In the first place, it might be pointed out that the coordinate r as used in the Wyman solution is not the distance from the origin, and hence its value a at the boundary of the sphere is not the true radius. The latter, a_0, can be obtained by integrating the line element,

$$a_0=\int_0^a (g_{11})^{\frac{1}{2}}dr, \tag{3}$$

from which it follows that

$$2a_0/m=(1+x)^3x^{-\frac{1}{2}}\text{ arc tan } x^{\frac{1}{2}}, \tag{4}$$

where $x=m/2a$. Similarly, in the Schwarzschild solution the corresponding radial variable, denoted by Wyman by $\bar{r}$ and obtained from r by means of the transformation equations given by Wyman, is not the distance from the origin. Let us denote the value of $\bar{r}$ at the boundary by $\bar{a}$. Then in the inequalities (2) a should really be replaced by $\bar{a}$. Corresponding to $\bar{a}$ we can again calculate the true radius of the sphere, a_0. Since the Wyman solution goes over into the Schwarzschild solution when one transforms r to $\bar{r}$, one would expect that a_0 (which is a scalar quantity) should be the same for both solutions.

It turns out, however, that this is not the case if one uses the limiting values as given by Wyman. The difficulty appears to lie in the criterion used by Wyman, namely, that x be a single-valued function of $y=a^2/R^2$, the two being related by Eq. (2.14) in Wyman's paper. In view of the fact that the quantity a (as distinguished from a_0) has no direct physical significance, the same is true of the variables x and y, and a criterion based on them is therefore questionable. If, instead of Eq. (2.14), one uses Wyman's Eq. (2.15) and asks that, for a given m, a be a single-valued function of ρ, one gets different limiting values.

A more satisfactory criterion appears to be the one based on the non-vanishing of $g_{44}=e^{\nu}$ (in Wyman's notation). If one uses this, one obtains, in place of (1), the conditions,

$$m\leqslant a,\quad a^2\leqslant 128R^2/729. \tag{5}$$

These are equivalent to the conditions (2) with $\bar{a}$ in place of a, on the basis of the relation between a and $\bar{a}$,

$$\bar{a}=(1+m/2a)^2a, \tag{6}$$

which follows from the transformation equations for $\bar{r}$ and r.

The true radius of the sphere a_0, from either form of the solution, is then found to satisfy the conditions,

$$\begin{aligned} m&\leqslant 2^{5/2}a_0/3^3\text{ arc tan } 2^{-\frac{1}{2}}=0.3404a_0,\\ a_0^2&\leqslant 4(\text{arc tan } 2^{-\frac{1}{2}})^2R^2=1.5153R^2. \end{aligned} \tag{7}$$

In conclusion, it might be pointed out that, while the Wyman and Schwarzschild solutions are equivalent (since one can be obtained from the other by a coordinate transformation), the Wyman solution has the advantage in that all the components of the fundamental tensor and their normal derivatives are continuous at the boundary of the sphere, which is not the case for the Schwarzschild solution. This is associated with the fact that $\bar{r}$ as a function of r has a discontinuous second derivative at the boundary.

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Decay Scheme for Te^{121}

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We have continued the investigation of the radiations emitted in the decay of Te^{121} ($125d^1$–$143d^2$) and have obtained a satisfactory explanation for the apparently anomalous x-ray coincidence previously observed.[3] Our results indicate that the metastable state of Te^{121} has an excitation energy of about 275 kev and that the transition to the ground state takes place in two steps.[4] The previously observed gamma-ray of 225 kev is preceded or followed by a strongly converted gamma-ray of about 50 kev within a mean time shorter than the resolving time of our coincidence circuit (0.8×10^{-6} sec.). The ground state of Te^{121} for which a half-life time of 17 days has been reported,[2] decays by K-electron capture to Sb^{121} which is usually left in an excited state of 610 kev.[3]

The following experiments led us to the suggested decay scheme:

(1) From x-ray crystal spectrometer studies[2] it is known that Sb and Te K x-rays are emitted by Te^{121} (125–$143d$) in equilibrium with its daughter product. With the help of matched Cd and In filters[5] we have established the existance of coincidences between Te K_α x-rays and the 225 kev gamma-rays. These coincidences could be understood if the 225 kev gamma-ray were preceded or followed by a hitherto overlooked internally converted gamma-ray transition.

(2) Since a previous search for soft electrons with the help of a Cellophane window counter had been unsuccessful[3] special counters were constructed containing samples of Te^{121} within the glass envelope. In one arrangement the electrons were bent into the sensitive volume of the counter by means of a variable magnetic field. Soft electrons were detected with an energy of about 17 kev and coincidences between these electrons and the 225 kev gamma-ray established.

(3) These soft electrons can be taken as evidence of a transition of about 50 kev. A search for an unconverted gamma-ray of this energy was made using a Xe-filled Geiger counter to emphasize this energy region. An absorption curve in Ag was taken and a gamma-ray component with an energy of about 48 kev was found.

(4) An isomeric chemical separation was performed, using the transition from telluric to tellurous acid.[1] The tellurous acid fraction, precipitated 7 days after synthesis of the telluric acid from Te^{121}, was found to show only the 610 kev gamma-ray component with a period of approximately 16 days.

The Te source used was produced by bombarding Sb with 10-Mev deuterons from the University of Illinois cyclotron. Our thanks are due to the cyclotron group for carrying out the bombardments.

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