Contribution ID: **173** Type: **Talk**

Configurational Thermometer for Lattice Gauge Theories.

Thursday 6 November 2025 15:50 (20 minutes)

We present a new temperature estimator for lattice gauge theories. This estimator is based on the gradient and Hessian of the Euclidean action. It draws inspiration from geometric methods in statistical mechanics. This approach provides a gauge-invariant and momentum-free way to check thermodynamic consistency in Monte Carlo simulations. Unlike traditional methods, which control temperature indirectly by adjusting lattice size or coupling, our estimator finds the effective temperature directly from field configurations. This allows for independent checks of thermalization and sampling accuracy. We apply the estimator to compact U(1) lattice gauge theories in one, two, and four dimensions. We compare the measured temperatures with the input temperatures over a wide range of couplings and lattice sizes. The estimator reliably reproduces the target temperature and performs well against discretization effects and algorithmic artifacts. It can spot sampling issues, slow thermalization, or errors in implementation, making it a useful tool for large-scale simulations. We also discuss potential extensions to non-Abelian theories, anisotropic lattices, and integration with hybrid Monte Carlo workflows.

Parallel Session (for talks only)

Algorithms and artificial intelligence

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