trometer was calibrated with known gamma-emitters to obtain the intensities shown in the decay scheme.

It is a pleasure to acknowledge the help of C. J. Borkowski and E. Fairstein in this work.

* This work was performed for the AEC.
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Au^{198} Decay

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A 1.09-MEV level in Hg^{198} has recently been reported[1-3] with gamma-transitions in Au^{198} decay between the 1.09-Mev and the 0.411-Mev levels and between the 1.09-Mev level and the ground state. These transitions have been confirmed using Oak Ridge National Laboratory reactor bombarded gold which was purified after bombardment by the method given by Noyes and Bray.[4] The NaI—TlI scintillation spectrometer pulse distribution in Fig. 1A shows the presence of the recently reported 1.09-Mev and 0.680-Mev gamma-rays in addition to the well-known 0.411-Mev gamma-ray. The shoulder on the curve corresponding to a gamma-ray energy of 0.820 Mev was shown to be the result of random coincidences between two 0.411-Mev gamma-rays.

Further evidence that the 0.680-Mev gamma-transition is part of the Au^{198} decay scheme was obtained by measuring the electron energy distribution coincident with it. This was done by mounting an essentially weightless source in a thin magnetic lens spectrometer on a beryllium disk thick enough to absorb the 0.97-Mev beta-group. A 13 g/cm² platinum absorber was placed between the beryllium disk and a NaI—TlI counter to reduce the counting rate of the 0.411-Mev gamma-ray relative to that of the 0.680-Mev gamma-ray by a factor of 25. With this reduction in intensity the random coincidences of the 0.411-Mev gamma-ray were essentially eliminated.

Coincidences were recorded between pulses from the detector on the thin lens spectrometer and the pulses produced by the 0.680-Mev gamma-ray in the NaI—TlI scintillation spectrometer. The energy distribution of the coincident electron pulses is shown as an N/I *vs* *E* plot in Fig. 1B. These data show that the 0.680-Mev gamma-ray is coincident with both a low energy beta-group and the *K*-conversion electron peak of the 0.411-Mev gamma-ray. The Kurie plot of the beta-energy distribution shown in Fig. 2 indicates a maximum energy of 290±15 kev for the coincident beta-group. These results are consistent with the coincidence absorption measurements of Cavanagh[2] and the decay scheme

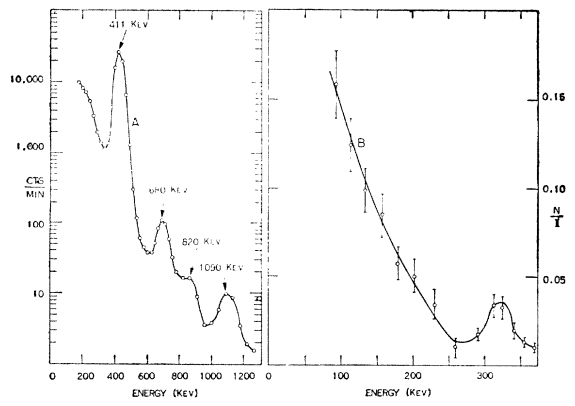

FIG. 1. Curve A: Scintillation spectrometer pulse-height distribution of Au^{198} gamma-radiation; curve B: electron energy distribution coincident with 680-kev gamma-radiation.

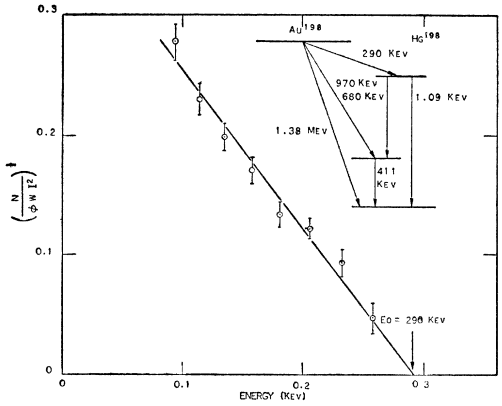

FIG. 2. Kurie plot of Au^{198} beta-energy distribution coincident with 680-kev gamma-radiation.

shown in Fig. 2. No attempt was made to confirm the low intensity beta-transition to the ground state reported by Elliott and Wolfson.[3]

Approximate measurements indicate that about 1 percent of the disintegrations are through the 0.680-Mev gamma-ray and about 0.2 percent are through the 1.09-Mev gamma-ray.

It is a pleasure to acknowledge the help of C. J. Borkowski and R. A. Dandl in this work.

* This work was performed for the AEC.
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Computation of Photonuclear Resonance Curves from Relative Activity Curves Monitored by Induced Radioactivity

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IN preference to the "total spectrum method," Katz and Cameron[1] have recently presented their "photon difference method" for obtaining photonuclear cross sections from observed bremsstrahlung activation curves. It is the purpose of the present note to point out that it is possible to obtain results of equal or better accuracy in the energy region of 20 to 100 Mev by monitoring with induced radioactivity. This latter method is relatively simple and may be extended to energies as low as 10–12 Mev if suitable monitor activities, characterized by low energy resonances, are used. To obtain good accuracy the activation curves must, of course, be measured carefully and it is preferable to employ two or three different radioactive monitors simultaneously.

The radioactivity induced in a monitor sample is proportional to the integral, over the resonance, of $\sigma_M \times N_{h\nu}$ (cross section times number of quanta). The character of the resonance curves for various suitable monitors is known with some accuracy and the relative number of bremsstrahlung quanta has been given by a number of authors.[2-4] The use of a monitor radioactivity in effect serves to normalize the bremsstrahlung spectra in terms of the area under the $\sigma_M \times N_{h\nu}$ curves. Schiff curves corresponding to $E_{max} > 20$ Mev and normalized in this way on the basis of the reported resonance curves[5] for Ta are shown in Fig. 1, which turned out to be substantially equivalent to normalization at 13.5 Mev.

When an activation curve is determined with the use of a radioactivity monitor, the change of relative activity ΔI attendant upon

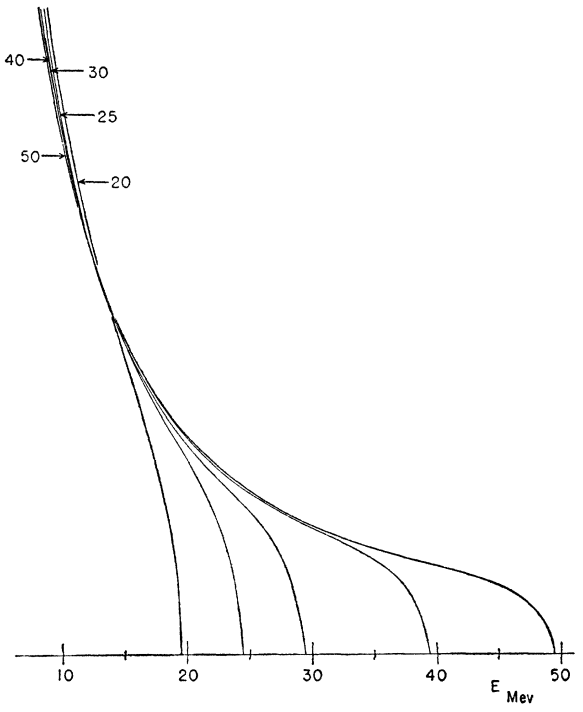

FIG. 1. Relative number of quanta, corresponding to several E_{max} settings, calculated by Schiff's formula ($C=111$) and normalized for constant activity of tantalum monitor. The resonance curve for Ta assumed to be as reported (see reference 5).

a change of E_{max} is proportional to the integral of σ times the difference between the appropriate normalized spectra. The character of this second factor is illustrated by the curve bounding the shaded area in Fig. 2. The desired cross section first may be roughly estimated by differentiation of the activation curve and then revised, by successive trials, so that the incremental relative yield ΔI is closely proportional to the integral of $\sigma \times \Delta n_{h\nu}$. This procedure is illustrated graphically in Fig. 2 for the reaction $C^{12}(\gamma, n)C^{11}$, monitored by the radioactivity induced in copper. It is estimated that if the accuracy of the activation curve is of the order of 1 or 2 percent, the shape of the resonance curves may be computed in this way with an accuracy of 3 to 5 percent. Subsequent recomputation in the light of new data can be readily performed.

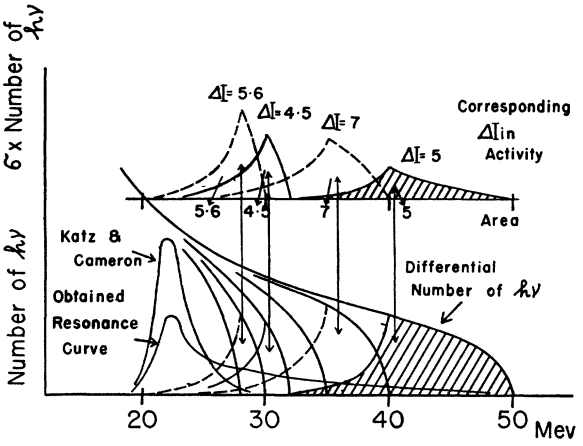

FIG. 2. Examples of procedure on how to adjust the area for

$$\int_{Em}^{Em+\Delta} \sigma \times N_{h\nu} dE \propto \Delta I.$$

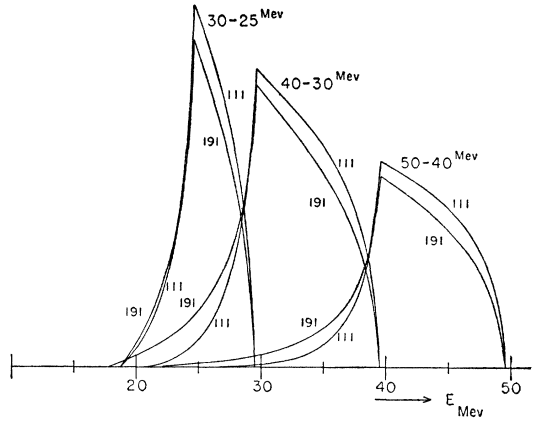

FIG. 3. Comparison of differential number of photons between Schiff curves corresponding to $C=191$ and $C=111$. Normalization was made with C^{62} activity.

The foregoing method is quite insensitive to the assumed shapes of the bremsstrahlung spectra and of the monitor resonance, if no prominent high energy "tail" is present. In Fig. 3 are given differential numbers of photons between Schiff's curves for constant activation of Cu corresponding to constant $C=191$ and $C=111$. The effects due to the difference of assumed value for the constant C are not very large. The necessity for detailed computations of ion-chamber response, differential absorption in the donut wall (because the monitor samples are usually insensitive to low energy quanta), and similar somewhat complicated phenomena is, of course, avoided. Special care should be taken in the use of monitor substances which are particularly sensitive to neutrons or to scattered x-rays. Errors from spurious induced activities may be kept to less than 5 percent, and commonly less than 2 percent, if suitable precautions are taken and the effects of geometrical changes (sample location, relative position, and thickness) are explored, enabling one to obtain a little better accuracy than with the usual Victoreen chamber.

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Unusual Broad Resonances in $C^{12}(\gamma,n)C^{11}$ and $O^{16}(\gamma,n)O^{15}$

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THE study of photonuclear resonances has been continued with the use of induced radioactivity as a monitor.[1,2] Use has been made of high energy x-radiation, with an upper limit adjustable to 70 Mev, obtained from the Iowa State College synchrotron.

The samples and monitors used were all of the same area ($\frac{3}{4}'' \times \frac{3}{4}''$) and with thicknesses usually from 1 mil to 10 mil. Lucite was used as a sample for carbon and oxygen. The targets were irradiated at fixed positions, either 10″ or 20″ from the x-ray source, and were so oriented that the beam struck a stack of