# COMPOSITION-STRUCTURE OF ELECTRON, PROTON & NEUTRON

Rati Ram Sharma, Retired Professor & Head, Department of Biophysics & Nuclear Medicine, Postgraduate Institute of Medical Education & Research, Chandigarh, India; Residence: # 615, Sector 10, Panchkula-134113, India; Phone: 0091-172-2563949; rrjss615@gmail.com ; http://www.geocities.com/drratiram_sharma/ ; http://www.sharma-upt.com

**ABSTRACT: An element is non-composite but composes other particles. The elementary quarks & leptons of the Modern Standard Model are found to be compressible and assembleable, hence having composition. These in Unified Theory are composed by two elementary cosminos, positrino & negatrino. The cosmino-sharmon composition-structures of electron, proton and neutron presented for the first time are defined by Form Factors and concentric regions. It is shown that no ½-spin Fermion can be neutral. Electric Dipole Moment of neutron calculated from Unified Theory agrees with observations. An almost neutral neutron emits electron, never positron, because its outer region is negative. Hofstadter's positive outer region in neutron is inconsistent with negatron decay. Effect of superimposed magnetic field on neutron's negatron decay is explained without Electroweak Theory's weak charge and $W^{\pm}$ & $Z^{o}$ particles. A new Hook's law mediated short-range nuclear force is suggested.**

An element is itself noncomposite but composes other particles. Under the Modern Standard Model the quarks and leptons are the non-composite elements, the proton and neutron being composed by quarks. But quarks were found to be compressible [1] and assembleable [2]. In Unified Theory [2], the quarks and leptons are NOT non-composite elements but are themselves composed by the two new basic elementary cosminos, the positive *positrino* and negative *negatrino* of diameter $1.6156\text{x}10^{-33}$ cm, mass $2.596\text{x}10^{-48}$ gm, electric charge ± $1.3729\text{x}10^{-30}$ esu and spin ± ½. A positrino and a negatrino constitute the neutral sharmon of mass $5.192\text{x}10^{-48}$ gm. Sharmon's spin is 0 or 1 when the ½-spins of the constituent cosminos are anti- or co-directional respectively. Two negatrinos with opposed ½-spins can give rise to a negatrino-negatrino Cooper pair 0-spin negative diad. Similarly two positrinos can yield a positrino-positrino Cooper pair positive 0-spin diad. A 0-spin ± diad can attract 0-spin sharmon to form a 0-spin ± diad-sharmon unit. The cosminos, sharmons, diads and diad-sharmon units go into the composition of the electron, proton and neutron. The spatial distribution of these constituents described by the Form Factors and concentric regions defines the structure of these basic particles.

## 1. **Cosmino-sharmon structure of electron in Unified Theory**

The electron with mass $m_e$ = $9.109389\text{x}10^{-28}$ gm and electric charge q= e =$-4.806532\text{x}10^{-10}$ esu is a dynamic composition of $n_1$ =$3.50\text{x}10^{20}$ negatrinos plus $n_2$ =$3.94\text{x}10^{17}$ 0-spin sharmons. The actual distribution of charge, mass and charge-to-mass ratio (q/m) in the electron are non-uniform. Because the experimental gyromagnetic ratio $g_e$ = -2.002319304 for the free electron is different from the Dirac average -2.0, and also from the $(-2\text{-}11\text{x}10^{-11})$ value for its $10^{-20}$ cm Dehmelt [3] core. The time-averaged dynamic q/m value varies from 1.0 $e/m_e$= $5.276\text{x}10^{17}$ esu/gm at the centre (Dehmelt core) to that of a -ve diad or of a negatrino $q_n/m_n$ = 1.003415 $e/m_e$ = $-5.288\text{x}\ 10^{17}$ esu/gm at the periphery.

That is, its dynamic mass-to-charge ratio $(m/q)_e = (m_e/e + m_n/q_n)/2 = 2/g_e .m_e/e$ is the mean of its value $m_e/e$ at the centre and $m_n/q_n$ at the periphery as against -1.0 $m_e/e$ for the noncomposite point electron of Dirac theory [1]. Its ½-spin consistent with Dehmelt core suggests that it has odd numbered negatrinos comprising $1.75x10^{20}$ negatrino-negatrino Cooper pair 0-spin -ve diads surrounding a single ½-spin negatrino at the centre.

The electron's q/m-distribution radius $r_d = (q_n/m_n).(h/2\pi c^3)^{1/2} = 3.306x10^{-12}$ cm giving the volume $V_e = 1.517x10^{-34}$ $cm^3$. The uniform volume density of diads is $d_D=1.154x10^{54}$ $cm^{-3}$, charge density $d_q = 3.168x10^{24}$ $esu/cm^3$, and inter-diad distance is $r_d / d_D^{1/3} = 5.9x10^{-19}$ cm. The volume density of sharmons $d_{sr} = d_{n2} - ar$, with $a = 7.858x10^{62}$ $cm^{-4}$, decreases linearly with radius from $d_{n2} = n_2/V_e = 2.6x10^{51}$ $cm^{-3}$ at the centre (r = 0) to zero at the periphery ($r = r_d$). The mass density $d_m$ has two components ($d_m = d_{m1} + d_{mr}$): the uniform $d_{m1} = 5.99x10^6$ $gm/cm^3$ due to diads and variable $d_{mr} = d_{m2} - br$, with $b = 4.08x10^{15}$ $gm.cm^{-4}$ due to sharmons decreasing with radius from $d_{m2} = 1.35x10^4$ $gm.cm^{-3}$ at the centre (r = 0) to zero at the periphery ($r = r_d$). See Fig-1 for comparison with proton and neutron structure.

The Cooper pair 0-spin negatrino-negatrino -ve diads are stable due to attractions at $10^{-33}$ cm distance for gravitational and opposite spins offsetting the electrical repulsion. The opposite spin, gravitational and electric attractions at $10^{-33}$ cm make the 0-spin sharmon stable with gregarious

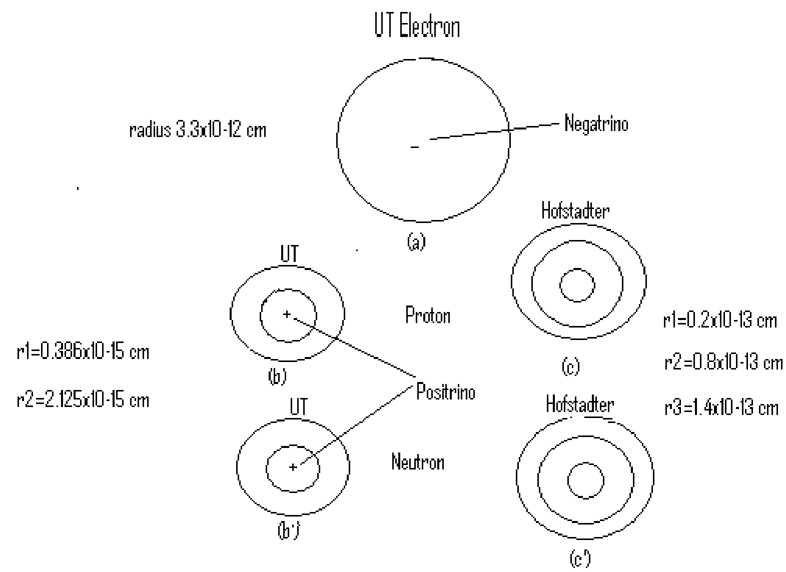


**Fig-1. Structures of Electron, Proton & Neutron**

(a) **UT electron, radius $3.3x10^{-12}$ cm, whole region negative.** A lone ½-spin negatrino at centre (-); 0-spin -ve diads (=), 0-spin sharmons (o), 0-spin diad-sharmon units (=o) distributed throughout..

(b) **UT proton, $r_1$ $0.386x10^{-15}$ cm, $r_2$ $2.125x10^{-15}$ cm, both regions positive.** A lone ½-spin positrino at centre (+); dynamic, interpenetrating, and overlapping two regions with 0-spin +ve diad-sharmon units (+o) distributed in both regions.

(b′ ) **Hofstadter proton**: static, nonpenetrating, annular 3 regions
**inner positive dense core**; $r_1$ $0.2x10^{-13}$ cm.
**middle positive region,** with +ve isoscalar mesons, $r_2$ $0.8x10^{-13}$ cm;
**outer positive region** with +ve isovector mesons, $r_3$ $1.4x10^{-13}$ cm.

(c) **UT neutron**: lone ½-spin positrino at centre (+); dynamic, interpenetrating and overlapping two regions:
**inner positive region:** $r_1$ $0.386x10^{-15}$ cm, 0-spin +ve diad-sharmon units (+o);
**outer negative region:** $r_2$ $2.125x10^{-15}$ cm, 0-spin -ve diad-sharmon units (=o) and individual 0-spin sharmons (o).

(c′ ) **Hofstadter neutron**: static, nonpenetrating, annular 3 regions:
**inner positive dense core,** $r_1$ $0.2x10^{-13}$ cm.;
**middle negative region** with -ve isovector mesons, $r_2$ $0.8x10^{-13}$ cm;
**outer positive region** with +ve isoscalar mesons,. $r_3$ $1.4x10^{-13}$ cm.

properties for other 0-spin sharmons and 0-spin -ve diads. Bosonic condensations between 0-spin diad-sharmon combinations supported by gravitational attractions at $10^{-19}$ cm inter-diad distances, off setting electrical repulsion, produce a dynamically stable spherical electron (Fig-1).

Totality of 0-spin sharmons and 0-spin diads spin together with the lone ½-spin negatrino at the centre to impart a spin ½ to the electron as a whole.

The Form Factor, representing distribution of charge over spherical shells of the constant thickness dr around varying radius r from the centre (r = 0) to periphery ($r = r_d$), is $F_q = d_q.4\pi r^2 dr$. Here dr is arbitrarily chosen as a small but constant radial thickness and r varies for r= 0 at the centre to $r = r_d$ at periphery. The Form Factor for the diad distribution is $F_D = d_D.4\pi r^2 dr$. Both $F_q$ and $F_D$ are parabolas. The sharmon distribution Form Factor $F_s = F_{s1} - F_{s2}$ is the difference of parabolic $F_{s1}$ and cubic $F_{s2}$. In the mass distribution Form Factor $F_m = F_{m1} + F_{m2} - F_{m3}$, the first two are parabolic and the third is cubic.

## 2. **Structure of nucleons in Unified Theory**

The experimental values of $g_p = +2.79284738$ and $g_n = -1.93455491$ for proton and neutron suggest that the dynamic $(q/m)_p = +1.39642369\ e/m_p$ and $(q/m)_n = -0.96727745\ e/m_p$. The inter-convertibility between proton and neutron points to the common core with q/m = +0.21457312 $e/m_p$. This gives $(q/m)_p = +0.21457312\ e/m_p + 1.18185057\ e/m_p$, and $(q/m)_n = +0.21457312\ e/m_p - 1.18185057\ e/m_p$.

The $(q/m)(h/2\pi c^3)^{1/2}$ radii of the two regions are $r_1 = 0.38578\text{x}10^{-15}$ cm and $r_2 = 2.12486\text{x}10^{-15}$ cm. The common ½-spin of the nucleons arises from the common +ve core with a lone ½-spin positrino at the centre surrounded by 0-spin diad-sharmon units. The outer 0-spin region in both the nucleons spins together with the inner ½-spin region to yield an overall ½-spin.

### 2.1. *Proton structure in Unified Theory*

Let $q_1$, $m_1$ and $q_2$, $m_2$ be the charge & mass of the two regions of radius $r_1$, $r_2$ respectively. Here $q_1/m_1 = +0.21457312\ e/m_p$ and $q_2/m_2 = +1.18185057\ e/m_p$; $q_1 + q_2 = e = +4.806532\text{x}10^{-10}$ esu for $1.75\text{x}10^{20}$ diads and $m_1 + m_2 = m_p = 1.67252\text{x}10^{-24}$ gm comprising $1.75\text{x}10^{20}$ diads plus $2.6199\text{x}10^{23}$ sharmons.

The $q_1 = +0.19389675\text{x}10^{-10}$ esu, $q_2 = +4.612635\text{x}10^{-10}$ esu; $m_1 = 3.144377\text{x}10^{-25}$ gm, $m_2 = 1.3580822\text{x}10^{-24}$ gm. The number of diads and sharmons in the two regions are $D_1 = 7.06\text{x}10^{18}$, $D_2 = 1.6798\text{x}10^{20}$; $s_1 = 6.04886\text{x}10^{20}$, $s_2 = 2.613919\text{x}10^{23}$.

The number densities of diad population are $d_{D1} = 2.936\text{x}10^{28}\ \text{cm}^{-3}$, $d_{D2} = 4.18\text{x}10^{25}\ \text{cm}^{-3}$ for the two regions and $d_D = 2.94\text{x}10^{28}\ \text{cm}^{-3}$ as overall for the core. The three mass densities are $d_{m1} = 1.307\text{x}10^{21}\ \text{gm/cm}^3$, $d_{m2} = 3.379\text{x}10^{19}\ \text{gm/cm}^3$, $d_m = 1.34\text{x}10^{21}\ \text{gm/cm}^3$. (see Fig-1). The corresponding charge densities are $d_{q1} = 8.06\text{x}10^{34}\ \text{esu/cm}^3$, $d_{q2} = 1.18\text{x}10^{34}\ \text{esu/cm}^3$ and $d_q = 9.21\text{x}10^{34}\ \text{esu/cm}^3$.

The Form Factors representing distributions of mass, charge, and diads are obtained by multiplying $4\pi r^2 dr$ to the corresponding density, where the constant radial thickness dr is arbitrarily chosen but $r^2$ is varied continuously from r = 0 at the centre to $r = r_d$ at the periphery. All Form Factors are parabolic in this case.

### 2.2. *Neutron structure in Unified Theory*

Its inner region is the same as for proton. But the outer region has a mixed population of two 0-spin species: -ve diad-sharmon and individual sharmons (only). Thus, $q_1/m_1 = +0.21457312$ $e/m_p$, $q_2/m_2 = -1.18185057\ e/m_p$, $q_3/m_3 = 0$. Since $m_1 + m_2 + m_3$ = neutron mass $m_n$ $= 1.67482\text{x}10^{-24}$ gm $= 1.0013751\ m_p$ and $q_3 = 0$, $q_1 = +0.04034026\ e = +0.19389675\text{x}10^{-10}$ esu = -$q_2$; $m_1 = 3.144377\text{x}10^{-27}$ gm, $m_2 = 1.35724\text{x}10^{-24}$ gm, $m_3 = 3.1444\text{x}10^{-25}$ gm.

The number of +ve diads in the inner region or -ve diads in the outer region is $D_1 = D_2 = 7.06\text{x}10^{18}$. The number of sharmons bound to the diad-sharmon units (+ve in the inner and -ve in the outer) are $s_1 = 5.984x10^{20}$, $s_2 = 2.61398x10^{23}$; that of free sharmons in the outer region is $s_3 = 6.0559x10^{22}$.

For the two regions the densities of mass (m) work out as $d_{m1} = 1.3074x10^{21}$ gm/cm$^3$, $d_{m2} = 1.4205x10^{19}$ gm/cm$^3$, $d_m = 1.34127x10^{21}$ gm/cm$^3$. The densities of charge (q) are $d_{q1} = 8.062x10^{34}$ esu/cm$^3$, $d_{q2} = 4.8249x10^{32}$ esu/cm$^3$, $d_q = 8.11x10^{34}$ esu/cm$^3$. And the densities of diads (D) are $d_{D1} = 2.936x10^{28}$ cm$^{-3}$, $d_{D2} = 1.757x10^{25}$ cm$^{-3}$, $d_D = 2.9537x10^{28}$ cm$^{-3}$. See Fig.1 for comparison with electron and proton.

The Form Factors representing distributions of m, q, D over spherical shells of constant thickness dr but varying radius r from centre (r=0) outwards for the two regions are obtained from the above densities by multiplying with $4\pi r^2 dr$. All these Form Factors are parabolas.

3. **Nature of the atomic nucleus**

Stable 0-spin diads (±), 0-spin sharmons, 0-spin diad-sharmon units with mutual inter-couplings are basic to the stability of free proton, electron, positron. *But the large number ~$10^{23}$ of their constituents makes their cosmino-sharmon composition fluctuable and NOT fixed. Hence the mass & charge of electron, proton, neutron and their anti-particles may slightly vary or even split. The upcoming 'Hadron Collider' at CERN, Geneva will show how the sharmon-cosmino content of the mass and kinetic energy of the smashingly colliding protons redistributes & reassembles as new particles, their energies and sharmon-cosmino dust.*

The proton and neutron should therefore loosen their unchangeably rigid composition and structure, allowing for emission and absorption of small aggregates of 0-spin diads (±), 0-spin sharmons, 0-spin diad-sharmon units and tend to mutually merge inside a nucleus. The +ve diads and +ve diad-sharmon units compose the net positive charge of the nucleus. This supports and is supported by the following facts of observation.

First, the radius R of a (spherical) nucleus of mass number A is given by the formula:

$$R = 1.3x10^{-13} A^{1/3} \text{ cm}$$

Secondly, the nuclear volume is proportional to the number A of the nucleons (proton + neutron), obliterating the inter-nucleon space.

Thirdly, the density of the nuclear matter in all nuclei is nearly the same [4].

3.1. *The mass defect*

The observed **mass defect** $\Delta m$ for a nucleus of mass $m_{nuc}$, mass number A and atomic number Z (number of protons) is:

$$\Delta m = [Zm_p + (A - Z)m_n] - m_{nuc}.$$

That is, in forming a nucleus the nucleons (protons & neutrons) loose some nucleonic mass $\Delta m$, which comprises small aggregates of 0-spin sharmons. The loss of some electric charge $\Delta q$ comprising 0-spin diads (±), 0-spin diad-sharmon units also is not ruled out.

4. **The radioactivity is a nuclear phenomenon**

In some nuclei, called the **radioactive nuclei**, even after their formation the cosmino-sharmon composition and the number of nucleons change. Emission of gamma photons composed by 0-spin sharmons suggests variation and readjustment in nucleonic mass. The (±) β decay (emission of +ve positron & -ve negatron) and the capture of an orbital negative electron involve variations in the mass and charge or the cosmino-sharmon composition of some nucleon(s). Emission of energetic alpha particle (nucleus of the atom helium having two protons and two neutrons) or of the proton or neutron changes even the number of nucleons.

The environment within a nucleus differs from outside affecting the composition of outer fringe and radioactive nature of a nucleon. Sufficient cosminos and sharmons are available only inside some nuclei for a proton to decay into a heavier neutron plus energetic positron and neutrino. The neutron, which in its free state is unstable, becomes stable in most of the nuclei.

Therefore ***Radioactivity is a nuclear rather than a mere nucleonic phenomenon.***

5. **The negatron decay of neutron**

Instability of a free neutron arises from the randomly moving sharmons in the outer region having electrical attractions of their constituent negative negatrinos with the positive inner region and of their positive positrinos with the negative diad-sharmon units in the outer region.

***Therefore the free neutron, though almost neutral, exhibits only negatron decay because its outer fringe is negative.***

The outer negative charge is supported by observation [5]. Hofstadter's [6] positive outer fringe of the neutron is inconsistent with observation [5] as well as with the negatron decay.

It can now be seen that during negatron decay of the neutron some $3.50 \times 10^{20}$ 0-spin sharmons split into $\pm 3.50 \times 10^{20}$ cosminos. The $1.412 \times 10^{19}$ positive positrinos neutralize the same number of negative negatrinos or $7.06 \times 10^{18}$ negative diads in the outer region of the neutron, and the rest create the surplus $1.6798 \times 10^{20}$ positive diads for the outer region of the proton. The $3.50 \times 10^{20}$ negative negatrinos plus $3.94 \times 10^{17}$ 0-spin sharmons constitute the β-particle or negatron. The $2.68 \times 10^{20}$ 0-spin sharmons compose the total energy of 0.782 MeV of the emitted negatron plus antineutrino.

The ½-spin of the antineutrino comes from the sole or odd numbered (2n + 1) negatrinos to give it a negative electric charge. Hofstadter's neutron with positive outer region cannot account for its negatron decay, or for its negative Electric Dipole Moment (see sec.6 below).

6. **Electric dipole moment of neutron**

The lone positrino at the centre of the inner region neutralizes the charge from one negatrino from the negative diad-sharmon and sharmon units, leaving a net negative charge of one negatrino $q_n = 1.3729 \times 10^{-30}$ esu on the neutron. So, the lower limit of neutron's Electric Dipole Moment (EDM) is $5.83 \times 10^{-45}$ esu.cm = $1.2 \times 10^{-35}$ e.cm, as actually observed [7, 8]. Due to natural fluctuations, however, the neutron can also acquire a few extra -ve diads giving it the net charge of (2n +1) negatrinos. This also slightly affects its $q_2/m_2$ ratio and the radius $r_2$ of the outer region. We thus get a variable EDM = (2n+1) $q_n.r_2$, as actually observed [7, 8]. Due to smallness of the charge, neutron appears "neutral" within allowed experimental errors.

6.1 *No fermion can be neutral*

The agreement between Unified Theory and experiment on the existence of electric charge on the neutron leads to the verifiable generalization that no fermion can be neutral. A fermion, with spin ½, 1½, etc., has to comprise odd numbered (2n+1) cosminos, with spin ½, of which at least one is un-neutralized. Therefore the neutron, antineutron, neutrino, antineutrino &c with spin ½, which in currently accepted theories are neutral, should actually carry $\pm 1.3729 \times 10^{-30}$ esu charge of a cosmino. This imparts an Electric Dipole Moment (EDM) to the fermion. As above, the neutron carries a negative electric charge and antineutron a positive electric charge. The antineutrino emitted during neutron's negatron decay is electrically negative. That is why it is repelled by the -ve negatron. The neutrino emitted with the +ve positron during proton's positron decay is likewise positive.

Unified Theory's predicted lower limit of the neutron's EDM $5.83 \times 10^{-45}$ esu.cm = $1.2 \times 10^{-35}$ e.cm, e being the electron charge, agrees with experimental findings [7, 8]. This observation on neutron distinguishes Unified Theory from, and establishes its superiority over, the current theories. Other fermions can test and verify this Unified Theory prediction further.

6.2 *The effect of superimposed magnetic field on neutron decay*

During negatron decay of neutron $n^- \rightarrow p^+ e^- \nu^-$, the slightly negative neutron $n^-$ splits into +ve proton $p^+$, -ve negatron (electron) $e^-$ and slightly -ve antineutrino $\nu^-$ at the same space-time point. The imposed magnetic field electromagnetically interacts with the mechanisms of creating three electrically charged particles ($p^+$, $e^-$, $\nu^-$). It also interacts with these mutually interacting particles themselves at the moment of beta decay. These interactions are basic to the inequality in the rates of beta emission from the Co-60 atoms for two opposite directions of the imposed magnetic field, as actually observed by Wu et al [9]. This is because $\nu^-$ has only right handed spin whereas both $p^+$ and $e^-$ can be right or left handed. This Unified Theory explanation does not need the weak charge or weak force, or the non-conservation of parity.

The above Unified Theory explanation of the neutron beta decay can be compared with the following set of mutually inconsistent and manifestly unrealistic speculations of the Electro-Weak theory. The neutron (udd) comprises one up (u) and two down (d) quarks. One d-quark (mass 0.35 GeV, charge -1/3 e) emits a “virtual” boson $W^-$ (mass 78 GeV, charge -1 e) and itself becomes a u-quark (mass 0.39 GeV, charge +2/3 e) transforming neutron (udd) into proton (uud). The $W^-$ decays at a different space-time point, to emit one electron $e^-$ and an antineutrino $\nu^-$. Spontaneous break in the vacuum symmetry creates the $W^-$ *out of nothing*. The mass to $W^-$ is imparted by the Higgs boson, whose mass, nay even existence is indefinite [10, 11]. Heisenberg's objective indeterminism and Uncertainty Principle, which UPT rejects, are invoked to validate the underlying violations of otherwise inviolable conservation of mass & energy, because $W^-$ is outside its mass shell!

Detection of $W^{\pm}$ and $Z^o$, not in the beta decays but in particle smashing experiments, has been hailed [11, 12] as a strong (but Unified Theory views it as the weakest) experimental support to the Electro-Weak theory. It treats them as “virtual” or unreal, being outside their mass shell and not conserving energy and momentum. But in Unified Theory the assembly of $W^{\pm}$ and $Z^o$ follow realistically from the totality of positrinos, negatrinos and sharmons generated from the masses and kinetic energies of the colliding particles. For example $W^+$ is made of $3.49 \times 10^{20}$ positrinos + $2.59 \times 10^{25}$ 0-spin sharmons, $W^-$ of $3.49 \times 10^{20}$ negatrinos + $2.59 \times 10^{25}$ 0-spin sharmons and $Z^o$ of one 1-spin sharmon + $2.99 \times 10^{25}$ 0-spin sharmons.

## 7. **Hofstadter vis-à-vis Unified Theory**

By curve fitting, Hofstadter [6} got three regions of 0.2 f, 0.8 f and 1.4 f (fermi f = $10^{-13}$ cm) radii with central +ve dense core and a +ve outer fringe for both proton and neutron. The middle region is +ve in proton and -ve in neutron. Outer two regions in proton comprise isoscalar and isovector meson clouds but vice versa in neutron. These three regions are static, annular, and non-penetrating as against Unified Theory's dynamic, overlapping and interpenetrating ones (Fig.1). Hofstadter sought the evidence from other scientists for his theory’s +ve outer fringe of neutron but observational evidence [6] is for the -ve outer fringe in support of Unified Theory.

However, Hofstadter radii of $10^{-13}$ cm represent the range of electrical influence in elastic electron scattering, whereas Unified Theory radii of $10^{-15}$ cm indicate physical q/m-distribution. Their relative magnitudes are therefore mutually consistent and supportive.

## 8. **Nature of the large angle electron scattering centre in proton**

As against the conclusions of Friedman et al [13], sec 2.1 above shows that proton has no -ve centre to scatter electrons at large angles. But the $3.9 \times 10^{20}$ negatrinos comprising every incident electron and the $3.42 \times 10^{14}$ negatrino-positrino pair sharmons per eV of its kinetic energy transform into short lived -ve, neutral, and +ve prehadronic units which later reassemble into the hadrons. The -ve units scatter the -ve electrons at large angles, neutral units at small angles and +ve units at smaller angles.

This Unified Theory also eliminates the "ignorance box" from the explanation [14] of hadron jets produced in $e^+e^-$ collider. The colliding $e^+$ and $e^-$ have only 0.51 MeV rest mass energy each, hence cannot generate the GeV hadrons. This leaves 1 to 3 TeV kinetic energy as the only source substance to create hadrons, as outlined above. Modern Physics offers no physical mechanism except the relation $E = mc^2$. Likewise follows the creation of some Quarks and Leptons from the collisions of 1.8 TeV kinetic energy protons-antiprotons. This was reported by D-Zero [15] and CDF [16] collaborators.

9. **Hook's law mediated short-range nuclear force**

In Unified Theory the atomic nucleus is a dynamic composite whole comprising 0-spin diads (±), 0-spin sharmons, 0-spin diad-sharmon units with mutual inter-couplings. The +ve diads and +ve diad-sharmon units account for the net positive charge of the nucleus. Therefore the Unified Theory rejects the existence of quarks as isolated rigid units to compose the nucleons and discards the inter-quark strong nuclear force.

The short-range nuclear force operates during small deformations of the nucleus. Here the nucleus behaves like a highly condensed elastic mass whose deformation follows the Hook's law of elasticity wherein stress is proportional to the strain. So the short-range deforming force is proportional to the deformation. It is slightly modified by the added electrical repulsions among the diads with like charges and electrical attractions among oppositely charged diads, both varying as inverse square of the intervening distance according to the Coulomb's law. The Newton's law based gravitational force also operates weakly. So the net short-range nuclear force appears as an attractive force whose magnitude increases with distance, as actually observed.
Its exact mathematical form depends on the actual distribution of the composing units, namely the charged and neutral diads. In the present stage of lack of knowledge it is therefore difficult to deduce the mathematical expression from the first principles.

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