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Determination of matter radii and neutron skin thickness of neutron-rich isotopes ^{51,52}Ca

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The unexpectedly large charge radius of the doubly magic nucleus ^{52}Ca, with the new neutron magic number $N = 32$, has puzzled theoretical studies, as this trend differs from a decrease in charge radius observed for closed-shell isotopes ^{40,48}Ca. Only the Hartree-Fock-Bogolyubov calculation with the Fayans energy density function was able to reproduce this experimental result. On the other hand, a rapid growth in the point matter radius was observed for $^{49-51}$Ca isotopes, which could only be explained by considering the swelling of the ^{48}Ca core. In order to understand the abrupt increase in charge radius of ^{52}Ca, it is necessary to determine the extent of its matter distribution to study the effect of neutrons. This also leads to the determination of the neutron skin thickness, which is correlated with the density derivative of the symmetry energy in the equation of state of asymmetric nuclear matter. Therefore, to address this issue, the reaction cross-section of $^{48-52}$Ca was measured at RIBF, RIKEN, using the BigRIPS and ZeroDegree Spectrometer. The cross-section was measured on carbon and polyethylene targets at an energy of approximately 230 MeV/u. The point matter radius of isotopes will be extracted from the measured cross-sections using the Glauber model. The results will determine the structure of neutron-rich calcium isotopes. By determining the neutron skin thickness of two doubly magic calcium isotopes, ^{48}Ca and ^{52}Ca, this measurement will constrain the density derivative of symmetry energy in the equation of state.

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