Letters to the Editor

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Communications should not in general exceed 600 words in length.

Capture Cross Sections for C Neutrons

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The total and scattering cross sections for slow neutrons have been measured reasonably well for most elements, but the capture cross sections are known for a few elements only. Lapointe and Rasetti,[1] simplifying the well-known "neutron density method" of Frisch, Halban and Koch,[2] have measured a number of capture cross sections for thermal neutrons. Their method, however, is valid only for capture cross sections $>10^{-24}$ cm^2. For smaller cross sections the "method of induced radioactivity" has recently been applied by Rasetti[3] and by the authors.[4] Though this method does not allow of any great accuracy it yields some valuable information which would be difficult to obtain in any other way.

This method can be employed for nuclei where the capture of a slow neutron leads to the formation of a radioactive isotope. By exposing an element of unknown capture cross section (σ_c) to slow neutrons, and comparing its activity with that produced under the same conditions in an element of known capture cross section one can calculate σ_c. A convenient standard for such measurements is Mn ($\sigma_c=9.4\times10^{-24}$ cm^2). Though our procedure was different from Rasetti's, as far as the geometrical arrangement is concerned, the agreement between his and our values is as good as can be expected for β-ray measurements. On the whole, we used thicker samples, of the order of one to two β-half-value thicknesses. To avoid several corrections, especially those caused by the difference in scattering and stopping power of different elements for β-rays, mixtures of Mn and the element under investigation, or an element close to it in atomic number, were exposed to slow neutrons. The largest errors are introduced by the somewhat uncertain corrections for the difference in the β-ray energies of the isotopes investigated and the standard element Mn. The effect caused by resonance neutrons was obtained in every case by repeating the measurement with samples exposed inside Cd. Only for the Sb and Ga isotopes was this contribution large. Just one-half of the light elements with $Z\leq20$ have properties which allow their investigation with a 100-mg Ra$-\alpha-$Be source. We have studied all these, and a few heavier ones.

Our results, somewhat revised and extended since our first report, are summarized in Table I. For K, which is difficult to investigate because of its natural radioactivity, we had previously reported $\sigma_{\text{eff}}<0.05\times10^{-24}$ cm^2. A repetition of the measurement under improved conditions gave a value in agreement with Rasetti's.

We wish to thank Professor Rasetti for informing us of his results before publication.

TABLE I. *Summary of results for capture cross sections for* C *neutrons. T=half-lifetime of radioactive isotope, σ_{eff}=effective cross section per "average" atom, σ_c=capture cross section corrected for abundance of isotope. The values marked (p) signify partial cross sections, as these isotopes may partially decay by β-emission and partially by K-electron capture. For comparison we give in the last two columns Rasetti's values and those measured by Manley, Haworth and Luebke,[5] with the help of a strong* D+D *neutron source.*

Element	T	σ_{eff} 10^{-24} cm^2	Absorbing Isotope	σ_c in 10^{-24} cm^2 Authors	R	M, H and L
$_7$N*	8 sec.	—	N^{15}	<0.2		<0.01
$_9$F	12 sec.	<0.05	F^{19}	<0.05		0.01
$_{11}$Na	14.8 hr.	0.4	Na^{23}	0.4	0.35	
$_{12}$Mg	10.2 min.	0.03	Mg^{26}	0.3		
$_{13}$Al	2.4 min.	0.2	Al^{27}	0.2	0.21	
$_{14}$Si	170 min.	<0.02	Si^{30}	<0.5		
$_{15}$P	14.3 days	0.3	P^{31}	0.3	~0.2	
$_{17}$Cl	37 min.	0.07	Cl^{37}	0.3		
$_{19}$K	12.4 hr.	~0.1	K^{41}	~1.5	~1.4	
$_{20}$Ca	2.5 hr.	<0.01	Ca^{48}	<5		
$_{28}$Ni	2.6 hr.	0.03	(Ni^{62})	(0.8)		
$_{29}$Cu	5 min.	0.8	Cu^{65}	2.4	1.8	
$_{31}$Ga	20 min.	0.6	Ga^{69}	1 (p)		
	14 hr.	1	Ga^{71}	2.6		
$_{51}$Sb	2.8 days	2	Sb^{121}	3.6 (p)	3.3	
	60 days	1	Sb^{123}	2.3 (p)		
$_{81}$Tl	4.2 min.	<1	Tl^{203}	<3.3 (p)		0.17
$_{83}$Bi	5 days	<0.1	Bi^{209}	<0.1		

* Through the courtesy of Professor Urey we were able to use ammonium nitrate enriched in N^{15} for this experiment.

[1] C. Lapointe and F. Rasetti, Phys. Rev. **58**, 554 (1940).
[2] O. R. Frisch, H. v. Halban and J. Koch, Proc. Danish Acad. **15**, 10 (1938).
[3] F. Rasetti, Phys. Rev. **58**, 869 (1940).
[4] M. Goldhaber and R. D. O'Neal, Phys. Rev. **59**, 109A (1941).
[5] J. H. Manley, L. J. Haworth and E. A. Luebke, Phys. Rev. **59**, 109A (1941).

The Abundance Ratio Ni^{61} : Ni^{64}

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The published values of the isotopic constitution of nickel have for some time shown strong discrepancies with respect to the ratio Ni^{61} : Ni^{64}. Aston[1] found Ni^{61} to be 1.7 percent of the total and failed to detect Ni^{64}. De Gier and Zeeman,[2] using the parabola method, failed to find Ni^{61} and found Ni^{64} to be 0.9 percent of the total. Lub,[3] using a similar apparatus, found Ni^{64} to be 0.9 percent of the total but found Ni^{61} to constitute 0.1 percent. Dempster[4] found Ni^{61} to be approximately equal in abundance to Ni^{64}.

These results were obtained photographically. Dempster used a spark between nickel electrodes as an ion source. The others used a discharge tube containing nickel carbonyl. In the latter case, the organic compounds present in the source may lead to entirely erroneous estimates of intensity because of their superposition on the lines of the substance under study.