POLARIZED PROTON SCATTERING AT 134 MeV FROM ^{154}Sm and ^{166}Er

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The coupled-channels analysis of the data from the ^{154}Sm(p,p') and ^{166}Er(p,p') reactions at 134 MeV are nearly complete. The angular distributions of cross sections and asymmetries for the 0^+, 2^+, 4^+, and 6^+ ground band states are shown in Figs. 1 to 4. These angular distributions are strongly oscillatory, even for the 6^+ states, and the cross sections decrease rapidly with angle. While the angular distributions for the 2^+ states for these two nuclei are very similar and the 4^+ angular distributions are fairly similar especially beyond 30°, the 6^+ cross sections are quite dissimilar. Not only are the 6^+ cross section distributions out of phase but the magnitude in the case of ^{154}Sm is twice that for ^{166}Er. The asymmetries

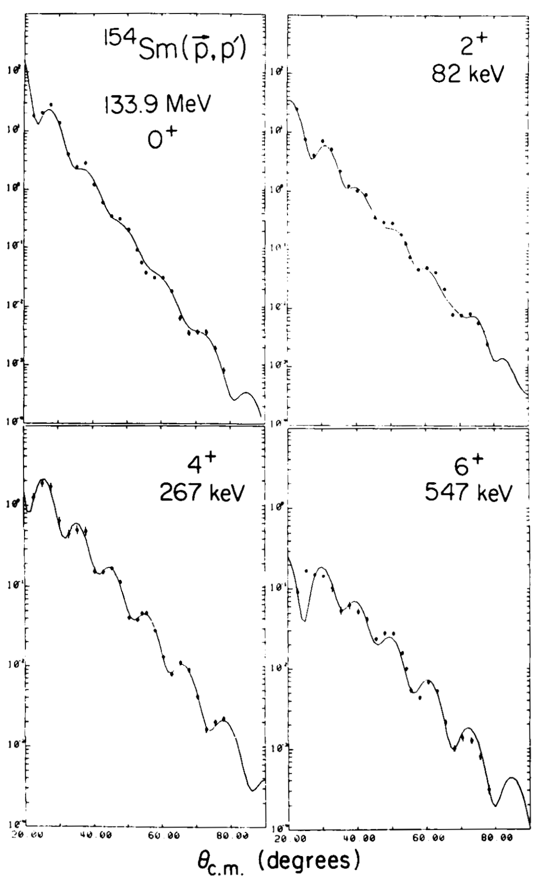

Figure 1. Angular distributions of cross sections for elastic and inelastic excitations of $J^\pi = 0^+$, 2^+, 4^+ and 6^+ ground band states in ^{154}Sm from (p,p') reactions at 134 MeV. The curves are coupled-channels calculations as described in the text.

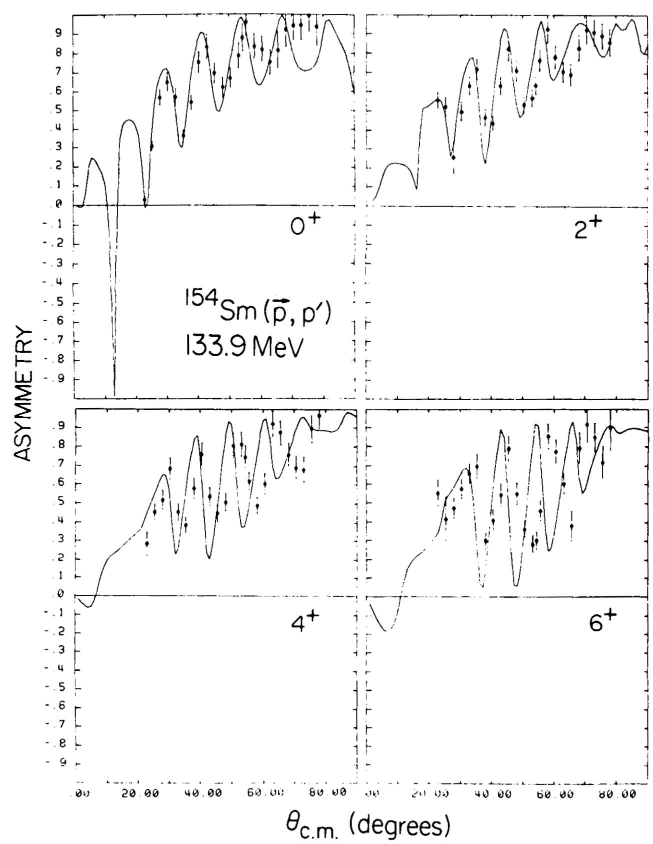

Figure 2. Angular distributions of asymmetries for elastic and inelastic excitations of $J^\pi = 0^+$, 2^+, 4^+ and 6^+ ground band states in ^{154}Sm from (p,p') reactions at 134 MeV. The curves are coupled-channels calculations as described in the text.

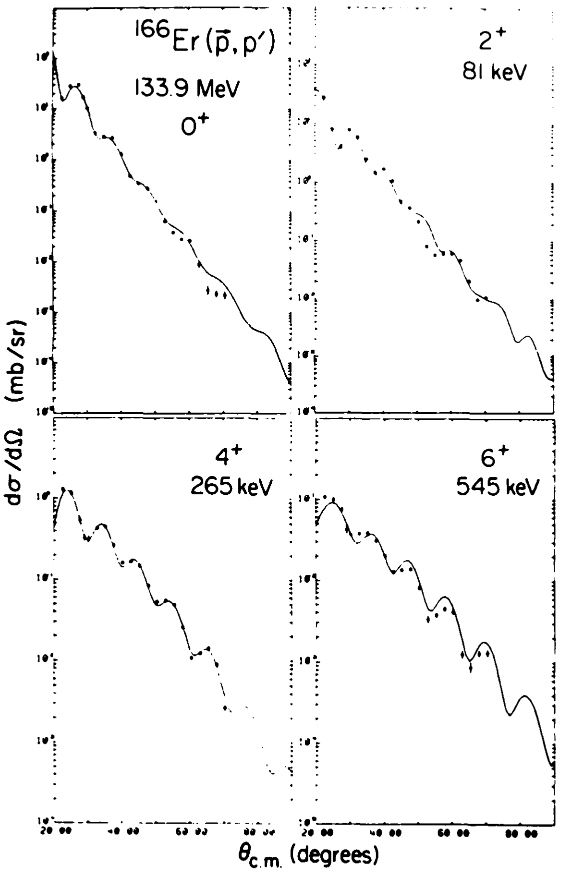

Figure 3. Angular distributions of cross sections for elastic and inelastic excitations of $J^{\pi} = 0^+$, 2^+, 4^+ and 6^+ ground band states in ^{166}Er from (p,p') reactions at 134 MeV. The curves are coupled-channels calculations as described in the text.

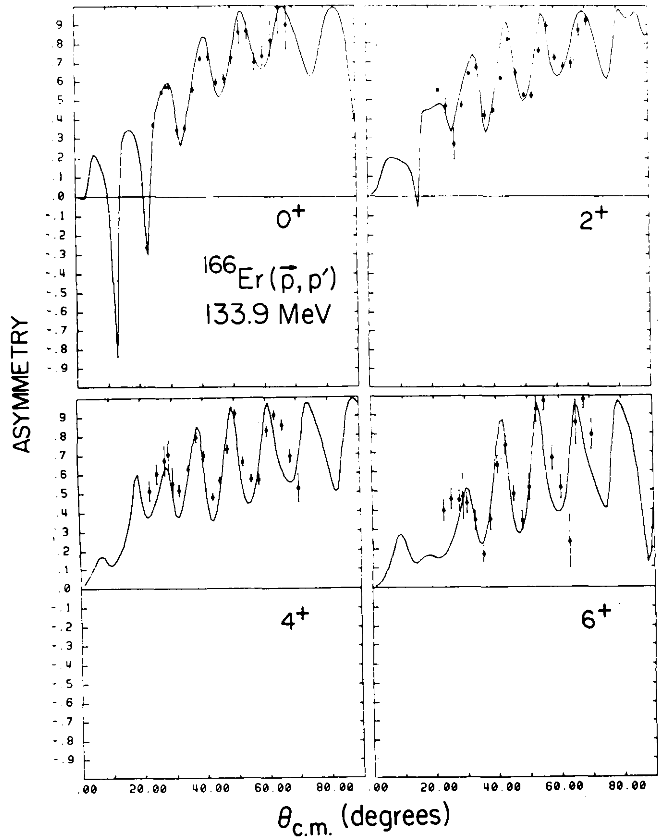

Figure 4. Angular distributions of analyzing power for elastic and inelastic excitations of $J^{\pi} = 0^+$, 2^+, 4^+ and 6^+ ground band states in ^{166}Er from (p,p') reactions at 134 MeV. The curves are coupled-channels calculations as described in the text.

are positive in the angular range measured, and are especially large when compared to proton scattering from lead near this energy.[1]

The data were analyzed using a deformed optical model with the coupled-channels code ECIS[2] which included a deformed full-Thomas spin-orbit term and employed relativistic kinematics. The nuclear potential was assumed to have the standard Woods-Saxon shape with the deformation parameters β_λ introduced in the usual way by replacing real, imaginary, and spin-orbit radii by

$$R(\theta) = r_o A^{1/3} \left(1 + \sum_\lambda \beta_\lambda Y_{\lambda 0}(\theta) \right)$$

All nonzero couplings between the 0^+ through 8^+ states involving β_2, β_4, β_6 deformations were included in the final calculations. Extensive multivariable searches on well depth, diffuseness, and deformation parameters were made. In all calculations we constrained the deformations of the real and imaginary potential terms to be equal. We find somewhat better fits when the spin-orbit deformations are allowed to vary independently. These in general are larger than those of the central term. As shown in Figs. 1-4 the cross sections are well fitted but the asymmetries are not. These show a steady slip of phase between data and calculations with increasing scattering angle and increasing spin.

The values of the central term deformation parameters β_2 and β_4 we find are consistent with those obtained by other methods: for ^{154}Sm, $\beta_2 \approx 0.28$ and $\beta_4 \approx 0.06$, and for ^{166}Er, $\beta_2 \approx 0.28$ and $\beta_4 \approx 0.01$. However, the values of β_6 we find are for ^{154}Sm, $\beta_6 \approx 0.008$, and for ^{166}Er, $\beta_6 = -0.007$. Although these values are consistent with the predictions of Nilsson et al.,[3] the ^{154}Sm result disagrees with earlier alpha scattering results[4] which indicated a value with the same magnitude but opposite sign.

We plan more meaningful comparisons between our results and those from different experiments in terms of a multipole moment analysis.[5] Also we are comparing the cross section angular distributions with those from the analytic eikonal model of Amado and co-workers.[6]

1) P. Schwandt et al., Phys. Rev. C 26, 55 (1982).
2) J. Raynal, unpublished.
3) S.G. Nilsson et al., Nucl. Phys. A131, 1 (1969).
4) D.L. Hendrie et al., Phys. Lett. 26B, 127 (1968).
5) R.S. Mackintosh, Nucl. Phys. A266, 379 (1976).
6) R.D. Amado, J.A. McNeil and D.A. Sparrow, Phys. Rev. C 25, 13 (1982).

THE PRELIMINARY OPTICAL MODEL ANALYSIS OF 200 MeV $\vec{p}$ + ^{9}Be ELASTIC SCATTERING

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The cross section and analyzing power angular distributions have been measured for 200 MeV elastically scattered polarized protons from ^{9}Be. The angular distributions were measured to θ_{cm}=130° which corresponds to a momentum transfer of $q \sim 5.3$ fm^{-1}. The data are displayed in Fig. 1, along with the preliminary results of optical model calculations employing two different parameterizations for the real part of the central potential. A discussion of the data and how the measurements were made are described elsewhere[1] and will not be repeated here. Only the results of the optical model analysis of the data will be reported here.

The optical model calculations were performed using the computer code SNOOPY8.[2] The standard optical model analysis employs the following parameterization to describe the local nucleon-nucleus potential U(r):

$$U(r) = V_R f_R(r) + iW f_W(r) + \lambda_\pi^2 \, [V_{so}\, g_{RSO}(r) + iW_{so}\, g_{WSO}(r)] \, (\vec{L}\cdot\vec{\sigma}) \qquad (1)$$

where

$$f_i(r) = \{1 + \exp[(r - r_i A^{1/3})/a_i]\}^{-1} \qquad (2)$$

and

$$g_j(r) = (1/r)(d/dr)\{1 + \exp[(r - r_j A^{1/3})/a_j]\}^{-1} \qquad (3)$$

The calculations using the single Woods-Saxon parameterization for the central potentials (Eq. 2) and the Thomas form (Eq. 3) for the spin-orbit will be labeled as 'SWS' throughout this discussion.

A second parameterization used in the optical model analysis consists of substituting for the term $V_R f_R(r)$ in Eq. 1 the expression

$$V_R f_R(r) = V_{R1} f_{R1}(r) + V_{R2}[f_{R2}(r)]^n, \; n = 1,2$$

and the central imaginary potential remains unchanged. Calculations using this double Woods-Saxon form with n=2 will be denoted by 'DWS'. This shape modification introduces three new parameters. The motivation for the DWS parameterization is given elsewhere[3] and will not be repeated here.

In this preliminary optical model analysis of the p + ^{9}Be elastic scattering data, the optical model