Contribution ID: **8** Type: **Talk**

Chiral symmetry breaking, instantons, and monopoles

Friday, 17 July 2015 14:00 (20 minutes)

The purpose of this study is to show that monopoles are related to chiral symmetry breaking and to instantons, using the Overlap fermions as an analytical tool.

In order to study these relations, we add one pair of monopoles with different magnetic charges to the quenched SU(3) configurations by a monopole creation operator. We then count the number of zero modes, and compute the average square of the topological charges as the number of instantons. We have shown that one pair of monopoles makes one instanton, and that the chiral condensate which is computed from the eigenvalues and eigenvectors of the Overlap Dirac operator decreases by increasing the charges of the monopoles.

We have also found that the fermion spectral density of the eigenvalues increases by increasing the charges of the monopoles. Moreover, we compare the low-lying eigenvalues with the prediction of the random matrix theory.

By now these studies have been done using one small lattice ($V = 14^4, \beta = 6.00$). Our program is to investigate this subject more precisely using larger lattices and different lattice spacings. In this study, we present results on the chiral condensate, the pseudo scalar mass, and pion decay constants on larger lattice.

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Session Classification: Vacuum Structure and Confinement

Track Classification: Vacuum Structure and Confinement