Internal Structures of Electron, Neutron, Proton and Nuclei – particle masses are not arbitrary

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Abstract:
The mass of neutron is slightly greater than1838 electrons. So it is argued that neutron contains 919 electron-positron pairs and that a positron is slightly heavier than electron. It can be shown that the minimum number of electron- positron pairs required to create a spherical structure with minimum imperfection is 919, thus validating the argument. A similar logic is applied to arrive at the structure of electron/positron. Based on these, it is argued that the natural choice of elementary particles is deterministic, and not random.

Key words: Fundamental particles, Packing of spheres, Electron-positron pairs, Neutrons, Protons, Nuclei of atoms, Particle-interactions

1. Introduction:

The masses of elementary particles like electron, proton and neutron are determined experimentally. Why these particles have the given masses cannot be explained based on existing concepts. The alternate concept that matter is made up of identical basic units[1] (fundamental particles) implies that electron, proton and neutron have internal structures.

2. Step by step integration:

The proposed fundamental particles move at speed 'c', and exist as pairs. The individual particles in a pair remain separated by a distance λ_n/π, where λ_n is the Compton wave-length of neutron (so, d= 4.2004×10^{-16} m). The pair rotates as it moves forward; so the paths of the individual particles in it are helical. Electromagnetic radiations[2] are streams of such pairs; the actual integration of pairs starts with the formation of spherical shells (radius λ_n/π). These shells integrate into electron-positron pairs, which integrate further into neutrons. Neutrons change into proton- electron systems (hydrogen atoms). Hydrogen atoms fuse together giving rise to heavier atoms.

3. Packing of spheres into spheres:

As heavier particles are formed from spherical shells, the integration is a process of packing smaller spheres into larger spheres. Visualize a single layer of closely packed spheres. Taking any sphere as the centre, and removing all spheres that are beyond a given distance, we get the central layer of the larger sphere. Layers can be built on both sides of this to complete the larger sphere of given radius. The distance of any particle from the centre of the sphere can be ascertained using the relation, $d^2 = x^2+y^2+z^2$, where x, y and z represent the position coordinates from the centre.

Though it is impossible to create a perfect sphere from smaller spheres, the imperfection will be the least in some cases, and the mathematical constant π decides this. The smallest whole number fraction for π is 22/7, implying that 22 spheres can be arranged in the form of a nearly perfect circle of diameter 7 spheres. Using the same logic, we can say that the minimum number of spheres required to form a larger sphere with minimum imperfection will be such that the radius of the larger sphere is nearly 7 times the other.

4. The criterion for integration:

Theoretically, any number of shells can integrate into a heavier particle, thus giving rise to a variety of heavier particles. But, "*the natural choice will be the one that will have the maximum perfection with minimum number of constituents*". So the constant π decides the natural choice. The structures of electron and neutron are proposed, based on this view.

5. Structure of electron/positron:

Arranging shells as explained above, the central layer of electron/positron can be obtained (fig.1). Here the diameter contains 7 shells. If the distance between shells in a line is 2 units, then the distance between the lines is $\sqrt{3}$ units. The next layer can be built by placing shells in the troughs in each line (not in between the lines), taking any set of parallel lines. So the distance between the layers will also be $\sqrt{3}$ units (exactly the same as the distance between the lines), thus giving symmetry. Completing the sphere, there will be three layers on either side of the central layer, and it will contain 155 shells (ref. table).

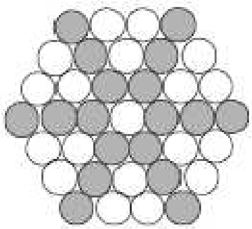

Fig 1: Central layer of electron/positron

Layer	No. of shells	
Central	1x37	37
I	2x30	60
II	2x19	38
III	2x10	20
Total		155

Table 1: Number of shells in each layer

The structure is symmetrical and the topology is such that if the maximum radius (along the shaded diameters) is taken as one unit, the radii at 90^o (both in the given plane and in the perpendicular plane) are $\sqrt{3}$ units. It can be seen that the classical radius of electron lies in between these two values (the maximum radius = $7x4.2004x10^{-16}$ m). At the time of formation of electron-positron pair, positron acquires some extra fundamental particles at the expense of electron. Thus, positron is slightly heavier, though both contain the same number of shells. Both have the same energy ($mc^2/2$, where 'm' is the average mass), but positron being slightly heavier, has shortage of energy, and electron has excess energy. So positron and electron have opposite charges[3].

> **Note:** Packing of shells around the central layer can be done in different ways and the number required will vary. Initially, as a possible average, the number of shells was taken to be 150; the physical constants of the fundamental particle given in my earlier paper[1] are based on that. However, considering the symmetry and topology, the above arrangement with 155 shells seems to be better. In my subsequent papers, physical constants based on this will be used.

6. **Structure of neutron:**

Based on the same argument, the central layer of neutron should contain electron-positron pairs closely packed in the form of a circle of diameter 7 pairs. But symmetry requires that neither the electron nor the positron should remain at the centre; so the centre will be vacant, and the diameter will be 7.5 pairs. Such a layer contains 168 particles (fig.2). Here, the particles are arranged such that the distance between particles in any line is 2 units, the 'maximum-radius' of electron taken as one unit; so the thickness of the layer is $\sqrt{3}$ units, the radius of electron in the perpendicular direction. The corners can be slightly rounded by rotating the last particle through 30^o, and thus the maximum radius of the layer is 14.732 units. Placing similar, but centre filled, layers above and below the central layer in such a way that the vertical arrangement of particles is linear, and removing all particles beyond 14.732 units, we can complete the sphere. Here also, the distance between layers is $\sqrt{3}$ units (the same as the distance between the lines). The sphere will have seven layers on either side of the central layer and will contain exactly1838 particles (refer table). The mass of neutron is slightly greater than the mass of 1838 electrons (m_n/m_e=1838.63). The small difference can be attributed to positrons.

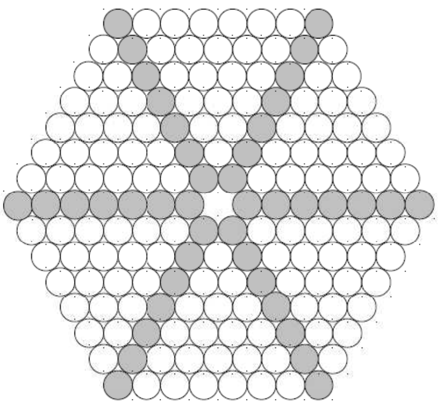

Fig 2: The central layer of neutron

Layer	No. of particles	
Central	1x168	168
I	2x163	326
II	2x163	326
III	2x151	302
IV	2x127	254
V	2x109	218
VII	2x85	170
VIII	2x37	74
Total		1838

Table 2: Number of particles in each layer

The central layer of neutron represents a plane of symmetry. In addition to the central layer, it has another nine 'planes of symmetry' in which the arrangement of particles is layer like (a set of three layers at 90^o and a set of six layers at 60^o to the given plane, passing through the marked diameters). The structure has thus perfect symmetry, and is nearly spherical. Thus neutron contains the minimum number of particles required to form a 'nearly spherical structure with perfect symmetry', and hence neutron is the natural choice for the integration of electron-positron pairs.

7. **Structure of proton and nuclei:**

In the above structure, remove one electron and fill the centre with the unpaired positron, and we get a proton, the nucleus of hydrogen atom. The nuclei of other atoms also have similar structures. They contain electron-positron pairs (not protons and neutrons) with unpaired positrons distributed uniformly. The positrons remain in a set of six planes around a common diameter. The electrons remain orbiting the nucleus in such a way that the number of electrons is equal to the number of positrons in any of these planes.

8. Interactions inside the particles:

The above structures agree with the alternate concept of force[3]: Force is reaction to motion, and so force is equivalent to energy, and like energy, force is conserved. The proposed shell moves at speed 'c', the natural speed of fundamental particles; so its energy and force are equal to $mc^2/2$ (in energy units). Here, gravity is the only force, and G is such that the force calculated using it is equal to the energy possessed, when two shells moving at speed 'c' touch each other; that is, force is completely used when two shells stick together. G varies with speed and is directly proportional to v^2. When an electron-positron pair is formed from shells, half the energy remains inside as vibrations and so the speed is only $c/\sqrt{2}$. For this speed, G of shells is just half and so force used is half. So inside electrons/positrons, the shells can form closed chains using the whole available force. Since half the energy remains as inside vibrations in electron/positron, half the force manifests as electrostatic force. An electron and a positron can stick together either by using the whole gravity or by using the whole electrostatic force; that is they can form closed chains with alternate gravitational and electrostatic bonds, using their whole force.

In symmetrical packing, the particle at the centre is surrounded on all sides by other particles, and so using Gauss theorem, there will be no net force on the central particle. So the central particle will not be exerting any force on the rest. Naturally, the whole available force of the central particle will remain unused. That is, centre filled structures will have unused force. Electrons and positrons have centre filled structures. The force of the central shell remains unused; the rest of the shells form a closed chain.

The proposed structure of neutron has a vacant centre. The electron-positron pairs in it form a closed chain using their whole available force. So a neutron has no fields and cannot interact. However, the motion of neutron creates an inertial force towards its centre, and so the structure is unstable. So neutrons turn into proton-electron systems. Proton has a more stable structure with a positron at the centre. The force of one positron is available for the proton to interact.

As pointed out, a positron has shortage of energy and hence a positive charge[3]. In atoms, the electrons acquire some extra energy to revolve around the nucleus. Naturally, the positively charged nuclei should have a corresponding shortage of energy. So, at the time of formation of atoms, electromagnetic radiations (streams of fundamental particles) are released. So the mass and internal energy of electron-positron pairs in protons and nuclei are slightly less, compared to those in neutrons.

9. Conclusion:

(i). Natural choice:

This paper puts forward the hypothesis that matter has only one type of fundamental particles, which can integrate into a variety of heavier particles; but the natural choice depends on symmetry and structural perfection, and the one with minimum number of constituents is preferred. This is found correct in the case of neutron, thus providing theoretical evidence for the hypothesis.

(ii). Step by step integration:

The step by step integration from shells to neutrons has been mathematically explained based on internal structures. Similarly, by proposing suitable structures for electromagnetic radiations[2], the step by step integration from fundamental particles to the shells can be explained. Based on these, we can arrive at the physical constants of the fundamental particle from the known values namely, the '*mass of neutron*', '*Compton wavelength of neutron*' and '*speed of light*'. Thus the picture at the particle level will be complete.

(iii). Meaningful physical structures:

This is for the first time that clear 'physical' structures are proposed for electron, proton, neutron and nuclei. The proposed sizes of neutron, proton and nuclei are proportionate to the size of electron. (The present method of calculating electrostatic force, using charge, has led to the wrong notion that the sizes of proton and nuclei are not proportionate to that of electron. The alternate concept of force[3] proposes that mass should be used for calculating all forces.)

(iv). Minimum arbitrariness:

The Standard Model proposes the internal structures of neutron and proton in a very complex manner; an entirely new concept namely 'chromo-dynamics' has been introduced solely for the purpose of explaining the interactions within these particles. In contrast, the structures proposed in this paper do not require any exclusive concepts; the forces and interactions that we observe at the normal level alone are required. Thus there is minimum arbitrariness.

Reference:

[1]. Jose P Koshy, *The fundamental particle of matter – Let's call it photon*, **viXra: 1401.0135** (high energy particle physics)

[2]. A paper proposing '*the structure of electromagnetic radiations*' will be posted subsequently in **viXra**.

[3]. Jose P Koshy, *The inherent relation between motion and force (Motion creates the forces of nature)*, **viXra: 1312.0176** (classical physics)