The 38th International Symposium on Lattice Field Theory

LATTICE 21

JULY 26-30 2021, ZOOM/GATHER@MIT

Contribution ID: **157** Type: **Oral presentation**

Confinement-Deconfinement transition and Z_2 symmetry in Z_2+Higgs theory

Wednesday 28 July 2021 22:45 (15 minutes)

Abstract: we study the confinement-deconfinement transition and Z_2 symmetry in lattice Z_2+Higgs theory in $3+1$ dimensional Euclidean space using lattice Monte Carlo simulation methods. In pure Z_2 gauge theory the CD transition is first order. Polyakov loop acquires non-zero thermal average value in the deconfined phase and the Z_2 symmetry is spontaneously broken. The Z_2 symmetry arises from the fact that the allowed gauge transformations are either periodic or anti-periodic in the temporal direction. In the presence of matter fields in the fundamental representation, only the periodic gauge transformations are allowed. Though the action is invariant under anti-periodic gauge transformations, the gauge transformed matter fields do not satisfy required boundary conditions. A configuration of the Polyakov loop and it's Z_2 rotated counter part do not have same action, resulting in the explicit breaking of Z_2 symmetry. Using numerical Monte Carlo simulations, we compute physical observable sensitive to Z_2 symmetry, in order to study the strength of this explicit breaking in the phase diagram of the theory.

Our results shows that this Z_2 symmetry is realised in the Higgs symmetric phase for large number of temporal lattice sites. Though the action does not have Z_2 symmetry but partition function averages exhibit Z_2 symmetry for large number of temporal sites. We also observe that the Z_2 symmetry is

badly broken in the Higgs broken phase and the strength of the explicit symmetry breaking decreases on approach towards the Higgs symmetric phase. To understand the dependence of Z_2 symmetry on the number of temporal sites, we consider a simple one dimensional model keeping terms of the original action corresponding to a single spatial site. The partition function and the corresponding free

energy for each of the two Polyakov loop sectors are calculated exactly. It is observed that the free energy difference between the two Polyakov loop sectors vanishes in the large temporal lattice sites, which leads to Z_2 symmetry. We argue that this is due to the dominance of entropy or the distribution of the density of states corresponding to the action.

Primary author: SHAIKH, Sabiar (The Institute of Mathematical Sciences, Chennai)

Co-authors: Prof. DIGAL, Sanatan (The Institute of Mathematical Sciences, Chennai); Dr BISWAL, Minati (Indian Institute of Science Education and Research, Mohali); MAMALE, Vinod (The Institute of Mathematical Sciences, Chennai)

Presenter: SHAIKH, Sabiar (The Institute of Mathematical Sciences, Chennai)

Session Classification: QCD at nonzero Temperature and Density

Track Classification: QCD at nonzero Temperature and Density