PROTON ELASTIC SCATTERING FROM LIGHT NEUTRON-RICH NUCLEI

H. Fujita, K. Kume, and S. Hirenzaki

Department of Physics, Nara Women's University, Nara 630-8506, Japan

Recently, light nuclei close to the neutron drip line are extensively studied both experimentally and theoretically. Much effort has been devoted to study the structure of these nuclei. The experiment of the proton elastic scattering on these unstable nuclei has been also done and these are analyzed with the phenomenological or semi-phenomenological optical model. Since these unstable nuclei present new features, like a neutron halo structure, it is interesting to study the proton elastic scattering on these nuclei based on the microscopic optical model potential.

In the microscopic approach, two-body effective interaction is constructed in the nuclear matter and then the optical potential is calculated by folding the effective interaction with the nuclear ground-state density. Since the two-body effective interaction has strong energy and density dependence, it is interesting to examine to what extent these microscopic optical potential describe the experimental elastic scattering from light neutron-rich nuclei.

Kohno [1] applied the microscopic theory of the optical model to the proton elastic scattering from lithium isotopes and has shown that the experimental elastic scattering data are explained well with the microscopic optical potential. Since several experimental data are available for the light neutron-rich nuclei, like ^{6,8}He, ^{9,11}Li, and ^{10,11}Be etc., we think it necessary to examine these nuclei systematically. We have also calculated the polarization observables and have studied the isotope dependence of the spin-orbit force in the proton-nucleus optical potential. In this report, we show the preliminary results of the cross section and polarization on ^{6,7,11}Li around $T_p = 60 \sim 70$ MeV.

We construct an optical potential by folding the complex effective interaction due to Yamaguchi *et al.* [2]. The spin-orbit part is calculated with the M3Y effective interaction [3]. The direct and exchange contributions to the optical potential are calculated for both of the central and the spin-orbit parts. We follow the prescription by Brieva and Rook for the central [4] and the spin-orbit parts [5].

For the ^{6}Li, we use the proton density deduced from the electron scattering with correction coming from the proton finite size. It is assumed that proton and neutron densities are equal. For the ^{7}Li, the nuclear density is calculated with the α-t cluster model [6]. Majorana parameter $m = 0.585$ is used which reproduces the experimental rms radius of ^{7}Li. For ^{11}Li, we examined two densities to see the dependence on the nuclear density. One is the density calculated with the ^{9}Li-2n cluster model by Descouvemont [7] with Volkov-2 effective interaction. The another one is that given by Kanungo *et al.* [8]. The ^{9}Li core and $2n$ densities were assumed to be of oscillator type and the local gaussian. The parameters were determined so as to reproduce the rms radius of ^{9}Li and ^{11}Li.

Figs. 1-3 show the calculated cross sections and polarizations for the ^{6,7,11}Li around T_p=60 $\sim$ 70 MeV. We do not multiply the effective mass to the imaginary part of the optical potential. Instead, we multiplied a renormalization factor NI to the imaginary part of the optical potential to see the dependence of the observables. As is well known, the imaginary part of the optical potential is overestimated in the nuclear matter approach for stable nuclei.

As seen in Figs. 1 and 2, our results reproduce the experimental cross section fairly well for ^{6,7}Li. For the polarization of ^{6}Li, the overall trends are reproduced but agreement is not good as for the cross section. For the cross section of ^{11}Li, the dip position is shifted to the forward direction. The two densities give slightly different results. Since there are no experimental data for the polarization, we compare the results with that obtained by the phenomenological optical potential which fit the cross section. Our results are similar to the phenomenological one. For the ^{7,11}Li cases, we need to evaluate the quadrupole effect which might be non-negligible around the first dip.

We also calculated the optical potential with the other effective interaction: we used the effective force by Jeukenne *et al.* [9]. The results are similar to those obtained with the effective interaction by Yamaguchi *et al.*

References

[1] M. Kohno, Phys. Rev. C **48**, 3122 (1993).
[2] N. Yamaguchi, S. Nagata, and J. Michiyama, Prog. Theo. Phys. **76**, 1289 (1986).
[3] G. Bertsch *et al.*, Nucl. Phys. **A284**, 399 (1977).
[4] F.A. Brieva and J.R. Rook, Nucl. Phys. A **291**, 317 (1977).
[5] F.A. Brieva and J.R. Rook, Nucl. Phys. A **297**, 206 (1978).
[6] N. Nose and K. Kume, Phys. Rev. C **50**, 321 (1994).
[7] P. Descouvemont, Nucl. Phys. A **626**, 647 (1997).
[8] R. Kanungo and C. Samanta, Nucl. Phys. **A617**, 265 (1997).
[9] J.-P. Jeukenne, A. Lejeune, and C. Mahaux, Phys. Rev. C **16**, 80 (1977).
[10] R. Henneck *et al.*, Nucl. Phys. **A571**, 541 (1994);
[11] M. Tosaki *et al.*, RCNP Annual Report 1995.
[12] C.-B. Moon *et al.*, Phys. Lett. **B297**, 39 (1992).