parallelism of the planes of polarization requires the latter situation. If the bending of the lines of force in a vibration is to be less than 0.2 radians, then it follows from Alfvén's formulas[9] that the connection between the magnetic field and the maximum transverse velocity of the material, v_t, is

$$B > 5v_t(4\pi\rho)^{\frac{1}{2}} \text{ gauss}, \tag{1}$$

where ρ is the density of the interstellar medium. Now v_t is $2^{\frac{1}{2}}$ times the root mean square transverse velocity and is 2 times the root mean square component along the line of sight, which may be taken to be $7\frac{1}{2}$ km/sec on the basis of Adams' measurements[10] of the velocities of discrete clouds of atoms producing the multiple interstellar absorption lines. Thus, take as typical $v_t = 1.5 \times 10^6$ cm/sec and $\rho \geqslant 10^{-23}$ g/cm^3 for the clouds of matter producing the lines and those producing the polarization. Then Eq. (1) gives $B \geqslant 10^{-4}$ gauss. Some additional support for such a large value of the magnetic field is given by the fact that in order to explain the observed interstellar polarization Spitzer and Tukey require slightly stronger fields in their detailed theory, while Davis and Greenstein require a field whose minimum value is nearly this large.

The existence of fields of this strength and their dominance over the motion of the interstellar matter indicates that the concept of isotropic turbulence may not apply to the interstellar gas.[8] The various theories of the origin of cosmic rays may also require modification if such field strengths are established.

Many interesting and most helpful discussions with Professor J. L. Greenstein are gratefully acknowledged.

[1] W. A. Hiltner, Science 109, 165 (1949).
[2] J. S. Hall, Science 109, 166 (1949).
[3] J. S. Hall and A. H. Mikesell, Pub. U. S. Naval Obs. 17, Part 1 (1950), see Figs. 4 to 7.
[4] L. Spitzer and J. W. Tukey, Science 109, 461 (1949); Astrophys. J., to be published.
[5] L. Davis and J. L. Greenstein, Phys. Rev. 75, 1605 (1949).
[6] H. Alfvén, *Cosmical Electrodynamics* (Oxford University Press, 1950).
[7] E. Fermi, Phys. Rev. 75, 1169 (1949).
[8] A. Schlüter and L. Biermann, Z. Naturforsch. 5a, 237 (1950).
[9] Reference 6, p. 80.
[10] W. S. Adams, Astrophys. J. 97, 105 (1943).

Scintillation Pulse Sizes of Solid Noncrystalline-Type Phosphors

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SINCE the initial report[1] on the solid noncrystalline-type phosphor, a more careful investigation of the relative pulse sizes from these scintillation materials under different types of radiation has been made. The solid phosphors are prepared by method (2) as given in reference 1. For some applications where large light pulses are not required, the plastic phosphor offers several advantages.

Measurements have been made using a Jordan-Bell type amplifier with a 0.2-μsec rise time. Data were taken utilizing three different photo-multiplier tubes: RCA 5819, 1P21, and 1P28 at fixed tube voltages and at room temperature. All samples studied were 5 mm thick. Integral bias curves were obtained and then analyzed to give average pulse sizes. Here the average pulse height results are proportional to the area under the integral bias curves divided by the extrapolated counting rates. Table I summarizes some representative values obtained in this fashion using several of each of the different type photo-tubes and different samples of plastic phosphor. The stilbene used in the experiments was purified and grown in our laboratories. Also included are values for a typical liquid phosphor. The results of other authors are included for comparison.

Although Kallmann's value represents integrated output current, it is included here because it should also be proportional to average pulse size. Of particular interest from the table is the relative improvement of the plastic phosphor on using the ultraviolet sensitive photo-multiplier tubes. A rough analysis of these data based on the average spectral responses of the three different type photo-multiplier tubes yields an emission maximum of about 3700A for the plastic phosphor, which is in good agreement with the emission spectra of terphenyl liquids as reported by Harrison.[2] However, work is in progress to obtain more accurate emission data. Further, it is estimated that for the light geometry employed that each Sr-90 beta-particle results in the emission of about 6 photo-electrons at the photo-cathode of the RCA 5819 tube as compared with 63 for anthracene. One could expect to improve these figures by a factor of two with better optical coupling. Also, our investigations indicate that the pulse size increases with increase in degree of polymerization.

TABLE I. Ratios of pulse heights of several phosphors.

Tube type	Stilbene/1 percent terphenyl in plastic β's and γ's	Stilbene/1 percent terphenyl in plastic Po-α's	Anthracene/1 percent terphenyl in xylol β's and γ's	Anthracene/stilbene β's and γ's
RCA 5819	6.0	3.5	7.3	1.8
Harrison[a]			2.9	
Hofstadter[b]				1.67
RCA 1P21	3.5		2.5	1.3
Harrison[a]			2.0	
Montgomery[c]			3.3[e]	
RCA 1P28	3.4		2.3	1.2
Harrison[a]			1.5	
Kallmann[d]			2.2	

[a] See reference 2.
[b] R. Hofstadter, Nucleonics, p. 69 (May, 1950).
[c] C. G. Montgomery and D. D. Montgomery, Phys. Rev. 80, 757 (1950).
[d] H. Kallmann and M. Furst, Phys. Rev. 79, 857 (1950).
[e] This value for both cosmic particles and gamma-rays.

Since one possible application of the plastic phosphor would lie in the use of very large samples, the light pulses from a long rod (3 cm diam × 20 cm) has been studied under irradiation from a beta-source. Preliminary results give total light transmitted through 20 cm of material about $\frac{1}{4}$ that of the light generated near the photo-tube end of the rod with a corresponding loss in counting efficiency.

Information on both the "long rod" experiments and studies on the effect of polymerization will be reported at a later date.

[1] M. G. Schorr and F. L. Torney, Phys. Rev. 80, 474 (1950).
[2] F. G. Harrison and G. T. Reynolds, Phys. Rev. 79, 732 (1950).

Gamma-Ray Spectrum of K^{40}†

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THE gamma-ray spectrum of K^{40} has been measured using a scintillation spectrometer. The crystal was a one-inch cube of NaI-Tl mounted as shown in Fig. 1. A modified Jordan and Bell pulse amplifier and an electronic differential pulse height discriminator were employed. Amplifier gain and discriminator window width were monitored by a pulse generator, the pulse

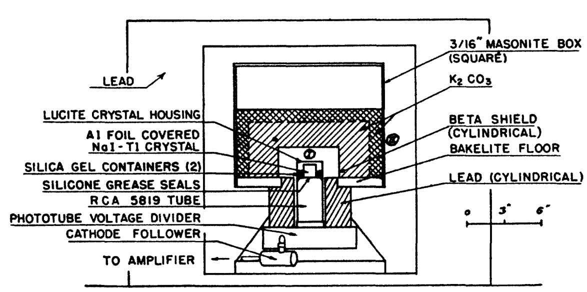

FIG. 1. Arrangement of crystal, sources, and photo-tube. In this experiment the entire cross-hatched region was filled with K_2CO_3.