Elastic Scattering of Polarized Protons off ^{40,42,44,48}Ca at 300 MeV

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The calcium isotopes provide an excellent set of nuclei since they are the only ones whose neutron distributions can be investigated with stable isotopes from one magic number to the next. From the electron scattering data, charge radii of Ca isotopes are almost constant and do not increase proportional to $A^{1/3}$. It is of great interest whether the neutron radii increase or not according to the neutron number. Neutron skins are implied if the neutron radii increase, while constant radii provide a puzzle to the nuclear theory.

There were very few attempts to obtain neutron distributions. Ray *et al.*[1] attempted to extract neutron density distributions in Ca isotopes from polarized proton elastic scattering at 800 MeV with a non-relativistic second-order KMT optical model. The obtained neutron radii were not constant but slightly below the $A^{1/3}$ rule. Since a discrete ambiguity due to the different solutions of the proton-nucleon amplitude parameters remained in their analysis, absolute values for the neutron radii were not determined.

In a previous series of proton elastic scattering measurements at intermediate energies, we developed a new method to extract neutron density distributions precisely in the framework of the relativistic impulse approximation (RIA) with medium modifications of NN interactions[2] and succeeded in observing a gradual change of neutron distributions in the tin isotopes[3]. By using same method we can deduce precise neutron distributions from proton elastic scattering off the calcium isotopes. We can provide decisive information on the long-standing Ca radii.

Thus we measured cross sections and analyzing powers of proton elastic scattering off ^{40,42,44,48}Ca at $E_p = 300$ MeV over an angular range of $\theta_{\rm LAB} \leq 51.0^\circ$ ($q \leq 3.5\,{\rm fm}^{-1}$). The targets were periodically changed in a few minutes by an automatic target changer system developed by us. Preliminary experimental results are displayed by solid circles in Fig. 1. Dashed curves represent the original RIA calculations with the codes developed by Horowitz *et al.*[4]. Relativistic Hartree distributions are used in the model. Detailed analyses including the extraction of neutron density distributions are in progress.

References

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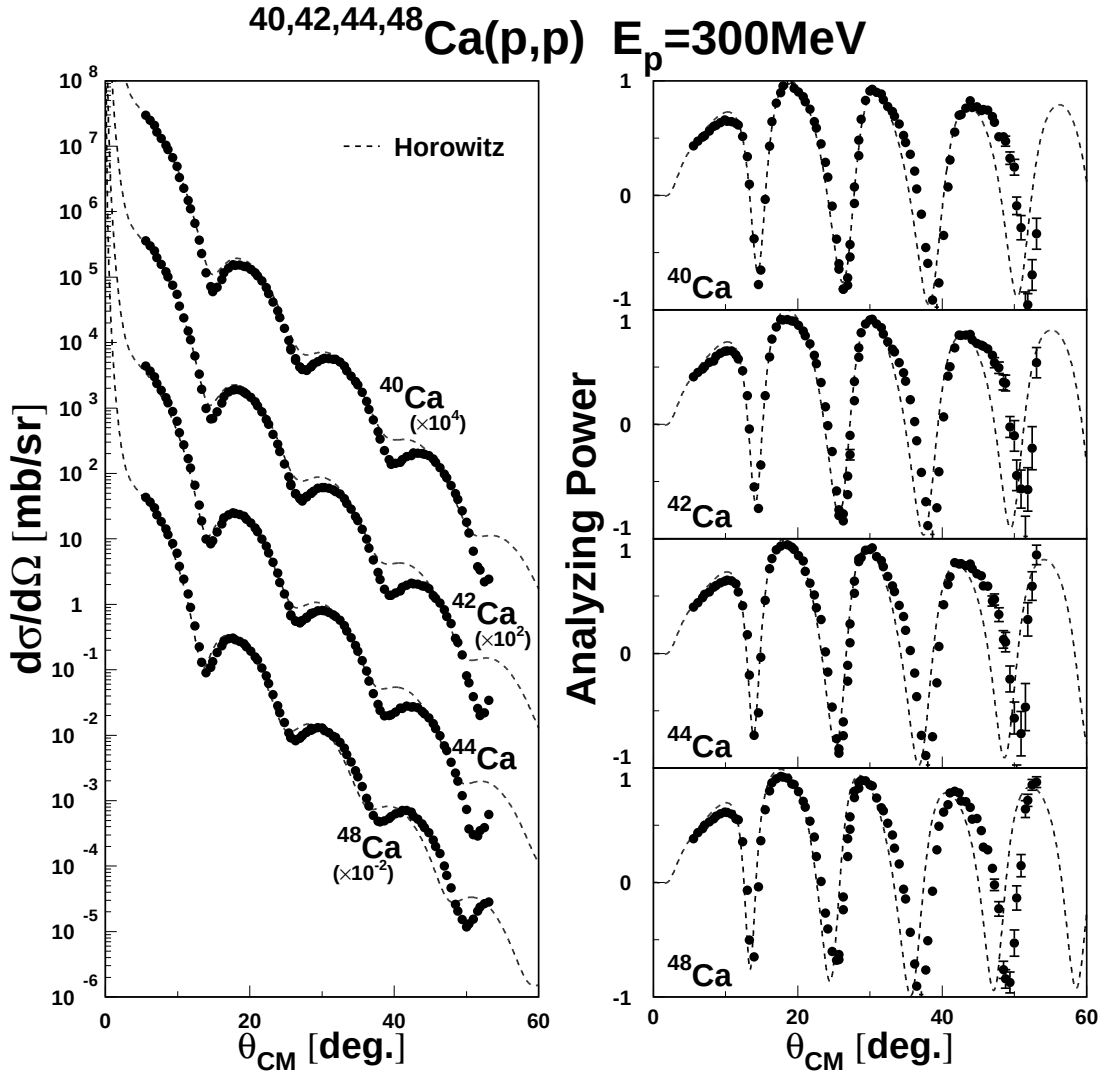

Figure 1: Preliminary experimental results of cross sections and analyzing powers of proton elastic scattering from ^{40,42,44,48}Ca at 300 MeV are shown. Dashed curves are the RIA calculations with the codes developed by Horowitz *et al.*