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Dirac-mode expansion for quark-number holonomy in lattice QCD

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We investigate the quark number density and the quark number holonomy at finite imaginary chemical potential in the lattice QCD using the Dirac-mode expansion. The quark number holonomy is defined by the quark number density and it can be an order parameter which detects the quark-deconfinement [1,2]. We find some analytical formulae of the quark number density. In the large quark mass regime, the quark number density is expressed in terms of the Polyakov loop. On the other hand, in the small quark mass region, the quark number density is expressed by the eigenmodes of the Wilson-Dirac operator on a lattice. It is found that the quark number density strongly depends on the low-lying Dirac modes. However, the quark number holonomy is not sensitive to the low-lying Dirac modes. Based on these results, we discuss the confinement-deconfinement transition [3].

References:

- [1] K. Kashiwa, A. Ohnishi, Phys. Lett. B750, 282 (2015), arXiv:1505.06799.
- [2] K. Kashiwa, A. Ohnishi, Phys. Rev. D93, 116002 (2016), arXiv:1602.06037.
- [3] T. M. Doi, K. Kashiwa, arXiv:1706.00614.

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