Infinite Particle Physics

Chapter 3 – The Defect-Pair Concept Of Nuclei

We begin our study of nuclei with a substantial advantage over quantum theorists — IPP permits us to *visualize* not only the shape of nucleons, but also the modes of interactions between them. Paired c-voids are surrounded by uncanceled residues of their expansion-contraction distortion patterns, so additional cancellations can occur when the clustered defect-pairs of nucleons have suitable alignments with those of neighboring nucleons. These cancellations reduce the cluster's mass, thereby binding the nucleons together. This process is the Theory's explanation of the "strong force", and the geometric alignment of nucleons necessary to produce "strong-force" bonds is our primary clue toward understanding nuclear structures.

There Are Two Kinds Of Strong-Force Bonds

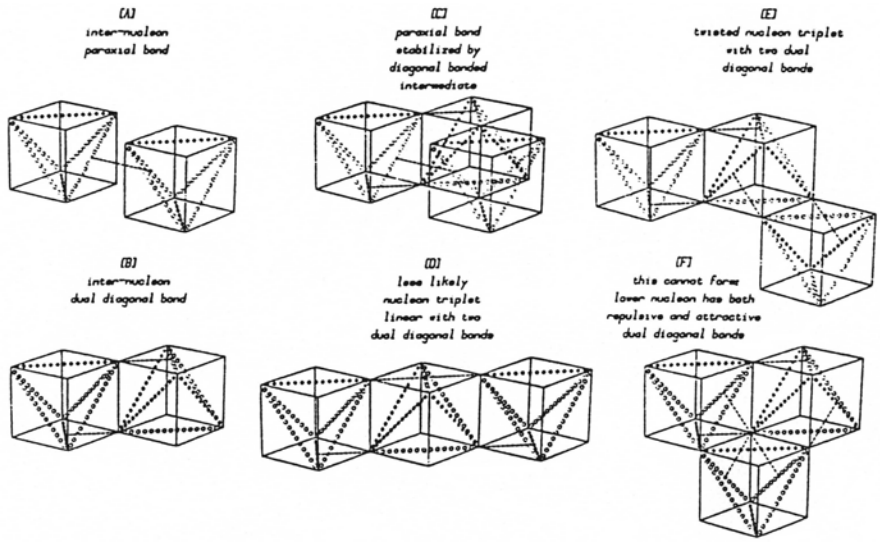
From our previous study of unstable baryons, we see immediately that both **diagonal bonds** and **paraxial bonds** are possible between two nucleons. However, only one of the two types of bonds can occur between any two nucleons, because each type of bond requires a different orientation of the two nucleons.

Paraxial Bonds Require Nucleons Of The Same Slant

For a *paraxial* bond to develop between two nucleons, two defect-pairs, one in each nucleon, must become aligned along a common pairing axis. For bonding to occur, the inner two of the four defects must have a "crossed" relationship of their axes of contraction. If we think of the nucleons as cubes (i.e. in their cube forms), these requirements produce a geometry similar to two cubes lined up on a plane surface, with a gap between their inner faces, as shown in [A] of Fig. 3-1, below. We should notice that the bonding of two nucleons in this geometry requires that the paraxially-bonded defect-pairs have the same slants in both nucleons (i.e. the two nucleons *could be identical*, say two protons, or two neutrons).

It is clear, however, that inter-nucleon charge exchanges are not possible in this configuration, since none of the defects in one nucleon is in a face-diagonal direction from any in the other nucleon. Therefore, this alignment would not be unconditionally stable against movement through the space lattice. However, an inter-nucleon paraxial bond *can* be stabilized by the presence of an intermediate nucleon, offset so as to form diagonal bonds with both paraxially bonded nucleons, as shown in [C] of Fig. 3-1.

Fig. 3-1 Basic Inter-Nucleon Bonds



Diagonal Bonds Require Nucleons Of Opposite Slant

For *diagonal* bonds to exist between two nucleons, the centers of the two nucleons must lie in lattice face-diagonal directions from each other. Hence, the geometry is similar to two cubes on a common plane, having parallel faces, but displaced diagonally from each other, and contacting along a cube edge (see [B] of Fig. 3-1). The defect-pairs participating in the inter-nucleon diagonal bond are those whose pairing axes are normal to the line between the nucleon centers (i.e. the top and bottom defects in the figure). For bonding to occur, the slants of the defects in the same cardinal plane must have crossed axes of contraction. This means that diagonal bonds *will not be possible between nucleons of identical slants!*

Diagonal Bonds Permit Inter-Nucleon Charge-Exchanges

When nucleons have this diagonal alignment, inter-nucleon charge-exchanges may be possible between defects on adjacent cube faces — but only if a charge gradient exists between the two nucleons similar to that existing between face-diagonally related defects in each nucleon. For these external gradients to be equivalent to internal gradients, the *inter-nucleon diagonal-bond* spacing *would have to be 9ü/*, since this places the inter-nucleon charge-exchanging defects at the same face-diagonal spacings (≈4.5ü/) as charge-exchanging defects in each nucleon. Fortunately for the Theory, this seems to be true, as the mass deficit of a 9ü/ diagonal bond spacing is closest to the measured mass deficit of the deuteron:

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db 9[ 8/] 9 = -3.01
db 9[ 9/] 9 = -2.33
db 9[10/] 9 = -1.86

deuteron    = -2.22455 MeV/c²
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Inter-Nucleon Charge-Exchanges Are Possible, But Do They Happen?

We see, then, that inter-nucleon charge-exchanges are plausible, and I will show persuasive evidence in Fig. 3-10, page 11, that they occur between protons and neutrons in the alpha particle. Whether or not they occur between other configurations of diagonally-bonded nucleons is difficult to resolve; we shall find compelling arguments pro and con, as we struggle through our analysis of increasingly more complex nuclides. Let us assume, first, that they do occur, and see what they entail:

Are Charge-Exchange Cycles Altered In Diagonally-Bonded Nucleons?

Since these inter-nucleon charge-exchange spacings are comparable to the nucleon's internal face-diagonal defect spacings, we may infer that inter-nucleon charge-exchanges are a possibility *in competition with* internal nucleon charge-exchanges. This suggests that the six-state charge-exchange cycle of each nucleon may be altered and complicated when a nucleon is diagonally bonded to another. This alteration of the charge-exchange cycles of bonded nucleons may account for the slight discrepancies in the magnetic moments of nucleons, compared to the simple algebraic sum of the moments of their component neutrons and protons. For example, when a proton and neutron join to form a deuteron, the sum of their individual magnetic moments is 2.793 +[-1.913] = 0.880, whereas the measured value is 0.857.

Inter-Nucleon Charge-Exchanges Shift p-n Identities

Another effect of single charge-exchanges between diagonally adjacent nucleons will be to alter the charge of each nucleon by ±e, thereby converting proton to neutron, and neutron to proton. In considering these inter-nucleon charge-exchanges, we should notice that each defect location in an isolated nucleon changes the polarity of its ½e charge only twice in a complete charge-exchange cycle, the proton charge sequence being ++++-- (See Fig. 2-8), while the neutron cycle is ++---- (See Fig. 2-9). We can see from these two sequences that the most favorable moment for a charge-exchange between face-diagonally adjacent defects of the two nucleons will be when their two charge-exchange cycles correlate such that the end of the four plus sequence of the proton defect coincides with the end of the three minus sequence of the neutron defect, since at that point the inter-nucleon gradient will be at a maximum. And if the external spacing is equivalent to the proton internal spacing, we see that the inter-nucleon gradient will be stronger than that to the next proton exchange location, because the latter is preceded by only two minus periods, rather than three for the neutron defect location. The absence of stable p-p and n-n bonds suggests that this slight bias is crucial in developing inter-nucleon charge-exchanges. If we accept this explanation, we should see that there is no possibility of preserving nucleon identity by two simultaneous charge-exchanges between nucleons, since the favorable charge sequences will have different phase relationships for each pair of defect locations.

If Charge-Exchanges Occur, Nucleons Exist In Both Slant Forms

Though it may not be immediately apparent, in accepting the possibility of single charge-exchanges between diagonally bonded T-slant nucleons, we are also accepting the presence in the universe of at least two distinct species of both protons and neutrons. The logic of this assertion is simple: diagonal bonding requires that the

bonded nucleons have different slants, and inter-nucleon charge-exchanges reverse neutron-proton identity. Since we have no way of identifying which state is the "true" particle, we must assume that either slant form is legitimate for either proton, or neutron. This simple conclusion is not without complications, however:

Complications In Nucleon Accretion Processes

Although a proton or nucleon of *either slant-form* can always find a location where it can bond to an already established nucleon cluster, not all bonding locations permit stable attachments. A perimeter, or non-planar, siting may render the added nucleon susceptible to electron capture, to β^-, β^+, or alpha emission, or it may provoke a rearrangement of the entire cluster into a more stable arrangement having additional, or stronger, bonds (termed an internal transition, I.T.). Stability of nucleon clusters usually requires:

1) That the nuclear geometry achieves the maximum possible bond mass-deficit among the component nucleons.

2) That every neutron has the possibility of charge-exchanges with a diagonally adjacent proton.

3) That the nuclide can develop sufficient face-charge-asymmetry in response to a grazing electron to prevent its hitting any of the component nucleons. (I discuss this in a later section).

We shall see that these requirements cause groups of nucleons to form *planar* arrays, because clustered nucleons can form the greatest numbers of diagonal & paraxial bonds if they site compactly with their centers lying in a common cardinal plane, as in Fig. 3-1C, rather than spread out, as in [D], or in two planes, as in [E] and [F]. As we pursue our study, we will find arguments that persuade us that light nuclei (up to A = 50 → 60) form in a single plane, while heavier nuclei form five-plane structures, with planes 1, 3, & 5, comprised of p's & n's, while planes 2 & 4 have neutrons only.

A Rationale For <u>Planar</u> Nucleon Clusters

I have shown in Chapter 2, Figs. 2-8 & 2-9, that the six *c-void locations* of protons and neutrons alternate between plus & minus charges as these nucleons undergo a repetitive pattern of charge-exchanges. Now, since the *sequence* and *direction* of these exchanges is *arbitrary*, we may presume that this repetitive pattern of c-void charge-alternation is not forever fixed in space, but is alterable by external charge influences. Thus, when two nucleons approach each other, we will expect each to adapt its charge-exchange cycle so as to produce the maximum electrostatic attraction & maximum bond mass-deficit between them. In this jockeying to maximize bonding, the two nucleons *will inherently align themselves so as to cause their centers to lie in a cardinal plane of the space lattice*. This cardinal alignment occurs because:

- Maximum diagonal bonding requires that participating c-voids lie in the same cardinal plane.

- Maximum paraxial bonding requires that defect-pairs share a common pairing axis, and pairing axes have cardinal alignments.

A New Nuclear Concept: Orientation Isomers

Now, since there are three cardinal plane directions in space, we infer that planar nuclei of the same isotope will tend to exist in a multiplicity of orientations in space. We shall call these possibilities, **orientation isomers**. I show the nature of these multiple orientations in Fig. 3-2:

Fig. 3-2 Orientation Isomers Of Hydrogen 3 Nuclide

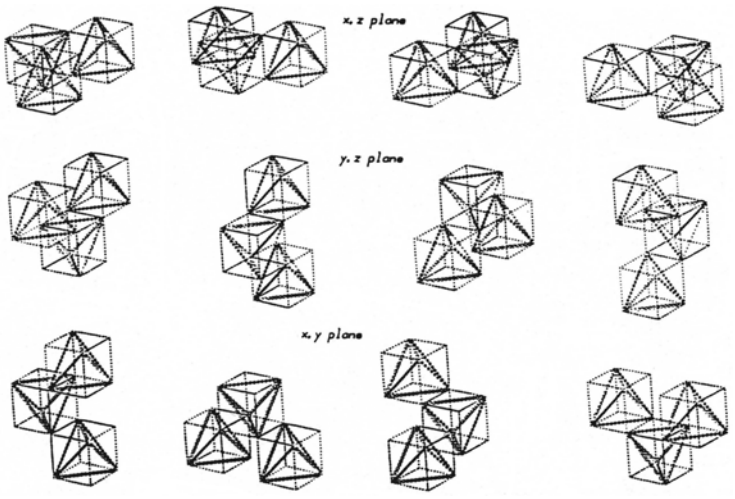


Fig. 3-2 shows *only half* of the potential orientation isotopes; there are twelve more of identical orientation, but with all slants reversed. There is further complexity: only State #1 of the synchronized six-state charge-exchange cycle is shown in each orientation, so there are actually 12x2x6 = 144 different c-void orientations possible for the H3 nuclide in its ground state. And if we add the complexity of structural changes implicit in excited states, p/n reversing inter-nucleon charge-exchanges, and different phase relationships between the nucleon charge-exchange cycles, the number of possible c-void orientations becomes mind-boggling. Of course, some planar nuclei exhibit perfect nucleon symmetry, but even these will have 6 orientation isomers, or 12, if the symmetry is bilateral.

Is there experimental evidence of orientation isomers? I'll defer taking on this question until we have a better understanding of nuclear structures:

We Begin Our Analysis With The Deuteron

If we place the dual requirements of bonding and inter-nucleon charge-exchanges on the nucleon association process, we see that the simplest complex nuclide, deuteron, must have a diagonal bond (Fig. 3-1B), rather than a paraxial bond (Fig. 3-1A). The calculation of the mass deficit of this bond is a formidable task, due to the continuing charge-exchanges of the two bonded nucleons, which will alter the defect spacings of the two diagonally bonded defect-pairs throughout the charge-exchange cycle, and will very likely cause the diagonally bonded *c-void* defects in some states not to lie in the same cardinal plane. Then there is the question of what phase relationship to assume between these two charge-exchange cycles, and, in addition, the problem of calculating

the effect of the postulated inter-nucleon charge-exchanges, if they, indeed, occur. Finally, there is the question of whether the paired nucleons move by *diagonal*, or *cardinal*, translation through the lattice, the latter movement causing the diagonal bond spacing to alternate between two values.

Changes In Nucleon Bond Spacings Do Not Lead To Scission

We should notice that a momentary increase in separation of the two nucleons, as required by cardinal translation, will not lead to scission of their bond, as we find in meson and baryon resonances, because the defect-pair spacings of the two nucleons are already at their unbonded (isolated) equilibrium values. Thus, we are free to postulate that the diagonal bond alternates between two equilibrium spacings as the joined proton and neutron move by cardinal translation through the space lattice. I will be able to show that diagonal translation of the deuteron is also a possibility, but this evidence emerges later in our exploration of mass-three nuclides.

The Synchronizing Of Proton And Neutron Charge-Exchanges

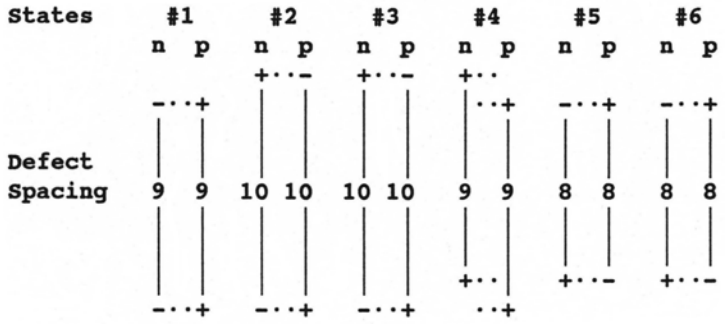
It seems clear that maximum diagonal bonding requires that the bonded c-voids lie in a face-diagonal direction from each other, and lie in the same cardinal plane. This requires that diagonally-bonded defect-pairs have *the same* defect-spacings, and *opposite* slants & charges. . Let's see whether this is possible, by looking at Table 3-1, where I show the defect spacings in the x, y, & z directions for the six charge-exchange states of Fig 2-8 (proton) & Fig. 2-9 (neutron):

Table 3-1 Proton & Neutron Charge-Exchange Sequences

Proton States	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**
x-defect-spacing	9	8	9	9	9	10
y-defect-spacing	9	10	10	9	8	8
z-defect-spacing	9	9	8	9	10	9
Neutron States	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**
x-defect-spacing	8	8	9	10	10	9
y-defect-spacing	9	10	10	9	8	8
z-defect-spacing	9	10	9	9	8	9

We notice, above, that the x & z defect-spacings have a very poor match, but, the y-defect-spacings match perfectly. Looking at Figs. 18 & 19, we see, also, that the bonding c-voids have the required *opposite slants* and *opposite charges* for bonding, with the exception of state #4, where all the y c-voids have plus polarity. I show these changing relationships, graphically, in Fig. 3-3, below:

Fig. 3-3 C-Void Alignments In Deuteride Diagonal Bond



In Fig. 3-3, I indicate diagonal-bond partners, and cardinal plane c-void locations, with horizontal dotted lines, and show pairing axes with vertical solid lines, broken by numbers indicating the neutron & proton defect-pair defect-spacings for each charge-exchange state. We see that only one charge-exchange state of the deuteron, the fourth one, is misaligned (because the c-void charges are all positive). It should also be clear that the diagonal bond relationship will be unaffected by changes in the diagonal bond spacings from 9ü/ to 10ü/, as the deuteride undergoes cardinal translations*, or *alternate translations***.

* In *cardinal translations*, both nucleons move 1ü/ simultaneously and *obliquely* toward, and then away from each other, alternately, in such a manner as to change the diagonal bond spacing ±1ü/.

** In *alternate translations*, the two nucleons move one at a time, sequentially, in one of the two directions of the diagonal bond.

It should be clear that most deuteride trajectories will need to be a combination of these two modes of translation.

Using the value for the diagonal-bond constant given in Equation 5-4, p. 2-22, we calculate the diagonal bond mass-deficits for the six charge-exchange states at both 9ü/ & 10ü/ bond spacings, along with the simple average of all twelve states:

Table 3-2 Calculating Deuteride Mass-Deficit

State #1	db 9[9/] 9	=	2.33	db 9[10/] 9	= 1.86
State #2	db 10[9/]10	=	3.57	db 10[10/]10	= 2.85
State #3	db 10[9/]10	=	3.57	db 10[10/]10	= 2.85
State #4	db 9[9/] 9	=	2.33	db 9[10/] 9	= 1.86
State #5	db 8[9/] 8	=	1.45	db 8[10/] 8	= 1.15
State #6	db 8[9/] 8	=	1.45	db 8[10/] 8	= 1.15
Average of 6 states		=	-2.45		= -1.96
Average of 12 states		=	-2.20		
Experimental value		=	-2.2246		

We see that, in choosing our ring diagonal bond constant, R, to produce the exact mass value for the psi(3685), and "fudge" factors, 1.004 & L (see pgs. 22,23 Sect. II), we have introduced a 1% error in the calculated deuteride mass-deficit value. To avoid this 1%

error, I have opted to adjust the diagonal bond constant for nucleon diagonal bonds so that it produces the exact deuteride mass-deficit value, and then use this value for all other nuclei db calculations.

Why Synchronization Of Charge-Exchange Cycles Occurs

Now, let's consider some factors which may account for the synchronization of the two charge-exchange cycles, when proton and neutron join to form a deuteron. Synchronization has two requirements, *spatial orientation* (which I discuss now), and *phase correlation*. Our first insight should be that the T-slant form has no inherent influence (other than the handedness of the "slant" tetrahedron) upon the spatial orientation of its charge-exchange cycle. Any cycle which sums to the correct mass, and yields the proper plus-minus charge ratios for each nucleon "face" is equally appropriate, and any cycle will function just as well in both forward and reverse directions. Next, we see that, at every state in charge-exchange cycles, there are multiple possibilities for the direction of the next charge-exchange, and that any cycle of a particular orientation will continue to retrace the same charge-exchange pathways only as a result of very subtle electrostatic "traces" left by the preceding cycle. We can infer that these "traces" are susceptible to alteration by external electrostatic (or magnetic) fields, thereby causing a new direction of charge-exchange in one, or several, or all, of the charge-exchange states. Thus, to find out why a particular spatial orientation of the charge-exchange cycles occurs between the two deuteron nucleons, we must first discover why each nucleon is susceptible to electrostatic (or magnetic) influences.

Induced Dipole Effects Alter Charge-Exchange Cycles

When we examine these cycles, we see that every charge-exchange state has both mass and charge asymmetry, even though the T-slant form possesses tetrahedral symmetry. This asymmetry is simply due to the fact that, in T-slant nucleons, defect-pairs comprised of plus c-void defects cannot have a common center of mass with orthogonal defect-pairs comprised of minus c-void defects. Additionally, we see that four of the proton states have even-spaced defect-pairs, and every state of the neutron has at least one even-spaced defect-pair; and even-spaced defect-pairs are always asymmetric with respect to orthogonal odd-spaced or other even-spaced defect-pairs. Hence, every state is endowed with both a moment of inertia, and a dipole moment.

When proton and neutron approach to each other, their mutual attraction will, at first, be independent of their orientation, and be purely electrostatic. The attraction, of course, results from the labile nature of the charge-exchange cycles, which interact upon each other to produce cycles with predominately attractive dipole moments. However, as the two particles circle each other, there may be orientations which manifest either a paraxial, or a diagonal bond, but not both! With T-slant nucleons, only like-slant nucleons can form paraxial bonds, and only unlike-slant nucleons can form diagonal bonds. *

* This insight possibly leads to a test of the Theory; if both protons and neutrons exist in both slant forms, in equal numbers, only 50% of proton-neutrons approaches can lead to deuteron formation. And if slant forms can be reversed by induced spin-flips (a remote possibility, but not a certainty!), it would be possible to create populations of both protons and neutrons in the same slant form, which populations should not be capable of interacting to form deuterons, but only transient duos, paraxially-bound.

Release Of Bonding Energy Leads To Synchronization

If the approaching neutron and proton have opposite T-slant forms, and approach close enough together, the mutually-induced dipole attraction should hold them together while they circle into a diagonal-bond alignment, with the consequent release of binding energy, which should split into two equal components, one generating a photon, the other being assimilated by the deuteron in the form of oppositely directed momentum. What I would expect to happen is that the charge-exchange cycles would quickly synchronize to produce the maximum diagonal bond mass-deficit, because the direction of charge-exchanges is sensitive to external fields, and will tend toward configurations which develop opposite-charges on adjacent *c-voids* of the two nucleons and opposite charges on diagonal-bonded *c-voids* in the same cardinal plane. In addition, sequences of favorable diagonal-bond alignments are stabilized by release of energy, so that subsequent bonds of lesser mass-deficit are discriminated against.

Mass Three Nuclides

When another nucleon is added to the deuterium nuclide, three structures are plausible, linear diagonal, twisted diagonal, and C-shaped, all with two diagonal bonds, and the last with an additional paraxial bond (See Fig. 3-1 D, E, C respectively). Note that the more compact form, Fig. 3-1F, cannot form, because, due to the geometry of the T-slant configuration, the neutron approaching the notch will find one of its two diagonal bonds repulsive, so that the net attraction is zero, or, at most, about 20% of a single diagonal bond, if the two diagonal bonds have different spacings (say, 9ü/ and 10ü/).

The Structure Of Hydrogen 3 Nuclide (Triton)

Of the four T-slant forms shown, it is clear that [C], having three attractive bonds, is more stable, and will be the ground state of triton. We may speculate that the linear diagonal and twisted diagonal forms may be excited states, as would be the expanded forms of all three shapes (i.e. those in which inter-nucleon bonds have greater spacings, and, hence, create smaller mass deficits). Other possibilities for excited states are those in which the charge-exchanges of the nucleons have different displacement directions, different spin directions, different intervals of inter-nucleon charge-exchanges, or even different synchronization vis-à-vis each other. Each of these alterations could create different patterns of bond spacings (or charge-exchange states) which might integrate to different values of mass-deficit. These complexities should provide interesting studies in the future, but we shall ignore them in this introductory work.

Since the experimental evidence indicates pairing of the two neutrons of triton (spin ½, magnetic moment +2.98 vs. spin 1, magnetic moment +0.86 for deuteron), we shall want some simple way of showing differences between paired and unpaired protons and neutrons in our schematics. Also, because large nuclei have so many nucleons, we shall want a *compact* presentation. Here are some of our conventions (I will introduce more, as we proceed):

Fig. 3-4 Compact Representations Of H2 & H3

The Structure Of Helium 3

Helium 3 clearly has the same range of nuclear structural possibilities as Hydrogen 3, only with neutrons replaced by protons, and vice-versa. Hence, it will also take the C-shape for its ground state:

Fig. 3-5 Compact Representation Of Helium 3

Why Do H_3 & He_3 Have Different Mass-Deficits

These two structures of mass 3 do not exhibit the same mass deficits (H_3 = -8.48 MeV/c^2; He_3 = -7.72 MeV/c^2), even though both have one unpaired nucleon, and the same numbers and types of bonds. These differences in the mass deficits can be accounted for, if we are willing to look deeply into the processes synchronizing the charge-exchange cycles of the associated nucleons.

For this study, it will be useful to redo TABLE 11 to show more clearly the spacing sequences used in the paraxial bond joining the paired nucleons. Since both Hydrogen 3 and Helium 3 nuclides have two diagonal bonds, we will assume that the sequence common to both protons and neutrons (9,10,10,9,8,8) is used in these diagonal bonds, and, hence, is unavailable for creating a paraxial bond between the paired protons; the neutron has two of these sequences, so one of these is available for use in the paired neutron bond. I have underlined the available sequences in Table 3-3, below:

TABLE 3-3 Sequences Available For Paraxial Bonds

Neutron States	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**
x-defect-spacing	8	8	9	10	10	9
y-defect-spacing	9	10	10	9	8	8
z-defect-spacing	9	10	9	9	8	9
Proton States	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**
x-defect-spacing	9	8	9	9	9	10
y-defect-spacing	9	10	10	9	8	8
z-defect-spacing	9	9	8	9	10	9

Both Available n-Charge-Exchange Sequences Must Be Used

You will notice that the two available proton sequences differ only in the order of defect-spacing changes. Hence, we need not be concerned which we select, since they should have the same consequence for the average mass-deficit of the paired-proton paraxial

bonds. On the other hand, the two available neutron sequences have a different mix of defect-spacings, so they would yield different averages for the paired neutron paraxial-bond mass-deficits. Hence, we must either choose just one sequence for the paired-neutron paraxial bonds, or assume that both are utilized in a statistically equal manner through repeated alternations induced by ambient lattice irregularities. I shall choose the latter, giving each sequence equal weight in the mass-deficit calculation, because experience teaches us that, where two equally plausible alternatives exist, Nature usually uses both without discrimination.

How IPP Views Nucleon Pairing

Now, let's think about the implications of pairing. The experimental evidence for this is two-fold: cancellation of spin, and larger mass-deficit compared to unpaired nucleons (This latter tendency is evident for even numbers of neutrons throughout the periodic table, as any nuclear text shows). We begin with spin:

Why Spin Is Canceled In Paired Nucleons

Our first clue to cancellation of the spin effects of paired nucleons is our inference that they will be diagonally bonded to the same intermediate nucleon. These two diagonal bonds obviously utilize the same defect-pair in the intermediate nucleon, so the charge-exchange cycles of the two paired nucleons will become synchronized, at least in this cardinal direction, so as to produce the maximum diagonal bond mass-deficit.

Our next clue is found in the need for lattice-density oscillations to initiate charge-exchanges. I imagine these as forming a superimposed sequence of (in this case) twelve different amplitudes, phase shifted relative to each other, so that the maximum central density of each returning phase is, step by step, appropriate to the instantaneous mass-energy requirements of that particular combined charge-exchange state. Now, since each nucleon tends to move toward the center of this returning zone of higher density, the three nucleons will adopt charge-exchange cycles which give each nucleon equal share of the instantaneous mass-energy, within the limitations of their individual charge-exchange options.

Thus, the tendency will be for all nucleons to be in the high-mass states together, the low-mass states together, etc. This will be most nearly achieved, if defect-pairs in the same cardinal directions (i.e. their pairing axes point the same way) develop the same defect spacings, and are spaced equal distances from the lattice-density-oscillation center. When we adjust the paraxial-bond parameters to meet these requirements, we see that the bond-spacings must always be odd, causing the paraxially-bonded defect-pairs to have the same polarities of their inner collapsed defects. Or putting in a different way, the paraxially-bonded defect-pairs, being of equal mass, and opposite orientation, will be mirror images of each other. And this will be possible, only if the charge-exchange cycles of the two paired nucleons have inverse directions. This leads to the cancellation of their individual spins.

We Calculate The Helium 3 Mass-Deficit

Let's now use these elements of understanding to calculate the mass-deficits of the nuclides of H3, and He3. I shall choose, first, the Helium 3 nuclide, because it is

simpler; here the two available defect-spacing sequences for the paraxially-bonded protons are identical except for phase, so only one needs to be computed:

Table 3-4 Calculating Mass-Deficit Of Helium 3 Nuclide:

	db spacing = 10ü		db spacing = 9ü	
State #1	pb 9[11] 9	= -1.47	pb 9[9] 9	= -2.48
State #2	pb 8[11] 8	= -0.84	pb 8[9] 8	= -1.43
State #3	pb 9[9] 9	= -2.48	pb 9[7] 9	= -4.67
State #4	pb 9[9] 9	= -2.48	pb 9[7] 9	= -4.67
State #5	pb 9[9] 9	= -2.48	pb 9[7] 9	= -4.67
State #6	pb 10[9]10	= -4.03	pb 10[7]10	= -7.49
Average of 6 states		= -2.30		= -4.24
Average of 12 states		= -3.27		
2 deut. bonds @ -2.2246*		= -4.45		
Total mass deficit		= -7.72		
Experimental value		= -7.72 MeV		

* This is now my calculated value. I alter the diagonal-bond constant in computing nuclear db's to conform to this value.

The two groups above, with different spacings, reflect the deuteron-type cyclical variations (10ü/, 9ü/, etc.) of the two diagonal-bond spacings. These two spacings should change symmetrically for the two diagonally bonded protons, causing the proton paraxial bond spacings to be larger by 2ü in the 10ü/ group. Notice, that there are two sets of paraxial bond spacings, which differ, also by ±2ü, in both the 9ü/ & 10ü/ groups. The reason for this, as I have explained earlier, is that the polarity, and, hence, the location, of the paraxially-bound defects must change to produce the required proton face-charge sequence (--++++). This shift will occur twice each cycle, each time the polarities of the opposing *c-voids* are reversed by a charge-exchange.

Calculating The Hydrogen 3 Mass-Deficit

We will calculate, first, the average paraxial bond mass-deficit at the diagonal bond spacing of 9ü/, which creates a separation of 18ü between the y-pairing axes of the two neutrons. As I mentioned above, we will need to use both of the available charge-exchange sequences in our calculation, because they differ in their numbers of 8ü, 9ü, & 10ü defect spacings. We give both sequences equal weight:

Table 3-5 Calculating Mass-Deficit Of Hydrogen 3 Nuclide:

	db spacing = 9ü		db spacing = 9ü	
State #1	pb 8[9] 8	= -1.43	pb 9[7] 9	= -4.67
State #2	pb 8[9] 8	= -1.43	pb 10[7]10	= -7.49
State #3	pb 9[9] 9	= -2.48	pb 9[9] 9	= -2.48
State #4	pb 10[7]10	= -7.49	pb 9[9] 9	= -2.48
State #5	pb 10[7]10	= -7.49	pb 8[9] 8	= -1.43
State #6	pb 9[7] 9	= -4.67	pb 9[7] 9	= -4.67
Average of 6 states		= -4.17		= -3.87
Average of 12 states		= -4.02		
2 deut. bonds @ -2.2246		= -4.45		
Total mass deficit		= -8.47		
Experimental value		= -8.48 MeV		

Wait a minute! Here is something totally unexpected! We get the correct mass-deficit by using only the 18ü spacing between the c.o.m.'s of the x-defect-pairs of the two neutrons, but must use both the 9ü/ and 10ü/ spacings for the two diagonal bonds. What could be happening to prevent the paraxial-bond spacings from increasing by 2ü, when the diagonal bond has the 10ü/ spacing? The only way we can explain this anomalous behavior is to assume that the y-axis defect-pairs of the two neutrons might shift their location by ±1ü/ in the x-z direction twice each six-charge-exchange cycle, while the x and z defect-pairs hold their locations. You will observe that these shifts could preserve the correct diagonal-bond mass-deficit, only if they occurred between States #2 & #3, and between States #5 & #6 of Table 3-6, below.

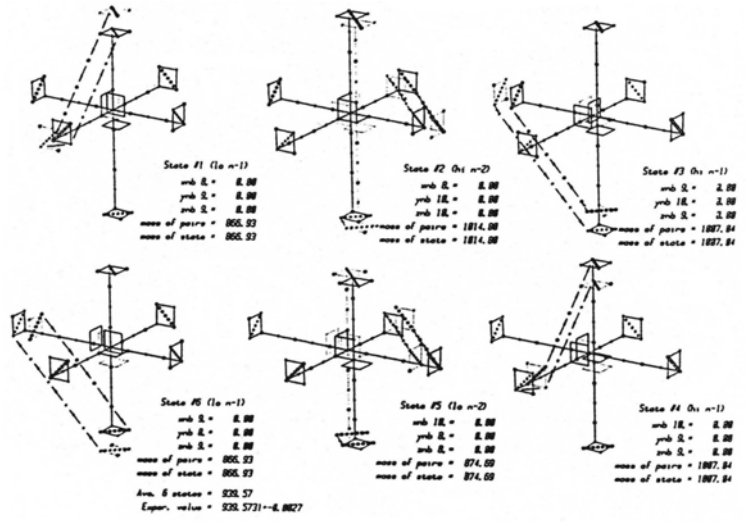
Table 3-6 Shift-Points In Fig. 15-5 Neutron Sequences

Neutron States	#1	#2		#3	#4	#5		#6
x-defect-spacing	8	8		9	10	10		9
y-defect-spacing	9	*10*	↑	*10*	9	*8*	↓	*8*
z-defect-spacing	9	10		9	9	8		9

Could The Y-Axis Shift In The Charge-Exchange Cycle?

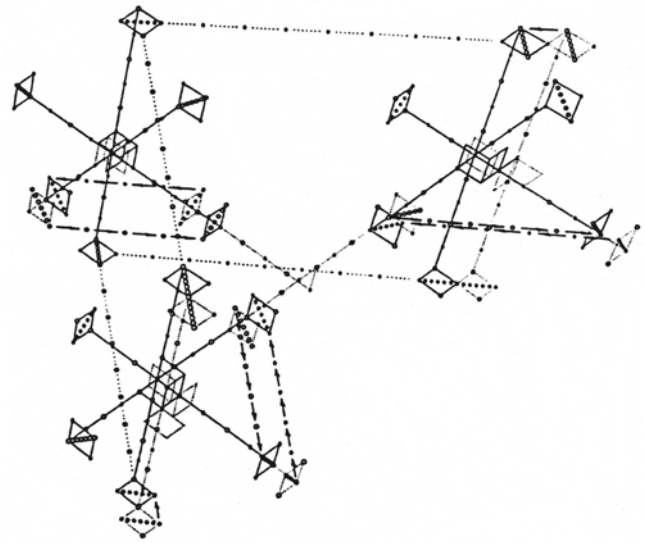
In Fig. 3-6, below, I draw a paired-neutron charge-exchange cycle in which the y-axis defect-pair shifts 1ü/ at the two appropriate points in the six-stage charge-exchange cycle.

Fig. 3-6 Paired-Neutron Charge-Exchange Cycle



This cycle does seem slightly contrived, but, as I have indicated on the drawing caption, these shifts are at a point in the cycle when the c.o.m. of the x and z defect-pairs is shifting in the same direction as the y-defect-pair shift. We see this interplay of defect-pairs more clearly, when we examine the transition from state #2 to State #3 of Fig. 3-6 in Fig. 3-7, below. Here, the intermediate proton creates electrostatic attractions to the x & z defect-pairs of the two neutrons, holding them close, even though their centers-of-mass are moving outwardly from the proton. The *c-voids* of the neutron y-defect-pairs are more remote; hence, they are freer to move out:

Fig. 3-7 The 9u To 10u Shift Point Of H3 Nuclide



Does The Neutron Use Both Charge-Exchange Cycles?

Should we assume that the neutron charge-exchange cycle is always of the Fig. 3-6 type? Probably not! Although, this cycle would simplify the deuteron diagonal bond to a six-state charge-exchange cycle, instead of a twelve, it will *not* work when the neutron is diagonally bonded to two protons, as in the Helium 3 nuclide. Here, the neutron must form two diagonal bonds in orthogonal directions, and the y-defect-pair shift of the Fig. 3-6 cycle would cause misalignment of one of the two bonds. The Fig. 2-9 neutron charge-exchange cycle, with a non-shifting y-defect-pair, avoids this misalignment difficulty by placing the burden of shifting on the two protons.

Accounting For The Different Lifetimes Of Mass-Three Nuclides

How can we account for the difference in the stability of H3 (half-life of 12.3 years), compared to He3 (which is stable, though its abundance is six orders of magnitude less that He4, suggesting instability at stellar temperatures, or wanton susceptibility to neutron capture)? From experiments, we know that the instability of H3 is not a result of its inability to hold both neutrons, but, rather, is due to a tendency of one neutron to undergo beta emission, and transform into a proton. A possible explanation for the second neutron's instability may be as follows:

Although our mass-deficit calculation suggests that inter-nucleon charge-exchanges are not a normal occurrence for the H3 nucleus, they may still be possible during the transient presence of a plus or minus *void*. Depending on the trajectory and polarity of the visiting *void*, either of these two changes may occur:

Fig. 3-8 Induced Proton Entity Shifts In H3 Nuclide

By these inter-nucleon charge-exchanges, which IPP terms "**proton/neutron *entity* shifts**", the left hand (or right hand) neutron no longer sees as strong an external electrostatic gradient, and becomes more like a free neutron, and the paraxial bond is weakened by the loss of neutron pairing. Therefore, during the time that these alternative structures exists, these neutrons are vulnerable to the influence of a passing electron neutrino, as I will explained in detail in Chapter 6 (Decay & Creation Processes). However, the charge-exchange with the passing neutrino is severely hindered both by the transient nature of the favorable configuration, and by the positive charge of the cluster, which tends to repel the positive *void* component of the electron neutrino with which the neutron makes the charge-exchange, and, thus, may require the synergistic presence of a countervailing influence, such as a suitably positioned plus (or minus) half-charge *void* (muon neutrino). These requirements may explain why this β^- decay is five orders of magnitude less probable than that of an isolated neutron. Of course, the change of neutron to proton is also hindered by the absorption of a substantial portion of the released energy in the Hydrogen 3 to Helium 3 nuclide conversion (released energy = 1.30 - 0.51 - 8.48 + 7.72 = 0.03 MeV).

By contrast, the helium 3 nucleus will be much less likely to rearrange by inter-nucleon change-exchanges under the influence of a passing *void,* because this would require the

protons to move adjacent to each other, and any external charge influence would have to be strong indeed to induce this shift:

Fig. 3-9 Unlikely Proton Entity Shift In He3 Nuclide

And, even if we were to assume that this shift is possible, we would be confident that decay of the left-hand (or right-hand) proton to a neutron by β^+ emission would be exceedingly unlikely, because at least 0.51 + 1.30 + 7.72 - 8.48 = 1.05 MeV of external energy would be required, in coincidence with the proximity of visiting neutrinos in the requisite geometrical configuration. However, protons do decay to neutrons in larger neutron-deficient (Z > ½A) nuclei by β^+ emission, if they are located on the periphery of the nuclide in a site which satisfies two requirements:

1) It must be sufficiently accessible to passing neutrinos to allow them to induce the conversion.

2) There must be an adjacent site which bonds the resulting neutron more strongly than this proton is bound, by at least -0.51 (the positron mass) -1.29 (proton mass - neutron mass) = -1.80 MeV.

Analyzing Mass Four Nuclides

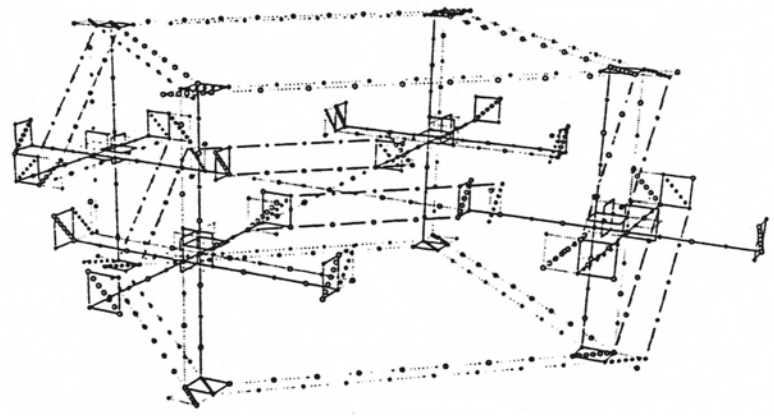
When we examine nuclides with four nucleons, we notice that only those with two protons and two neutrons form. This fact, along with the non-existence of di-protons and di-neutrons (except as short lived resonances), reinforces our suspicion that diagonal bonds are stable only between neutral and charged nucleons. However, the alteration of proton-neutron identities through inter-nucleon charge exchanges makes it possible for any nuclide to accrete either slant of nucleon, although a given nuclide may have stronger binding sites for one slant form compared to the other. Here is one explanation for meta-stable states, since the accretion of a nucleon into a weaker-bond site sets the stage for later rearrangement of a "wrong-slant" nucleon, after "slant"-reversal*, into a stronger bonding location.

* On page 2-21, I offered a possible mechanism for slant-reversals, based upon the supposition that space is polycrystalline. The case for "slant"-reversals is persuasively argued in Chapter 4.

Inter-Nucleon Charge-Exchanges In He4 Nuclide

The mass-deficit of Helium 4 (-28.30 MeV/c^2) is astoundingly large compared with that of Helium 3 (-7.72 MeV/c^2), even though He4 has only three more bonds (+1pb+2db). Here is another test which IPP passes with flying colors. We find that the symmetry of the 2p/2n arrangement permits a p/n "entity" interchanging mode of charge exchanges having only two states, in which the bond mass-deficits are augmented by decrements in both the proton and neutron masses, as I illustrate in Fig. 3-10, below:

Fig. 3-10 pn Identity-Changing Charge-Exchanges Of He4



Here are some things to notice in this lattice-form diagram, where the solid-line tabs are State #1, dotted-line tabs, State #2:

- The x-axis nucleons are protons in State #1, but neutrons in State #2; the z-axis nucleons are the reverse.

- The proton "entities" are always in the **p1** state (9ü,9ü,9ü), the neutron "entities" change from **n1-high** (9ü,9ü,10ü) to **n1-low** (8ü,9ü.9ü) from State #1 to State #2. These charge-exchange states are lower mass states than p2 (9ü,8ü,10ü), and n2-high (10ü,8ü,10ü), or n2-low (8ü,10ü,8ü); *thus, n's & p's lose mass in the a-particle*.

- Orthogonal T-slant nucleons must be of **opposite slant-form** in order to permit ring-diagonal bonding of the y-axis defect-pairs; this slant reversal causes the *inter-nucleon charge-exchanges* of the four central c-voids to mimic the K_L^0 exchanges.

- The four "outrigger" c-voids **do not enter into the charge-exchanges**, but remain always positive. Explanation: these are the a's *dominant-charges*, which having moved toward maximum separation, remain there due to perfect balance of inner charges.

- Notice, in each nucleon, that the two defect-pairs *orthogonal to the paraxially-bonded one* retain their 9ü spacings in both charge-exchange states by virtue of their **offset** K_S^0 type charge-exchange, but this offset causes the ring-bond spacings to alternate between 9ü/ & 10ü/.

Now, let's validate this two-state structure by mass calculations:

Table 3-7 Calculating the Mass-Deficit of the Alpha Particle

State #1 Bonds		State #2 Bonds	
xpb	9[9] 9 = - 2.48	xpb	8[11] 8 = -0.84
zpb	10[9]10 = - 4.03	zpb	9[11] 9 = -1.47
yrb	9[9/] 9 = - 4.67	yrb	9[10/] 9 = -3.73
yrb	9[9/] 9 = - 4.67	yrb	9[10/] 9 = -3.73
Total	= -15.85	Total	= -9.77

Average bond mass-deficit **=** -12.81 MeV/c²

Average mass-loss of p's & n's in a-particle

proton = $2m_p$-6*9ü*
= 2*938.28-6*311.04 = 10.32 MeV/c²

neutron = $2m_n$-4*9ü-10ü-8ü
= 2*939.57-4*311.04-384.97-244.86 = 5.15 MeV/c²

Total mass-deficit of Alpha Particle

bonds-p's-n's = -12.81-10.32-5.15 = -28.28 MeV/c²
Experimental Value = -28.30 MeV/c²

* interpret 9ü, 10ü, 8ü as mass of 9ü defect-pair, etc.

Analyzing Mass Five Nuclides

With mass number five nuclei, we find something unexpected; both varieties are unstable, with exceedingly short lifetimes, even though either nucleon joins with both a diagonal and a paraxial bond, a combination with more than twice the mass-deficit of a deuteron:

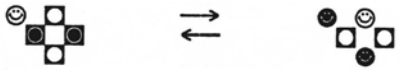
Fig. 3-11 Neutron Or Proton Attachment To Alpha Particle

How can we understand this failure to bond permanently, when we know that a deuteron is stable with only a single bond, and we know that an alpha particle is unusually stable, because of its unique charge-exchange cycle?

Clues To The Instability Of Mass-Five Nuclides

Our first clue toward understanding mass-five instabilities is the alternation of proton/neutron identities in the charge-exchanges of alpha particle component of the mass-five nuclide. Would not the fifth nucleon provide an alternative path for an inter-nucleon charge-exchange, allowing the proton *entities* to separate further apart:

Fig. 3-12 Possible States Of Helium 5

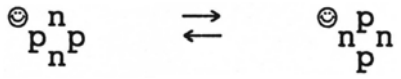


Should this occur, it could destroy the symmetry of the alpha group, and cause all five nucleons to revert to their normal six-stage charge-exchange cycle, releasing 15.51 MeV of energy. Since this exceeds the binding mass-deficit of the fifth nucleon, we can consider this change to be a potentially disruptive influence. However, since Helium 5 does have a measurable half-life ($\approx 10^{-15}$ sec) and mass-deficit (-27.41 MeV/c^2), we suspect that these two structures alternate repeatedly through inter-nucleon charge-exchanges.

Calculating The Mass-Deficit Of The Helium 5 Nuclide

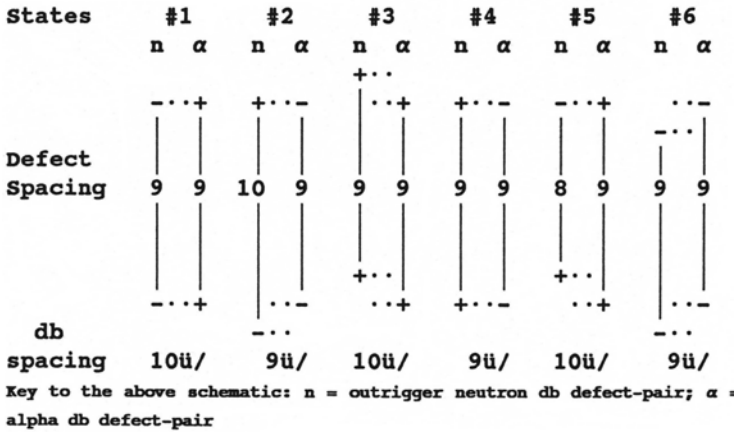
The first form can obviously exist in these two states:

Fig. 3-13 Alternating p/n "Entities" Of n-a Structures



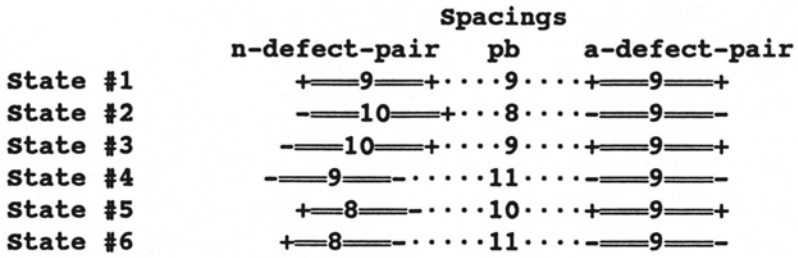
To calculate the mass deficit of these two states, we must look carefully at Fig. 3-10. Notice that the defect-pairs which bond to the outrigger neutron move inwardly and outwardly *in opposite directions* to effect the two-state a-charge-exchange. This opposite movement of a-defect-pairs requires the outrigger neutron to undergo gyrations of its normal six-state charge-exchange cycle, if it is to maintain the integrity of its two bonds (the pb between it and the upper nucleon & the db with the left nucleon). Let us draw a schematic for the manner in which the outrigger neutron adapts its six-cycle charge-exchange to maximize bonding to the shifting polarity & location, but constant 9ü spacing of the bonding a-defect-pairs:

Fig. 3-14 Outrigger Neutron Diagonal-Bond Parameters



Notice that I have chosen the six-state sequence for the outrigger neutron which has the maximum number of 9ü spacings (9,10,9,9,8,9). This should result in maximum diagonal bonding to the constant 9ü spacing of the a-defect-pair. Even so, there are four misaligned diagonal pairings in this sequence, compared to one for the deuteron bond. Thus, we should not be surprised to find that our calculated average somewhat overstates the mass-deficit of this bond, as we shall discover when we put all the pieces together to calculate the Helium 5 mass-deficit. Having chosen this sequence for the diagonal bond, we see that the inter-nucleon paraxial bond of the outrigger n must use one of two remaining sequences, each with the same average mass-deficit, (8,8,9,10,10,9), or (9,10,10,9,8,8):

Fig. 3-15 Outrigger Neutron Paraxial-Bond Parameters



We can calculate the mass-deficit of the neutron-joined-to-alpha form of Helium 5, by finding the average mass-deficits of the above diagonal & paraxial bonds, and adding these to the mass-deficit of the alpha particle. Doing this, we get:

Table 3-8 Mass-Deficit Of n-alpha Helium 5

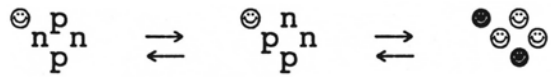
State #1	db 9[10/] 9 = - 1.88	db 9[9/] 9 = - 2.48
State #2	db 10[9/] 9 = - 2.91	db 10[8/] 9 = - 4.25
State #3	db 9[10/] 9 = - 1.88	db 10[9/] 9 = - 3.16
State #4	db 9[9/] 9 = - 2.35	db 9[11/] 9 = - 1.47
State #5	db 8[10/] 9 = - 1.48	db 8[10/] 9 = - 1.43
State #6	db 9[9/] 9 = - 2.35	db 8[11/] 9 = - 1.11
Average of 6 states	= - 2.14	= - 2.32

Mass deficit of alpha group	= -28.30
1 diagonal bond	= - 2.14
1 paraxial bond	= - 2.32
Mass deficit of n-alpha	= -32.76 MeV

What Structure Shall We Choose For The Non-Alpha He5 Nuclide?

Now let us find the mass-deficit of the "separated-proton-entity" component of the Helium 5 nuclide. When a proton "entity" changes places with the outrigger neutron, we expect the remaining a-proton to move toward maximum separation (below, right):

Fig. 3-16 Conversion Of n-a Form Of He5 To Non-a Form



Notice that I have drawn this structure with all five nucleons unpaired. This choice is supported by the experimental value of 3/2 for the spin of Helium 5, since the non-a form should have a spin of 5/2, the a-form, 1/2; hence, if the two forms alternate, their summation spin should be 3/2.

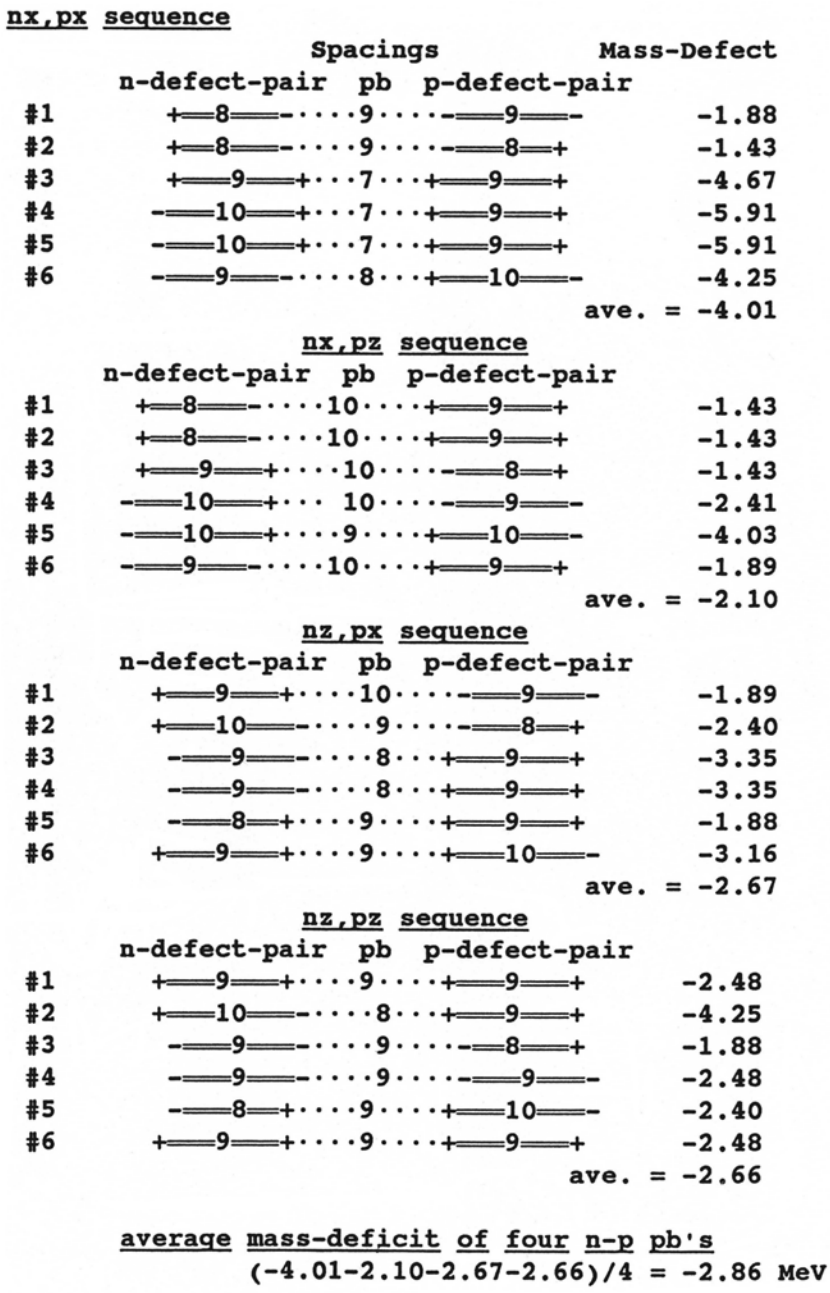
Some Structural Complexities To Consider

So, how do we calculate the mass-deficit of this cluster? And what spacings will diagonal-bonds have in a structure which probably lasts only as long as one complete charge-exchange cycle, before it shifts back to the n-a form? Another complexity we see is that the top neutron has orthogonal paraxial bonds with the two protons "entities"; thus, these bonds must utilize different "sequences" of the neutron charge-exchange cycle, and, if the diagonal bonds utilize the expected defect-pair sequence (9,10,10,9,8,8), the two remaining proton sequences will not match either of the available neutron sequences, so mirror-image paraxial bonds will not be possible between neutron and proton. Also, even though the two paraxially-bound neutrons are on opposite-sides of the particle center, and may be expected to have mirror image charge-exchanges, they site in different ambiences vis-à-vis other nucleons, and so can't be expected to have identically-opposite charge-exchanges. Here are the reasons for assigning 1/2 spin to all five nucleons.

Calculating The Mass-Deficit Of Non-Alpha He5

Let's compute these paraxial bonds, using the x & z values in Table 3-3: neutron states x =(8,8,9,10,10,9), z = (9,10,9,9,8,9), and proton states x = (9,8,9,9,9,10), z = (9,9,8,9,10,9). Notice that the use of the y-defect pair spacing sequences for diagonal bonds delineates the values in each state that we can use for the n-p paraxial bonds between the neutron and the two protons "entities". As is our custom, we will assume that both n-p paraxial bonds will use all four pairs of the n & p sequences, interchangeably and equally, so we take the average these four combinations, (nx,px; nx,pz; nz,px; nz,pz), to find the mass-deficit of the proton "entity" paraxial bonds:

Table 3-9 Calculating Mass-Deficits Of Proton-Entity pb's



Now, having found a value for these n-p paraxial bonds, we find the rest of the calculation straightforward:

Table 3-10 Mass-Deficit Of Separated Proton "Entity" Form Of He5

Five 9ü/ diagonal bonds @ -2.47	= -12.35
2 pb p-n @ -2.86	= - 5.72
One H 3 type pb n-n @ -4.02	= - 4.02
Sum	= -22.09 MeV

You will notice that I have chosen 9ü/ spacing for all the diagonal bonds. There is a rationale for this, beyond its necessity for yielding the correct mass calculation. Since the separated proton "entity" form has lower mass that the n-alpha form, it can only be approached from the lower-mass state of the alpha particle (the 10ü/ db state), and the next state after this is, of necessity, a 9ü/ db state.

Drawing The Parts Together For The Final Calculation

We are now ready to calculate the mass of the Helium 5 nuclide. We will assume that the n-alpha states and the separated proton "entity" states have equal duration. The rationale for this is that the neutron charge-exchange cycle, being three times slower than that of the alpha group, will control the timing of the inter-nucleon charge-exchanges. Thus, we calculate the Helium 5 mass-deficit as the simple average of the two mass deficits:

Table 3-11 Mass Deficit Of Helium 5

(-32.76-22.09)/2	= -27.43
Experimental value	= -27.41 MeV/c²

We see that the calculated value is slightly higher than the experimental value, which we suspected might occur because of the larger number of misaligned diagonal bonds in the n-alpha form. The amount of error in the n → alpha db is about 2% (-0.04/-2.14).

Short-Cuts Needed To Simplify Calculations

These calculations for the Helium 5 nuclide illustrate how much attention to detail is required for a relative simple nuclide, so you can readily see that we will need to find shortcuts, if we are to validate the structures of more massive nuclides. What we may hope to find are nucleon configurations which invariably induce the same charge-exchange sequences and bond spacings among the protons and neutrons comprising them, irrespective of the complexity of the nuclide to which it is attached. If these configurations can be identified, we obviously can assign a mass-deficit value to them, based on previous detailed analysis, which we need not repeat. Finding these shortcuts will not be easy.

Factors Influencing The Decay Of Helium 5

The half-life of Helium 5 is exceedingly short (in the vicinity of 10^{-15} seconds). Nevertheless, this is exceedingly long compared to the time of inter-nucleon charge-exchanges, so that hundreds of millions of oscillations may be expected between the two

forms of Helium 5 illustrated above, before breakup occurs into a neutron and an alpha particle. What drives the separation is, of course, the fact that the mass of the two particles, separated, is 0.89 MeV/c^2 more than when they are bound together, so this amount is released to provide momentum for their separation. However, when we consider that the neutron (or proton "entity") is bound to the alpha group in both forms with two bonds, whose mass deficit sums either to -4.46 MeV, or -5.35 MeV, we see that the separation requires a more complex scenario than just the release of 0.89 MeV of energy.

Two processes contribute to momentary instabilities of the bond between the "lone" neutron and the alpha particle:

1) The alpha group alternates each charge-exchange between a mass of 3590 and 3864 (±135 MeV from the average mass), during its charge-exchange cycle (see Table 3-7).

2) The lone neutron, having a six-state charge-exchange cycle, undergoes mass changes of +75.2, +67.5, +67.5, -64.9, -72.6, -72.6 MeV (or, with opposite direction of charge-exchanges, a reverse of this sequence)(see Fig. 2-9, p. 2-11).

External Factors In The Helium 5 Decay

Although these mass changes are exceedingly brief in duration, their magnitudes are so much greater than the mass-deficits of inter-nucleon bonds that the system becomes susceptible, during the mass-release phases of the cycles, to differential motion of the individual nucleons, whenever the nuclide is buffeted by passage through a grain-boundary of polycrystalline space, and simultaneously suffers differential deflection by the close approach of a relativistic half-charge *void*. Only relativistic muon neutrinos can cause appreciable deflection of the nucleons, and, at the speed of light, their influence will be very transient. Hence, their arrival time must coincide precisely with the most susceptible part of the charge-exchange cycle, and their trajectories must course above, or below, the nuclide plane, and near enough to produce sufficient displacement effects to cause neutron bond misalignment. These stringent requirements account for the large number of inter-nucleon charge-exchange cycles before Helium 5 disruption occurs.

Alpha Particle Is Immune To Electrostatic Breakup

Why does a passing charge induce differential motion between the lone neutron and the alpha particle? It ultimately depends upon the fact that the four nucleons of the alpha particle exchange their neutron-proton identities with each charge-exchange. If these charge-exchanges are at the speed of light, and the "refractory" period between exchanges are brief, we should expect the deflection from a passing charge, even moving at the speed of light, to affect all four nucleons equally, just as if each nucleon possessed a charge of +1/2e. Thus, the alpha group moves as a unit, and we can readily see how a passing *plus void* would deflect it away from the momentarily unbonded lone neutron, which would move slightly *toward* either polarity of passing *void*, by induced dipole attraction (changes in charge-exchange cycle orientation). And, if the separation at the conclusion of this deflection episode is sufficient to prevent the alignment necessary for re-establishing the neutron-to-alpha group bond, the two particles will continue to separate, each assimilating half the released 0.89 MeV of

mass-energy in the form of momentum. Incidentally, if you are somewhat uncomfortable with this scenario, thinking that a half-charge *void* could not deflect a plus-two-charge alpha particle adequately, we can simply change the ground rules, requiring that two plus *void*s appear simultaneously. So much depends upon what concentration of *void*s exists in "empty" space.

Separated-Proton-Entity Form Has Low Mass, Reforms Easily

In contrast to the above scenario, when the nuclide is in the separated-proton-"entity" form, the protons and neutrons will exchange their identities at least six times slower (because the inter-nucleon charge-exchanges can take place no more often than once during each six-state charge-exchange cycle). Here, although a passing *void* will produce more separation of protons and neutrons, this separated-proton-"entity" structure is at the low mass part of the two-structure cycle, so the return of the higher component of undedicated shrinkage will cause all the separated nucleons to move toward the particle center, inducing a return to the n-alpha form.

Helium 5 Offers Proof That Nature Opts For T-Slant Nucleons

Now, let's move on to a peripheral issue of some importance: whether, or not, a nucleon can bond above or below the central "hole" of an alpha particle. If Nature has opted for the T-slant form for both protons and neutrons, neither nucleon could bond strongly in these super-plane positions. Although a neutron, for example, could form two attractive diagonal bonds with the two protons (assuming it has the same slants as the other two neutrons), it would form repulsive diagonal bonds with the other two neutrons, as we have explored earlier in the similar geometry of Fig. 3-1F. A similar analysis would hold for a neutron of opposite slant, or for both slants of protons. Perhaps there might be some asymmetry between the attractive and repulsive diagonal bonds, due to the occurrence of different charge-exchange sequences, but this could results in only a few tenths of a MeV difference in mass deficit.

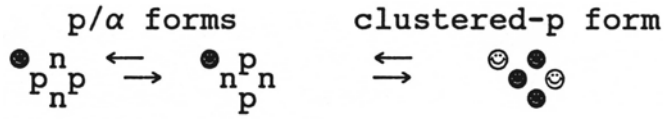
On the other hand, if M-slant forms are assumed, we can find configurations in which all four diagonal bonds are attractive. Since these four diagonal bonds would develop a bond strength of at least 8 MeV, this structure would yield a summation mass-deficit of the n-alpha & EPE forms (or p-alpha and CPE forms) which would exceed the mass-deficit of the separated alpha particle and nucleon, and, hence, would be stable against electrostatic charge disruption. *Thus, we have in this analysis the first concrete evidence that Nature prefers the T-slant form.* If the M-slant form were possible for nucleons, we should find stable mass 5 nuclides, or, at least, ones which could decay only by $\beta \pm$ emission!

Now, let's calculate the mass of the other mass 5 nuclide, Li 5:

Calculating The Mass Of The Lithium 5 Nuclide

When a *proton* adds to an alpha particle, the inter-nucleon exchanges between proton and a are not completely analogous to the n/a exchanges, because the "clustered-proton form" (shown below) brings the three protons into proximity, whose mutual repulsion tends to increase bond spacings. This clustered form would most likely derive from the right-hand of the two p/a forms, as shown:

Fig. 3-17 Inter-Nucleon Exchanges Of Lithium 5



Let's calculate the right hand form, first. Because the transfer of the proton "entity" places it in diagonal proximity to the two remaining protons of the alpha group, we will assume that the increased mutual repulsion will cause the four diagonal bonds in this group to alternate between 9ü/ & 10ü/ in successive recurrences, rather than to stay at 9ü/, as we assumed for the neutron rich cluster of the outrigger proton "entity" form of Helium 5. On the other hand, the outrigger neutron "entity" will have to remain in the 9ü/ spacing, because it must move left-and-right to maintain alignment of its diagonal bond with in-and-out "breathing" motion of the proton "entity". Meanwhile, the outrigger neutron's paraxially-bonded defect-pair (with the upper alpha proton) must shift up-and-down to maintain alignment (because its proton partner is also "breathing"). These two shifts can't maintain a common center, so the outrigger neutron must adopt a defect-pair-displacing mode of charge-exchanges analogous to the paired-neutron exchange cycle of Fig. 3-6.

We conclude, from the in-and-out motion of the 3p/n group, that the paraxial bond between the upper and lower protons will have the same average value as we calculated for the Helium 3 nuclide, and that the two p-n paraxial bonds will have analogous spacing changes, so we may assume that all three pb's will have the same mass-deficit:

Table 3-12 Mass-Deficit Of "Clustered-Proton-Entity" Form

4 deuteron-type db @ -2.2246	= - 8.90
1 p-n 9ü/ db @ -2.47*	= - 2.47
1 pb p-p @ -3.27	= - 3.27
2 pb n-p @ -2.86	= - 5.72
Sum	= -20.36 MeV

* Note: The calculation for this charge-exchange sequence of 9ü/ spacings of p/n db's appears on Table 3-2, left column, on page 3-5, where the value (calculated with the db constant suitable for mesons and baryons) is -2.45. The above value is obtained when the "nuclear mode" of Program 2-0-1 (see page 2-25) is used (See page 2-24).

Calculating The p-Alpha Mass-Deficit Of Lithium 5 Nuclide

The calculation of the p-alpha forms of Li 5 is slightly more complex than we found for the n-alpha forms of He 5. When we notice that that the alpha defect-pair which diagonally bonds to the outrigger proton retains the same defect-spacing, 9ü, in both charge-exchange states, we must presume that the outrigger proton will use one of its two 9ü-"rich" charge-exchange sequences for this xy diagonal bond. This choice leaves two different charge-exchange defect-spacing sequences, (9,8,8,9,10,10) & (9,9,10,9,8,9), for the x-direction paraxial bond, rather than just one, as we found for He 5:

Fig. 3-18 Bond Parameters For p-Alpha Diagonal Bond

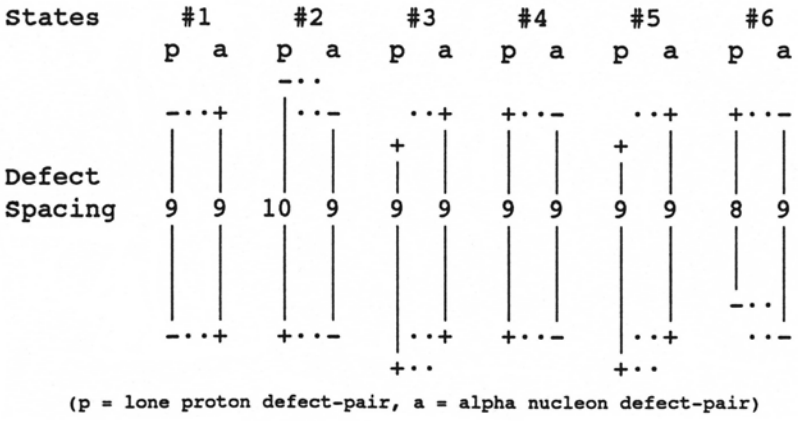


Fig. 3-19 Paraxial-Bond Parameters, Sequence #1

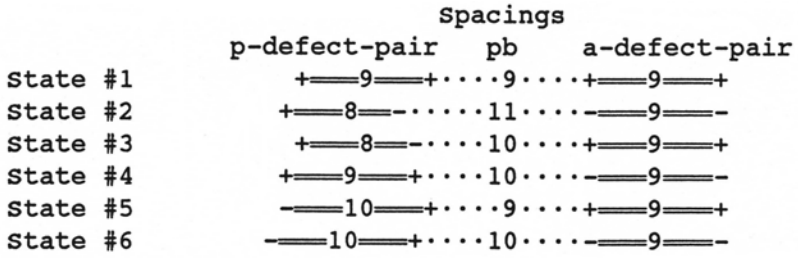
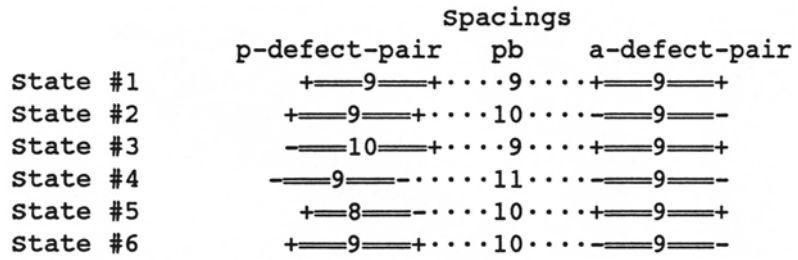


Fig. 3-20 Paraxial-Bond Parameters, Sequence #2



We calculate the mass-deficit of the p-alpha form of Lithium 5, by finding the average mass-deficits of the above diagonal & paraxial bonds, and adding these to the mass-deficit of the alpha particle. Notice that the diagonal bond spacings between the lone proton and the alpha group do not alternate, but remain at 10ü/ throughout. I have assumed, here, that the mutual repulsion between the adjacent protons induces a slightly different mode of accommodation to the shifting diagonal-bond partner in the alpha group, so that the diagonally-bonding proton defect-pair moves left and in (relative to the page), thereby maintaining the same spacing, while the paraxially-bonding defect pair moves down and left, thereby increasing the paraxial-bond spacings. Here is the detailed calculation:

Table 3-13 Mass-Deficit Of p→alpha Bonds

State #1	db 9[10] 9 = -1.88	pb 9[9] 9 = -2.48	pb 9[9] 9 = -2.48
State #2	db 10[10] 9 = -2.33	pb 8[11] 9 = -1.11	pb 9[10] 9 = -1.89
State #3	db 9[10] 9 = -1.88	pb 8[10] 9 = -1.43	pb 10[9] 9 = -3.16
State #4	db 9[10] 9 = -1.88	pb 9[10] 9 = -1.89	pb 9[11] 9 = -1.47
State #5	db 9[10] 9 = -1.88	pb 10[9] 9 = -3.16	pb 8[10] 9 = -1.43
State #6	db 8[10] 9 = -1.48	pb 10[10] 9 = -2.41	pb 9[10] 9 = -1.89
Avg 6 States	= -1.89	= -2.08	= -2.05

Table 3-14 Mass-deficit Of p-alpha Form

mass deficit of alpha group	= 28.30
1 diagonal bond	= 1.89
1 paraxial bond	= 2.07
mass deficit of p-alpha	= 32.26 Mev

If we assume equal duration of the two forms, we get:

Table 3-15 Mass Deficit Of Lithium 5 Nuclide

(-20.36-32.26)/2	= 26.31
Experimental value	= 26.33 Mev

Notice that we have a +0.02 Mev error, rather than the -0.02 Mev error of the Helium 5 calculation. Perhaps we were wrong to attribute the error of Helium 5 to misaligned diagonal bonds, since misalignment also occurs in the 10ü/ diagonal bonds of Lithium 5. Very likely, there are second-order effects which I have failed to consider. I cheerfully bequeath these problems to my successors.

An Explanation For Those Interested In Esoteric Details

Now, let me explain why I used the same mass-deficit values for the n-p paraxial bonds in both the "clustered-proton-entity" forms (CPE), and the "extended-proton-entity" (EPE) forms of Lithium 5, even though the diagonal-bonds alternate between 9ü/ and 10ü/ in the CPE form, and stay at 9ü/ in the EPE form:

Let's first try to understand why the diagonal-bond spacings should alternate between two values, 9ü/ & 10ü/, in the CPE form, and what we mean by "alternate". Suppose we say that the natural equilibrium diagonal-bond spacing for the CPE form is half-way between these two values; then, it would take only subtle differences in the manner of switching from the p-alpha form to the CPE form to select one or the other diagonal-bond spacing. For example, we can imagine this sequence of alternation between the p-alpha and CPE forms (where H = high-mass p-alpha form, L = low-mass p-alpha form):

H-L-H-L-H-L → 9ü/-CPE → L-H-L-H-L-H → 10ü/-CPE → etc.

Conversely, the n-alpha → EPE transitions may have this form:

H-L-H-L-H-L → 9ü/-EPE → H-L-H-L-H-L → 9ü/-EPE → etc.

In addition to this insight, we merely need to observe that the four sequences of the n-p paraxial bonds have different mass consequences, so, perhaps, the sequences yielding

higher mass-deficits will use the 9ü/-CPE forms, and lower ones, the 10ü/-CPE forms (e.g. nx,px & nz,px with 9ü/-CPE, nx,pz & nz,pz with 10ü/-CPE).

For Additional Mass-Deficit Calculations, Write Me

The foregoing mass-deficit calculation of Helium 5 & Lithium 5 show how tedious these calculations are, and I will spare you further examples. I have made calculations for He6, Li6, Li7, Li8, Li9, Li10, Li11, Be8, & Be9. These all agree reasonably well with the experimental values, but they require so many novel assumptions, and so many steps, that they will be of interest only to those who desire to specialize in this aspect of IPP. Please contact me if you want to see what I have accomplished.

Now let us investigate the structures of the larger nuclides, particularly when, why, and how multiple planes form. You will find this in the next chapter.