[3] M. V. Babykin et al., JETP 43, 1976 (1962), Soviet Phys. JETP 16, 1391 (1963).
[4] M. V. Babykin et al., JETP 46, 511 (1964), Soviet Phys. JETP 19, 349 (1964).
[5] E. K. Zavoiskii, Atomnaya energiya 14, 57 (1963).
[6] S. P. Zagorodnikov et al., JETP 47, 1717 (1964), Soviet Phys. JETP 20, 1154 (1965).
[7] D. G. Bulyginskii et al., JETP 44, 183 (1963). [sic!]

EXCITATION FUNCTION OF THE REACTION $S^{36}(p\gamma)Cl^{37}$ IN THE INTERVAL E_p = 1.4 - 2.1 MeV

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The Cl^{37} nucleus has 20 neutrons and 17 protons and belongs to the group of nuclei with shell 1d2S. The spin and parity $3/2^+$ of the ground state of this nucleus follow from the predictions of the shell model and of the Nilsson scheme, according to which they are determined by the last odd proton on the $1d_{3/2}$ orbit [1]. These predictions of the models do not contradict any experimental facts, but the spin and parity of the ground state of Cl^{37} has not yet been directly determined in an experiment.

Experimental data on the excited levels of Cl^{37} are very scanty. They were obtained in a study of β decay of S^{37} in [2], the results of which were confirmed in [3], after which Stribel [4] determined more accurately the energy of the γ rays accompanying the β decay.

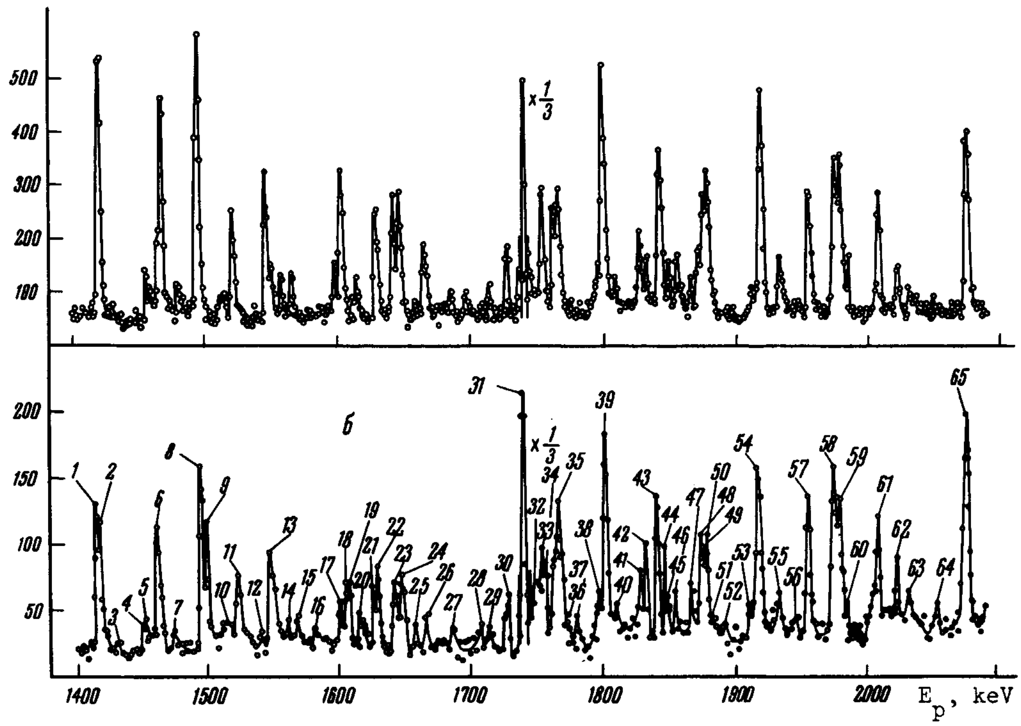
The most accurate and reliable observations of the excited states were made in [5], in a study of the reactions $Cl^{37}(p, p'\gamma)Cl^{37}$. The authors of that paper used protons accelerated to 7 MeV and analyzed the inelastically scattered protons with a magnetic spectrometer. The observed groups of inelastically scattered protons pointed to the existence in Cl^{37} of levels with excitation energies 0.838, 1728, 3.087, and 3.105 MeV. All the energies were determined accurate to ±0.005 MeV.

The same nuclear reaction, but with a target enriched with Cl^{37}, was investigated in [6] in a proton energy interval 4.6 - 5.6 MeV. However, only one Cl^{37} level was observed, with excitation energy 1.73 ± 0.010 MeV.

To obtain new experimental data on the excited states of Cl^{37}, it would be very attractive to use the hitherto unobserved radiative proton capture reaction $S^{36}(p\gamma)Cl^{37}$. The energy released in this reaction is Q_m = 8.401 ± 0.009 MeV. Thus, one could hope to obtain more knowledge with the aid of this reaction on the excited states of Cl^{37}, up to 12 MeV, using protons accelerated to 3.5 MeV.

The present work is an attempt to investigate the $S^{36}(p\gamma)Cl^{37}$ reaction.

Natural sulfur contains only 0.014% S^{36}. Therefore one of the first important methodological problems to be solved was to prepare a thin isotopic S^{36} target sufficiently enriched to make radiative capture of a proton by S^{36} observable. The target was prepared in an electromagnetic separator by knocking S^{36} ions into a tantalum base. The method of preparation of such targets is described in [7]. The target used in our experiments was approximately 3 keV



Excitation function of the reaction $S^{36}(p\gamma)Cl^{37}$. Abscissas - proton energy, ordinates - number of counts.

thick at a proton energy on the order of 2 MeV. The proton source was the 4-MeV electrostatic accelerator of the Physico-technical Institute of the Ukrainian Academy of Sciences, described in [8].

The proton current to the target amounted to 8 - 10 μA during the course of the experiment, and was monitored with a current integrator. The monitor was a 70 x 50 mm NaI(Tl) crystal.

The measured excitation function of the reaction $S^{36}(p\gamma)Cl^{37}$, in the incoming-proton energy interval 1.4 - 2.1 MeV, is shown in the Figure. The measurements were made at 90° to the proton beam. Figure a corresponds to the case when the monitor registered γ rays with energy $E_\gamma \geq 7.5$ MeV, and Fig. b corresponds to the case when the monitor registered γ rays with energy equal to the excitation energy of Cl^{37}.

From a comparison of a and b we are justified in stating that the resonances observed by us correspond to the Cl^{37} resonance levels produced in the reaction $S^{36}(p\gamma)Cl^{37}$. The Table lists the positions of the resonances and the corresponding excitation energies of the Cl^{37} nucleus.

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Res. No.	E_p MeV	E_{exc} MeV	Res No.	E_p MeV	E_{exc} MeV	Res No.	E_p, MeV	E_{exc} MeV
1	1.421	9.783	23	1.646	10.002	45	1.854	10.205
2	1.424	9.786	24	1.652	10.008	46	1.860	10.211
3	1.437	9.799	25	1.662	10.018	47	1.872	10.222
4	1.456	9.818	26	1.670	10.026	48	1.879	10.229
5	1.459	9.821	27	1.690	10.045	49	1.881	10.231
6	1.468	9.829	28	1.712	10.067	50	1.883	10.233
7	1.481	9.842	29	1.718	10.072	51	1.889	10.239
8	1.499	9.859	30	1.734	10.088	52	1.898	10.248
9	1.503	9.863	31	1.744	10.098	53	1,916	10.265
10	1.519	9.879	32	1.753	10.106	54	1,921	10.270
11	1.527	9.887	33	1.759	10.112	55	1.938	10.286
12	1.545	9.904	34	1.761	10.114	56	1.950	10,298
13	1.551	9.910	35	1.771	10.124	57	1.959	10.307
14	1.565	9.924	36	1.778	10.131	58	1.979	10.326
15	1.573	9.931	37	1.785	10.138	59	1.983	10.330
16	1.585	9.943	38	1.802	10.154	60	1.990	10.337
17	1.605	9.963	39	1.806	10.158	61	2.014	10.360
18	1.609	9.966	40	1.816	10.168	62	2.030	10.376
19	1.612	9.969	41	1.834	10.185	63	2.038	10.384
20	1.620	9.977	42	1.838	10.189	64	2.061	10.406
21	1.630	9.987	43	1.846	10.197	65	2.083	10.428
22	1.633	9.990	44	1.852	10.203			

Remark. E_p - proton energy, E_{exc} - excitation energy. The proton energy is accurate to 0.15%.

[1] Gonchar, Inopin, and Tsytko, Legkie yadra i obobshchennaya model' (Light Nuclei and the Unified Model), FTI AN USSR (Offset), Khar'kov, 1959.

[2] E. Bleuler and W. Zunti, Helv. Phys. Acta 19, 137 (1946).

[3] H. Morinaga and E. Bleuler, Bull. Amer. Phys. Soc. 1, 30 (1956).

[4] Th. Stribel, Z. Naturforsch. 11a, 254 (2) (1956).

[5] Enge, Angleman, and Jarrell, M.I.Tμ Laboratory for Nuclear Science Progress Report, May 31, 118, 1956.

[6] Schiffer, Gossett, and Young, Phys. Rev. 103, 134 (1956).

[7] M. I. Guseva, PTE no. 5, 112 (1952).

[8] A. K. Val'ter and A. A. Tsygikalo, PTE no. 4, 3 (1957).

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