Spectral flow of staggered Wilson Dirac operator in $SU(2)$ instanton backgrounds

Andriy Petrashyk

Nanyang Technological University, Singapore
Investigate robustness of **staggered Wilson** fermion index in rough $SU(2)$ instanton backgrounds.
Staggered fermions correctly reproduce index when looking at the spectral flow of

$$H_{st}(m) = iD_{st} - m\Gamma_5$$

[Adams, 2010]

here varying the parameter $m$ is equivalent to varying the Wilson parameter $r$ in the Wilson case.

A true analogue of the hermitian Wilson $H(m) = \gamma_5(D_W - m)$ will be

$$H_{sW}(m) = \Gamma_{55}(D_{st} + (1 - \Gamma_{55}\Gamma_5) - m)$$

[Adams, 2011]
Instanton Backgrounds

We’ll look at spectral flows of $H_W(m)$, $H_st(m)$ and $H_sW(m)$ in $SU(2)$ instanton backgrounds

$$U_\mu(n) = \exp \left[ i \vec{a}_\mu(n) \cdot \vec{\sigma} \vartheta_\mu(n, \rho^2) \right]$$

[Edwards et al., 1998]

And will roughen the smooth instanton fields by acting on the smooth link variables with random $SU(2)$ elements in the vicinity of $I$:

$$U_\mu(n)_\epsilon = I \cdot r_\mu^{(0)}(x) + i \sum_{j=1}^{3} \sigma_j r_\mu^{(j)}(x)$$
Spectral flow in smooth background

Instantons are of size 2.0 are at the centre of the lattice. Lattice size $8^4$, Dirichlet B.C.s
zoomed in
roughen the background
roughen the background
roughen the background
roughen the background
Conclusion

Wilson fermion index still seems more robust, although not significantly. Computational efficiency of staggered Wilson outweighs this lack of robustness?