Proc. Sixth Int. Symp. Polar. Phenom. in Nucl. Phys., Osaka, 1985
J. Phys. Soc. Jpn. 55 (1986) Suppl. p. 932

4.9 800 MeV Polarized Protons Inelastic Scattering on ^{16}O and ^{18}O

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The extraction of nuclear deformation parameters β_L or deformation lengths δ_L from different inelastic scattering experiments on various nuclei has shown large differences among these deformation parameters β_L. For light nuclei, the β_L obtained in inelastic scattering experiments using composite particles as probes are smaller than those obtained from protons or neutrons experiments[1,2]. For heavy nuclei, the inelastic scattering of 201 MeV protons from ^{208}Pb has shown that the transition probability extracted through the δ_L is much smaller than those obtained in (α,α') or (e,e') experiment. The possible existence of equidensity contours inside the nucleus, the differences of penetration of the various probes into the nucleus may explain some discrepancies observed in these experiments.

In order to further study nuclear deformations for light nuclei, we have analyzed 800 MeV polarized protons elastic and inelastic scattering on ^{16}O and ^{18}O LAMPF data. Using the code ECIS, we have analyzed with the coupled channels (CC) collective model the analyzing powers and differential cross sections obtained from these experiments. For ^{16}O, by coupling the 0^+, 3^-_1 (6.13 MeV) and 2^+_1 (6.92 MeV) states in the vibrational model and by using the full Thomas term for the deformed spin orbit potential, good agreement has been obtained with $\beta_2 = 0.213$, $\delta_2 = 0.54$ fm and $\beta_3 = 0.596$, $\delta_3 = 1.50$ fm. As for ^{18}O, the best CC calculations using the rotational model and coupling the 0^+, 2^+ (1.98 MeV) and 4^+_2 (7.12 MeV) states were obtained with $\beta_2 = 0.34$, $\delta_2 = 0.87$ fm, $\beta_4 = 0.16$, $\delta 4 = 0.41$ fm and $\beta_6 = 0.05$, $\delta_6 = 0.14$ fm. CC calculations using the vibrational model and coupling the 0^+, 2^+_1 and 3^-_1 (5.09 MeV) states of ^{18}O with $\beta_3 = 0.45$, $\delta_3 = 1.15$ fm have also shown good agreement with the data. These deformation parameters have been compared to those obtained from low energies (p,p')[2] or (n,n') experiments[3]. The conclusion is that there is a relatively good agreement between the deformation parameters obtained at low energies for protons and neutrons and those obtained in this work using intermediate energy protons. Consequently it is interesting to point out first that there is no apparent energy dependence for the deformation parameters and secondly that the deformation parameters or deformation lengths obtained using protons or neutrons as probes are nearly equal, this is in agreement with results obtained recently on the energy dependence of deformation parameters in the $^{12}C(\vec{p},p')^{12}C$ reaction[4].

References

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