Letters to the Editor

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Photo-Neutron Thresholds of Titanium^{46} and Chromium^{50}*

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THE photo-neutron thresholds of Ti^{46} and Cr^{50} have been measured using the 20 Mev betatron at Los Alamos. The threshold values were determined by comparing the observed thresholds with the threshold of Cu^{63}, where the threshold for the $Cu^{63}(\gamma, n)Cu^{62}$ reaction was taken as 10.85 Mev. That value for the threshold of the copper reaction is the average of the value obtained by Baldwin and Koch,[1] by J. McElhinney *et al.*,[2] and by McElhinney and Ogle at Los Alamos.[3] The experimental arrangement was similar to that used by J. McElhinney *et al.* at the University of Illinois.[2]

In both cases it was possible to irradiate the element under investigation and to observe the resultant activity. The total irradiation was in each case measured by means of an integrator circuit employing a photomultiplier phosphor combination and a standard current integrating circuit. The response of this integrator has been found to be proportional to that of a Victoreen R Thimble over the intensity ranges used in this experiment. The activity per integrator unit for a standard sample weight and for irradiating the counting geometry was determined as a function of the maximum energy of the bremsstrahlung spectrum from the betatron.

Both elements under consideration were in the form of the oxides. Extraneous activities due to the (n, γ) and (n, p) processes on various isotopes of the elements under consideration were observed in both cases. However, there was no difficulty in separating out the 42-minute positron period of Cr^{49} and the 3.08-hour period due to Ti^{45}. The data taken during this work indicate that the threshold for the $Ti^{46}(\gamma, n)Ti^{45}$ reaction is 13.3 $\pm$0.2 Mev, and that the threshold for the $Cr^{50}(\gamma, n)Cr^{49}$ reaction is 13.4$\pm$0.2 Mev.

* This document is based on work performed at the Los Alamos Scientific Laboratory of the University of California under Government contract W-7405-Eng. 36.
[1] George C. Baldwin and H. W. Koch, Phys. Rev. **67**, 1 (1945).
[2] McElhinney, Hanson, Duffield, Becker, and Diven, Phys. Rev. **75**, 542 (1949).
[3] J. McElhinney and W. E. Ogle, Phys. Rev., this issue.

The Cu^{63} Photo-Neutron Threshold*

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THE threshold for the reaction $Cu^{63}(\gamma, n)Cu^{62}$ has been measured using the University of Illinois 20 Mev betatron by Baldwin and Koch[1] and by McElhinney *et al.*,[2] and found to be 10.9$\pm$0.2 Mev. The binding energy of a neutron in Cu^{63} has been measured through the $Cu^{63}(n, 2n)Cu^{62}$ reaction by Fowler and Slye.[3] Their value for that quantity, which is expected to be the same as the (γ, n) threshold, is 11.2$\pm$0.3 Mev.

Copper serves as a convenient energy calibration point for betatron work since it has a very sharp threshold. There was, however, some doubt in the minds of the authors as to the validity of the past determinations using a betatron. This doubt arose because of two possible uncertainties. (1) Neutrons from the betatron produce an activity that may be confused with the Cu^{62} activity and hence lead to an incorrect value of the threshold. (2) The apparent position of the threshold may possibly vary with the intensity of irradiation, that is, with the sensitivity of the detecting system. Hence, it was thought worth while to remeasure the (γ, n) threshold under varying conditions in order to check the above points.

Copper^{62} decays by positron emission with a ten minute half-life. Copper,^{66} which is formed upon bombardment by the betatron radiation by the reaction $Cu^{65}(n, \gamma)Cu^{66}$, decays by beta-emission with a five minute half-life. In the process of determining the threshold, the five minute period causes little difficulty until points are taken very close to the threshold, but there some error may be made in interpreting the data. In order to check this point the threshold was measured using both unshielded and cadmium shielded copper samples. The apparent threshold was also determined at two distances, one three times farther than the other from the target of the betatron, in order to check the effect of gamma-ray intensity on the apparent threshold. All measurements gave the same value of the (γ, n) threshold within one-half percent of each other. The value of the threshold determined in this work is 10.8$\pm$0.2 Mev, in good agreement with the values of Baldwin and Koch, and of McElhinney *et al.*

The energy scale of the betatron was calibrated by determining the (γ, n) thresholds of N^{14} and F^{19}. The thresholds of those reactions are assumed to be 10.54$\pm$0.1 Mev and 10.40$\pm$0.3 Mev, respectively.

* This document is based on work performed at the Los Alamos Scientific Laboratory of the University of California under Government contract W-7405-Eng 36.
[1] George C. Baldwin and H. W. Koch, Phys. Rev. **67**, 1 (1945).
[2] McElhinney, Hanson, Duffield, Becker, and Diven, Phys. Rev. **75**, 542 (1949).
[3] J. L. Fowler and J. M. Slye, Phys. Rev. **76**, 169 (1949).

Thresholds for the Photo-Disintegration of Zr^{90}, Pr^{141}, As^{75}, I^{127}, and Ni^{58}*

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THE photo-neutron thresholds of several elements have been measured using the 20 Mev betatron at Los Alamos. The threshold values were determined by comparing the observed thresholds with the thresholds of N^{14} and F^{19}, where the threshold for the $N^{14}(\gamma, n)N^{13}$ reaction was taken to be 10.54 Mev and the threshold for the $F^{19}(\gamma, n)F^{18}$ reaction was taken to be 10.40 Mev.[1] The experimental arrangement was similar to that used by J. McElhinney *et al.*[2]

In all cases it was possible to irradiate the element under investigation and observe the resultant activity. The total irradiation was in each case measured with a Victoreen R Thimble. The activity per roentgen unit for a standard sample weight and counting geometry was then determined as a function of the maximum energy of the bremsstrahlung spectrum from the betatron. The maximum energy of the bremsstrahlung spectrum was varied by varying the amplitude of the magnet oscillation. Expansion of the electrons from the equilibrium orbit always took place at the peak of the magnetic flux wave, thus reducing any energy errors due to uncertainty in the time of expansion.

An automatic regulating circuit kept the magnet amplitude constant to 0.2 percent or better. The magnet amplitude, which is a measure of the maximum bremsstrahlung energy, was observed by measuring the voltage induced in two turns of wire around the legs of the betatron magnet with a model 19 Hickok voltmeter.