Nuclear Binding

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(Note: This is a synopsis of the concepts developed in Radioactive Decay, by w. t. gray at mqnf.com, showing that nuclear binding is an electromagnetic force enhanced by relativistic effects.)

A neutron is a quantum relativistic state of hydrogen with a 0.78233 MeV orbital electron. This 2.531 increase in electron mass causes a relativistic effect that observers at the electron level see as a Classical 2.76136 fm Bohr radius with equal electric, magnetic and kinetic energies while observers in independent space see an orbital surface contracted by 2.531 to a 1.091 fm radius.

Its magneton is attenuated by the proton's mass, enhanced by its 4.837 lower density than an electrons, and attenuated by the 2.531 orbital contraction, so $u_n = \frac{1}{2}(eh/2pi)(u_o/m_p)(4.837/2.531) =$ -1.9111 nuclear magnetons, since (e/2pi) is an orbiting charge and $\frac{1}{2}$(eh/2pi) is the magnetic component of de Broglie's E = hf energy, m_p is static mass attenuating that generated field, a 4.837 less density reduces that attenuation, and a 2.531 orbital contraction increases the relative cross-section of the attenuating mass.

It is $\frac{1}{2}$-spin since relativistic orbital contraction moves its proton mass center toward the surface seen from independent space, (not surface toward mass center), so its spin is a vector sum of a spin-1 orbital angular moment and its relativistic contraction. On decay the $\frac{1}{2}$-spin is conserved as a $\frac{1}{2}$-spin neutrino because the 3-dimensional 0.78233 MeV electric, kinetic and magnetic energies decay to 2-dimensional electric and kinetic energies, with 13.6 eV values that combine to yield a $(2 \times 13.6^2)^{\frac{1}{2}} = 19.2$ eV resultant. The emitted neutrino is the relativistic 3rd dimension's energy on decay to the 2-dimensional state, or $19.2^{1/3} \times 2.531 = 6.78$ eV.

When a neutron and proton approach within 2.76136 fm, energy is added according to a modified $1/r^2$ coulomb repulsion relation until they are 1 fm apart. The nucleons then release equal energy on forming a 0.4 fm bond, with a repulsion component that prevents compression and a quantum binding force that requires addition of the released energy to separate them back to the 1 fm transition point, as shown in nucleon potential energy separation plots. The modified coulomb repulsion between 2.76136 fm and 1 fm is from the two proton's repulsion partially shielded by the orbital electron.

However, at 1 fm the orbital electron absorbs enough coulomb energy from the 2nd proton to overcome its bond to the 1st proton and form a neutron state with the 2nd, since it is 1 fm from the 2nd proton's surface and 2.76136 fm from the 1st proton's center. On forming a neutron state with the 2nd proton the electron enters a 2.76136 fm orbital with it, 1 fm from the 1st proton's surface. This electron delocalization results in a resonance oscillation between the protons similar to resonance delocalization in benzene type conjugated chemical bonds. Electron mass increase from the absorbed coulomb energy contracts the 1 fm n-p separation by 2.531 to yield a relative 0.4 fm separation, just as it contracts the 2.76136 fm neutron radius to 1.091 fm for independent observers.

In an orbital oscillation the electron has equal and opposite momentums in each planar dimension so net mass is zero, and since inertial motion forms an acceleration gradient in the direction of motion an oscillation causes acceleration toward its center. This creates a negative energy well since net mass is 0 and energy may be absorbed without mass increase. The gradient persists over the entire oscillation cycle, since time dilation sustains it while the electron is moving in the opposite direction, so the protons accelerate toward each other from 1 fm to 0.4 fm.

However, since proton charges repel by $1/r^2$ they decelerate in the acceleration field and, just as an electron's acceleration toward a proton increases its mass energy, a proton's deceleration in an acceleration field results in mass loss. This is the binding energy that releases on formation of the 0.4 fm bond and since the relativistic 1 fm to 0.4 fm bond length contraction only occurs with respect to independent space the mass loss is only apparent to independent space. So the local space of the orbital electron behaves according to classical coulomb physics while the force is amplified by the relativistic contraction for independent space.

The released energy is contracted distance times the average coulomb force difference between the protons at 1 fm and 0.4 fm, or Binding Energy = $\frac{1}{2}(0.6\ \text{fm})(F_{0.4}-F_{1.0}) = (0.3\ \text{fm})(k_e e^2/0.4\ \text{fm}^2 - k_e e^2/1.0\ \text{fm}^2) = (0.3\ \text{fm})(1438\ \text{N} - 230\ \text{N}) = (0.3\ \text{fm})(1208\ \text{N}) = 3.624\times10^{-13}\ \text{J} \times 6.25\times10^{18}\ \text{eV/J} = 2.26\ \text{MeV}$, which is within 2% of deuterium's 2.224 MeV B.E. and attributed to electron shielding.

Deuterium's 2.224 MeV bond is a 1-dimensional neutron-proton structure and higher nuclei are deuterium, tritium, helium-3 and helium-4 structural combinations. These helion-triton structures have 2 and 3-dimensional orbitals with B.E. = $3^{1/d}$ (p x 2.2147)^{n}, where 3 is available dimensions, d is structural dimensions (2 for H-3 or He-3; 3 for He-4), p is the number of protons (1 for H-3; 2 for He-3 or He-4), n is the number of neutrons (2 for H-3 or He-4; 1 for He-3) and 2.2147 is deuterium's 2.224 MeV 1-dimensional B.E. reduced by 0.4% to account for orbital resonance distortion in the 2 and 3-dimensional orbital structures of H-3, He-3 and He-4.

The calculated B.E.'s of H-3, He-3 and He-4 are 8.5, 7.67 and 28.296 MeV, within 1% of the respective 8.48, 7.72 and 28.297 MeV empirical values. Their magnetons are sums of individual particle magnetons adjusted for orbital geometric and relativistic effects. The neutron's magneton was previously calculated to be -1.9111, within 0.2% of its empirical -1.9135 value. The proton's magneton is its nuclear magneton adjusted for its 4.837 lower density than an electron in 1 dimension, so $u_p = 4.837/3^{\frac{1}{2}} = 2.7926$ nuclear magnetons, within 0.1% of its empirical 2.7928 value.

Deuterium's magneton is its proton and neutron magneton sum adjusted for the effect of resonance which reduces its 2.76136 fm orbital radius by 0.067158 fm to 2.6942 fm and its relativistic radius from 1.091 fm to 1.06448 fm, so its magneton is (2.7912 - 1.9135) x 1.06448/1.091 = 0.8793x0.9757 = 0.8579, which is within 0.06% of its empirical 0.8574 value.

Tritium's proton and neutrons form deuterium-type bonds, with its electrons forming a 8.482 MeV B.E. well of 8.482 - 2(0.78233) = 6.917/2 = 3.459 MeV individual electron energies if the 0.78233 MeV neutron state energies are excluded. This $(3.459 + m_e) / m_e$ = 7.768 mass increase causes a 1/7.768 = 0.129 / $2^{\frac{1}{2}}$ = 0.091 average contraction of the resonance region between 1 fm from the surface of each proton and its 2.76136 fm neutron state orbital radius. So each electron is 2.76136 fm from a neutron center, 1 fm from the surface of a bonded 1.0355 fm radius proton, and transitions to a 2.76136 fm neutron state with that bonded proton, 1 fm from the surface of the next proton, in a continuous orbital oscillation.

This region is r_n - 1 fm - r_p = 2.76136 fm - 1 fm - 1.0355 fm = 0.72586 fm which the 0.091 contraction reduces to 0.066 fm. Two such electrons reduce the neutron orbitals to 2.76136 - 2(0.066) = 2.629 fm, which the 0.78233 MeV neutron state energies contract by 2.531 to 1.039 fm, instead of a normal 1.091 fm contracted neutron radius. This 1.039 / 1.091 = 0.952 resonance relativistic effect factors the proton and neutron magnetons of each deuterium-type bond to yield a (2.7928-1.9135) = 0.8793 x 0.952 = 0.8371 magneton and the combined proton and 2 deuterium magnetons is $(2.7928^2 + 2(0.8371)^2)^{\frac{1}{2}}$ = 3.0333. Factoring in the 8.482 MeV proton mass loss effect of $(m_p - 8.482)/m_p$ = 0.991 on the 2 electron's magneton generation yields a 3.0333 x $(0.991)^2$ = 2.9789 tritium magneton.

This value is within 0.1% of tritium's empirical 2.9788 value and was calculated by the compounded neutron and resonance orbital relativistic effects, along with the 8.482 MeV B.E. mass loss, on the magneton generating effect of 2 electrons in deuterium bonds to a proton. Helium-3's magneton is calculated differently since its neutron and 2 protons share 1 electron between 3 protons. Its 7.718 MeV B.E., reduced by the 0.78233 MeV neutron state energy, yields a 6.936 MeV electron with a $(6.936 + m_e) / m_e = 14.573$ mass increase and a $1/14.573 = 0.0686 / 2^{\frac{1}{2}} = 0.0485$ average contraction of the 0.72586 fm resonance region to 0.0352 fm.

This contraction reduces the 2.531 contracted neutron radius to yield a 1.091 fm - 0.0352 fm = 1.05578 fm neutron radius, which represents a volumetric reduction of $(1.05578/1.091)^3 = 0.90625$ to the electron's neutron state orbital. This relative proton volume increase of 1/0.90625 = 1.10345, with respect to the higher energy electron orbital, constitutes a less dense proton and a 1.10345 magneton increase. The 6.936 MeV proton mass loss also represents a $m_p / (m_p - 6.936) = 1.00745$ magneton increase, and the two effects increase the magneton to (-1.9135)(1.10345)(1.00745) = -2.1272, which is within 0.1% of Helium-3's -2.1275 value.

Helium-3 constitutes an inverted neutron structure, with its orbital electron in the center and 3 protons on the outside. It is enhanced because of the electron's higher energy and the protons' mass loss, as reflected by its -2.1275 magneton. Tritium however constitutes an enhanced proton with a 2.9788 magneton because the compounded deuterium bond's proton nature. In higher nuclei the H-3 and He-3 tritons are added as enhanced protons and neutrons.

So in Li-6, an H-3 enhanced npn "proton" and an He-3 enhanced pnp "neutron" form a deuterium-type overlayed triton bond in a $n_p p_n n_p$ Star of David structure. In H-2 resonance reduces orbital radius by 1.064/1.091 = 0.975 so BE_{Li-6} = 1.975 (BE_{H-3} + BE_{He-3}) = 1.975 (8.482 + 7.718) = 31.995 MeV and u_{Li-6} = (u_{H-3} + u_{He-3}) x 0.975 x % mass loss x sub-resonance = 0.8300 x 0.975 x ($6m_p$-BE)/$6m_p$ x (1 - 6(m_e/m_p)) = 0.8513 x 0.975 x 0.994 x 0.997 = 0.8225 (0.1% error).

Helium-4 has no magneton because it forms a tetrahedron with its protons and orbital electrons in their lowest energy state of dynamically aligned magneton pairs that cancel. In higher nuclei He-4 behaves as an (He-3 + n) or (H-3 + p), so in Li-7 it forms He-4 + H-3 = (He-3 + n) + H-3 in a deuterium-type bond so BE_{Li-7} = (BE_{He-4} + BE_{H-3} + BE_{H-2}) = 39.003 MeV x sub-resonance = 39.003 x $7m_p$/($7m_p$ - BE) = 39.003 x 1.006 = 39.236 MeV, within 0.1% of Li-7's 39.245 MeV. The (He-3 + n + H-3) structure is an "n"np, or "n"pn, enhanced H-3 "proton" type magneton, so He-3 and n align to (2.1275-1.9135) = 0.214, add to H-3's 2.9788 to yield 3.1928, and are enhanced by the 0.975 resonance and 1.006 mass loss to yield 3.1928 / (0.975 x 1.006) = 3.2551, within 0.1% of Li-7's 3.2563.

Other higher structures are similarly derived and their spins are derived by the summation of the substrutures. Deuterium would seem to be the sum of a ½-spin neutron and ½-spin proton to yield spin 1, but it's actually a ½-spin proton, spin 1 orbital, ½-spin orbital contraction, and ½-spin electron to yield a ½-spin neutron and a ½-spin proton, with the orbital aligning them into a spin 1.

The same reasoning applies to the neutrons in H-3 and He-3 so they each are ½-spin, Li-6 aligns its ½-spin tritons into spin 1, and in Li-7 the ½-spin tritons align with a ½-spin neutron to yield a 3/2 spin. So although He-3's 3 protons and 1 electron would yield an integer spin, it is ½-spin because of the orbital contraction. Similarly Li-6's 6 protons and 3 electrons have an integer spin.

Nitrogen-14, with spin 1, was used to rebut the concept of a proton-electron model because N-14 would have 7 electrons and 14 protons which would yield a non-integer spin. However the ½-spin orbital contractions negate the electron's ½-spins and 14 protons will yield the observed integer spin. Nitrogen-14 is based on a C-12 structure of 3 He-4 tetrahedrons arranged as an H-3 center in the horizontal plane with He-3's bonded to its neutrons and an H-3 bonded to its proton, each of which are in the vertical plane, and which oscillate so that He-3's and H-3's interchange as electrons change neutron states. This 3 He-4 structure, comprised of 2 He-3 and 2 H-3 structures, has 0 spin. N-14, with a proton-neutron pair through the central triton, has a deuterium spin 1 magneton.

This summary of the neutron structure and nuclear binding based on relativistically enhanced coulomb force is more fully described with orbital diagrams in Radioactive Decay at mqnf.com.

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