Letters to the Editor

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Communications should not in general exceed 600 words in length.

Radioactive Isotopes of Osmium

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OSMIUM has the following stable isotopes:[1]

Mass	184	186	187	188	189	190	192
Abundance in %	0.018	1.59	1.64	13.3	16.1	26.4	41.0

Slow neutron bombardment of osmium should, therefore, be expected to yield at least two radioactive osmium isotopes, Os^{191} and Os^{193}. When the present work was started, only one osmium activity had been reported,[2] its half-life being given as 40 hours. Meanwhile Zingg[3] has reported two periods obtained by slow neutron bombardment of osmium, one of 29.8 ± 1 hours and one of about 10 days.

We bombarded osmium metal, surrounded by paraffin, with neutrons from the 60-inch cyclotron for several days. The chemically separated osmium fraction showed two periods, one of 32 ± 2 hours and one of 17 ± 1 days. From absorption measurements, the upper energy limits of the beta-particles from these two activities were found to be about 1.5 Mev and 0.35 Mev, respectively. Both activities have gamma-rays associated with them.

How these two periods are to be distributed between Os^{191} and Os^{193} cannot be decided by bombardment of neighboring elements with neutrons, protons, deuterons, or alpha-particles, assuming the ordinary nuclear reactions. A clue to the assignment might be expected from fast neutron bombardment of osmium. This should produce Os^{191} by the reaction $Os^{192}(n,2n)Os^{191}$, while Os^{193} cannot be formed by a similar reaction. In addition, n,γ reactions leading to both isotopes will occur, even with moderately fast neutrons.

We surrounded one sample of osmium with boron carbide and cadmium, another one with paraffin, and bombarded them with beryllium+16-Mev deuteron neutrons under otherwise identical conditions. Both the 32-hour and the 17-day periods were stronger in the slow neutron sample and the ratio of 32-hour to 17-day activity was twice as large with the fast as with the slow neutrons. The latter result may indicate that the 17-day period is due to Os^{193} and the 32-hour period to Os^{191}, although this is not the only possible interpretation and the possibility of isomerism cannot be excluded.

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[1] A. O. Nier, Phys. Rev. **52**, 885 (1937).
[2] I. V. Kurtchatow, C. D. Latyschew, L. M. Nemenow and I. P. Selinow, Physik. Zeits. Sowjetunion **8**, 589 (1935).
[3] E. Zingg, Helv. Phys. Acta **13**, 219 (1940).

Coulomb Exchange Energy in Light Nuclei

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A NUMBER of isobaric mass differences of the type $(Z+1,Z)-(Z,Z+1)$ are known with considerable accuracy. The recent determinations of Haxby, Shoupp, Stephens and Wells[1] yield

$$\begin{array}{ll}(7) & Be^7-Li^7=\ 9.4\pm0.3 \text{ in } 10^{-4}\text{mu},\\ (9) & B^9-Be^9=11.6\pm0.2\ \text{"}\quad \text{"}\ ,\\ (11) & C^{11}-B^{11}=21.3\pm0.2\ \text{"}\quad \text{"}\ ,\\ (13) & N^{13}-C^{13}=23.8\pm0.4\ \text{"}\quad \text{"}\ .\end{array}$$

In addition[2]

$$(15)\quad O^{15}-N^{15}=30.8\pm2.0\ \text{"}\quad \text{"}\ .$$

The large differences (11)−(9) and (15)−(13) and the small differences (9)−(7) and (13)−(11) find a simple qualitative explanation in the periodic variation of the Coulomb exchange energy as calculated in the Hartree approximation.[3, 4] In the notation of references 3 and 4 the theoretical results are

$$\begin{aligned}\{Be^7-Li^7\}-\{Li^5-He^5\}&=L_c+2K_c/3,\\ \{B^9-Be^9\}-\{Be^7-Li^7\}&=L_c-6K_c,\\ \{C^{11}-B^{11}\}-\{B^9-Be^9\}&=L_c+2K_c/3,\\ \{N^{13}-C^{13}\}-\{C^{11}-B^{11}\}&=L_c-6K_c,\\ \{O^{15}-N^{15}\}-\{N^{13}-C^{13}\}&=L_c+2K_c/3.\end{aligned}$$

Here L_c and K_c are the direct and exchange Coulomb integrals, respectively, for protons in the p shell. With the exception of (1) and (2) these equations are listed in reference 4. The theory yields numerical values $L_c\sim4.9\times10^{-4}$ mu, $K_c\sim0.30\times10^{-4}$ mu, but no quantitative significance is claimed for these numbers. The experimental mass differences are fitted reasonably well by $L_c=7.0\times10^{-4}$ mu and $K_c=0.7\times10^{-4}$ mu. In view of the crudeness of the Hartree approximation we prefer not to stress the possibility of numerical agreement, especially since supplementary effects, such as the one studied by Bethe,[5] may account for part of the observed periodicity.

[1] Haxby, Shoupp, Stephens and Wells, Phys. Rev. **58**, 1035 (1940).
[2] Fowler, Delsasso and Lauritsen, Phys. Rev. **49**, 561 (1936). The upper limit of the position spectrum from O^{15} is 1.7 Mev by inspection and 2.0 Mev by the K-U plot. We use the value 1.85 ± 0.20 Mev to compute the mass difference (15).
[3] E. Feenberg and E. Wigner, Phys. Rev. **51**, 95 (1937).
[4] E. Feenberg and M. Phillips, Phys. Rev. **51**, 597 (1937).
[5] H. A. Bethe, Phys. Rev. **54**, 436 (1938).