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## Diffusion Models for Sampling on $SU(N)$

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Ensemble generation remains a central challenge in lattice field theory simulations, as traditional MCMC algorithms suffer from long autocorrelation times. Recent advances in generative modeling, including diffusion models, offer accelerated approaches for sampling complicated probability distributions. In this work, we present a diffusion-based framework for sampling  $SU(N)$  degrees of freedom. We adapt the traditional score matching technique for training diffusion models to the  $SU(N)$  group manifold and demonstrate that our models faithfully reproduce both the heat kernel evolution as well as a family of target densities for toy theories. By solving the reverse-time ODE directly on the group, we can efficiently generate unbiased  $SU(2)$  estimates from single-site toy models. These results mark a step for diffusion models towards modeling full  $SU(N)$  lattice field theories and, ultimately,  $SU(N)$  gauge theory on the lattice.

### Parallel Session (for talks only)

Algorithms and artificial intelligence

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