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Determination of the neutron skin of Pb-208 from ultrarelativistic nuclear collisions

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In heavy nuclei the neutron distribution has a larger spatial extent than the proton distribution. This size difference represents the so-called neutron skin and is determined by the strong nuclear force in the same regime as that determining the masses and radii of neutron stars. The neutron skin of ^{208}Pb, owing to its simple structure and large neutron excess, has been the target of many dedicated efforts. We present a state-of-the-art global analysis to fit a hydrodynamic model to soft sector measurements of ultrarelativistic ^{208}Pb+^{208}Pb collisions performed at the LHC to achieve the first determination of the neutron skin of ^{208}Pb in scattering processes mediated by gluons at high energy. Thanks to the high sensitivity of high-energy observables such as the total hadronic cross sections and elliptic flow to the overall size of the colliding ^{208}Pb ions, we achieve an accurate determination of the skin: $\Delta r_{np} = 0.217 \pm 0.058$ fm. This is consistent with state-of-the-art nuclear theory predictions, and competitive in precision with a recent extraction from polarized electron scattering by the PREX collaboration at JLab.

Category

Theory

Collaboration (if applicable)

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