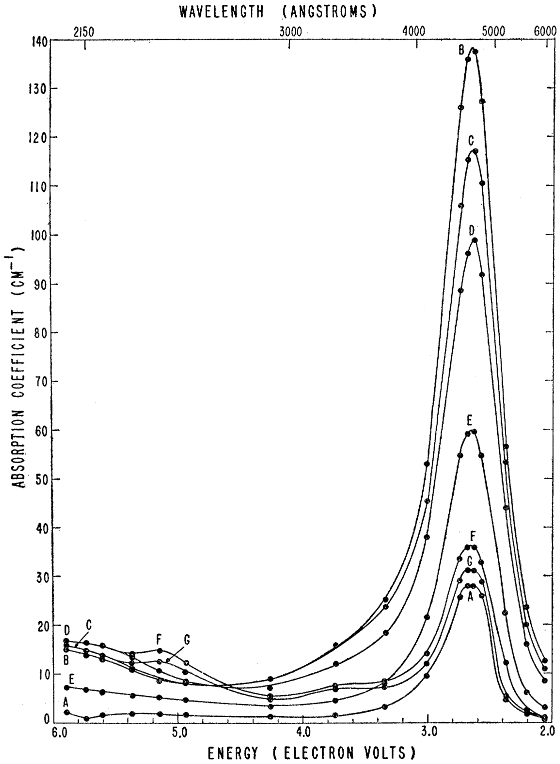

FIG. 1. Spectral absorption of x-rayed NaCl single crystals containing the following nominal mol ratios of impurities to Na in the melt: curve A: None; B: 0.005 Ca/Na; C: 0.001; D: 0.0005; E: 0.0001; F: 0.005 Cd/Na; G: 0.001.

since two Na^+ are replaced by each Ca^{++}. If the crystal is then x-rayed, the probability for the capture of holes by positive ion vacancies to form V-centers is greater than it would be in a "pure" crystal. As a result, the probability for the recombination of holes and electrons is reduced. The probability for the formation of F-centers is thereby increased since more electrons are free to be trapped by negative ion vacancies. If the F-band is enhanced, then an increase in the V-band absorption which occurs in the short wavelength ultraviolet region should also be observed. Figure 1 shows a three- to eightfold increase in the absorption in the neighborhood of 2100A for Ca^{++}-bearing crystals over that of "pure" NaCl. Irradiation into this band produces no observable emission, indicating these crystals are not radiophotoluminescent in this region. The same conditions do not exist in crystals containing Cd^{++} since the excess positive ion vacancies are bound to the Cd^{++} at room temperature and are not favorable traps for holes. Therefore, recombination of electrons and holes occurs with nearly the same probability as exists in a "pure" crystal, and the F-band is not significantly enhanced. Unfortunately NaCl containing Cd^{++} has radiophotoluminescent absorption bands at 2400A and 3400A; thus it is not possible to strengthen the explanation further by showing no enhancement of the V-band in the crystals containing Cd^{++}.

Further experiments are planned with Ca^{++} and Cd^{++} in NaCl and in other alkali halides. If the observed differences in the behavior of these ions in NaCl appear in other alkali halides, arguments[4] based on the *a priori* similarity of these ions may require modification.

The writer wishes to express his appreciation to Mr. R. D. Kirk for growing the single crystals used in this work.

[1] H. Hummel, thesis, Göttingen University (1950) (unpublished).
[2] H. W. Etzel and R. J. Maurer, J. Chem. Phys. **18**, 1003 (1950).
[3] C. Bean and R. J. Maurer, ONR Technical Report No. 4 (1952) (unpublished).
[4] F. Seitz, Phys. Rev. **83**, 134 (1951).

Threshold for (γ,p) Reaction in Be^9

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ALTHOUGH the (γ,n) reaction in Be^9 is well known, only one paper[1] has established the existence of the $Be^9(\gamma,p)Li^8$ in beryllium. They identified a Li^8 beta-activity and made a rough estimate of 18 ± 1 Mev for the (γ,p) threshold.

The radioactive chain for $Be^9(\gamma,p)Li^8$ is:

$$Be^9+\gamma\rightarrow p+Li^8;\quad Li^8\rightarrow\beta+Be^8;\quad Be^8\rightarrow2\alpha.$$

The 0.88-sec half-life beta-particles from Li^8 have a maximum energy of 13 Mev. The final α-particles have about 1.5 Mev each.

Possible alternative reactions from Be^9 in a betatron beam are: $Be^9(\gamma,n)2\alpha$, $Be^9(n,\alpha)He^6$, and $Be^9(\gamma,d)Li^7$. He^6 from the (n,α) reaction has a 0.86-sec beta-activity with a 3.5-Mev maximum energy. In spite of a low ($\sim$2.6 Mev)[2] threshold, the (n,α) probability is far below the (γ,p) because the neutron flux is far lower than the γ-intensity. There was no evidence of beta-activity below 16.9 Mev.

A large ($1\frac{1}{2}$ in.$\times$1 in.) NaI crystal was mounted in contact with a 5819 photomultiplier as shown in Fig. 1. The gate was off during the complete acceleration cycle of the betatron so that spurious γ-counts from the beam and the injection gun were avoided. The discriminator was set for the best ratio between background and true counts. The background remained high even during the dead time of the γ-beam, probably because iron, aluminum, and copper are all beta-active under γ-radiation of this energy.

Threshold determinations from seven sets of data for the (γ,p) reaction give 16.93 ± 0.15 Mev. An accurate mass difference calculation gives a theoretical value of 16.872 ± 0.008 Mev.[3] Graphical extrapolation of the seven curves agreed with calculations of the $N=k(E-E_0)^m$ type.

As a check against confusion of other beta-activities, the half-life was measured at 0.89 sec, and the beta-particles penetrated 0.39 in. of aluminum, indicating an energy above 6 Mev.

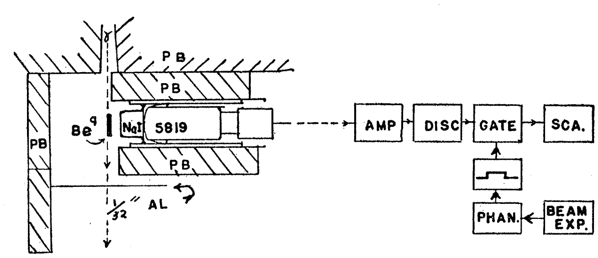

FIG. 1. Experimental arrangement.

A very rough estimate of the absolute cross section for (γ,p) indicates $\sim3\times10^{-28}$ cm^2 at 19 Mev. Further work is in progress to make an accurate determination of σ between 17 and 21 Mev.

* This work was done under the AEC.
[1] Ogle, Brown, and Conklin, Phys. Rev. **71**, 378 (1947).
[2] 2.6 Mev is the sum of the (γ,n) and (n,α) thresholds.
[3] D. M. Van Patter, Office of Naval Research Technical Report ONR-57 (1952) (unpublished).

Neutron Total Cross Section for Lead Between 37 and 156 Mev

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IN the course of an investigation into the variation of neutron total cross sections with energy for a number of elements, a dip has been found in the lead cross section at about 60 Mev. The neutrons used in this experiment were produced by proton bom-