We expect then that at small b the potential $U(b)$ will not be greatly changed from the result of BBP. Since it will be halved at large b, we believe that the effective mass correction, $1-m^*$, will be roughly divided by 2 while the constant term A_2 in the potential (7.1) of BBP will not be changed much. Detailed calculations are needed for more accurate predictions.

The only other third order graph that has not been considered here involves a hole-bubble interaction. This can, however, be absorbed in the hole energy as shown by BBP. Thus, all third-order diagrams are eliminated by this procedure which renders the first-order estimation for the binding energy correct up to third order.

Finally, it is clear that the above procedure not only eliminates all third-order graphs but also greatly reduces the effect of a very large number of fourth- and higher-order graphs that involve interactions shown in Fig. 3. The evaluation of the off-diagonal $\langle k|G|k_0\rangle$ also paves the way towards estimating the contribution of the remaining higher-order graphs which are not thus eliminated. Hopefully, they will not make large corrections to the binding energy.

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New Isotope In^{122}

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A new isotope, In^{122}, has been produced by 14–15 MeV neutron bombardment of tin. The basis for mass and atomic number assignment is presented, as well as the following decay characteristics: half-life, 7.5±0.8 sec; beta end-point energy, 4.5±0.8 MeV; two coincident gamma rays having energies 1.140±0.010 MeV and 0.995±0.010 MeV.

IN connection with a systematic study[1] of the level structure of even tin isotopes resulting from the decay of neutron-excess indium isotopes, a new 7.5-sec activity was found and was assigned to the hitherto unknown isotope In^{122}. The purpose of this note is to report the principal decay characteristics of this new activity and the basis for assigning it to In^{122}.

In this investigation, the activity mentioned was produced upon irradiations of a 90.8% enriched metallic Sn^{122} sample with 14–15 MeV neutrons from the University of Arkansas 400-kV Cockcroft-Walton accelerator. Neither bombardments of highly enriched Sn^{118} (96.6%), Sn^{120} (98.39%), and Sn^{124} (96.0%) samples nor irradiations of natural tin produced any observable amount of the activity under consideration, due in the latter case to masking by other strong activities produced. In most experiments, the samples were sealed in light polyethylene ("Marlex") capsules that could be transported from the accelerator target to the spectroscopy laboratory in less than 0.5 sec with the aid of a pneumatic transport system. The radiations produced in the capsule itself [mainly radiations characteristic of N^{16} decay[3])] were studied and taken into account in analysis of the actual data. About 30 to 50 short runs were needed for acceptable statistics in most cases.

Gamma and beta radiations were investigated by means of scintillation detectors; namely, two 3 ×3-in. NaI(Tl) crystals for gamma-ray studies and a 1½-in. diam by 1-in. deep plastic crystal for rough beta spectroscopy. The sum-peak spectrometer[4] of our laboratory was also used for gamma-gamma coincidence studies. Due to low activities produced, resolving times of 0.4 to 0.9 μsec could be used, which assured complete electronic coincidence efficiency. Decay curves were obtained usually by using an RIDL 200-channel analyser as a multi-channel scaler.

Since the first (probably 2^+) excited state of Sn^{122} was known[5,6] to lie at 1.14 MeV, possible short-lived isomers of In^{122} could be expected to decay at least in

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[1] J. Kantele, M. Karras, and R. B. Moler (to be published).
[2] Supplied by the Isotopes Sales Department, Union Carbide Nuclear Company, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
[3] *Nuclear Data Sheets* (Printing and Publishing Office, National Academy of Sciences–National Research Council, Washington 25, D. C.).
[4] J. Kantele and R. W. Fink, Nucl. Instr. Methods **15**, 69 (1962); J. Kantele, *ibid.* **17**, 33 (1962).
[5] D. G. Alkhazov, D. S. Andreev, K. I. Erokhina, and I. Kh. Lemberg, Zh. Eksperim. i. Teor. Fiz. **33**, 1347 (1957); [translation: Soviet Phys.—JETP **6**, 1036 (1958)].
[6] P. H. Stelson and F. K. McGowan, Phys. Rev. **110** 489 (1958).

part via this state. As anticipated, a fast decaying gamma-ray of energy of 1.14±0.01 MeV was observed, the half-period being about 8 sec, as determined both from a study of the corresponding photopeak areas in several successive singles spectra and by following directly the decay of the 1.14-MeV line with a single channel analyzer and the multichannel scaler. In addition to the 1.14-MeV gamma, another gamma of energy of 0.995±0.010 MeV was found to decay with the same half-life, the relative intensities of these gamma-rays being $I_{1.140}/I_{0.995}=1.8\pm0.3$. Preliminary sum-peak spectrometry studies show clearly that these gammas are in coincidence. A fast decaying gamma observed at 0.51 MeV is attributed at least in part to annihilation radiation due to the strong gammas from the N^{16} present.

The excellent agreement between the measured gamma-ray energy, 1.140±0.010 MeV, with the energy of the first known excited state suggests strongly that the new activity[7] is either due to the isotope In^{122} or is an isomeric state in Sn^{122}. (Of course, *a priori*, the latter possibility is rather unlikely.)

A study of betas emitted by the new activity was performed using a sample holder constructed of 0.001-in thick polyethylene sheets, to avoid interfering activities, such as the strong betas of N^{16}. The spectrum exhibited by the new activity was very similar to that of N^{16}, except at higher energies where no component as high in energy as the 10.4-MeV one[3] of N^{16} was found. The latter fact also shows that the beta spectrum observed is not due to any possible oxygen impurity in the sample irradiated. To confirm this further, a gamma-ray spectrum was taken with the requirement of a coincidence in the beta detector biased integrally at 1 MeV. As strong 1.0- and 1.14-MeV gammas were observed also in this spectrum, it is concluded that the new activity definitely emits strong betas and consequently cannot be an isomer of Sn^{122}. Due to the poor resolution of the plastic crystal and the fact that a "thick" (powder) beta source was used, only one beta end-point energy, 4.5±0.8 MeV, is conclusively observed with the possibility of having one or more higher energy components of considerably less intensity.

The gross-beta decay followed with the beta crystal biased at 1 MeV showed a half-life of 7.4 sec. The weighted mean value for the half-life studied is 7.5±0.8 sec.

[7] No activity with the decay characteristics presented in this paper has been reported. See, e.g., J. Kantele and R. Rogers, U. S. Atomic Energy Commission Report ORO-436, 1961 (unpublished).

If one assumes that the strong 4.5-MeV beta component feeds the (995 keV) (1140 keV) gamma cascade, one obtains a total beta disintegration energy of about 6.6 to 6.7 MeV. This is in a good agreement with the value (~6 to ~7 MeV) one expects from beta-decay systematics[8,9] for In^{122}. On the other hand, it is most likely that the new activity is produced by the (n,p) reaction in Sn^{122}, since products of other reactions with a reasonable cross section are known[3] and are excluded by the observed decay characteristics.

In order to obtain information about possible isomeric transition in In^{122}, the K x rays emitted by the source were studied with a 3-in.×3-in. NaI(Tl) crystal. When a careful calibration was performed with In and Sn K x rays from known sources, it was unambiguously established that Sn K x rays were emitted by the source with a half-life of about 7 sec. When corrected for absorption, it was estimated that the total intensity of the K x rays is of the same order of magnitude as that of the 1.14-MeV gamma. This x ray is apparently due to a prominent internal conversion in Sn since the fluorescent x rays due to betas were shown to be of two orders of magnitude weaker intensity. (This was accomplished by surrounding a N^{16} source with a 200-mg/cm² tin sheet and by comparing the intensities of the Sn K x rays and the N^{16} gammas.) Since, however, due to the presence of strong betas, no conclusive coincidence could be observed between the x rays and the 995- and 1140-keV gammas, there is no definite proof that there was a highly converted gamma associated with the decay studied, although this probably is the only possibility. If this is really so, the new activity cannot be due to any Cd isotope (which is unlikely anyway) but must be assigned uniquely to In^{122}. Since no In K x rays were found, there probably is no prominent isomeric step in In^{122} with an energy release of more than about 28 keV.

Further work on the In^{122} decay is in progress; in particular, the possible multiplicity of the 1.14-MeV gamma, which is of prime importance, is being studied. A tentative decay scheme will be proposed and discussed later, as well as the probable isomeric nature of the initial In^{122} state.[1]

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