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Worldvolume tempered Lefschetz thimble method and its error estimation

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As a new algorithm towards solving the sign problem, we propose the "worldvolume tempered Lefschetz thimble method" (WV-TLTM) [1]. In this algorithm, we make hybrid Monte Carlo updates on a continuum set of integration surfaces foliated by the antiholomorphic gradient flow ("the worldvolume of the integration surface"). This algorithm is an extension of the tempered Lefschetz thimble method (TLTM) [2]. It tames the sign and multimodal problems simultaneously as the original TLTM. Furthermore, one no longer needs to prepare replicas of configuration space or compute the Jacobian of the flow except for the evaluation of its phase upon measurement, which reduces the computational cost significantly compared to the original TLTM. We apply this algorithm to the Stephanov model (a chiral random matrix model), for which the complex Langevin method is known not to work. We also discuss the effect of choosing a specific flow time region on the estimation of observables, especially by analyzing the autocorrelation times and the statistical errors [3].

[1] M. Fukuma and N. Matsumoto, "Worldvolume approach to the tempered Lefschetz thimble method," PTEP 2021, no.2, 023B08 (2021) [arXiv:2012.08468 [hep-lat]].
[2] M. Fukuma and N. Umeda, "Parallel tempering algorithm for integration over Lefschetz thimbles," PTEP 2017, no.7, 073B01 (2017) [arXiv:1703.00861 [hep-lat]].
[3] M. Fukuma, N. Matsumoto, and Y. Namekawa, in preparation.

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