Substance	ν = 542	ν = 296	ν = 146
$FeNH_4(SO_4)_2 \cdot H_2O$	450 Oe	220 Oe	Not resolved
$Fe_2(SO_4)_3 \cdot 3H_2O$	300 „	160 „	„ „
Mn $(CO_2CH_3)_2$	320 „	200 „	„ „
$CuCl_2$	400 „	200 „	90 Oe

above, quite narrow resonance curves of $\chi''(H_\perp)$ are observed at 542 Mcs in perpendicular fields. This indicates the presence of incomplete exchange interaction between the ions. In such substances the spin-spin absorption depends very little on the field intensity $H_{||}$; therefore the absorption observed by us, at sufficiently low values of $H_{||}$, is due only to second relaxation in the spin system.

In the frequency range 600 to 150 Mcs in Cr_2O_3, CuO, and Nd_2O_3,[1] we have succeeded in detecting absorption at T = 90°K and 295°K both in perpendicular and in parallel fields. In these oxides, the absorption decreases monotonically with increase of the field $H_{||}$. The half-widths $\Delta H_{||}$ and $\Delta H_\perp$ become narrower with decrease of frequency and with rise of temperature.

Apparently the absorption observed by us in oxides and anhydrous salts is due to relaxation between two antiferromagnetic sublattices, which are partly preserved even above the Curie temperature in these substances. At frequency 10,000 Mcs in Cr_2O_3 and CuO, no paramagnetic resonance absorption below the Curie point has been observed.[11] Furthermore, second relaxation is also observed upon partial dilution of hydrated paramagnetic salts with diamagnetic ones. No second relaxation was detected in the interval 90 to 300°K in substances with strong exchange ($CuCl_2 \cdot 2H_2O$, $Fe_2(SO_4)_3$, $Mn(SO_4)_2$, in free radicals, and in alkaline metals), in liquid solutions of paramagnetics, and in vitreous systems. Apparently, in all these substances there is a single spin system.

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[*] In $CuCl_2$ at T = 90°K, there is a phase transition; consequently the absorption both in parallel and in perpendicular fields changes.

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FISSION CROSS SECTION OF Pu^{240} *BY FAST NEUTRONS*

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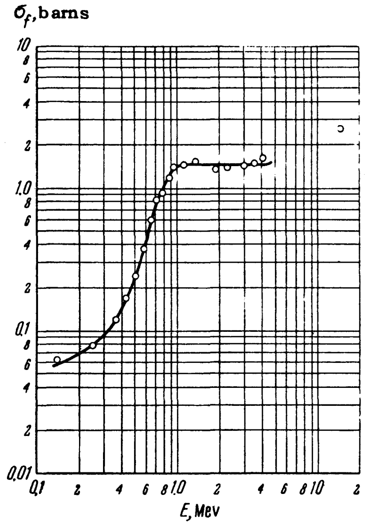
ALL that is known from published data on the cross section for the fission of Pu^{240} by fast neutrons is that its plateau amounts to 1.4 to 1.6 barns[1,2] and that the threshold of the (n, f) reaction is in the neutron-energy interval from 250 to 900 kev.[1]

In the present work we measured the fission cross section of Pu^{240} relative to the fission cross section of Pu^{239}, using a double ionization chamber. Layers of Pu^{240} (2.5 mg) and Pu^{239} (4 mg), 5 centimeters in diameter, were deposited on a common high-voltage electrode and were consequently located in an identical neutron flux. The collecting electrodes were hemispheres of 14 cm diameter. Electrodes of this shape, along with the use of a working gas mixture of 90% Ar + 10% CO_2 at a pressure of 35 mm Hg, made it possible to separate reliably the fission fragments from the α particles.

The Pu^{239} layer contained Pu^{240} impurities amounting to 1.80 ± 0.05%, while the concentration of Pu^{239} in the Pu^{240} specimen amounted to 7.7 ± 0.5%. The Pu^{241} content was negligibly small in the first layer and less than 0.2% in the second one. The source of fast neutrons of energy < 2 Mev was the $T(p, n)He^3$ reaction, those from 2 to 4 Mev were obtained from the $D(d, n)He^3$ reaction, and those with energies of 15 Mev from the $T(d, n)He^4$ reaction. The first reaction was produced in a van de Graaf generator, and the remaining two in a cascade generator. The fissions were counted in the two halves of the chamber both by fast and by thermal neutrons. Measurements with thermal neutrons are essential to determine the ratio of the effective amounts of fissionable matter in the chambers. Thermal neutrons were obtained by moderating fast neutrons in a paraffin block. The cadmium-difference method was used to exclude the influence of resonant neutrons and of fast neutrons passing through the paraffin. An experimental check disclosed practically no screening of one layer by the other.

To determine the absolute value of the Pu^{240} fission cross section, we used the energy dependence of the Pu^{239} fission cross section, obtained by averaging the data of our latest investigations. The energy dependence of the Pu^{240} fission cross section is shown in the diagram.



The Pu^{240} fission cross section is 1.50 ± 0.15 barns at the plateau and agrees with the results obtained by Dorofeev and Dobrynin[1] by measurements with neutrons from a Ra-Be source (1.40 ± 0.15 barns). The fission cross section obtained for 15-Mev neutrons was 2.6 ± 0.2 barns.

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DIAMAGNETISM AND INTERATOMIC BONDS IN MOLECULES AND NON-METALLIC CRYSTALS

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THE majority of magnetic investigations of diamagnetic substances has remained up to now practically useless for a study of the nature of interatomic binding forces. The method suggested by us to treat diamagnetism[1] enables one to approach this problem anew. In the present note we intend to show some possibilities and perpectives of this method in an application to diamagnetic molecules and non-metallic crystals.

It is known that the diamagnetic susceptibility χ of molecules and non-metallic bodies, which is experimentally measured, can theoretically be written in the form[2]

$$\chi = \chi_d + \chi_p = -(Ne^2/6mc^2)\sum \overline{r_i^2} + 2N\sum |(n|\mu_z|0)|^2/(E_n - E_0). \quad (1)$$

Although the terms χ_d and χ_p are individually not invariant with respect to a transformation of the origin of coordinates, only their sum being invariant, they take on a unique physical meaning, if we take for each electron the center of gravity of the corresponding electron shell as the origin. The Langevin component χ_d depends only on the dimensions of the electron shells. The Van Vleck component χ_p, on the other hand, depends on the symmetry type of these shells and on their deformability; for atoms and spherically-symmetric shells $\chi_p = 0$. In this way χ_p can be used as a source of interesting information about the structure of the electron shells.

Since there is no method to split χ experimentally into χ_d and χ_p an estimate of χ_p can only be performed by means of comparing χ_d with χ, if there is a reliable method to determine χ_d independently for each given substance. Kirkwood[3]