High Altitude Observatory[4] as region $51E$ crossing the solar disk for the fifth and sixth time, respectively. Similarly, a sequence beginning 24 July was identified as $51K$. The 2800 Mc/sec radio noise for this period is shown at the top of Fig. 1.

Further validity of these data is obtained from the approximate correlation of the magnitude of solar activity and the observed particle intensity changes. A new solar region ($51P$) became important on its August transit and was at c.m. on 5 August. Also the region $51E$ was reported decaying on the September transit thus decreasing the importance of $51E$ relative to $51P$ on the September transit. It should be noted that we have not yet developed any method to distinguish between two local regions at nearly the same heliocentric longitude except when there is a great difference between the observed activity of the two regions.

From a group of 22 consecutive neutron intensity maxima coincident among the monitors, 19 have been identified with solar c.m. positions for active regions, two are uncertain, and one although real does not appear to correspond to a reported active region. It may be shown that the intensity decreases do not have any simple relationship to the onset of geomagnetic storms.

Tentatively, we call the solar component of the primary cosmic radiation that part of the low and intermediate energy primary radiation which shows extra-terrestrial intensity changes associated with active regions on the sun. This solar component may arise from either of the following:

1. Redistribution of some cosmic-ray particle energies (for example, when the cosmic-ray particles are accelerated by low energy neutral ion beams emitted from local active regions on the sun);[5] or

2. Direct production by the sun of a small fraction of the cosmic-ray particles.[6]

Since the measurements at $\lambda \approx 41°$ show that these time-dependent changes occur for primary proton energies even >5 Bev and there is no large diurnal effect at the maximum intensity, there are some difficulties with both concepts, but perhaps the greater difficulties exist with the assumption of direct solar production.

These experiments will be reported in detail covering the period 1950 and 1951. The authors wish to thank Mr. S. B. Treiman for assistance in the early stages of the work.

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† Bull. Am. Phys. Soc. **26**, No. 6, 24 (1951).
[1] J. A. Simpson, Phys. Rev. **81**, 895 (1951); Phys. Rev. **83**, 1175 (1951), Sec. VI.
[2] J. A. Simpson, Proc. Echo Lake Conf., p. 252 (1949).
[3] 2800 Mc/sec data were kindly furnished by Mr. A. Covington, National Research Council, Ottawa, Canada. 200 Mc/sec data are kindly provided by Dr. C. Burrows and the Radio Astronomy Group, Dept. of Electrical Engineering, Cornell University, Ithaca, New York.
[4] These corona data were prepared by Dr. W. O. Roberts and Miss Dorothy Trotter, High Altitude Observatory, Boulder, Colorado. We are indebted to them for the careful preparation of isophotal charts of the 5303A emission and their close cooperation in reporting solar flare effects. The assistance of Dr. A. H. Shapley and the Central Radio Propagation Laboratory, National Bureau of Standards, in providing prompt S. I. D. and flare data is greatly appreciated.
[5] H. Alfvén, Phys. Rev. **75**, 1732 (1949).
[6] See, for example, E. M. McMillan, Phys. Rev. **79**, 498 (1950).

An Investigation of the Double Beta-Decay of $_{50}Sn^{124}$ *

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FIREMAN[1] has reported a half-life between 4×10^{15} and 9×10^{15} years for the decay of $_{50}Sn^{124}$ to $_{52}Te^{124}$ by the simultaneous emission of two negative beta-particles. This result would indicate that double beta-decay is unaccompanied by neutrinos, since the expected half-life for the process with the emission of two neutrinos is of the order of 10^{10} times longer. However, the results of Inghram and Reynolds[2] for the double beta-transition of $_{52}Te^{130}\rightarrow{}_{54}Xe^{130}$ and Levine *et al.*[3] for the double beta-transition of $_{92}U^{238}\rightarrow{}_{94}Pu^{238}$ give minimum half-lives of the order of 10^{19} years. Further investigation of the activity of $_{50}Sn^{124}$ therefore seemed desirable.

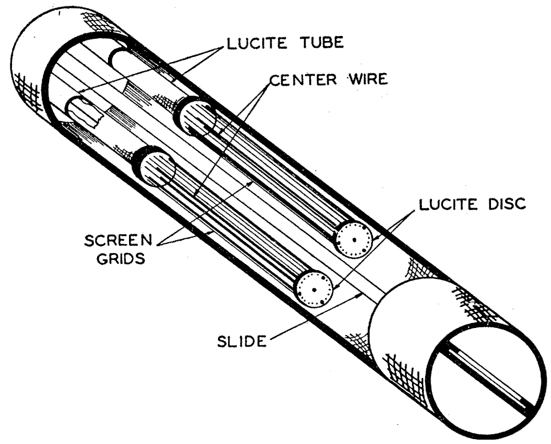

FIG. 1. Double screen wall counter.

Our method of measurement involves two screen wall counters[4,5] in coincidence within the same 24-inch long, 3-inch diameter cylinder, as is shown in Fig. 1. The sample is mounted on one-half of a 16-inch long slide and the background material on the other half. Alternate counting of the background and sample can be accomplished by tipping the counter, so that the sample slide can move from one end to the other inside a fixed center slide. The total counting volume, for the two halves of the cylinder, has an eight-inch length and a three-inch diameter. This enables us to measure samples of up to 140 cm² area. The two screen wall counters are in coincidence, while a set of 11 counters, 18 inches long, 2 inches in diameter, surround the cylinder and are in anti-coincidence with the screen wall counters. The entire setup is in an 8-inch iron shield to reduce the gamma-ray background. Tests showed that coincidences between the two halves occur at a rate expected if the counter were sensitive all the way to the corners of the hemicylindrical volumes defined by the counter cylinder and the sample foil.

A 3.013-gram sample of stannic oxide containing 95 ± 1 percent Sn^{124} was obtained from the Stable Isotopes Research and Production Division of the Oak Ridge National Laboratory. The sample was reduced to the metal by mixing it with a small excess of sodium cyanide and heating for several hours. This was then rolled to a 24-mg/cm² thickness and 83-cm² area. Some pure stannic oxide, of ordinary isotopic abundance, was treated in exactly the same fashion and used as the background material. Since investigations of the coincidence background showed a marked dependence on the thickness of slide material due to scattering of chance gamma-rays, the background metal was rolled to the same thickness and then cut to the same shape and area as the sample.

Both the singles and coincidence activity of both the sample and background were measured and the results are listed in Table I. The errors given are standard deviations calculated from the counting statistics.

TABLE I. Measured activities of enriched and ordinary tin.

Activity measured	Background (cpm)	Sample (cpm)
Singles (half-cylinder) without A.C.'s[a]	90.5 ± 1.1	89.3 ± 1.0
Singles (half-cylinder) with A.C.'s	8.40 ± 0.15	8.23 ± 0.16
Coincidence without A.C.'s	38.1 ± 0.2	38.2 ± 0.2
Coincidence with A.C.'s	1.310 ± 0.007	1.304 ± 0.007

[a] Anticoincidence shielding.

TABLE II. Minimum half-lives for various energies from measurement of enriched tin sample.

Energy (Mev)	Minimum half-life (years)
1.0	1.7×10^{17}
1.5	2.1×10^{17}
2.0	2.4×10^{17}

Assuming that the maximum possible activity is less than twice the standard deviation, we can calculate a minimum half-life for the double beta-decay of Sn^{124}. The minimum half-lives as a function of the energy assumed for the process are given in Table II.

An investigation also was made of the possibility of two successive beta-emissions through an intermediate nucleus. Antimony carrier was added to nine moles of pre-war stannic chloride and then separated. The antimony was then counted for the 60-day beta-particle of Sb^{124}. An activity of 0.38 ± 0.23 cpm above background was obtained. Assuming the activity for the sample to be less than 0.5 cpm, the minimum half-life for the transition is 10^{17} years.

These results differ significantly from those of Fireman.[1] In order to obtain his result, we would have had to observe at least 0.5 cpm due to the sample, whereas our measured activity was -0.006 ± 0.010 cpm.

A number of possible explanations for Fireman's activity, other than double beta-decay, suggested themselves during the course of this work. One possibility is that his two samples were not of the same thickness. If there were any gamma-ray contamination in the samples or elsewhere in the experimental environment and if his enriched sample was thinner than the other, a higher coincidence rate for the enriched sample would result. Another possibility is contamination of his enriched sample with a beta-activity that would give coincidence counts by backscattering from one counter into the other.

Appreciation is expressed to Dr. C. P. Keim of the Stable Isotopes Research and Production Division of the Oak Ridge National Laboratory for his cooperation in making available the enriched Sn^{124} isotope used in this work. The experiment on the removal of antimony from a large tin sample and testing it for Sb^{124} was proposed by Dr. T. P. Kohman.

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L-Electron Capture and Alpha-Decay in Np^{235}*

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THE isotope Np^{235} has previously been reported[1] to decay by orbital electron capture with a half-life of approximately 400 days. By the bombardment of 10 grams of enriched U^{235} (95 percent U^{235}) with 20-Mev deuterons in the 60-inch Crocker Laboratory cyclotron, a much larger sample has been prepared and more accurate measurements made on the radiations of Np^{235}.

After allowing the bombarded target to decay for several months so that all short-lived activities had completely decayed, a very pure neptunium fraction was isolated. This sample, in addition to the x-rays accompanying electron capture, emitted a small number of alpha-particles having an energy of 5.06 ± 0.02 Mev (disintegration energy 5.15 Mev). The decay of these alpha-particles and the x-rays have now been followed for a little more than 2 years and both give a half-life of 410 ± 10 days, showing that both originate from decay of Np^{235}.

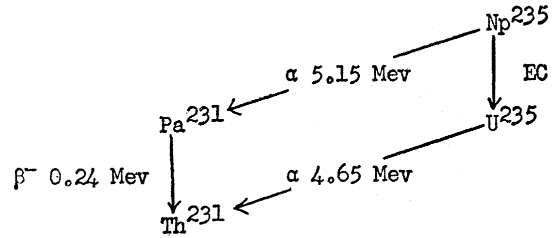

FIG. 1.

The disintegration energy for the reaction $Np^{235}+e^-=U^{235}$ can be calculated using the closed cycle system and the disintegration energies shown in Fig. 1. These values give $5.15-(4.65+0.24)=0.26$ Mev as the energy avilable for capture of a free electron. After subtracting the orbital electron binding energies, 0.14 Mev and 0.24 Mev are the energies available for *K*-electron capture and *L*-electron capture, respectively. This very low disintegration energy and the high nuclear charge are expected[2] to give a high ratio of *L*-electron captures to *K*-electron captures, particularly in the case of forbidden transitions.

In agreement with this prediction, a large excess of *L* x-rays over the number of *K* x-rays has been observed, corresponding to greater than 90 percent *L*-electron capture and less than 10 percent *K*-electron capture. This conclusion was first reached from absorption curves using the best available estimates of the counting efficiencies of these *K* and *L* x-rays and has since been confirmed by the use of xenon filled proportional counters connected through a linear amplifier to a 48-channel pulse analyzer in an arrangement similar to that of Hanna *et al.*[3] This last method also gives evidence that most of the *L* x-rays arise from vacancies in the L_{II} and L_{III} levels. These vacancies can be created either by (1) capture of electrons from the L_{II} and L_{III} levels or (2) capture of an electron from the L_I level followed by a transition of the Coster-Kronig type to the L_{III} level. The available data do not seem to warrant an estimate of the relative numbers of captures from the various *L* levels but do warrant the conclusion that at least 90 percent of the electrons captured are from the *L* levels.

Figure 2 shows a typical curve obtained on the sample with settings of counter tube voltage and grid bias voltage corresponding to an energy range of about 7–27 kev. The observed curve (solid line) has the general shape expected from the *L* x-rays arising from the L_{II} and L_{III} levels while the dotted line shows the general shape expected if they originated in the L_I level.

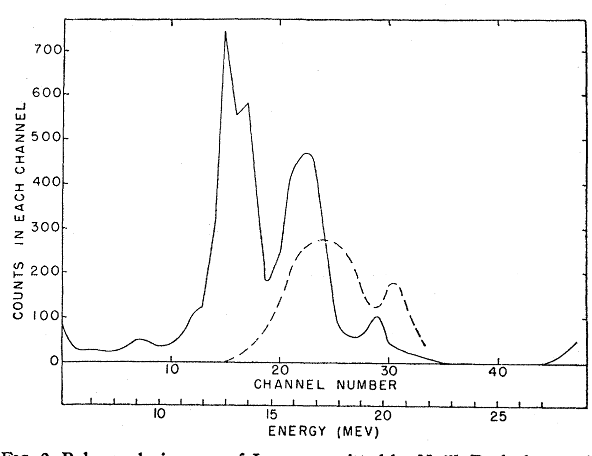

FIG. 2. Pulse-analysis curve of *L* x-rays emitted by Np^{235}. Dashed curve is general form of curve expected for transitions from the L_I level.