International conference on nuclear physics.
Berkeley, USA, August 24 - 30, 1980.
CEA CONF 5352

poor quality

FR 81 00143

DETERMINATION OF MATTER DENSITY BY LOW ENERGY PROTON SCATTERING

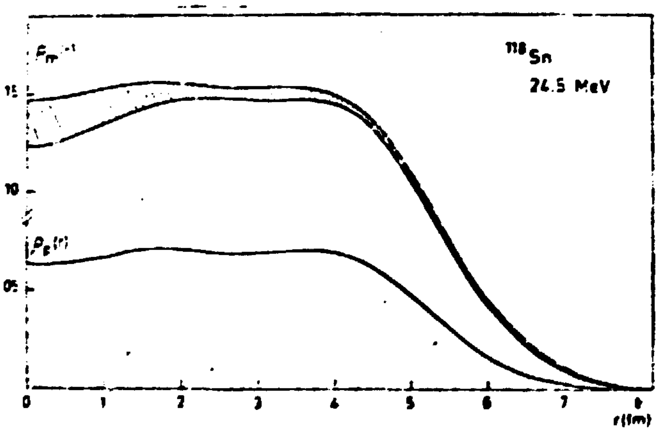
A. Tarrats, I. Brissaud* and J.L. Escudié

DPh-N/ME, CEN Saclay, BP 2, 91190 Gif-sur-Yvette, France

It is difficult to extract information on the matter density in the interior part of heavy nuclei by scattering of high energy hadrons, because of the strong projectile absorption[1]). For example, the mean free path ($\lambda = 1/\rho\sigma$) of 1 GeV protons is only about 1.4 fm, corresponding to a N-N total cross section σ of about 44 mb. However at low energy the Pauli effect decreases the effective total cross section ; it has been shown[2]), for instance, that λ is about 4 fm for 20 MeV protons. One hopes then that low energy proton scattering could yield accurate information about the density near the nuclear center.

We have analyzed the 24.5 MeV proton elastic scattering by ^{118}Sn by means of the OMP calculations a Tarrats and Escudié[3]). The NN interaction was first calibrated by fitting of range of different nuclei[3]). Then this calibrated interaction was used to extract the neutron density of ^{118}Sn. Following the Sick model (SOG)[4]), we write : $\rho_n(r) = \sum_i A_i \left[\exp-((r-R_i)/\gamma)^2 + \exp-((r+R_i)/\gamma)^2\right]$. The proton density was taken from Sick et al.[4]). We have determined the i values (i = 10) of A_i for many sets of R_i by fitting the elastic angular distribution data. The envelope of the trial densities gives the uncertainty of the neutron density. The figure shows our results for the matter density ($\rho_m = \rho_p + \rho_n$) and the proton density used in the calculation.

Unfortunately, an unambiguous interaction could not be obtained by fitting the whole range of calibration masses (32-208). While the possible differences of the t-matrix are small, the nuclear densities depend quite sensitively on them. We find that the nuclear surface region is stable against changes in the interaction, while the interior region envelope remains thin but moves by 2 ou 3 times its width for different reasonable interactions.



This clearly indicates that : i) the model is basically realistic ; ii) the extraction of reliable interior nuclear densities from this approach is beyond the present state of the theory ; iii) the sensitivity of low energy elastic observables (due to the long mean free path) to nuclear matter density is established.

*IPN, BP 1, 91406 Orsay, France.

1. I. Brissaud and X. Campi, Phys. Lett. 86B (1979) 141 ; N.J. DiGiacomo et al., Phys. Rev. C19 (1979) 1132.
2. K. Kikuchi and M. Kawai, Nuclear matter and nuclear reactions, North Holland (1968) p. 33.
3. A. Tarrats and J.L. Escudié, Microscopic optical potentials, Springer Verlag, Edited by H.V. Geramb (1979) p. 200 and contribution to this conference.
4. I. Sick, Nucl. Phys. A218 (1974) 509 and B. Frois, private communication.