# INELASTIC SCATTERING OF PROTONS ON $F^{19}$ NUCLEI

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A magnetic analysis is performed on 6.6-Mev protons inelastically scattered on $F^{19}$ with the excitation of five levels. The cross sections and angular distributions are measured. Conclusions are drawn regarding the spin, parity, and nature of the levels.

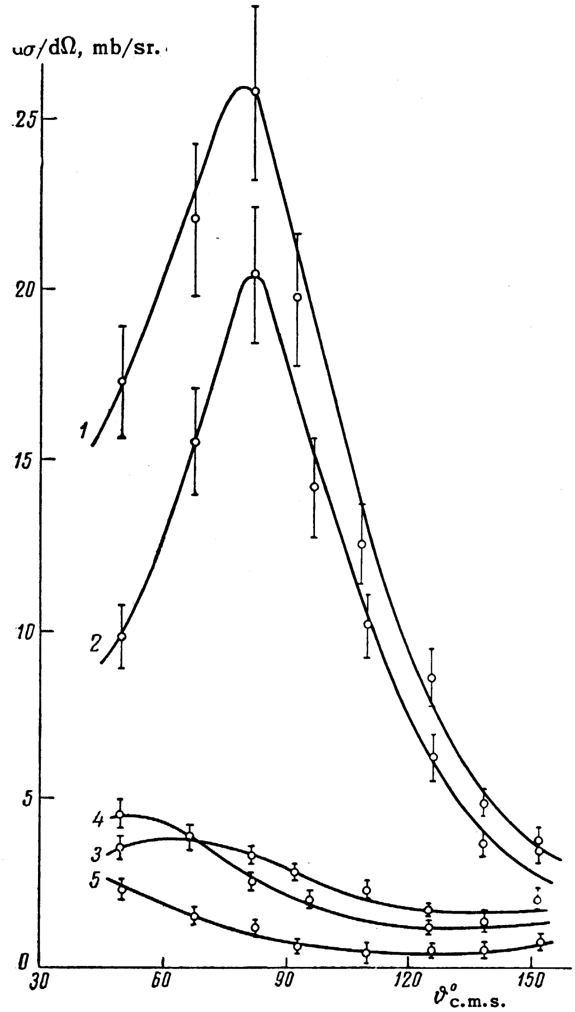
THE $F^{19}$ nucleus has only three nucleons beyond the closed shell of the $O^{16}$ nucleus. We can therefore calculate numerically the properties of $F^{19}$ low-lying levels in the intermediate coupling model of shell theory [1] and also classify the levels within the framework of the nucleon cluster model. [2] On the other hand, three extra nucleons can lead to a pronounced deformation of the nucleus, so that the presence of rotational levels in $F^{19}$ can be expected. [3]

For this reason, a more precise determination of the excited state properties of the $F^{19}$ nucleus is of interest. In the present article we investigate the inelastic scattering of 6.6-Mev protons by $F^{19}$ nuclei. The measurement techniques have been described earlier. [4] The measured angular distributions, which correspond to excitation of the levels at 0.198 ± 0.012, 1.553 ± 0.012, 1.344 ± 0.012, 1.458 ± 0.012, and 2.789 ± 0.006 Mev, are presented in the figure.

All the angular distributions are asymmetric about 90°. The absolute values of the cross sections vary sharply with small changes in the energy of the excited level. The total cross section for excitation of the five $F^{19}$ levels ($\sigma_t \sim 400$ mb) is comparable with the geometric one. The enumerated facts allow us to conclude that the inelastic scattering is, on the whole, due to direct interaction.

In excitation of the 0.198 and 1.553-Mev levels, the transferred orbital angular momentum is $l = 2$, and the possible spin and parity values are in accord with the tables of [5], being respectively $5/2^+$ and $3/2^+$. In the case of excitation of the 1.334 and 1.458-Mev levels, $l = 1$ and our measurements confirm the correct assignment of odd parity to these levels (determined on the basis of data on the decay of $O^{19}$ [6]).

The measured total cross sections for excitation of the 1.344, 1.458, and 2.789-Mev levels are,




Angular distributions of protons ($E_p$ = 6.6 Mev) inelastically scattered on $F^{19}$ with excitation of the following levels: 1 – 0.198 Mev, 2 – 1.553 Mev, 3 – 1.344 Mev, 4 – 1.458 Mev, and 5 – 2.789 Mev.

respectively, 25, 25, and 15 mb. The total cross section for the (p, n) reaction on $F^{19}$ is about 55 mb. [7] On the other hand, the total cross sections for excitation of the 0.198 and 1.553-Mev levels are 180 and 130 mb. The total cross sections for excitation of the 0.198 and 1.553-Mev levels, which are large in comparison with the cross sections for the excitation of other levels as well as with the cross section for the (p, n) reaction on $F^{19}$, indicate the collective nature of these excited states (in accord with Cohen's hypothesis[8]). This conclusion confirms the assumption[3] that the ground state and the 0.198 and 1.553-Mev states belong to one rotational series.

The small cross section for excitation of the 1.344- and 1.458-Mev levels indicates a single-particle mechanism in the excitation of these states. They can be interpreted as "hole" states[9] or as states possessing a nucleon cluster structure which differs from that of the ground state.[2]

In the excitation of the 2.789-Mev level $l = 0$, and consequently the spin and parity are $1/2^+$ or $3/2^+$ and not $7/2^\pm$ or $9/2^\pm$ as assumed earlier.[10] Paul and Rakavy[3] propose that the spin and parity of this level are $9/2^+$, and on this basis conclude that the 2.789-Mev level belongs to the rotational series indicated above. On the basis of our measurements, it seems more probable that the 2.789-Mev excited state has a single-particle nature. The rotational level with spin and parity $9/2^+$ must, it seems, lie higher than 2.789 Mev.

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