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Monte Carlo calculations on Lefschetz thimbles and beyond

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A possible solution of the notorious sign problem for systems with non-zero chemical potential is to deform the integration region in the complex plane to a Lefschetz thimble. We introduce an easy to implement Monte Carlo algorithm to sample the dominant thimble, based on a contraction map on a thimble. We point out that manifolds other than Lefschetz thimble could be useful for numerical simulations. We describe a family of such manifolds, using the contraction map, that interpolate between the tangent space at one critical point (where the sign problem could be severe) and the union of relevant thimbles (where the sign problem is mild but a multimodal distribution function complicates the Monte Carlo sampling). We show how this works using a simple fermion model.

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