Heavy quark action on the anisotropic lattice

J. Harada,[a] H. Matsufuru,[b] T. Onogi,[b] and A. Sugita,[c]

[a] *Department of Physics, Hiroshima University, Higashi-hiroshima 739-8526, Japan*
[b] *Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto 606-8502, Japan*
[c] *Research Center for Nuclear Physics (RCNP), Ibaraki, Osaka 567-0047, Japan*

We investigate the $O(a)$ improved quark action on anisotropic lattice as a potential framework for the heavy quark, which may enable precision computation of hadronic matrix elements of heavy-light mesons. The relativity relations of heavy-light mesons as well as of heavy quarkonium are examined on a quenched lattice with spatial lattice cutoff $a_\sigma^{-1} \simeq 1.6$ GeV and the anisotropy $\xi = 4$. We find that the bare anisotropy parameter tuned for the massless quark describes both the heavy-heavy and heavy-light mesons within 2% accuracy for the quark mass $a_\sigma m_Q < 0.8$, which covers the charm quark mass. This bare anisotropy parameter also successfully describes the heavy-light mesons in the quark mass region $a_\sigma m_Q \leq 1.2$ within the same accuracy. Beyond this region, the discretization effects seem to grow gradually. The anisotropic lattice is expected to extend by a factor ξ the quark mass region in which the parameters in the action tuned for the massless limit are applicable for heavy-light systems with well controlled systematic errors.

The simulation has been done on NEC SX-5 at Research Center for Nuclear Physics, Osaka University and Hitachi SR8000 at KEK (High Energy Accelerator Research Organization).

References

[1] J. Harada, A. S. Kronfeld, H. Matsufuru, N. Nakajima and T. Onogi, Phys. Rev. D **64**, 074501 (2001).
[2] H. Matsufuru, T. Onogi and T. Umeda, Phys. Rev. D **64**, 114503 (2001).
[3] J. Harada, H. Matsufuru, T. Onogi and A. Sugita, hep-lat/0202004.
[4] J. Harada, H. Matsufuru, T. Onogi and A. Sugita, hep-lat/0203025, to appear in Phys. Rev. D.