# Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 264.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Beta Processes and Nuclear Stability

1. IT is well known that the stability of the atomic structure is closely connected with the mechanical conservation laws. It has been shown that even the stability of the atomic nucleus, in particular the nuclear beta stability, is subject to conditions which can at least formally be interpreted as conservation laws for the mechanical integrals of motion[1]. It may be pointed out, however, that the application of the usual mechanical conservation laws only is not sufficient to account for nuclear stability.

If one assumes a coupling of the nucleus with the electron field, the mechanical conservation laws alone would not exclude transitions in which a nucleus emits two electrons simultaneously and thus changes its charge by two units. This process would not involve the occurrence of a so-called neutrino, and we should expect considerable transition probabilities for such transformations. The radioactive transformations, however, show no indication of this type of double processes. RaD, for example, emits only a single electron, a second electron being afterwards emitted by the product nucleus, RaE. We have to conclude from this fact that the simultaneous emission of two electrons is a higher order transition of very small probability, involving the simultaneous occurrence of two 'neutrinos'.

The question arises why the neutrino occurs even if the mechanical conservation laws do not require such a particle. We are led to conclude that the beta-transitions are subject to an additional condition. The simplest form in which such a condition can be expressed seems to be the following: "Any production of particles has to involve the simultaneous production of an equal number of antiparticles". Attributing a positive sign to particles, a negative sign to antiparticles, the above condition can be regarded as a conservation law for the total number of particles. In the case of the natural beta decay this rule can be easily satisfied if one calls the hypothetical second particle an 'antineutrino'.

So long as we confine our attention merely to the production of pairs of differently charged electrons, the conservation of the total number of particles is secured by the conservation of charge and thus does not require the introduction of any special assumption. Any theory of the beta decay using the concept of a neutrino has to abandon this connexion and has to introduce an additional condition beside the conservation of charge.

2. It has been suggested by several authors that the interaction between nuclear particles might be due to beta processes of higher order. The small probabilities of the beta transformations, however, make it extremely difficult to account for the actual order of the nuclear interaction. Prof. Lauritsen and Prof. Oppenheimer have kindly pointed out to me that the possibility of very high beta decay probabilities for high decay energies is incompatible with recent investigations on the beta decay of $Li^8$ and $B^{12}$ and that therefore the beta decay must be due to an extremely weak coupling energy. This fact is very likely connected with the occurrence of the so-called neutrino.

I should like to point out here that it seems to be inconsequential to connect the nuclear interaction with the natural beta decay so long as there is no necessity to assume a neutrino to be involved in nuclear binding. We have to expect that the coupling between a nucleus and the electron field is very much stronger than the interaction with what is called a neutrino. It is only due to the restrictions implied by the conservation laws discussed above that the coupling between nucleus and electron field does not become effective in the natural beta decay. If we proceed, however, to higher order processes such as are involved in the above considerations on nuclear binding, these restrictions do not hold any longer and the weak coupling with the neutrino can be entirely neglected in comparison with the production of electron pairs. It may be found difficult, however, to reconcile even the known facts on the production of pairs and on the small isotope shift observed in spectral lines with the strong nuclear binding forces.

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[1] For example, NATURE, 132, 967; 1933.

## Beta Ray Spectra of Artificially Produced Radioactive Elements

WE have investigated a series of β-ray spectra emitted by radioactive elements obtained by neutron bombardment. The results of the measurements together with those previously published by us in NATURE are given in the accompanying table.

| Atomic No. | Element | Half-life period (τ) | Max. energy (in kv.) | $\tau.F(\eta_0)$ |
|---|---|---|---|---|
| 7 | N | 11 m. | 1,400 | 58 |
| 13 | Al | 2·3 m. | 3,000 | 340 |
| 15 | P | 3·2 m. | 3,600 | 1,400 |
| 15 | P* | 14 d. | 2,050 | 630,000 |
| 25 | Mn* | 2·5 h. | 3,200 | 50,000 |
| 35 | Br* | 18 m. | 2,000 | 480 |
| 35 | Br* | 4·2 h. | 2,050 | 15,000 |
| 35 | Br* | 36 h. | 950 | 5,900 |
| 45 | Rh | 44 s. | 2,600 | 170 |
| 45 | Rh | 3·9 m. | 2,100 ? | 420 |
| 47 | Ag | 22 s. | 2,800 | 130 |
| 53 | I* | 25 m. | 2,100 | 3,700 |
| 79 | Au | 2·7 d. | 1,100 | 17,000 |
| 77 | Ir | 19 h. | 2,200 | 585,000 |