter with the wrong statistics, as per the spin-statistics theorem. Such theories, though non-unitary, have negative central charge, and an essentially-free spectrum of single-trace operators -- and via the holographic dictionary these appear to correspond to higher-spin theories in de Sitter space (although there may be certain subtleties associated with this interpretation.) Theories dual to conventional theories of gravity in AdS contain matrix-degrees of freedom, such as $\mathcal{N}=4$ SYM, and ABJM theory. Can one extend the constructions of vector models with ghost matter to constructions of matrix-like theories with ghost matter to obtain more realistic toy models of dS/CFT? There are serious difficulties with this program, as we discuss in the talk. Moreover, a priori it is hard to see how one could compute anything of interest in a ghost CFT with a putative de Sitter dual. However, we are able to construct two instructive examples -- an $O(N) \times O(M)$ generalization of the critical $O(N)$ vector model, and an adjoint generalization of the Gross-Neveu Yukawa model, which can be studied with ghost matter in $4-\epsilon$ dimensions, allowing for reasonably non-trivial calculations of quantities such as the central charge and scaling dimensions of low-lying operators. While it seems unlikely these theories are dual to quantum gravity de Sitter space, we find a fixed point of the adjoint GNY model with ghost matter (with an appropriate number of flavours) that passes a few obvious consistency checks. We also comment on the possibility of defining bifundamental ghost theories with Chern-Simons gauge fields, as in the ABJM theory.