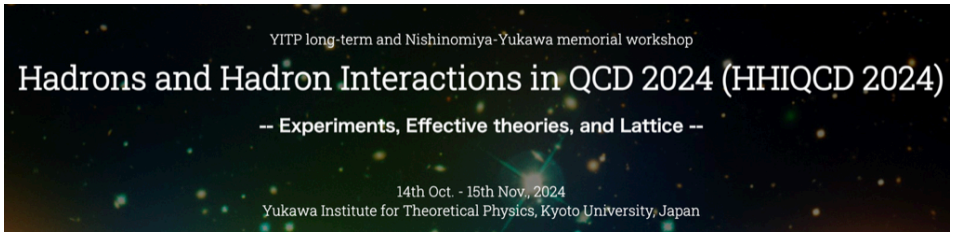

Contribution ID: **108** Type: **3rd week (Nishinomiya-Yukawa symposium)**

D-Theory: Asymptotically Free Quantum Fields from the Dimensional Reduction of Discrete Variables

Monday, November 11, 2024 4:00 PM (1 hour)

CP(N-1) models in (1+1)-d have a global SU(N) symmetry and share many features with QCD. They are asyptotically free, have a non-perturbatively generated mass gap, and non-trivial theta-vacuum states. CP(N-1) models can be regularized unconventionally by using discrete SU(N) quantum spins forming a (2+1)-d spin ladder that consists of n transversely coupled quantum spin chains. The (1+1)-d asymptotically free CP(N-1) fields then emerge from dimensional reduction when n is increased. Even n leads to the vacuum angle theta = 0, while odd n leads to theta = pi. In a similar way, gluon fields emerge naturally from the dimensional reduction of (4+1)-d quantum links, which are discrete gauge variables that generalize quantum spins. In this formulation, quarks arise as domain wall fermions. In contrast to the usual quantum fields, quantum spins and quantum links realize asymptotically free field theories with finite-dimensional local Hilbert spaces, directly representable by qubits. This is advantageous in the context of quantum simulation and quantum computation.

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Session Classification: Seminar (5th week)