PHYSICS

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ABSTRACTS

The Nuclear States in the RaE β -Decay. NEAL NEWBY, JR. and E. J. KONOPINSKI, Indiana University.—It is shown that the β -transforming neutron of B²¹⁰ most probably has an $i_{11/2}$ character, despite a $g_{3/2}$ character of the ground state neutron in Pb³⁰⁰. This makes a critical difference to the RaE spectrum parameter, $\hat{\xi}' = i\langle r \rangle / \langle \sigma | x r \rangle$, yielding $\hat{\xi}' \approx + 1$ rather than $\hat{\xi}' \approx -1/10$. The effect of configuration mixing is also investigated and seems able to reduce $\hat{\xi}'$ no lower than to 0.92.

To arrive at the above conclusion, it is necessary to show that the neutron-proton attraction in the $(h_{9/2} i_{11/2})_1$ state is the large amount, 840 kev, greater than in the $(h_{9/2} g_{9/2})_0$ state. The resulting shell-model problem has interest independent of the β -theory application which was the primary objective of this work. True and Ford had found that two neutrons extra to the doubly-magic core, Pb³⁰⁶, as against nucleons deep in the core matter, interact with about the same strength and range of force as do two free nucleons. The problem here checks the extension of that important finding to neutron-proton and proton-proton pairs. The force strength is consequently *not* used as an adjustable parameter, as it has been in previous approaches to such problems.

The True-Ford problem involved only singlet, central forces between like nucleons in an essential way. The RaE daughter, Po²¹⁰, investigated here, has only coulomb repulsion superposed. The resultant comparison with experiments is about as good as that obtained by True and Ford.

The extension to the neutron-proton pair of Bi^{210} is far more complex, since triplet forces, an exchange character, and non-central forces, may now come into play. We find that the finite-range, central forces alone cannot give substantially more attraction in the $(h_{\theta/2} i_{11}/_2)_1$ state than in $(h_{\theta/2} g_{\theta/2})_0$. Even using the strength as a parameter cannot help significantly. However, the tensor forces produce attraction in the former and repulsion in the latter state. Hence, the two-body forces must be imitated even in this detail in order to yield an explanation of the RaE level scheme. This is unfortunate for quantitative results, because the strength of the two-body tensor force has never been determined unambiguously.

Our final conclusion is that the two-body neutron-proton force may be well represented by O-range forces of the same volume energy as found experimentally. Tensor effects vanish identically in this limit and so an unambiguous representation of the strength can be obtained. The results for the relative position of the J = 0 and 1 states, used as the test above, now turn out in almost perfect agreement with the

PHYSICS

observations. Configuration mixing plays a role in this result, and, in consequence, the work includes a generalization of DeShalit's formulas, for the interaction energies with O-range forces, to non-diagonal matrix elements.

Disintegration of I¹²⁴ and I¹²³. ALLAN C. G. MITCHELL, JOSE O. JULI-ANO, CHARLES B. CREAGER and C. W. KOCHER, Indiana University .- This distintegration of I^{124} (4.2d) has been studied with the help of magnetic spectrometers and scintillation spectrometers. This disintegration occurs 71% by electron capture and 29% by positron emission. Three positron groups were found having end-point energies of 2130 (46.0%), 1531 (46.4%) and 786 (7.5%) kev. The most energetic positron group has a shape characteristic of \triangle I = \pm 2, yes. Positron-gamma coincidence experiments show that this group goes to the ground state. Gamma rays of energies 2700, 2300, 2100, 1700, 1520, 1350, 723 and 603 kev together with annihilation radiation and Te K X-rays have been found and the relative intensities measured. A distintegration scheme, consistent with the levels of Te^{124} as determined from the decay of Sb^{124} , has been established. No beta rays were found showing that a transition of Xe¹²⁴ is highly improbable. The former work on I¹²³ (13.5 hours)¹ has been substantiated and, in addition, it seems highly unlikely that any positrons are emitted from I¹²³.

The Disintegraton of Iron-52 and Iron-53. JOSE O. JULIANO, C. W. KOCHER, T. D. NAINAN and ALLAN C. G. MITCHELL, Indiana University.-The disintegration of Fe⁵² (8.2 hours) and Fe⁵³ (8.9 min.) has been investigated with the help of scintillation and coincidence counting equipment. Fe⁵² decays 56.5 per cent by positron emission and 43.5 per cent by electron capture. The end-point energy of the positron group is 0.804 \pm 0.01 Mev. This is followed by a gamma ray of energy 165 key leading to $Mn^{5^{2}m}$ (21 min.). The chain $Fe^{5^{2}} \rightarrow Mn^{5^{2}} \rightarrow Cr^{5^{2}}$ has been studied. In addition to the well known states of Mn52-the ground state, with character 6 + and half-life of 5.7 days, and the first excited state (Mn^{52m}), with character 2 +, half-life of 21 min., and energy of 390 kev-these experiments show a third excited state at 555 kev having a configuration 0+ and a half-life of 1.2 \pm 0.2 x 10⁻⁸ sec. The disintegration of Fe⁵³ is accompanied by the emission of a gamma ray of energy 380 kev and positron groups of end-point energies 2.84 ± 0.10 , 2.38 ± 0.10 MeV, and an indication of a third group at 1.57 ± 0.15 Mev.

Spectroscopic Applications of Atomic Beams. V. KAUFMAN and K. W. MEISSNER, Purdue University.—Atomic beams in absorption and emission have played an important role in spectroscopic investigations of high precision spectroscopy, especially in problems concerning fine and hyperfine structure of spectral lines. Numerous investigations have been carried out with atomic beams excited by electron impact and observed perpendicularly to the direction of flight of the atoms.

This suggests that such a source would be ideal as the future primary standard of wavelength and length itself. To prove this and to arouse the interest of metrologists in atomic beam sources, experiments have been carried out with an atomic beam of calcium. These investigations show definitely that atomic beam sources are superior to all other sources with regard to sharpness of the emitted radiation. The latest experiments, regarding the limit of interference ("coherence length") of the radiation λ 4226 A of a calcium beam source, showed that at path differences of 1.3 meter, corresponding to an order number of over 3 million, distinct interference fringes can be observed. This must be compared with the order of 1.32 million obtainable with the best krypton line, λ 6057 A, produced in a hot cathode discharge tube which is filled with the krypton isotope Kr^{s6} and cooled to the triple point of nitrogen, 63°K. This line has been recommended by the Committee on Redefining the Meter as the future primary standard of length.

Measurements with a Slotted Line. M. E. HAYES and A. D. HUMMEL, Ball State Teachers College.—This paper is concerned primarily with the educational aspects of the Slotted Line in the physics laboratory. This piece of equipment is basically a length of coaxial line with a longitudinal slot cut in it for the purpose of inserting a sampling probe. When UHF electromagnetic waves are fed into this line and a load is connected to receive this energy, the field strength of the waves may be determined at any point by an indicating instrument connected to the traveling probe. If the load does not absorb all of the energy it is receiving, it will reflect part of the energy back through the line and thus produce standing-waves which may then be measured. The wavelength of the waves may be measured directly, and the voltage standingwave ratio (the ratio of the maximum to the minimum voltage along the line) and the impedance of the load may be calculated.

It is suggested that this equipment could be of considerable value in undergraduate physics courses through the utilization of the simpler aspects of standing-waves and their measurement.