Letters to the Editor

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Decay Schemes for Isotopes W^{187} and W^{185}

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November 13, 1945

INVESTIGATIONS since the earliest reports[1,2] have added considerably to our knowledge of the radiations associated with the 24.1 hour W^{187} activity. By coincidence absorption measurements, Clark[3] has shown that the beta-radiations are complex, with maximum energies of 0.5 Mev and (roughly) 1.3±0.1 Mev. A careful analysis of our previously reported beta-ray absorption curves, using the Feather comparison method,[4] has confirmed his observations. The ranges of 600 mg/cm² Al and ~140 mg/cm² Al correspond to energies of 1.4 Mev and 0.5_5 Mev, respectively, according to the Feather relation.[4]

Clark observed also that beta-gamma coincidences occurred only with aluminum absorbers thin enough to permit passage of the 0.5 Mev negatrons, showing that the 0.9 Mev gamma-ray was associated with the softer beta-radiation. At the same time gamma-gamma coincidences were found, indicating that other gamma-rays occurred in parallel with the 0.9 Mev gamma-transition. From measurements giving the number of gamma-gamma coincidences per recorded gamma ray and the number of beta-gamma coincidences per recorded beta-ray, Clark calculated that four low energy gamma-rays were emitted simultaneously, with a branching ratio of 0.4. Thus, he proposed the decay scheme shown in Fig. 1.

In other studies, Valley[5] has examined the complicated spectrum of internal conversion electrons emitted by tungsten specimens irradiated with 11 Mev deuterons and has found that six of the lines, decaying with a 24-hour half-life, are associated with gamma-rays having energies of 0.086, 0.101, and 0.135 Mev. More recently, Mandeville[6] has redetermined the energy of the hard gamma-radiation by measurements of the Compton recoil electrons in a magnetic ray spectrograph and has obtained a value of 0.94±0.02 Mev.

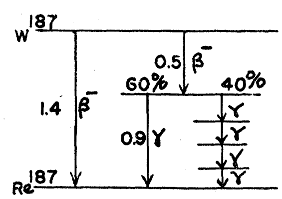

FIG. 1. Decay scheme for the 24.1-hour W^{187} as proposed by Clark. Energy changes are in Mev.

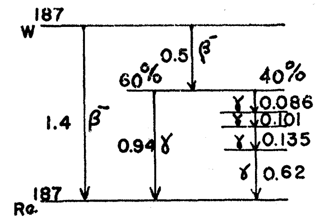

FIG. 2. A proposed decay scheme for the 24.1-hour W^{187} isotope. The 0.086, 0.101, and 0.135 Mev transitions are largely converted.

The correlation of the above data into a unified picture for the decay scheme may be initiated by assuming that three of the four soft gamma-rays postulated by Clark from coincidence measurements were observed by Valley. Accordingly, a fourth gamma-ray, with an energy of $0.94-(0.086+0.101+0.135)=0.62$ Mev should be present.

Evidence suggesting the existence of this gamma-ray may be obtained from absorption data in lead for the W^{187} gamma-rays. The absorption curves appear to have a half-value thickness of 7.0 g/cm² Pb. By use of the absorption coefficient *versus* energy curves derived from the data of Heitler[7] and Gentner,[8] which have been found applicable in other measurements with the same experimental set-up, the energy of the gamma-ray would appear to be 0.7 Mev. Since Mandeville[6] has shown that the hard gamma-ray has an energy of 0.94±0.02 Mev, one must conclude that the absorption curve in lead is composed of two components. A rough graphical analysis of this curve, assuming that the hard gamma-ray is about 1.5 times more intense than the soft component, gives a half-value thickness of ~5 g/cm² Pb for the lower energy radiation. This value corresponds to an energy of $\sim 0.5_5$ Mev, which is in reasonable agreement with the predicted value of 0.62 Mev, considering the errors of such an analysis. Thus, if these deductions are valid, the probable decay scheme for isotope W^{187} is that shown in Fig. 2.

In previous investigations of the 75-day W^{185} activity, maximum beta-ray energies of 0.4–0.5 Mev[1] and 0.55–0.65 Mev[2] have been reported. Additional aluminum absorption measurements with stronger sources have confirmed the 0.55 Mev value for the energy, by use of the Feather comparison method, and have indicated also that no gamma-rays accompany the decay of this isotope, as deduced from absorption curves in aluminum which show beta/gamma ratios of $\gtrsim 3000$ (at zero absorber). Since cloud-chamber measurements have indicated a normal spectrum, it would appear that the decay scheme is simple, according to the mechanism W^{185} (β^-/0.55 Mev) Re^{185}.

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