CHONG WANG, Perimeter Institute

Stiefel liquids: possible non-Lagrangian quantum criticality from intertwined orders

We propose a new type of critical quantum liquids, dubbed Stiefel liquids, based on 2+1 dimensional Wess-Zumino-Witten models on target space SO(N)/SO(4). We show that the well known deconfined quantum critical point and U(1) Dirac spin liquid are unified as two special examples of Stiefel liquids, with N=5 and N=6, respectively. Furthermore, we conjecture that Stiefel liquids with $N > 6$ are non-Lagrangian, in the sense that the theories do not (at least not easily) admit any weakly-coupled UV completion. Such non-Lagrangian states are beyond the paradigm of parton gauge theory familiar in the study of exotic quantum liquids in condensed matter physics. The intrinsic absence of mean-field construction also makes it difficult to decide whether a non-Lagrangian state can emerge from a specific UV system (such as a lattice spin system). For this purpose we hypothesize that a quantum state is emergible from a lattice system if its quantum anomalies match with the constraints from the (generalized) Lieb-Schultz-Mattis theorems. Based on this hypothesis, we find that some of the non-Lagrangian Stiefel liquids can indeed be realized in frustrated quantum spin systems, for example, on triangular or Kagome lattice, through the intertwinement between non-coplanar magnetic orders and valence-bond-solid orders.