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Fixing the nuclear charge density with finite nucleons

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The measured charge distribution of a nucleus is often used to sample positions of nucleons within the nucleus. However, since nucleons have finite size, the resulting charge distribution is different from the sampled distribution. We show that this can have significant observable effects: Not only does it increase the size of the nucleus, but also changes the surface diffusiveness. This in turn can have effects as simple as an overestimate of the transverse size of the collision system resulting in an underestimate of the final transverse momentum, to changes in centrality determination and even total nucleus-nucleus cross section. These differences can, for example, add significant bias to Bayesian parameter estimation. We then show a simple method for correcting this, so that nucleons are sampled in a way that the average charge distribution is fixed to the desired function, and approximately independent of the size of the nucleon. This method can be easily implemented in existing Monte Carlo simulations that utilize a spherical Woods-Saxon distribution. We also discuss a more general treatment that can be used for an arbitrary charge distribution.

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