Note on the Disintegration Energies of Na^{24} and Al^{28}

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SIEGBAHN[1] and others[2] have presented rather complete evidence that the disintegration energy of Na^{24} is in the neighborhood of 5.53 Mev. It has been stated[3] that this figure is not in agreement with the writer's[4] calculations, and an alternative level scheme has been proposed which provides a disintegration energy of 4.15 Mev.

The mass of Na^{24} calculated in ref. (4) is referred to the mass scale of Livingston and Bethe,[5] while ref. (3) has compared this figure with one calculated on a revised scale. For the present purpose such a comparison of absolute masses is incorrect. Relevant comparisons may, however, be made of the $Na^{24}-Mg^{24}$ mass differences.

The disintegration energy of Na^{24} obtained in ref. (4) was 5.0 Mev. This was calculated as follows:

$$(N-H^1)+4L+\Delta T+\Delta C$$
$$=0.80+8.32+1.10-4.87=5.35 \text{ mMU}=5.0 \text{ Mev.}$$

In this calculation $(N-H^1)$ is the neutron-hydrogen mass difference, L is the empirical function $L(A)$ derived in ref. (4), ΔT is the increment of kinetic energy entailed by the difference of isotopic spin, and ΔC is the corresponding decrement in coulomb energy. The figures for $(N-H^1)$ and ΔC are probably reliable. The divergence of 0.53 Mev between the calculated and experimental disintegration energies is accountable by assuming an error of six percent in L or fifty percent in ΔT (a minor, poorly known term). Probably each is uncertain to about this degree, and Wigner and Feenberg[6] have now, in fact, obtained somewhat different estimates of these terms. Accuracy only to one mMU was originally indicated in ref. (4). Despite this amount of uncertainty, the calculated figure definitely favors the level structure of Siegbahn.

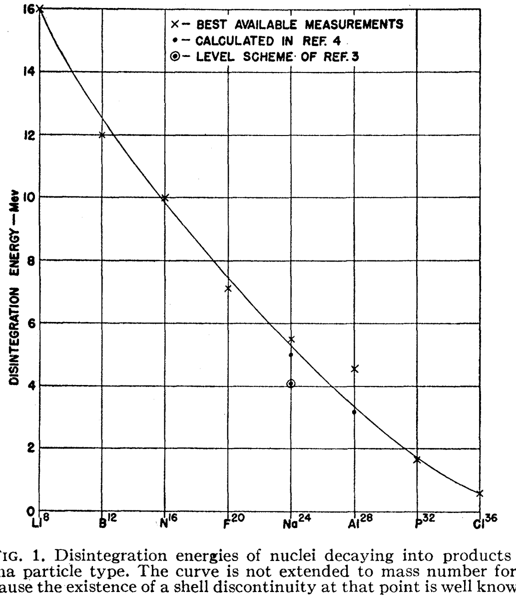

FIG. 1. Disintegration energies of nuclei decaying into products of alpha particle type. The curve is not extended to mass number forty because the existence of a shell discontinuity at that point is well known.

The question of the disintegration energy of Na^{24} may also be approached by examining the behavior of adjacent nuclei having corresponding symmetry. If the basic ideas of ref. (4) approximate reality, we should expect such disintegration energies to vary smoothly with mass number, except that nuclear shells may be revealed by discontinuities.

In Fig. 1 are plotted the disintegration energies of isobars decaying into alpha-particle type nuclei. For the disintegration energies of Li^8, B^{12}, N^{16}, F^{20}, P^{32}, and Cl^{36}, there has been sufficient accord in the recent literature so that we have entered points in these instances without further discussion. It will be seen that the plotted points for these nuclei fall close to a smooth curve, and that the result of Siegbahn for Na^{24} also fits in well with the general trend of disintegration energies.

While the old[5] value (3.3 Mev) for the disintegration energy of Al^{28} would also fall on the smooth locus, recent results of Bleuler and Zünti[7] supported by other evidence[8] lead to a disintegration energy for Al^{28} of about 4.55 Mev. The disintegration seems to consist of a beta-ray of 2.75 Mev followed by a gamma-ray of 1.8 Mev in cascade.

In summary, whereas no anomaly seems now to be presented by the disintegration energy of Na^{24}, recent results for the disintegration energy of Al^{28} are higher than anticipated by one Mev or more. If confirmed, these data indicate either a significant deficiency in the postulates of ref. (4) or the presence of an additional unsuspected shell closure.

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Cavity Accelerator for Electrons*

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A LINEAR electron accelerator employing a series of cavity resonators is under construction in this laboratory. Unlike accelerators thus far described, the cavities are mutually uncoupled. Frequency and phase coherence in the separate cavities are provided by a master oscillator driving a set of power amplifiers, each of which excites a single cavity. The phase of the fields in each cavity is adjustable independently of the other cavities by a phase shifter between the oscillator and the amplifier.

The system is designed for pulse operation at 580 Mc/sec., that being about the highest frequency at which high power amplifiers were available when this work was