Extraction of neutron density distributions in ^{116,118,120,122,124}Sn by proton elastic scattering at 295 MeV

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Cross sections and analyzing powers of proton elastic scattering of tin isotopes at 295 MeV have been measured up to the angle of 3.5 fm^{-1} in momentum transfer to deduce a systematic change of neutron density distributions. In our previous measurement for ^{120}Sn we have succeeded to deduce the increase of the neutron densities at the nuclear center by analyzing the elastic scattering of polarized protons [1]. It seems to reflect the neutron occupation of the neutron $3s_{1/2}$ orbit in ^{120}Sn . In this experiment we have studied a systematic change of the neutron density distributions in tin isotopes.

The experiment was performed with the use of the GRAND RAIDEN magnetic spectrometer and a newly constructed rapid target changer to minimize the relative ambiguity among different isotopes due to the drift of the beam condition even in a single run. Thus we have measured angular distributions of 3 isotopes at the same time by changing frequently the target isotope in every 100 seconds.

We used relativistic impulse approximation (RIA) calculation [2] to analyze experimental data. In RIA we have used density dependent coupling constants and exchanged mesons which can explain precisely the scattering of N=Z nuclei and reflect the medium effect [3]. We have confirmed that the same intraction can explain even ^{208}Pb proton elastic scattering data, cross section and analyzing powers at 300 MeV, if we use three-parameter gaussian distribution via 800MeV proton elastic scattering expriments [4].

During the analysis , we have used the point proton density distribution unfolded from the model independent charge distribution data [5, 6] and searched neutron densities in the form of sum-of-gaussian type to explain the obtained data.

Figure 1 shows the results of the fitting for $^{116-124}$Sn. The solid curves are RIA calculations with the medium effect by using the searched neutron densities. The dashed lines are the fitting results with trial neutron densities of relativistic Hartree approximation. Hatched area shows superposition of possible densities with good χ^2 smaller than χ^2_{min} plus degrees of freedom. The solid curves below the neutron density distribution are point proton densities. Hatched area shows superposition of possible densities with good χ^2 smaller than χ^2_{min} plus degrees of freedom. In this figure we notice a gradual change of the neutron densities in tin isotopes, especially a decrease of central densities before the occupation of the s state. Further analysis to include the model error is in progress.

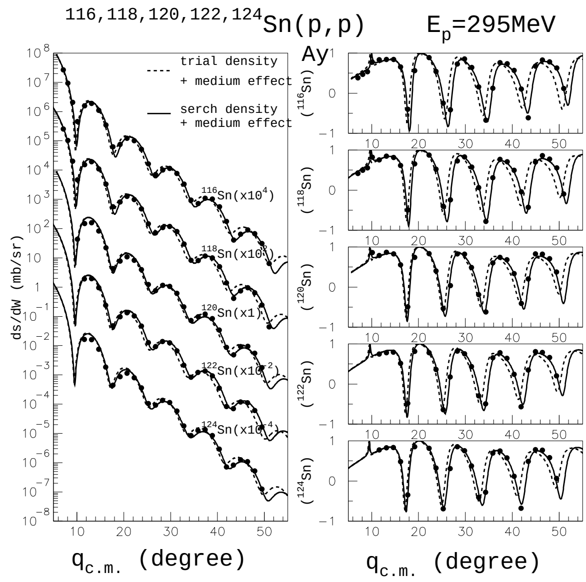

Figure 1: experimental data and fitting data.

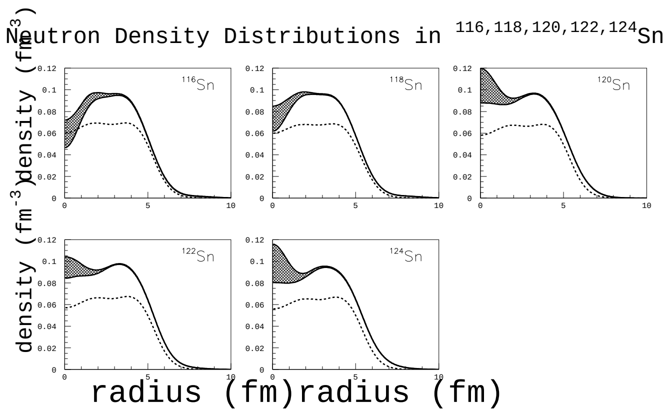

Figure 2: deduced neutron densities Sn isotopes.

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