Quark Field Smearing in Two-Flavor Lattice QCD

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Abstract

Effective masses for six representative nucleon operators are examined as a function of different values of Gaussian quark field smearing parameters. Fixed stout link smearing parameters of $n_\rho \rho = 2.5$ and $n_\rho = 16$ are used throughout. The results are based on 50 dynamical configurations using the anisotropic Wilson action with $\beta = 5.5$, $m_u = -0.4125$ ($m_\pi \approx 470$ MeV), and a renormalized anisotropy $\xi = 3.0$ on a $16^3 \times 64$ lattice.

The effective mass signals from all six operators respond similarly to variations in the quark smearing parameters. Contamination from higher-lying states dramatically drops as smearing is increased to $\sigma_s = 4.0$, $n_\sigma = 32$ and remains steady thereafter. No examination of higher-lying states is performed in this study. Based on these findings and a previous quenched study of the excited states by Juge, it is concluded that $\sigma_s = 3.0$, $n_\sigma = 32$ is the preferred value of the smearing parameters for this lattice. These unquenched findings are consistent with the results of an earlier quenched study.

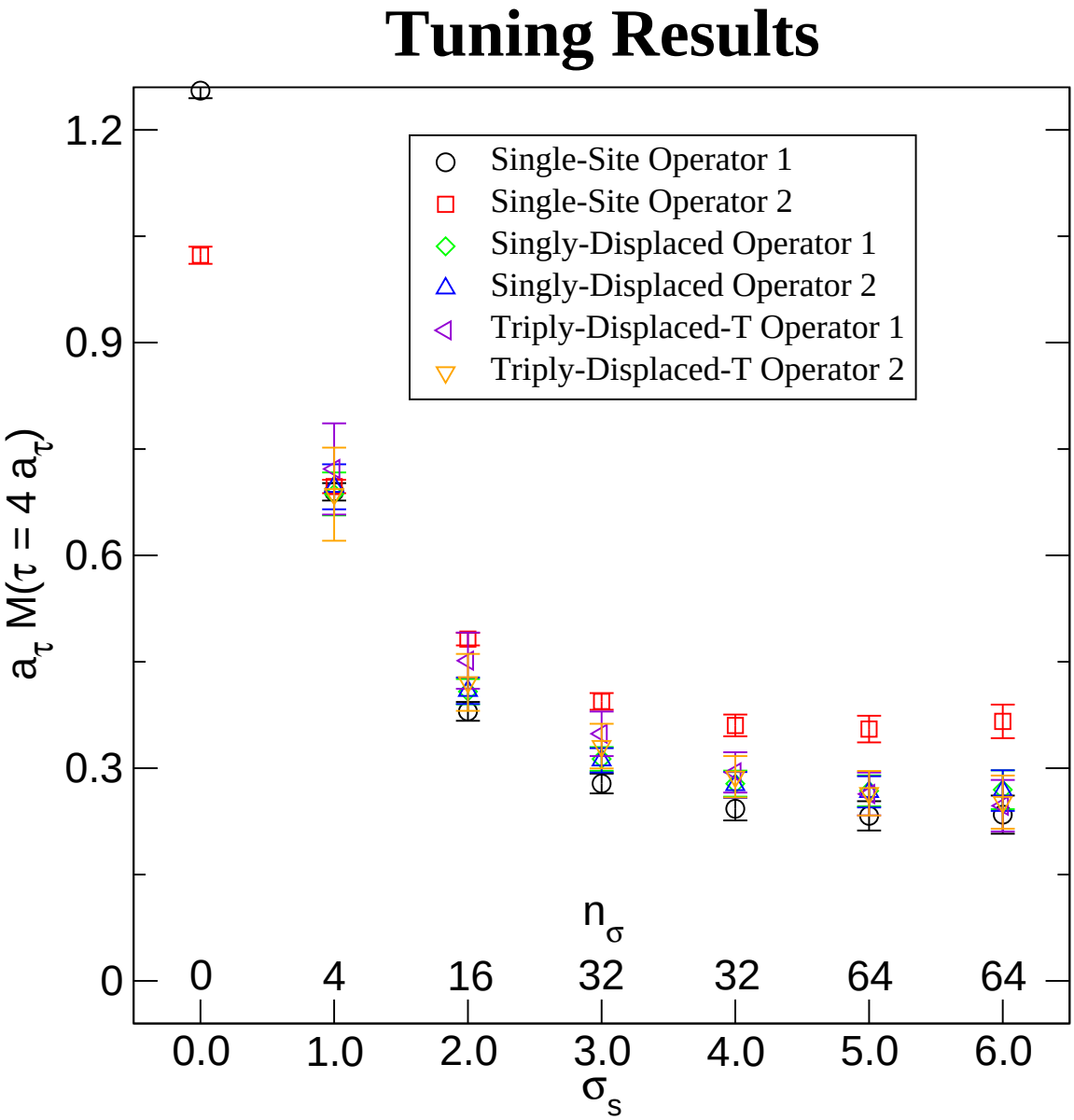

Figure 1: The effective masses $a_\tau M$ evaluated at a fixed time separation $4a_\tau$ for six representative operators as a function of Gaussian smearing radius σ_s and iteration count n_σ.

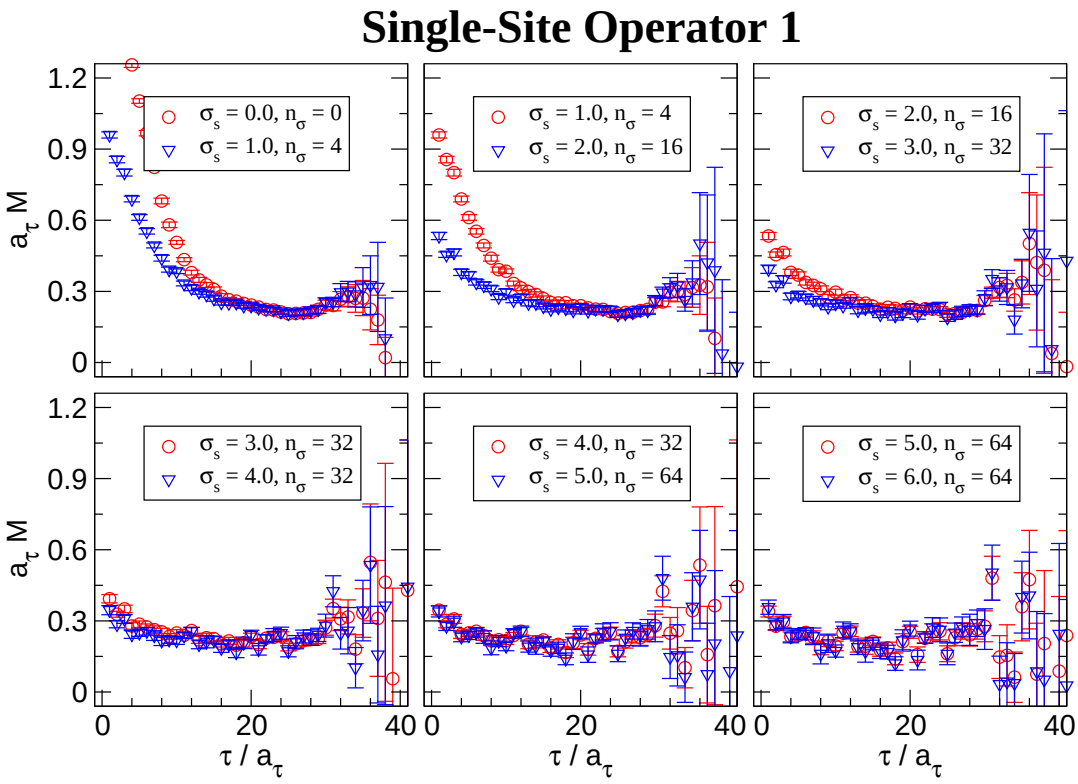

Figure 2: The effect of various values of the Gaussian smearing parameters on the effective mass function of a single-site nucleon operator.

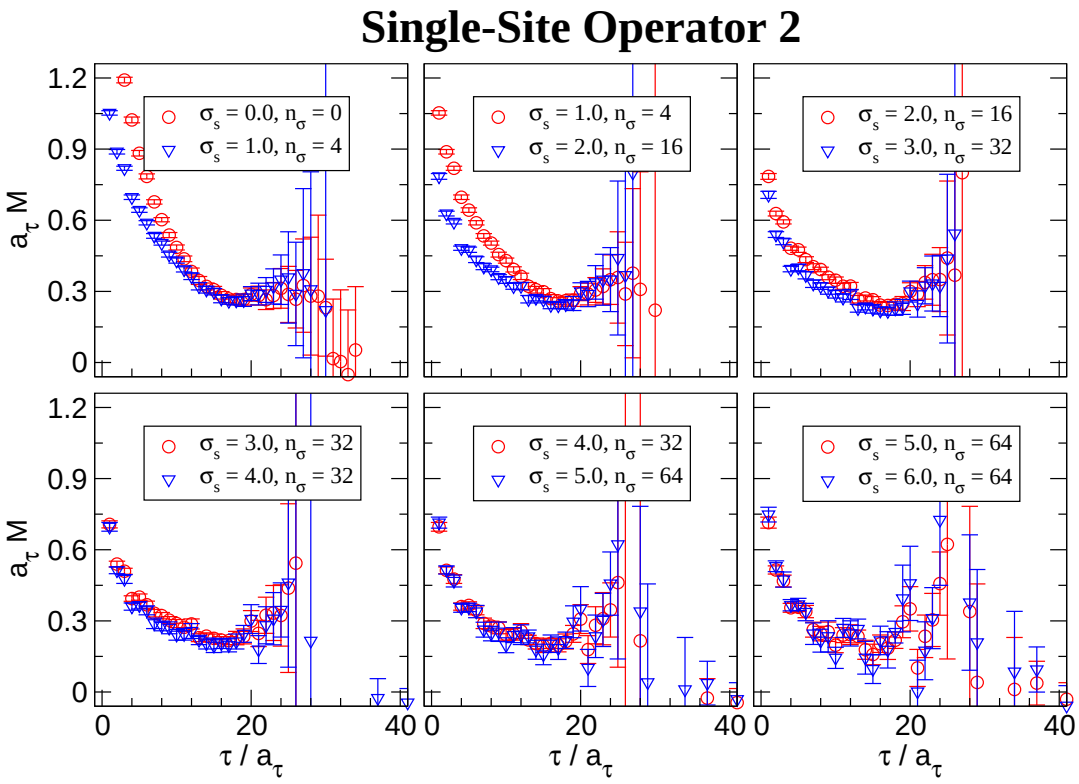

Figure 3: The effect of various values of the Gaussian smearing parameters on the effective mass function of a single-site nucleon operator.

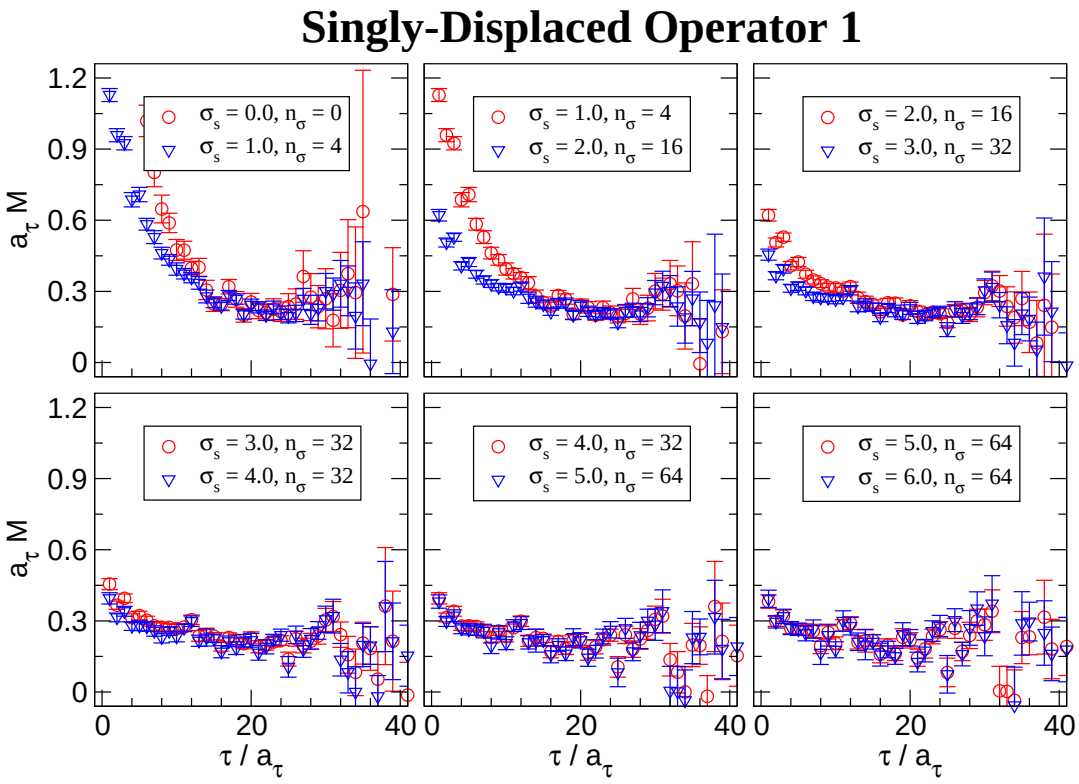

Figure 4: The effect of various values of the Gaussian smearing parameters on the effective mass function of a singly-displaced nucleon operator.

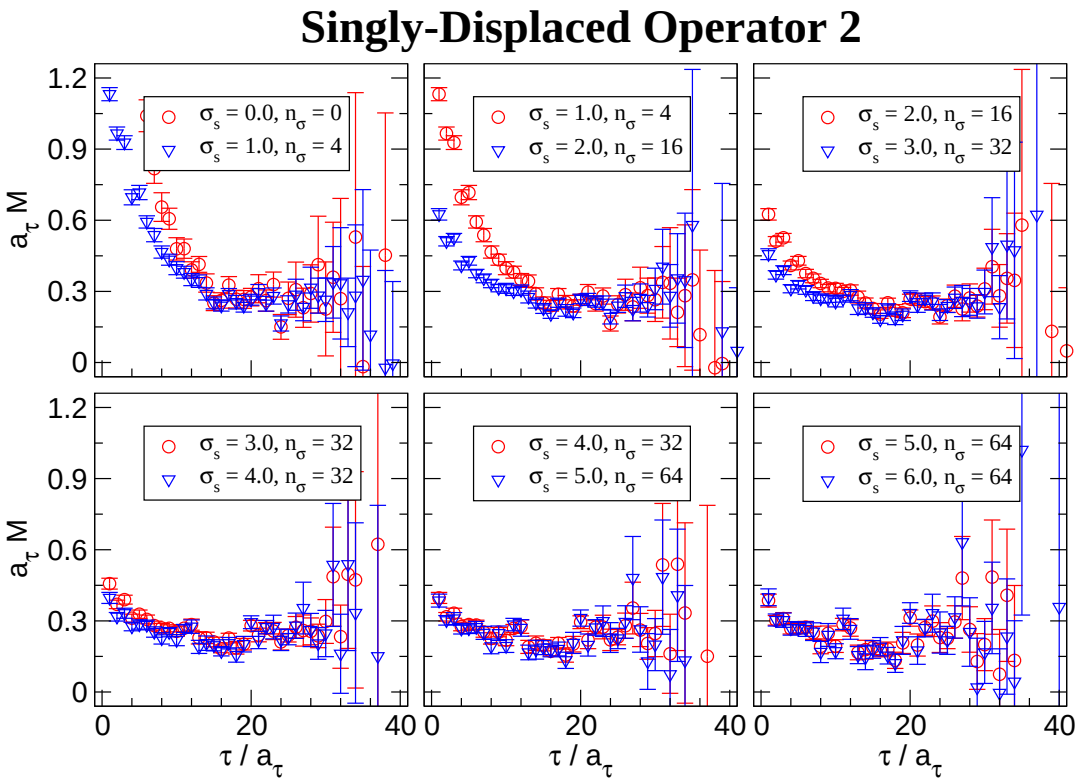

Figure 5: The effect of various values of the Gaussian smearing parameters on the effective mass function of a singly-displaced nucleon operator.

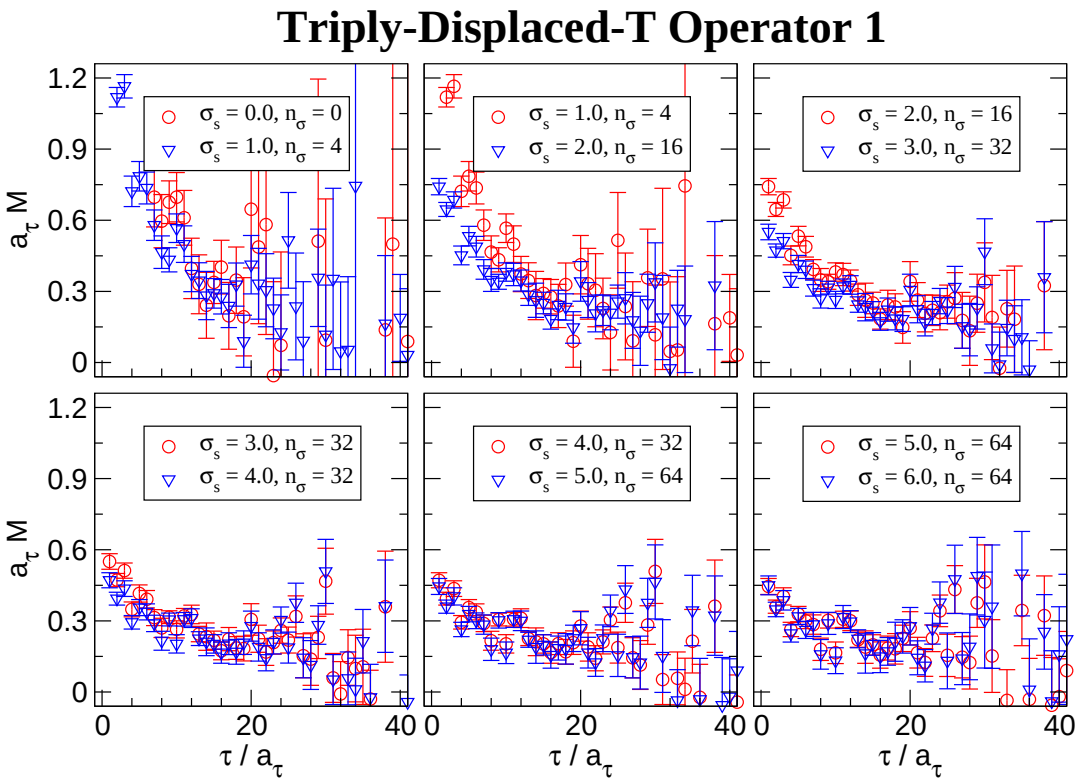

Figure 6: The effect of various values of the Gaussian smearing parameters on the effective mass function of a triply-displaced-T nucleon operator.

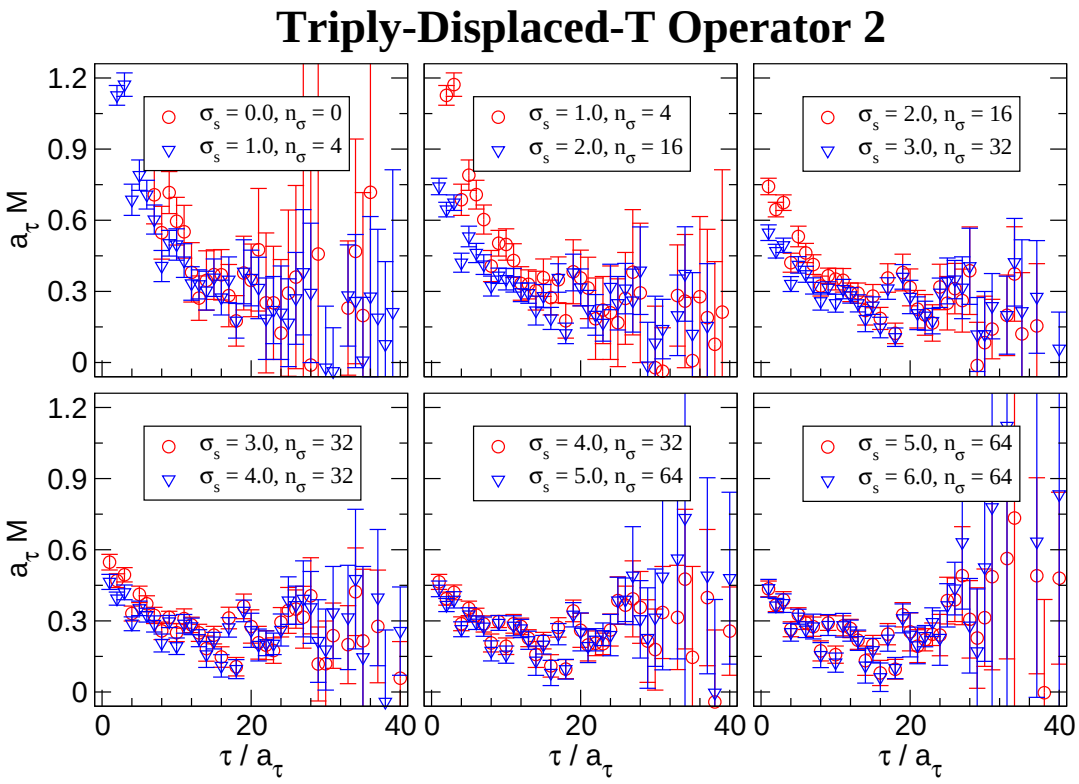

Figure 7: The effect of various values of the Gaussian smearing parameters on the effective mass function of a triply-displaced-T nucleon operator.