This value permits an estimate of the induced fission rate assuming 2×10^{-24} cm^2 for the fission cross section of normal isotopic uranium. In a mass of 36.4 g of the metal the number of induced fissions per day will be approximately:

$$20.1\times9.25\times10^{22}\times2\times10^{-24}=3.71.$$

If each fission releases between 1 and 3 fast neutrons, about 4 to 11 fast neutrons will be generated in the test mass of uranium per day of exposure. Since the plate records one track for each 460 fast neutrons, the correction seems too small for consideration.

Neutron yield from Sm-alpha-particles interaction with Be^9.—The average cross section of the $Be^9(\alpha,n)C^{12}$ reaction was approximated from the relationship $\sigma=\pi R^2\bar{G}$. The average Gamow factor $\bar{G}$ for alpha-particle energies between 2.1 and 0 Mev is estimated at 0.067 using the Mattauch and Fluegge tables.

$$\sigma=\pi(2\times10^{-13}Z^{\frac{1}{3}})^2\times0.067=0.021\times10^{-24}\text{ cm}^2.$$

The 18.6 g Sm_2O_3 emit:

$$18.6\times\frac{300}{348}\times89\times3600\times24=1.23\times10^8\text{ alpha-particles per day.}$$

The differential count between Experiments D and $E=92-63=29$ boron tracks per cc per day corresponds to the emission of $29\times460=13.3\times10^3$ fast neutrons. If these be attributed to (α,n) on Be^9, the number of the latter must be:

$$\frac{13.3\times10^3}{0.021\times10^{-24}\times1.23\times10^8}=5.16\times10^{21}\text{ Be}^9\text{ atoms in 18.6 g of }Sm_2O_3$$

equivalent to a concentration of 0.37 percent Be or 1 percent BeO.

It is unlikely that our Sm_2O_3 pellet contains as much as 1 percent BeO. However, the additive effect of traces of Be, B, Mg, and Al may contribute in part to the observed neutron emission.

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Nuclear Spin and Quadrupole Coupling of S^{35}*

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THE rotational absorption transition $J=1\rightarrow2$ of carbonyl sulfide, OCS, containing S^{35} has been observed at 23461 ± 5 mc/sec. This frequency agrees with the value calculated from bond distances and isotopic masses given in the literature, and directly from interpolation of the published frequencies of $O^{16}C^{12}S^{32}$, $O^{16}C^{12}S^{33}$, $O^{16}C^{12}S^{34}$, and $O^{16}C^{12}S^{36}$.[1-3]

Complete resolution of the spectrum was not attained. However, sufficient resolution of groups of hyperfine components was realized to permit a determination of the spin of S^{35}, the sign of the quadrupole coupling and an estimate of the magnitude of the coupling constant.

A typical record of the $J=1\rightarrow2$ transition with its associated hyperfine and Stark structure is shown in Fig. 1. Immediately below the experimental curve is the theoretical hyperfine structure pattern expected for a nuclear spin of $\frac{3}{2}$. All Stark components give negative deflections due to the properties of the phase-sensitive detector used. Comparison of our experimental results with theoretical patterns that would be expected for higher nuclear spins[3] indicates that our results are not compatible with any spin value other than $\frac{3}{2}$. The frequency separation between the strong central components and the weaker components are 5.0 and 3.8 mc/sec., with the larger frequency separation on the high frequency side of the central components. The ratio of these

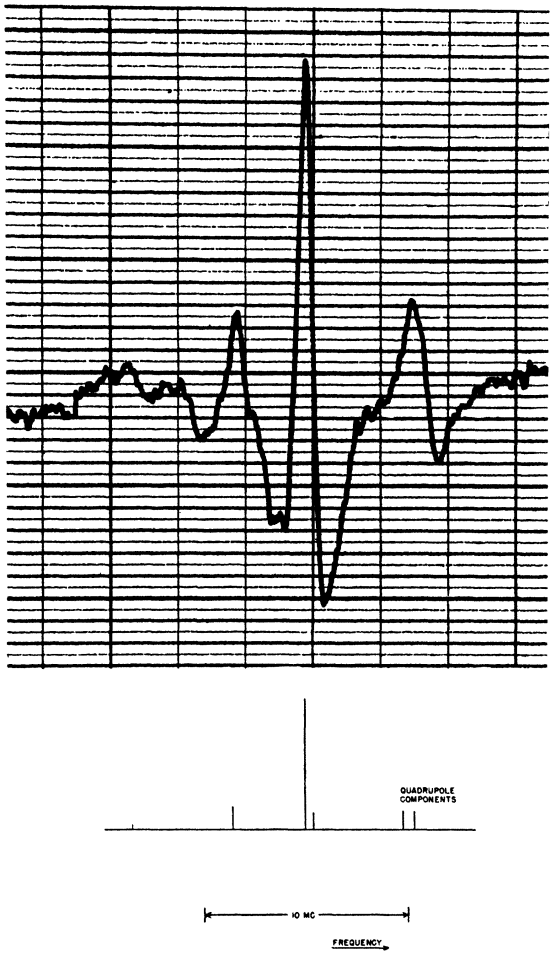

FIG. 1. *Above*: the experimental curve showing the partially resolved spectrum of COS^{35}. *Below*: the theoretical pattern calculated for a spin of 3/2 for S^{35}.

separations is approximately 1.3, which agrees within our experimental error with the theoretical value of 1.43 for a spin of $\frac{3}{2}$. Comparison of our curves obtained from S^{35} and S^{33} which also has a spin of $\frac{3}{2}$ show that the patterns are mirror images, indicating that the quadrupole moment in S^{35} is positive, or opposite in sign to that of S^{33}. We have estimated the electric quadrupole coupling constant eqQ[4,5] as $+20\pm4$ mc/sec. The corresponding value of S^{33} in OCS is -28.5 ± 0.7 mc/sec.

The principal error in the quadrupole interaction was due to the absolute error in determining the dispersion of the recorded spectrum. This was measured with a wave meter at many points, and compared with the observed, know spectra of COS^{33} and the Stark pattern of COS^{34}.

The detection system was a Stark modulation spectroscope operating at 100 kc/sec. and used a phase-sensitive or "lock-in" detector which drove an ink recorder. The 2K33 Klystron used was swept in frequency by a low speed mechanical drive operated by a synchronous motor. The absorption cell, cooled by dry ice, was 14 feet of K-band wave guide in which the Stark electrode was supported by quartz spacers.

The frequency of the central component was measured with a wave meter.

The OCS^{35} was prepared from H_2SO_4 obtained from Oak Ridge. The ratio of S^{35} to S^{32} at the time of use was about 0.004 and because of gaseous impurities the concentration of the OCS^{35}

used was about 0.1 percent. The pressure in the absorption cell was approximately 70 microns and the total number of COS^{35} molecules was of the order of 3×10^{15}.

* Work performed at Brookhaven National Laboratory under contract with the AEC.
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Confirmation of Cl^{39} Activity

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In an attempt to discover the activity of the isotope A^{39}, pure argon was irradiated by the University of Saskatchewan betatron, at a pressure of 10 atmospheres and at a betatron energy of 23 Mev. The irradiated gas was then allowed to expand into a counting chamber surrounding a thin-walled beta-counter. An activity of half-life of about 110 minutes was present, due to A^{41}. It was noticed however, that the apparent half-life of this activity was always less than the expected 110 minutes[1] and varied considerably from run to run. It was surmised that this deviation was caused by the presence of an activity of somewhat similar half-life which might be due to A^{39} or Cl^{39}. A plug of glass wool saturated with antimony powder was introduced into the tube connecting the irradiation and counting chambers to absorb any chlorine present. The activity measured in the counting chamber, and thus due to the filtered argon, was then found to have a half-life of exactly 110 minutes, and the glass wool-antimony filter carried a β^--activity of 55.5 ± 0.2 minutes (curve *A*, Fig. 1). This is ascribed to the isotope Cl^{39} produced in the reaction $A^{40}(\gamma,p)Cl^{39}$. This isotope is listed in the table of Seaborg and Perlman[2] as having a half-life of one hour. This result is based on unpublished data.

A careful chemical separation confirmed the assignment of the activity to a chlorine isotope.

A greatly increased count is obtained by washing the glass wool filter and the inside of the brass irradiation chamber with dilute HCl, precipitating with $AgNO_3$ and filtering out the active AgCl precipitate. When this is done, there is evidence of a long period activity which may be due to A^{39} formed by the disintegration of Cl^{39} (curve *B*). At present the evidence is not conclusive and further work is in progress to test this assumption, and, if it is valid, to measure the half-life of A^{39}. However, it appears certain that the 4-minute activity ascribed to A^{39} in the above-mentioned table[2,3] and given an *F* rating does not occur. Such an activity would easily have been detected in our experiments, for in general the cross section for a (γ,n) reaction is greater than that for the (γ,p) reaction in the same isotope.

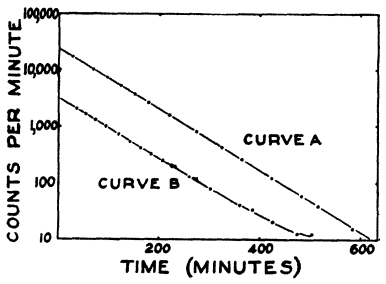

FIG. 1. Decay curve of Cl^{39}. Half-life—55.5 m.

Aluminum absorption curves show that if only one β^- is present in the Cl^{39} decay, it has an energy of 2.5 Mev. A more exact analysis is in progress to determine the disintegration scheme of this isotope.

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Detection of X-Ray Quanta by a Cadmium Sulphide Crystal Counter

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We have observed voltage pulses of the order of 50 μvolts from a CdS crystal irradiated with 0.5A x-rays.

A single crystal of CdS 7×10^{-3} cm thick with flat faces of 1 mm^2 area was prepared for use as a counter by applying Aquadag coatings to opposite faces and attaching a fine copper wire to each coating. The crystal was inserted in a metal tube so that it was located directly behind an end window of 5×10^{-4} cm silver foil. The other end of the tube was fastened to the can containing the first stage of amplification. One lead was attached to the input grid and the other to a 21 v battery which supplied the voltage across the crystal.

The circuit diagram of the first preamplifier is shown in Fig. 1. The voltage pulses were amplified further by a commercial pre-amplifier and linear amplifier[1] and the amplified pulses were fed to a discriminator and scaler.[2] The system was calibrated with step function input pulses over the region from 20 to 500 microvolts. The background level under operating conditions was such that approximately two counts/minute were observed of amplitude greater than 20 microvolts. The input capacity of the first stage plus crystal was found to be 8 $\mu\mu$f.

The crystal was inserted in a beam of x-rays from a molybdenum target x-ray tube operated at 20 ma and 45 kv peak voltage, self-rectified. Pulses were obtained of amplitudes up to 68 microvolts. Absorption curves were taken by inserting aluminum absorbers in the beam, and yielded the familiar concave upward plot for heterochromatic radiation. (Fig. 2.)

At higher intensities, corresponding to counting rates in excess of 10^6 per minute, a direct current through the crystal was detected. This current was measured by placing a microammeter in the plate lead to the first amplifier tube. The plate current was known as a function of grid voltage from a previous calibration, so a reading of the plate current yielded the grid voltage and hence the current through the grid resistor. A plot of change in crystal current *vs.* absorber thickness yielded a logarithmic plot of approximately the same slope as the one obtained by counting.

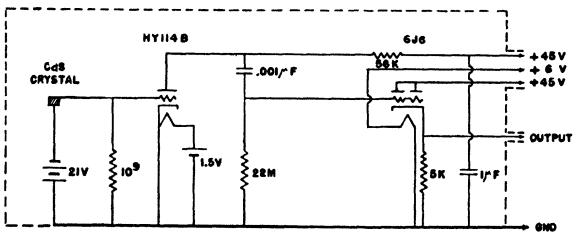

FIG. 1. First pre-amplifier schematic and counter.