7

Particles of Matter

The Deuteron

The positron was discovered in 1932. It appeared in cosmic rays and is, of course, merely a particle exactly like the electron but with a positive charge *e*. Positrons are ejected from radio-active substances, which suggests their existence in the atomic nucleus. It has been found that a proton can lose a positive electron, or positron, and become a neutron. Also, a neutron can lose a negative electron and become a proton. This suggests that the proton and neutron must each contain an electron and a positron. Both must contain a heavy nucleon.

All this supposes, without excluding the possibility, that there are no inversions of polarity of the charge constituents or energy exchanges between them as they undergo these various transmutations. If we go on to consider the prospect of combining the neutron and the proton, we find that there is a suggestion in the scientific literature that they might be bound together by what is called an 'exchange interaction' arising because they are rapidly changing their identity. The idea is that they are exchanging electrons and positrons so that, according to a proposal by Fermi, the neutron and proton are really different quantum states of the same fundamental particle. Now this may be true, but there are other possibilities. If we know that these elementary particles are aggregations of electrons, positrons and some heavy particles, and we know the physical size of these particles from our energy relationship as used extensively in previous chapters, it is worth while examining what may flow from this knowledge. The result contains a double surprise, and is all the more gratifying because of its simplicity.

The deuteron, the nucleus of heavy hydrogen, is the particle formed when a proton and a neutron are bound together. By studying this first we are likely to learn something about both the proton and the neutron as well. Also we do have a useful starting point because we know the measured binding energy of the deuteron. Wapstra and Gore* have shown its value to be 2·22464(4) Mev. In an article by McKee on the 'Nature of the Deuteron'† it is described as a diffuse vacuous particle of radius 4·3 10^{-13} cm.

Quark theory suggests that particles comprise an aggregation of charge components called 'quarks'. Early ideas about quarks of fractional charge $e/3$ or $2e/3$ seem less in evidence today. Quark theory is advancing more on the basis of quarks with charge $+e$ or $-e$. Thus the H particles of our previous chapter together with electrons and positrons become the prime candidates for consideration as the basic building blocks for particles of matter, at least as far as atoms are concerned.

The deuteron must, therefore, comprise two H particles which account for its main mass and an odd number of electrons and positrons, at least one of which must separate the two H particles. Note that two H particles of opposite polarity in contact would have a very substantial binding energy. This energy of electric interaction would correspond to the negative energy term in (166) and, for $P = Q$, this is three quarters of the energy of either P or Q.

In proceeding, we will, as before, not suppose that the energy of a charge e of radius x is $2e^2/3x$. Instead, we use the general energy expression e^2/kx and see whether the value of k can be determined by comparison of theory and experiment.

The choice for the quark structure of the deuteron is presented in Fig. 25. Electric interactions are deemed to favour the in-line configuration. Also we must remember that all matter shares a motion with the space lattice and motion relative to the lattice can induce electrodynamic effects. This is a factor which may well be conducive to the in-line configuration, because the charge may prefer to lie strictly in line with the lines joining adjacent lattice particles.

It is convenient to evaluate mass quantities in terms of electron mass as a unit, though remember that we are really speaking in terms of energy. The H particle is assigned the mass M and the electron or positron the mass unity. The electron radius is denoted a, as before. Model A depicts two positive H particles separated by one electron. We ignore at this stage the small radius of the H particle and consider all interaction energies referenced on the unit

* A. H. Wapstra and N. B. Gore, *Nuclear Data Tables*, **A9**, 265 (1971).
† J. S. C. McKee, *Physics Bulletin*, **23**, 349 (1972).

spacing a. Thus the energy represented by model A is $2M+1$ for the self-energies plus three interaction energy components. The latter are $e^2/2a$ for interaction between the H particles less two interactions each of e^2/a between the electron and an H particle. Since e^2/a is the

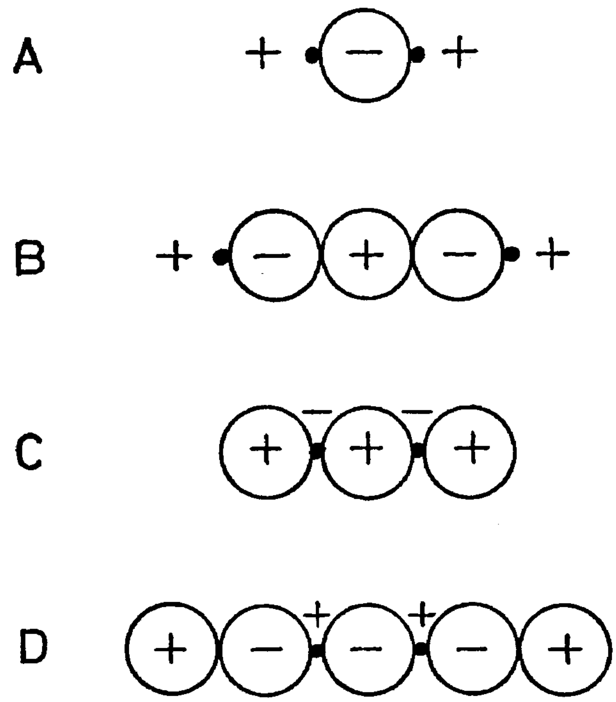

Fig. 25

unit k, this becomes $-1{\cdot}5k$. The total mass of model A is then $2M+1-1{\cdot}5k$.

When this is repeated for the four models shown in Fig. 25 we obtain:

A $2M+1-1{\cdot}5k$
B $2M+3-2{\cdot}317k$
C $2M+3-2{\cdot}917k$
D $2M+5-3{\cdot}558k$

The deuteron will be the one having the most stable form, that is the one of smallest mass. This depends upon k. The negative term in the above list represents the energy binding the deuteron together. Experimentally, this is about 2·22 Mev or 4·35 electron mass units. Note that the rest mass energy of the electron is 0·5110 Mev. Thus each model satisfies a different value of k. For model A, k becomes 2·9. We know this is impossible because k cannot exceed 2, as we saw when discussing the psi particles. However, ignoring this, a value of 2·9 would make the mass of model C least amongst the four models listed. Model B, as a model determining k is ruled out on direct comparison with C, the latter having less total mass energy. Similarly, model D, which would require k to be 1·222, is ruled out in comparison with model C. The deuteron has to be structured as shown by C. Then k becomes 4·35/2·917 or approximately 1·5, as we established before.

The classical radius of the electron often quoted in physics books is $e^2/m_e c^2$ or 2·8 10^{-13} cm. The radius of the electron recognized in this work, and based upon the formula $2e^2/3m_e c^2$, is 1·88 10^{-13} cm. There are three such particles accounting for the main bulk of the deuteron model under discussion. It is a cigar-shaped object of length 6 times this radius and diameter twice this radius. It could well appear in experiments to have a diffuse radius midway between these values, at about double the quantity 1·88 10^{-13} cm. This seems in reasonable accord with the radius of 4·3 10^{-13} cm, quoted by McKee.

Of special interest to the author is the fact that the binding energy of the deuteron is quoted to so fine a value as 2·22464(4) Mev. When two charges e are separated their interaction energy depends upon their separation distance. If they are separated repeatedly and the same energy is required then they must be separated to a definite distance, unless we contemplate separation to the fiction of infinity. An uncertainty of 0·00004 Mev then implies separation with certainty to a distance beyond about 3 10^{-9} cm. This seems a very high distance to regulate the binding energies of a nucleus. It is very nearly the radius of the electron orbit of the unexcited Bohr hydrogen atom. It is well outside the range of electrons in heavier atoms.

To reconcile this with logically-based physics, we need to have a mechanism which limits the separation distance between the quarks when transmutations occur. The author believes that the distance $2r$ in the space theory presented is critical to such separation. Firstly, the σ continuum and the oppositely charged lattice system are separated by this distance. Thus it is a fundamental separation distance for charge of opposite polarity provided by Nature itself. Secondly, it happens to improve the agreement between theory and experiment if we make such an assumption. Note that the energy of interaction at the separation distance is $e^2/2r$ and this is simply $\alpha m_e c^2$, where α is the fine structure constant. $2r$ is about 3·86 10^{-11}

cm. This is well free of the electrons in Bohr orbits and yet well beyond the dimensions of the deuteron.

One question we face is how, upon separation, three positive charges from the deuteron dispose themselves in relation to the two negative charges. Here the author indulges in some speculation. We imagine that charges of the same polarity as the lattice particles actually displace these lattice particles and transiently assume their positions. The oppositely charged particles each take up positions in juxtaposition at the separation distance $2r$ and, further, the five particles interact with a sixth charge in the environment to assert their interactions as three pairs. The separated system is shown in Fig. 26.

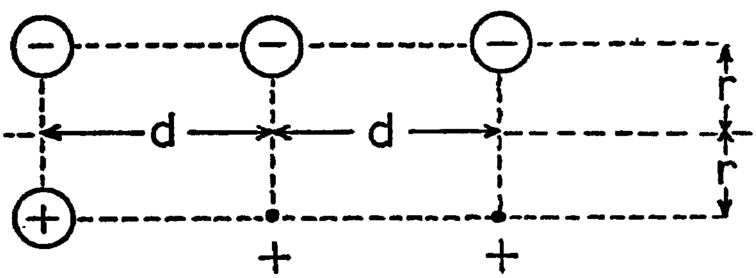

Fig. 26

The space metric has a cubic lattice dimension d, shown from the previous analysis to be about $6{\cdot}37\ 10^{-11}$ cm. This follows because r is known from data put in (93) and we have established the value of r/d as 0·3029.

The assumption we have made is that charge has an affinity for lattice positions and that three charge pairs in the critical disintegration ground state are arrayed side-by-side forming a rectangular lattice configuration of spacing d between charges of the same polarity and $2r$ between charges of opposite polarity. The mysterious sixth charge may be that of whatever influence caused the disintegration. It could have been a charged particle conveying the energy needed to trigger the disintegration.

The calculation of the total interaction energy for the system shown in Fig. 26 may be verified as giving:

$$-\alpha m_e c^2[3 - 5z + 4z(1+z^2)^{-\frac{1}{2}} + z(1+\tfrac{1}{4}z^2)^{-\frac{1}{2}}] \qquad (171)$$

Here z denotes $2r/d$. Note that α is 0·007298. The value of (171) is $-0{\cdot}01914\ m_e c^2$.

In the basic model C of the deuteron, assuming charge separation to infinity, the binding energy was 4·375 m_ec^2. This was subject to a reduction to allow for the finite size of the H particles. These are proton-sized and their effect is to reduce this calculated binding energy by a factor of 1/1836, that is to 4·37262 m_ec^2. Adjusting this for the ground state correction just calculated, that is subtracting 0·01914 m_ec^2, gives 4·35348 m_ec^2 as the theoretical energy needed to trigger disintegration of the deuteron. The conversion factor to Mev is 0·511003. Accordingly, the theoretical energy derived is 2·22464 Mev. This is exactly the measured binding energy of the deuteron.

The result must, therefore, encourage us to believe that this deuteron model is essentially correct and that the lattice structure of space does have a role in the disintegration criteria of atomic nuclei.

The Proton

We come next to the structure of the proton. The structure of the proton and its importance has been discussed in recent years by Feynman* writing in *Science* and Jacob† writing in *Physics Bulletin.* Feynman's article begins with the words:

> Protons are not fundamental particles but seem to be made of simpler elements called quarks. The evidence for this is given. But separated quarks have never been seen. A struggle to explain this paradox may be leading us to a clearer view of the precise laws of the proton's structure and other phenomena of high energy physics.

The three constituent quarks forming the proton have the same spin property as the electron. Their angular momentum quantum is $h/4\pi$.

A proton must then, on our model, comprise an H particle and an electron-positron pair or a negative H particle and two positrons. The latter can be shown to be slightly more stable than the former, by the method used to analyse the deuteron. However, given an H particle as a starting point, the creation of an electron-positron pair by deployment of some of its energy is so probable that the prevalent form of proton is sure to be the one depicted in Fig. 27.

In the theory developed in this work so far we have relied upon

* R. P. Feynman, *Science*, **183**, 601 (1974).
† M. Jacob, *Physics Bulletin*, p. 175, April, 1975.

three basic principles. These require conservation of energy, charge parity and the space occupied by charge. In applying these principles we have found that interactions are quite complex but involve a primary interaction in which charge parity plus *either* energy *or* space are conserved and an associated secondary scheme of interaction in which the residual conservation property is catered for. Thus in psi particle creation our primary interaction involved energy conservation, whereas in the lattice particle-electron equilibrium interaction the primary concern was space conservation.

When we come to consider the production of the proton from an H particle we look to energy and charge conservation as the primary

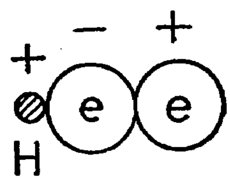

Fig. 27

interactions and look also to intrinsic stability of the resulting proton. Having created a proton, we must have intrinsic conservation of charge, space, and energy. Given N charge constituents, each of charge $+e$ or $-e$, we know that N must be odd for the proton to have an overall charge $+e$. Also, there will be N radius dimensions governing the interaction energy and the total volume of space displaced by the proton as whole. If there is a perturbation tending to change the intrinsic energy of an individual charge component then its radius dimension must change. For total energy and total volume to be conserved in such a situation N must exceed unity. It must be 3 or more. These two conditions determine two equations which only have unique solution if two, and only two, radius parameters are involved. The proton must comprise particles in two sizes. Hence we see that the H particle must appear in association with pairs of identical oppositely-charged particles to form a stable entity. Electrons and positrons are the likely partners. The proton shown in Fig. 27 is the one of least total energy, with $N=3$.

The energy is, of course, exactly that supplied by the H particle. Thus the proton-electron mass ratio is 1836·152, as found for the newly-created H particle. Obviously, in sharing this energy to create the electron-positron pair and then recovering some from the interaction energy of the resulting proton, the H particle will, as a proton constituent, adopt a slightly smaller energy value itself.

Our problem now is one of verification. Two confirmations of the proton model just developed will be given. We will calculate the energy released in the process by which a neutron created by disintegration of a deuteron decays into the proton. This will afford a numerical check. Secondly, we will calculate the proton spin magnetic moment, as a further numerical check. The latter involves techniques which are at the forefront of the current state of development of this theory and which have not yet been fully interpreted. The calculation of proton spin magnetic moment is therefore left until later in this chapter, where it also fits well with the outcome of our analysis of the muon.

If the deuteron model and the proton model are compared it will be seen that the deuteron has two negative H particles and the proton has one positive H particle. For the deuteron to decay into a neutron and a proton the energy added to cause this disintegration must also somehow cause the H particle polarity to invert. This is depicted in Fig. 28. There must, therefore, either be a polarity inversion or an

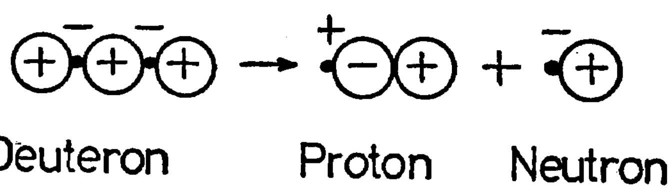

Fig. 28

energy interchange between an H particle and a positron. Our attention must turn to this phenomenon before we can study the balance of energies in the deuteron disintegration.

Remember the process by which the 1843-quantum was explained. The characteristic volume of the lattice particle was utilized to create electrons and positrons and so account for an energy quantum of the same order as that of the H particle. Our hypothesis is that the H particle changes polarity by converting into a whole cluster of virtual electrons and positrons, mixing with an electron or positron of opposite polarity, and then condensing back into an H particle of opposite polarity to leave an electron or positron which also *appears* to have undergone polarity inversion in the process.

This is an interaction primarily involving energy and charge conservation, in spite of the apparent polarity inversion. We can expect the space requirements to be met transiently by the displacement of the space medium and the compaction of a lattice particle to form an electron or positron, coupled with an energy fluctuation elsewhere. Thus the lattice particle size could set the space quantum in which the electrons and positrons, possibly interspersed by some virtual muons, migrate at random, pending the formation of the new H particle. The self-energy of such a cluster, without regard to number or size of charges, is $3e^2/5b$, assuming that the charges are all paired with opposites except for one charge e. This is the energy of the cluster itself, taken as a uniformly-distributed spherical charge e of radius b, and not the self-energy of each charge.

This energy $3e^2/5b$ is the component which tends to disperse as kinetic energy. It is offset by a potential energy linked with the volume of the sphere of radius b. The sphere has an effective mass given by (130) and this involves an energy stored locally by the balancing graviton system. The energy is $e^2/3b$. The net result is that the inversion of an H particle involves a loss of energy given by:

$$E_L = (\tfrac{3}{5} - \tfrac{1}{3})e^2/b \qquad (172)$$

Such a dispersal of energy must occur when lattice particles interact with the 1843-quanta of energy to create clusters of electrons and positrons in the mutual equilibrium process between electron and lattice particle. However, this is a universal activity and the energy dispersed is merely energy shared by the lattice particles. In short, the loss is reversible in the vacuum medium itself.

Evaluating E_L from our knowledge of the size of the lattice particle in relation to the electron, we find:

$$E_L = 0{\cdot}4 m_e c^2/(1843)^{1/3} \qquad (173)$$

or 0·032625 electron mass units.

It is important now to keep in mind that the protons produced by deuteron distintegration involve H particles which need not shed energy to form electron-positron pairs. There is enough energy or a source of electrons and positrons anyway. This applies to the onward stage of neutron decay as well. Thus such protons may be anomalous and have a slightly higher energy than the normal proton formed directly from H particles in isolation. The deuteron sourced protons could well have an onward decay stage which hitherto has not been detected or they may remain stable and exist in an anomalous form which has not yet been detected. The H particle in the deuteron is negative and is assigned the mass value M^-, with electron mass unity. The H particle produced from this by inversion is assigned the mass value M^+. Thus M^- is equal to $M^+ + E_L$.

The deuteron when excited to its ground state has used the energy causing disintegration to offset its interaction energy. The five constituent particles of total self mass $2M^- + 3$ then represent the energy in the ground state. They could reform to re-establish the deuteron but for the inversion of one M^- particle. This releases energy E_L which separates the particles well beyond their ground state level. Note that E_L is about 70% greater than the ground state excitation energy of the deuteron. Thus we can consider the constitution of the proton and the neutron as if we begin with the five particles at infinity.

The M^+ and the electron-positron pair come together to form a proton. In so doing they release their interaction energy E_P to augment the energy of the neutron. Thus:

$$(M^+ + M^- + 3) = (M^+ + 2 - E_P) + (M^- + 1 + E_P) \qquad (174)$$

The neutron lives for many minutes before decaying, an event which requires further H particle inversion with the positron being substituted by an electron. Thus:

$$(M^- + 1 + E_P) \text{ becomes } (M^+ + 1 + E_P + E_L) \qquad (175)$$

This divides into a proton to leave the electron with surplus energy:

$$(M^+ + 2 - E_P) \text{ plus } (1) \text{ plus, as energy } (2E_P + E_L - 2) \qquad (176)$$

Some of the energy has been deployed into a captured electron-positron pair associated with the proton. The remaining energy carried away by the electron is $(2E_P + E_L - 2)$ and this is simply kinetic energy of the electron.

The value of $-E_P$ for the proton shown in Fig. 27 is the sum of three interaction energies. These are, approximately, $-e^2/a$, $-e^2/2a$ and $+e^2/3a$. The total is $-7e^2/6a$ or $-1{\cdot}75$ units of electron mass energy. The kinetic energy of the electron liberated by the neutron in creating the proton is therefore about 1·5 electron rest mass energy units, ignoring E_L.

The measured value is of this order and is known to be one part in 10^4. Accordingly, to check our theory we need rigorous analysis of the proton model, allowing for the finite size of the proton.

The formula for E_P is:

$$(3/2)[1/(1+n) - 1/(3+n) + 1/2] \tag{177}$$

where n is 1/1836. Upon evaluation this gives:

	$E_P = 1{\cdot}7492743$
Thus:	$2E_P = 3{\cdot}4985486$
Add:	$E_L = 0{\cdot}032625$
	3·531173

Substractıng 2 to cater for the creation of the electron and positron leaves an energy of *1·531173* as our calculated energy in electron rest mass units. It is the energy measured from the beta spectrum of neutron decay. The experimental value reported in 1976* is: *1·53116(8)*. This gives very good support for the theory presented.

The Pion

The technique by which we have just calculated the binding energy of the proton will now be used extensively to discover the process of creation of the pion and the real muon.

Our object is to calculate the masses of the pion and the muon to a very high order of accuracy and to check the results with measured values. The discovery on which this effort is based is summarized in Fig. 29.

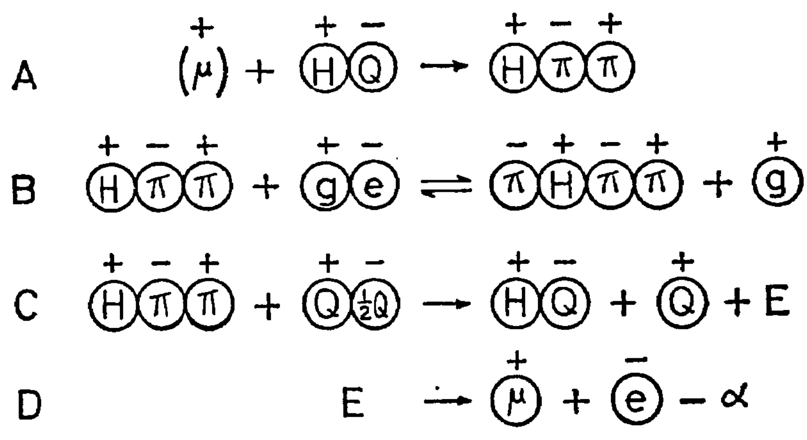

Fig. 29

* 'Particle Data Group', *Rev. Mod. Phys.*, **48**, S1–245 (1976).

The particle reactions are as follows:

(A) A virtual muon of positive charge combines with the system generating the H particles, Q being the energy E_0 of (160). Energy and charge are conserved to produce a particle aggregate similar to the proton but with the electron-positron pair replaced by a pair of mesons denoted π.

(B) The particle aggregate formed in A is able to convert a well-energized electron or positron, whichever has an opposite polarity to the H particle, into its own meson species, but as an addition to itself. Thus it can act as a catalyst in the type of equilibrium energy exchange shown in B. The graviton g has been chosen as the mediating particle because it happens to be around in the vacuum medium.

(C) The decay process of this catalyst occurs when an interaction with a neutral virtual muon combination, of the kind discussed following expression (168), occurs. This is an interaction with a surplus energy E.

(D) The energy E released by the decay of the catalyst is used to generate a real muon and either an electron or positron at the space system separation distance of $2r$, this accounting for the energy deficit of α electron mass energy units.

The latter condition was discussed when we studied the deuteron binding energy. The electron could merge with the Q^- particle to reconstitute the virtual muon combination in its neutral form, with a little energy release. The muon could decay into a virtual muon to reconstitute the virtual muon used in A. The whole cycle of events could, therefore, occur in a moderately energetic environment. It allows us to calculate the mass of the resulting muon and the mass of the intermediate meson, the pion, in terms of H, with a small-order dependence upon g.

We now use n to denote the pion/H-particle mass ratio. $1/g$ is the electron/graviton mass ratio. The energy released in B by the graviton complex in shedding an electron is:

$$1-(3/2)g/(1+g) \qquad (178)$$

The energy added to the H particle and double pion complex in acquiring the electron in pion form is:

$$nM\{1-(3/4)[1/(1+n)]-(3/4)[1/(2+n)]\} \qquad (179)$$

where M is the mass of the H particle in electron units as given by (168). By comparing (178) and (179) we should find equality. Therefore, given g we can evaluate n. An approximate answer of $n = 0{\cdot}151$ is found ignoring g by equating (179) to zero. By rigorous solution, taking g as 5063, we find:

$$n = 0{\cdot}1488809 \qquad (180)$$

Now although we have spoken of the pion, we really have used the word 'pion' more in the sense of a quark, like the H particle. The pion, unlike the H particle, forms unstable particle aggregations. The stabilizing influence of other similar charged bodies in the local environment is not so strong in the case of the pion. Therefore, whereas the H particle, if created equally in positive and negative forms, has some kind of polarity bias favouring survival of the positive form (possibly due to the preponderance of electrons which capture the proton in a hydrogen atom form), the pion quark is just as likely to be present in positive as negative form during its short lifetime. The resulting pions always form in an environment populated by virtual electrons and positrons with ample energy present. Thus, they can capture both electrons and positrons in equal numbers and there is no special reason why the pion quark should deploy its energy to create an electron-positron pair. Instead, it can capture either two electrons or two positrons and form in the lowest energy state, as depicted in Fig. 30.

Fig. 30

The resulting pion mass for this state is given by:

$$nM + 2 - (9/4)[1/(1 + 1/nM)] \qquad (181)$$

The expression involving brackets defines the three interaction energy terms in the pion system shown in Fig. 30.

From the fact that M is 1836·152 and the value of n derived in (180), we can evaluate the pion mass from (181). It gives:

273·1262

in electron mass units. This is in excellent accord with the experimental mass of the negative pion as given by Carter *et al.** Their value of 139,568·6 ± 2·0 kev is equivalent to 273·1266 ± 0·0039 electron mass units.

The Muon

The muon is a lepton. It does not involve any particle aggregation. It is a discrete charge like the electron. The pion quark has been evaluated from the energy balance of the reversible reaction shown in B in Fig. 29. Now we look to C to derive the energy quantum E by which the muon forms in D.

The Q systems have the same energy on both sides of the equation. They provide a basis for energy-free charge transfer. This arises from the use of equation (166).

The energy value of the $H:Q$ system is known from (170), with k as 3/2. It is:

$$M - M[(3/2)^{\frac{1}{2}} - 1]^2 \tag{182}$$

or

$$(1 - 0{\cdot}0505102)M \tag{183}$$

The energy of the H and pion quark system is given by:

$$\{1 + 2n - (3/2)[1/2] - (3/2)[1/(1+n)] + (3/2)[1/(3+n)]\}M$$

From (180) this is:

$$(1{\cdot}0626403)M \tag{184}$$

The value of E is then found by substracting (183) from (184):

$$0{\cdot}1131505\ M \tag{185}$$

which, with M as 1836·152, becomes:

$$207{\cdot}7615 \tag{186}$$

Adding the fine structure constant $\alpha = 0{\cdot}007297$ and subtracting the unit mass of one electron, as required by the D reaction in Fig. 29, we obtain:

$$206{\cdot}7688 \tag{187}$$

The measured value of this muon mass quantity is:†

$$206{\cdot}76859(29) \tag{188}$$

* A. L. Carter *et al.*, *Phys. Rev. Lett.*, **37**, 1380 (1976).
† D. E. Casperson *et al.*, *Phys. Rev. Lett.*, **38**, 956 (1977).

At the end of Chapter 5 it was indicated that we would return to the problem of the muon g-factor. The above discussion by reference to reaction D in Fig. 29 shows that the muon and electron (or positron) are formed in close proximity. Indeed, the α term signifies that their Coulomb interaction energy upon creation is fixed for a separation distance of $2r$, the fundamental separation between the C-frame and the G-frame, the former being the frame we associate with the q charge lattice and the latter being the frame we associate with the oppositely-charged continuum and graviton system.

$2r$ is about one sixth of the Compton wavelength, the diameter of the resonant field cavity which we spoke of in explaining the electron g-factor. Accordingly, it is difficult to contend that both the muon and the electron (or positron) have separate field cavities at the time they are created. We suppose that when a particle pair is created at the $2r$ separation distance they share the same field cavity. Then the physical size of neither particle will be relevant as they both move around centrally within a common cavity. Accordingly, we take the cavity size as determined solely by resonance between the surface and the centre, making the diameter equal to the Compton wavelength. The formulae derived for the g-factors of each charge in the pair in this state should then be that applicable effectively to a point charge. The term involving 3 in (123) must be removed to obtain the relevant g-factor:

$$g = 1 + (\alpha/2\pi) + (\alpha/2\pi)^2 + (\alpha/2\pi)^3 \dots \quad (189)$$

Imagine now the creation of an electron-positron pair from energy $2\,m_ec^2$. In fact, if created at the separation distance $2r$, the creation energy is $(2-\alpha)m_ec^2$ but the balance of energy is needed to separate them fully. Assuming such full separation, the electron will adjust, upon leaving the sphere of the resonant cavity of the positron, and establish its normal cavity resonance. It adopts a g-factor given by (123) and has a stable existence at the resonant frequency of the space medium. The residual positron, however, is not so stable. Let us suppose that in such a transition the spin energies and field energy outside the resonant cavity are separately conserved. This is simple hypothesis, to be judged on the results obtained. In this case, the residual positron will be left with a contracted resonant cavity and a slightly higher frequency oscillation than that of the space medium. Also, its g-factor will be given by (123) with the 3 terms preceded by a minus sign. The g-factor will become twice that applicable for the point charge (189) less that applicable to the normal electron. Subtracting (124) from twice (189) we obtain:

$$g = 1 + (\alpha/2\pi) + 0{\cdot}82735(\alpha/\pi)^2 + 0{\cdot}04(\alpha/\pi)^3 \dots \tag{190}$$

To this we must add the gravitational potential correction $0{\cdot}84(\alpha/\pi)^3$, as we did in deriving (126). The result is:

$$g = 1{\cdot}001165884 \tag{191}$$

It is then of interest to see that this compares with a reported experimental value* of the muon g-factor of:

$$g = 1{\cdot}001165895(27) \tag{192}$$

This is very close accord, but we have to explain why the residual positron in this electron creation process has the same g-factor as the residual muon accompanying the creation of a normal electron or positron. It will be understood that the above process could have produced a normal positron and a residual electron having this higher g-factor but being very unstable. Hence, we must examine the process by which reaction D in Fig. 29 could consolidate the residual energy around a muon with the same g-factor as given by (191).

The process we will suggest is based upon the electron-positron pair creation as a continuous sequence involving decay and recreation until eventually we are left with the muon.

First, note that the creation of a normal electron in the C-frame will be accompanied by the creation of a residual positron in the G-frame. Alternatively, there is the equal probability that we could create a normal positron in the C-frame and a residual electron in the G-frame. There is a minor difference because matter in the C-frame can have a different gravitational effect when compared with matter in the G-frame. As a result, a slight energy difference will exist between the normal electron or positron and the residual electron or positron. This is likely to be very small, possibly set by the factor φ/c^2 or $1{\cdot}06\ 10^{-8}$ applicable from the gravitational potential at the Earth's surface, but it can be very important in explaining how the muon mass energy, which is not an integral multiple of electron-positron pair energy, can be constituted from an action cycle of the kind considered.

Next, suppose that the muon builds up from a residual positron as a normal electron is ejected, and that it absorbs all residual

* See data in Cohen and Taylor reference in footnote on page 102.