The disorder scattering arising from magnetic effects would be negligible even if the atomic spins were oriented at random, and this is, of course, not the case since both temperatures are below the Curie point.

We accordingly obtain the inelastic scattering by subtracting the other two contributions to the total cross section; it is shown in Fig. 2 as a percentage of $S=10.2$ barns. The value of S is determined from the amorphous scattering cross section ($\sigma=4\pi\Sigma_r p_r a_r^2$) by means of the relation $\sigma=S+s$, taking[2] σ as 11.0 barns.

The rather large nuclear capture (approximately $\frac{3}{4}$ of the total cross section) makes it difficult to obtain really accurate values, but the experiment so far shows that the inelastic scattering is rather more than the theory predicts, and perhaps has a different energy dependence in this region.

The discrepancies are probably caused by departures from the Debye spectrum, which are, of course, to be expected.[4-6] More accurate experimental data should indicate quantitatively the modifications required, since by varying the temperature and neutron wave-length it is possible to weight the contributions from different parts of the spectrum.

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Fading of the Latent Image in Nuclear Emulsions

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RECENTLY Yagoda and Kaplan[1] reported that the latent image produced by alpha-particles in an emulsion with a high percentage of silver halide fades with time. Qualitatively, our results confirm this work, and it seems appropriate we publish this confirmation of the phenomena because a different technique was employed.

Eastman NTA plates (emulsion No. 359938) were irradiated identically with Po^{210} alpha-particles. Some of these were developed immediately as controls and the remainder were stored at 0°C, 20°C, and 40°C. Plates were developed after delays of 5, 12, 20, 29, and 46 days; these were examined after development with a microscope using normal illumination and the number of tracks (about 200 per plate) counted. The fractional loss in numbers of tracks was computed

$$(N\ \text{control} - N\ \text{counted})/N\ \text{control},$$

and Fig. 1 is a plot of this as a function of the period of delayed development. It is believed this increase is due to the fading of the tracks. Only the longer period trends are deemed to be real, and the deviation from these trends may be accounted for by the inherent subjective errors of visual counting.

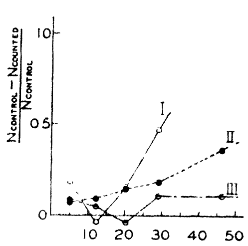

FIG. 1. Period of delayed development in days.

Experiments are under way to see if there is a significant difference between the rate of fading of the tracks of other highly ionizing particles and that of images produced by visible light.

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Wide Range Frequency Modulation*

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THE cyclotron frequency-modulation systems, so far proposed, utilize mechanical variation of capacity. This capacity is most effective when placed at the leading edge of the dee. In this position, however, many difficulties are introduced. A system has been developed at the Radiation Laboratory, in which the variable capacitor is outside the magnetic field.[1] Tests made with a one-half scale model of the proposed system for the 184-inch cyclotron show that a frequency range of 2.4 to 1 can be covered continuously. This range can be shifted approximately 10 percent by addition of fixed inductance or capacity. Since the frequency ranges required for protons and deuterons in the 184-inch magnetic field are 22.9 to 15.8 megacycles, and 11.5 to 9.8 megacycles, respectively, it seems that the cyclotron can accelerate either type of ion by making minor adjustments, or possibly both ions at once if so desired. Recent measurements on the 184-inch cyclotron indicate that the required frequency range need be only a few percent greater than the theoretical range, and also the shape of the frequency time curve is not critical.

A schematic diagram is shown in Fig. 1(a). It resembles the arrangement used on the Berkeley 37-inch and 184-inch cyclotrons in which the dee and rotary capacitor are joined by a transmission line and form an electrical half-wave system.[2] In the new system the capacitor is grounded, not directly, but through a large rectangular cross-section line, somewhat less than a $\frac{1}{4}$ wave-length at the upper frequency limit. The lower frequency limit is now greatly extended, since the capacitor and transmission line eventually pass through series resonance. The voltage distributions corresponding to f, $\frac{3}{4}f$, $\frac{1}{2}f$, and $\frac{2}{5}f$ are shown in Fig. 1(b) for the expected condition where the minimum ca-

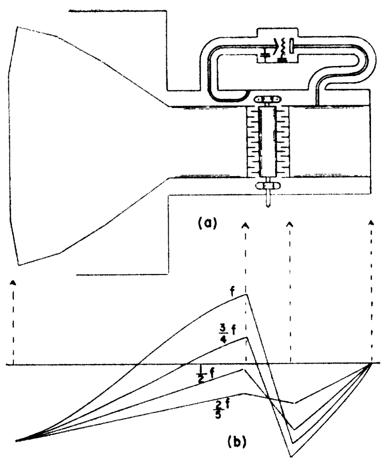

FIG. 1.

pacity of the condenser is one-half the effective dee capacity.

The condenser consists of a rotor with six rows of teeth, approximately 50 teeth per row, which mesh with two stator rows. The rotor is held on a high inductance frame, which reduces the frequency range slightly, but provides a rigid support. The final maximum and minimum capacities will probably be around 2500$\mu\mu$fd and 100$\mu\mu$fd.

Power is supplied by two grounded grid 9C21 tubes, coupled to the system by transmission lines as shown in Fig. 1. There are three fundamental modes, but with this coupling scheme the two undesired modes will produce voltages at the tubes with the wrong phase relation. Phase shift between filament and plate r-f voltages (in the correct mode) is controlled by a condenser between filament and grid. Amplitude modulation throughout either the proton or deuteron ranges can be held to about 20 percent by choosing the correct lengths and impedances of the plate and filament lines and the large cross-section line from the rotary condenser to ground. Peak power will be around 200 kw, but it is planned to pulse the oscillator over only the needed range. Dimensions have been determined from the model with a fair degree of accuracy, and engineering drawings for the 184-inch installation are now well under way.

* This paper is based on work performed under Contract No. W-7405-eng-48B, with the Atomic Energy Commission in connection with the Radiation Laboratory of the University of California, Berkeley, California.
** Present location.
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Energy of the Be^7 Gamma-Ray

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WHEN Li is irradiated by deuterons, a radioactive Be^7 is formed according to the reaction $Li^6(d,n)Be^7$, which has a half-life of approximately 43 days. This isotope decays by K-capture to Li^7, either directly to the ground state or to an excited state with the subsequent emission of a gamma-ray. The energy of this gamma-ray has been measured by several investigators who give values for the energy lying between 453 kev and 485 kev, each author giving his estimated error in the neighborhood of 10 kev. The results obtained by the various authors and the methods used are shown in Table I.

In addition the energy of the excited state of Li^7 has been determined by studying the reactions $Li^6(d,p)Li^7$, $B^{10}(n,\alpha)Li^7$, and $Be^9(d,\alpha)Li^7$.[1] A study of these reactions showed that there were two groups of protons from the first reaction, and two groups of alpha-particles in the second two reactions. From a measurement of the energies these two groups of particles, from any of the three reactions, the energy of the excited state of Li^7 can be determined. The results of these determinations are also given in Table I.

Since the magnetic lens determinations by Siegbahn and Rubin show considerable disagreement, we have made another determination of the energy of this gamma-ray using a magnetic lens. Be^7 was produced in the Indiana University cyclotron by bombarding lithium for 500 microampere-hours with 11.5-Mev deuterons. The chemi-

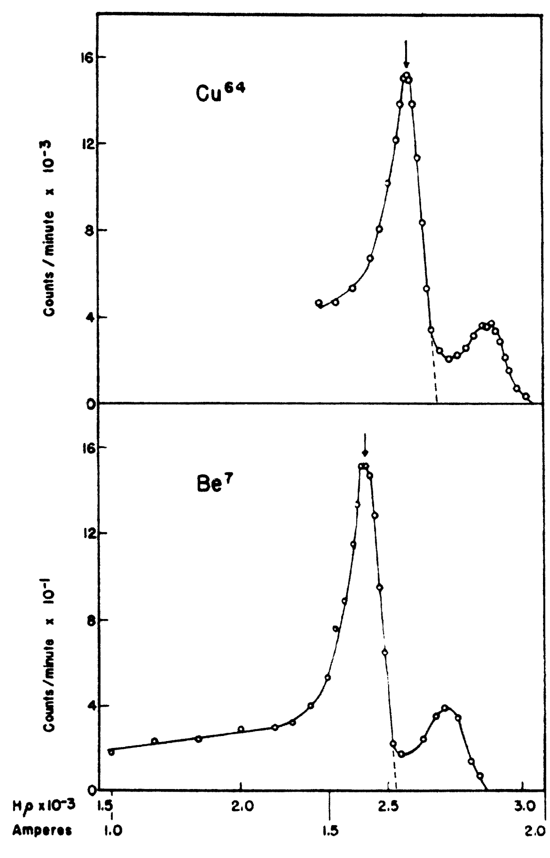

FIG. 1.