Proc. Sixth Int. Symp. Polar. Phenom. in Nucl. Phys., Osaka, 1985
J. Phys. Soc. Jpn. 55 (1986) Suppl. p. 682-683

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Structure Study Using $(\vec{d},d)$ and $(\vec{d},d')$ Reactions at 52 MeV

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Measurements of $(\vec{d},d')$ scattering carried out using 56 MeV polarized deuterons[1] indicated possible nuclear structure dependence of the vector analysing powers for the 2^+_1 states in the even-even nuclei. Following this earlier work a more systematic study has now been undertaken for nuclei in the s-d shell.

Measurements of the elastic and inelastic scattering were carried out using 52 MeV vector polarized deuterons from Karlsruhe cyclotron. Solid state ΔE-E counter telescopes were employed in the measurements. The low intensity of the polarized beam, typically around 5 nA, restricted the measurements to the most strongly excited states. Angular distributions of the differential cross-sections, $d\sigma(\theta)/d\Omega$ and of the vector analysing powers, $iT_{11}(\theta)$, were measured for ^{22}Ne, ^{26}Mg, ^{28}Si, ^{32}S, ^{34}S, ^{36}Ar and ^{40}Ar[2]. All data reduction, consisting in extracting around 10000 data points was carried out using computer code LORNA[3]. With the exception of ^{28}Si, all $iT_{11}(\theta)$ distributions for the 2^+_1 first excited states were found to have similar features.

Coupled channels analysis of the data, using ECIS code[4], is in progress. In this paper we present results for ^{26}Mg and ^{28}Si nuclei. An unsuccessful attempt was made to fit the data using potentials from ref.[5]. All four types of potentials listed there failed to reproduce the data for the inelastic scattering. More promising results were obtained using global potential F' of ref.[6]. Each component of this complex potential was studied in detail and the imaginary spin-orbit part was found to play an essential role in the calculations.

Parameter search was carried out for all parameters by fitting all four distributions ($d\sigma(\theta)/d\Omega$ and $iT_{11}(\theta)$ for the ground state and for the first excited, 2^+_1, state) simultaneously assuming either prolate or oblate quadrupole deformations for each target nucleus. Symmetric rotor with quadrupole and hexadecapole deformations was assumed in the calculations. The best fit parameters were found to be close to the values given in ref.[6].

Experimental data and the best fits obtained assuming either prolate or oblate quadrupole deformations are displayed in Fig. 1. The figure demonstrates that there is a marked but not strong preference for the correct shapes with the dependence on the sign of the quadrupole deformation being stronger for ^{28}Si than for ^{26}Mg.

References

1) K. Hatanaka et al., Phys. Rev. Letters 46(1981)15.
2) J. Nurzynski et al., to be published.
3) J. Nurzynski, to be published.
4) J. Raynal, Phys. Rev. C23(1981)2571.
5) G. Mairle et al., Nucl. Phys. A339(1980)61.
6) W. Dahenick, J.D. Childs and Z. Vrcelj, Phys. Rev. C21(1980)2253.

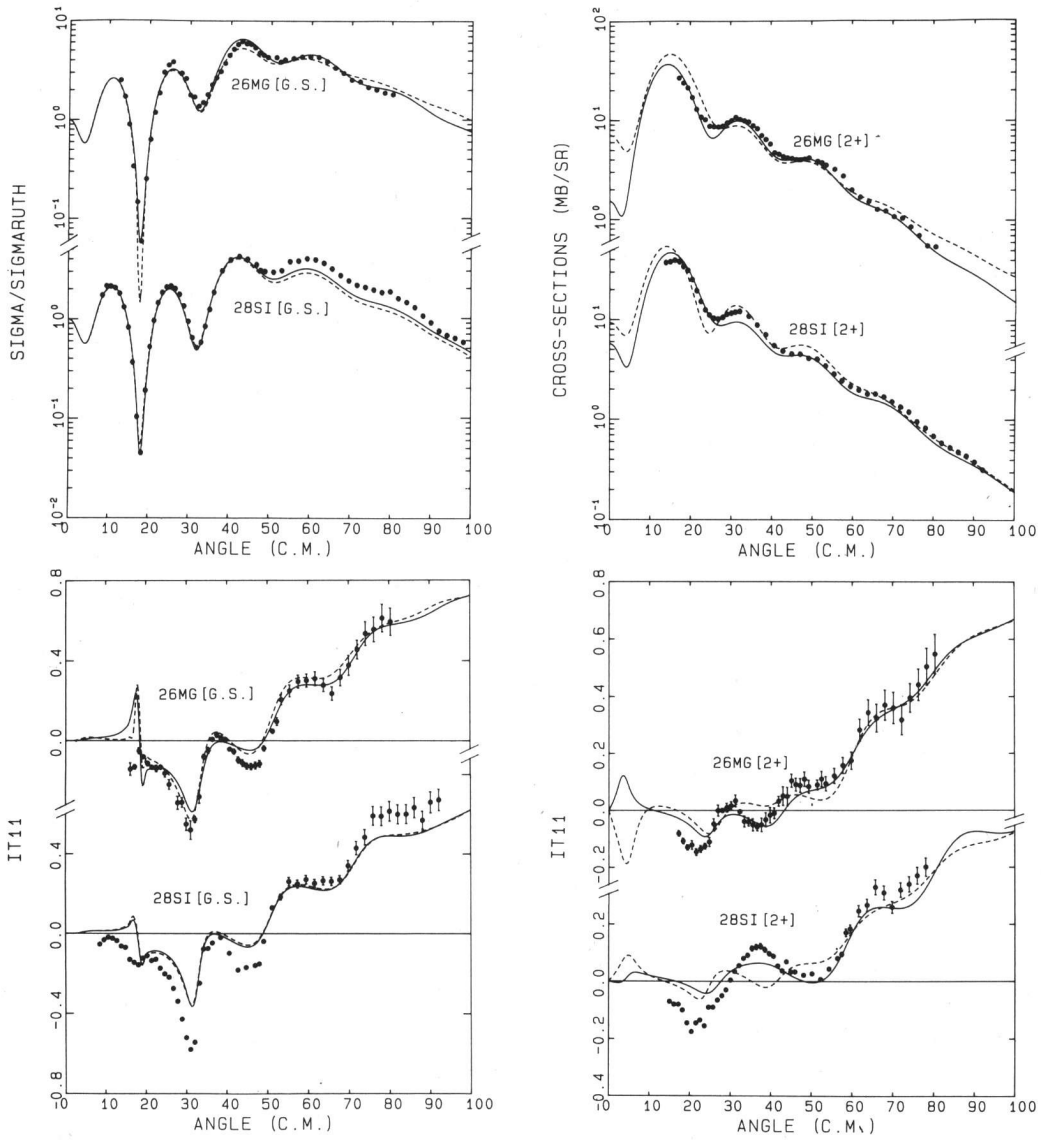

Fig. 1. Differential cross sections and vector analysing powers for $(\vec{d},d)$ and $(\vec{d},d')$ scattering from ^{26}Mg and ^{28}Si at 52 MeV. The solid and dotted lines are the coupled channels predictions obtained using correct (prolate for ^{26}Mg and oblate for ^{28}Si) and reversed quadrupole shapes, respectively. Deformation parameters β_2/β_4, +0.30/-0.03, -0.35/-0.03 (for ^{26}Mg) and ±0.34/+0.08 (for ^{28}Si) were used.