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Lattice QCD calculation of the pion charge radius using a model-independent method

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We use a method to calculate the hadron's charge radius without model-dependent momentum extrapolations. The method does not require the additional quark propagator inversions on the twisted boundary conditions or the computation of the momentum derivatives of quark propagators and thus is easy to implement. We apply this method to the calculation of pion charge radius $\langle r^2 \rangle$. For comparison, we also determine $\langle r^2 \rangle$ with the traditional approach of computing the slope of the form factors. The new method produces results consistent with those from the traditional method and with statistical errors 1.5-1.9 times smaller. For the four gauge ensembles at the physical pion masses, the statistical errors of $\langle r^2 \rangle$ range from 2.1% to 4.6% by using ⊠50 configurations. For the ensemble at $m_\pi \approx 340$ MeV, the statistical uncertainty is even reduced to a sub-percent level.

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