A detailed discussion of the results of prominence observations made at Kodaikanal during 1905–50 will be published in the *Bulletin of the Kodaikanal Observatory*.

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Meson Masses

THE classical electron radius r_e is defined by $e^2/r_e = m_ec^2$. A sphere of constant density with radius r_e possesses a radius of gyration $r_g = (0\cdot4)^{1/2}r_e$. The energy eigenvalues of the rigid rotator are not yet known in the extreme relativistic region; but there one can quantize with integers k as for circularly polarized photons: thus $r_kp_k = k\hbar$. For $k = 1$ and $r_1 = r_g$ it can be deduced that:

$$m_1/m_e = p_1/m_ec = \hbar/m_ecr_1 = \hbar/m_ecr_e\,(0\cdot4)^{1/2} = 137 \times 1\cdot58 = 216\cdot6. \quad (1)$$

Thus the first rotation level compares with the first meson mass 212 m_e.

The mass of the π-meson requires $r_g = \frac{1}{2}r_e$. This is true for a disk. The non-relativistic eigenfunction P_1^1 consists of a section through the axis. In the extreme relativistic region it will contract and may indeed degenerate into a disk rotating about an equatorial axis.

Levels with $k > 1$ are not impossible. But it seems that the observed higher meson masses can be approximated better by quadratic relations. These can be derived, for example, if one assumes that a sphere with radius r_e can contain n rotators in a row, with radius $r_n = r_e/n$. According to (1), one rotator with radius r_n has a mass nm_1. This leads to a total mass $m_n = n^2m_1$, if all n rotators are of the same kind ($r_g = 0\cdot632r_n$ or $r_g = \frac{1}{2}r_n$, and $k = 1$). One obtains the following masses:

	$P_{1,0}$	$P_{1,1}$	$P_{2,0}$	$P_{2,1}$	$P_{2,2}$	$\Delta_{3,0}$	$\Delta_{3,1}$	$\Delta_{3,2}$	$\Delta_{3,3}$	$P_{3,0}$	$P_{3,1}$	$P_{3,2}$	$P_{3,3}$	$P_{4,0}$
Calc.	216·6	274	866	981	1,096	1,400	1,523	1,647	1,771	1,949	2,121	2,293	2,466	3,464 m_e
Obs.	212±5	275	796	967	1,125	1,370	1,510				2,203			
	μ	π	V_2	τ	$\varkappa_2$	$\varkappa_4$	$\varkappa_1$				V_1			

The systems are called $P_{n,m}$. The first index specifies the number of rotators contained in the sphere; the second suffix indicates how many rotators possess $r_g = \frac{1}{2}r_n$. The same principle allows the arrangement of three rotators in an equilateral triangle (called Δ), or of four in a tetrahedron (T) within a sphere of radius r_e.

The first seven levels of this scheme seem to have been observed[1]. V_1 compares with the mean of P_3 or T_4 ($T_{4,2} = 2{,}183\ m_e$). $\varkappa_1 = 1{,}510$ or $1{,}550$, according to Von Friesen. The observations by Leighton *et al.*[2] can be taken as further evidence for masses $P_{2,0}$, $P_{2,2}$ and $\Delta_{3,1}$.

Incidentally, the proton mass can be obtained if two rotators of the system $\Delta_{3,3}$ gyrate around a twofold symmetry axis. This gyration may, as in ortho-hydrogen, be stabilized by spin symmetry.

The radius r_e can be interpreted as the range of a force with a potential steep enough to balance the centrifugal force due to rotation.

Though the present rotator scheme can represent only a simplified picture of the true eigenfunctions, it already gives the masses of the μ, π, V, τ and $\varkappa$-mesons and has features (symmetry characters, etc.) which should be contained in a final theory.

These results were reported originally at the Bristol Conference on Heavy Mesons, held during December 18–20, 1951.

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Evidence for Nuclear Shells from Atomic Mass Measurements

THE successful manner in which the single-particle model of the atomic nucleus has accounted for many nuclear properties is well known to those who follow developments in nuclear physics. This model, which pictures nuclei as constituted of shells of protons and neutrons, predicts that closed shells should be exceptionally stable configurations. Both experiment and theory (in that order) have indicated that such closed shells occur[1] with 2, 8, 20, (28), 50, 82 or 126 protons or neutrons. In addition to these primary 'magic numbers', there are predicted a number of secondary ones, marking the closure of sub-shells; but the location of most of these is debatable. It is to be expected that certain mass effects are associated with the closing of these nuclear shells, and it is with this subject that the present communication is concerned.

For some time we have been making mass spectrographic measurements of the masses of many of the heavy nuclides, with the view of studying the gross features of the binding energy per nucleon curve. Descriptions of portions of this work have appeared[2] in the literature. We are taking this opportunity to present briefly the significant results of our investigations to date, some of which are based on unpublished work, while others appear only when the data are examined *in toto*.

In the accompanying graph, the binding energy per nucleon is plotted against mass number for approximately 115 of the heavier stable nuclides ($Z > 21$). About half these values have been obtained mass spectrographically, while the remainder have been computed from these using disintegration, transmutation and microwave absorption data. On this plot the completion of a nuclear shell should be indicated by a sudden change in the slope, in keeping with the view that a completed shell represents an exceptionally stable configuration to which additional nucleons are rather loosely bound. The fact that such sudden changes in slope are found experimentally can be seen from the graph. Attention will now