

## Illustrations of a Modified Standard Model: Part 1-The Solar Proton-Proton Cycle

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### Abstract

A proposed modification of the Standard Model, when applied to the Solar Proton-Proton Cycle, provides a more in-depth explanation of the nuclear reactions within each step of the process.

### Introduction

After many years of examining the decay products of subatomic particles, I raised the question, "Are the u- and d-quarks just packets of energy or can they be considered to be made of smaller entities?" The decays of positronium, the free neutron, the charged pion, the muon, and photo dissociation of the deuterium nucleus led me to consider that the smaller entities were neutrinos. In order to balance the decay schemes, I found that all I needed were a single neutrino and its antiparticle. The idea seems preposterous considering that neutrinos are so unreactive with matter, but the equations nicely balanced out in both electric charge and spin.

In my first paper, [A Proposed Modification of the Standard Model: The u-, d-, and s-quarks](http://vixra.org/), ( <http://vixra.org/> , High Energy Particle Physics #1301.0197, January 2013), I presented a model for the internal components of u-, d-, and s-quarks as well as photons, electrons, pions, muons, protons, and neutrons. Some surprises were in order. The u-quarks had the same internal components of photons, a neutrino/antineutrino pair; the u-quarks were their own antiparticles and they had an electric charge of zero. The d-quarks were more interesting; a d-quark consisted of an antineutrino connected to three neutrinos and had a spin of  $\frac{1}{2}$  and a negative charge. The anti d-quark had a positive charge and contained a neutrino connected to three antineutrinos. When I applied these ideas to the proton and neutron, the assignment of quarks by the Standard Model did not match. I discovered that in the case of the proton (uud) the d-quark needed to be replaced by the equivalent of a positron. In a similar manner, the decay of a free neutron (udd) required an additional u-quark and the second d-quark also needed to be replaced by the equivalent of a positron. In my second paper, [Schematic Diagrams Illustrating Baryon Content and Decay Patterns Using New Configurations](http://vixra.org/), (<http://vixra.org/> , High Energy Particle Physics #1303.0052, March 2013), I found that all of the baryons considered consisted of a muon-like structure with an attached positron equivalent.

The more I applied these ideas, more reactions and decay schemes have fallen into place. The Modified Standard Model, however, is still a work in progress with many concepts and processes still to be worked out. In a change from my first paper I now equate my neutrino with both the anti-electron neutrino and the anti-muon neutrino. In addition I have added the probability of a high energy, “heavy” proton.

This paper presents how the Modified Standard Model provides greater insight into the nuclear reactions in the Solar Proton-Proton Cycle. The remainder of this paper consists of four parts: 1- A condensed summary of the concepts and notations of the Modified Standard Model, 2- The Solar Proton-Proton Cycle as it is currently presented, 3- The Solar Proton-Proton Cycle expanded by use of the Modified Standard Model, and 4- A detailed description of each of the steps in the Solar Proton-Proton Cycle utilizing the Modified Standard Model.

## **1. Proposed Modified Standard Model** **Condensed Concepts and Notations**

### **1. neutrinos**

$\bar{\nu}$  replaces  $\nu_e$  and  $\nu_\mu$  and is associated with positive charge.  
 $\nu$  replaces  $\bar{\nu}_e$  and  $\bar{\nu}_\mu$  and is associated with negative charge.  
( $\nu_\mu$  is associated with higher energies than  $\nu_e$ .)

### **2. photons**

A regular photon consists of  $(\nu \bar{\nu})$ .  
There is also a heavy, high energy photon,  $(d \bar{d})$ .

### **3. u-quarks**

A u-quark consists of  $(\nu \bar{\nu})$  and is its own antiparticle.  
A u-quark has zero charge and spin of 0 or 1.  
The arrangement of the neutrino pair may differ from that of a photon.

#### 4. d-quarks

A d-quark (  $d$  ) consists of an anti-neutrino connected to 3 neutrinos and has a negative charge.

An anti d-quark (  $\bar{d}$  ) consists of a neutrino connected to 3 anti-neutrinos and has a positive charge.

Electric charge is created by a combination of one neutrino and two opposite neutrinos.

The type of charge is determined by the two similar neutrinos.

The third like neutrino neither adds nor distracts from the electric charge.

d-quarks have spins of  $\frac{1}{2}$ .

#### 5. electrons and positrons

The electron (  $e$  ) has the configuration:  $\nu - \bar{\nu} - \nu$

The positron (  $\bar{e}$  ) has the configuration:  $\bar{\nu} - \nu - \bar{\nu}$

#### 6. pions

The positive pion is  $u\bar{d}$  and the negative pion is  $\bar{u}d$ . The neutral pion can be either  $u\bar{u}$  or  $d\bar{d}$ .

#### 7. muons

The positive muon is  $u\bar{e}$  and the negative muon is  $\bar{u}e$ .

#### 8. protons

The common proton is  $\bar{u}u\bar{e}$  (in contrast to the Standard Model with  $uud$ ).

Some reactions require the addition of a high energy or "heavy" proton of  $\bar{d}\bar{d}\bar{e}$ .

#### 9. neutrons

There are three types of neutrons:

$d\bar{e}$  super-bound neutron

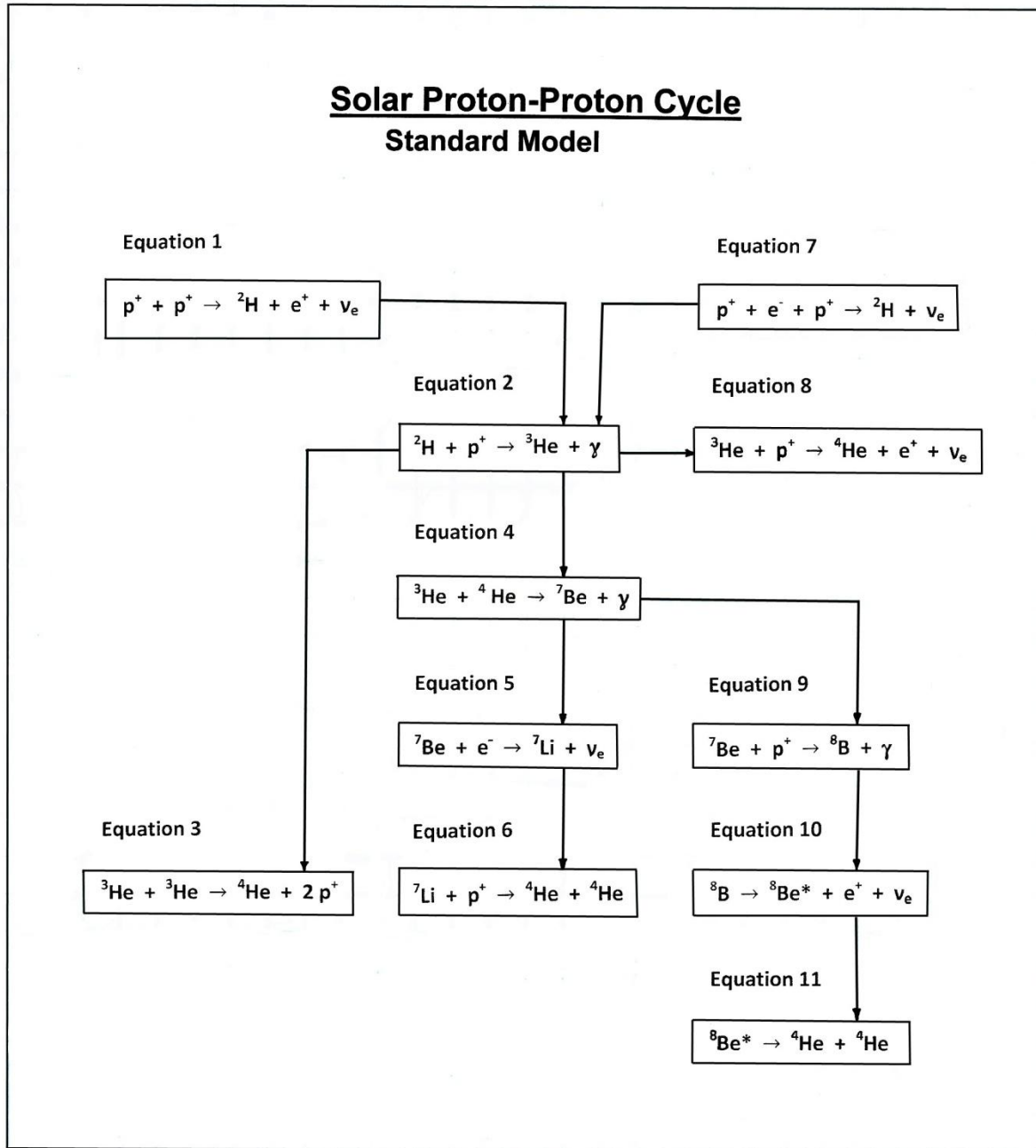
$\bar{u}d\bar{e}$  bound neutron

$u\bar{u}d\bar{e}$  free neutron

Outside of a nucleus the d quark within the free neutron is unstable and decays to an electron and a neutrino.

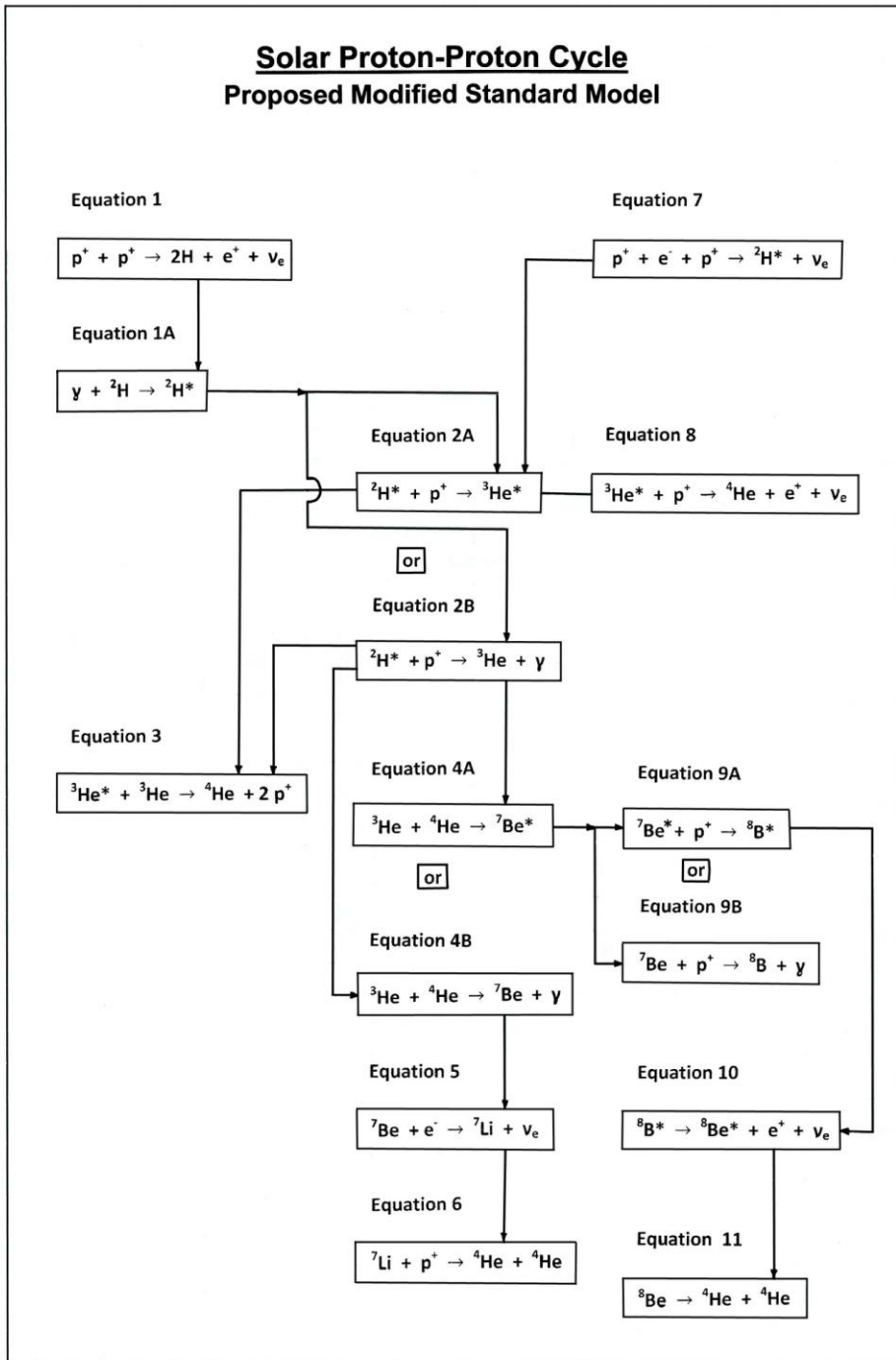


## 2. Solar Proton-Proton Cycle Current View



### 3. Solar Proton-Proton Cycle Expanded by Modified Standard Model presented using standard notations

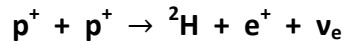
Major changes being proposed include the addition of step 1A and the expansion of equations 2, 4 and 9.



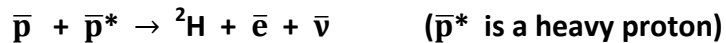
#### 4. Detailed Steps in the Solar Proton-Proton Cycle Contrasting the Standard Model and the Modified Model

##### Equation 1

###### Standard Model

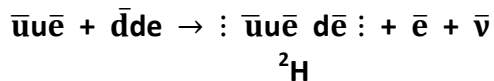
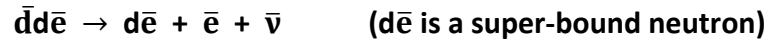


###### Modified Model



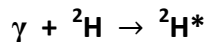
###### Modified Schematic

The  $\bar{d}$  quark within the heavy proton breaks down, yielding a positron, anti-neutrino, and a super-bound neutron.

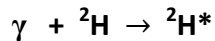


##### Equation 1A

###### Standard Model



###### Modified Model

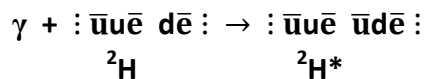


###### Modified Schematic

This is a new step being added to the Proton-Proton Solar Cycle.

It was necessary to add this step in order to have Equation 2 balance.

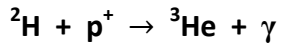
The addition of a photon to  ${}^2\text{H}$  changes the super-bound neutron to a bound neutron. A photon has the equivalent content of a u-quark.



${}^2\text{H}^*$  is the regular deuterium nucleus.

## Equation 2

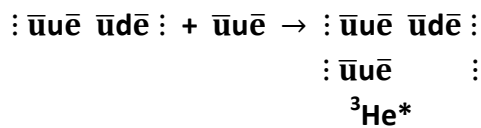
### Standard Model



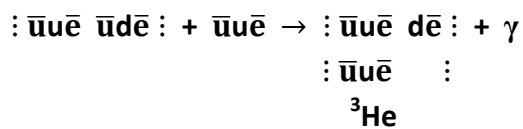
### Modified Model

There are two pathways instead of one.

## Equation 2A

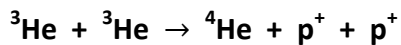


## Equation 2B

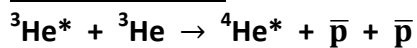


## Equation 3

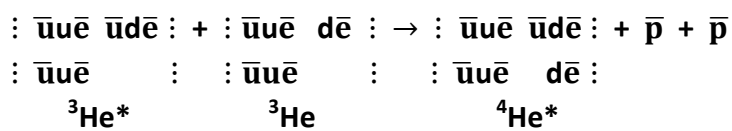
### Standard Model



### Modified Model



### Modified Schematic

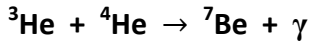


( $\bar{u}d\bar{e}$  is a bound neutron)

( $d\bar{e}$  is a super-bound neutron)

### Equation 4

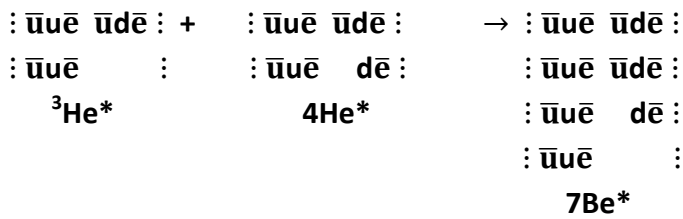
#### Standard Model



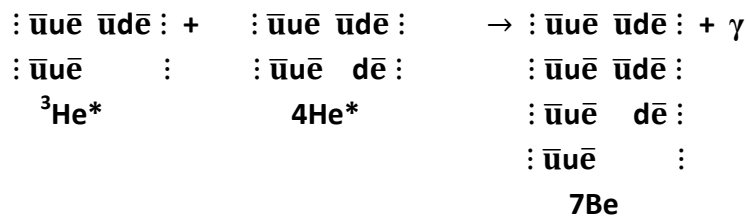
#### Modified Model

There are two pathways instead of one.

### Equation 4A

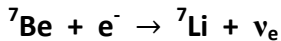


### Equation 4B

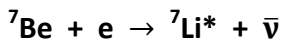


### Equation 5

#### Standard Model

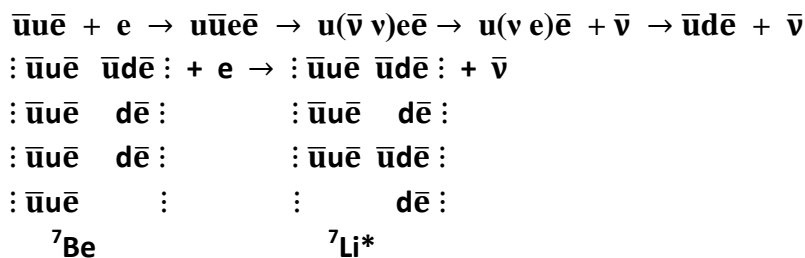


#### Modified Model



#### Modified Schematic

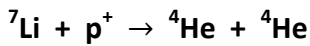
The electron is absorbed by a proton where it then converts to a d-quark by first breaking down a u-quark into a  $\bar{\nu}$ ,  $\nu$  pair. In this complicated process the anti-neutrino is ejected and the other neutrino unites with the electron to form the d-quark.



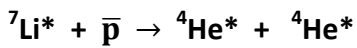


## Equation 6

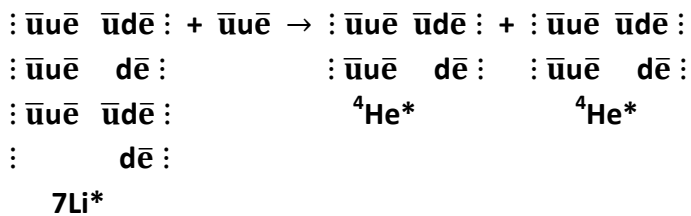
### Standard Model



### Modified Model

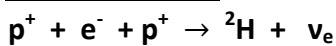


### Modified Schematic

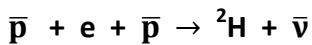


## Equation 7

### Standard Model

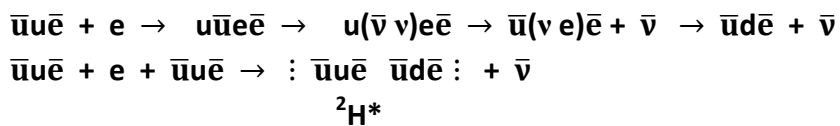


### Modified Model



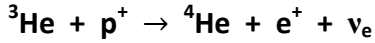
### Modified Schematic

A proton plus an electron becomes a bound neutron. A u-quark dissociates in a neutrino/anti-neutrino pair; the anti-neutrino is ejected and the remaining neutrino combines with the new electron to become a d-quark.



## Equation 8

### Standard Model

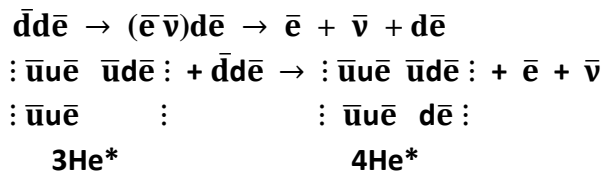


### Modified Model



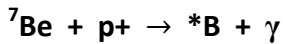
### Modified Schematic

The  $\bar{\text{d}}$ -quark within a heavy proton breaks down into a positron and an anti-neutrino which are both ejected, leaving behind a super-bound neutron.



## Equation 9

### Standard Model



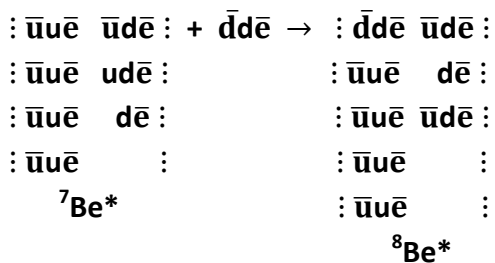
### Modified Model

There are two pathways instead of one.

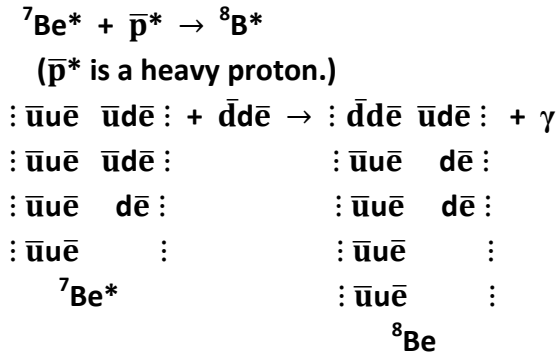
## Equation 9A



( $\bar{\text{p}}^*$  is a heavy proton.)

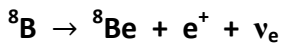


**Equation 9B**



**Equation 10**

**Standard Model**

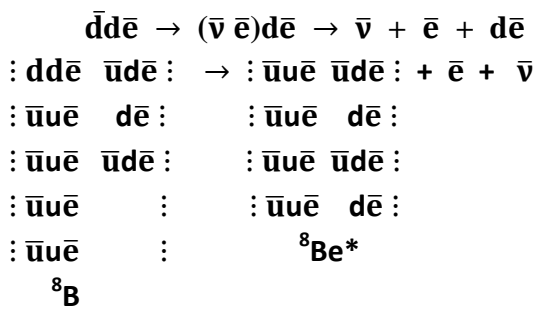


**Modified Model**



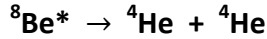
**Modified Schematic**

A heavy proton within  ${}^8\text{B}$  converts to a positron, anti-neutrino, and a super-bound neutron. The anti d-quark within the heavy proton dissociates to a positron and anti-neutrino which are ejected.



## Equation 11

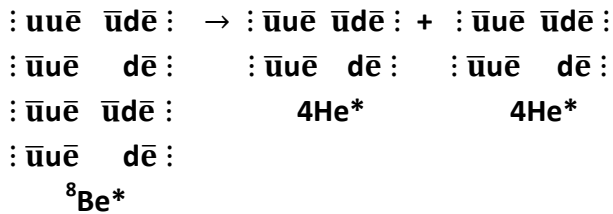
### Standard Model



### Modified Model



### Modified Schematic



## Conclusion

The Modified Standard Model does not remove any of the steps in the Solar Proton-Proton Cycle. Instead, it expands the details within each of the steps explaining how the transformations take place. A new idea is introduced concerning the neutron content of specific isotopes; there are different varieties depending upon the number of super-bound neutrons and bound neutrons. This idea is not difficult to digest if one simply considers the bound neutron (with an additional u-quark) to be an excited form of the super-bound neutron. With this idea, the free neutron would be a double-excited form of the super-bound neutron because of its two u-quarks.

The Modified Standard Model does play havoc with some of the concepts of the Standard Model. There is no longer a need to search for fractional charges. Also, the conservation of leptons rule simply is an outcome of the instability of the d-quark dissociating into an electron and neutrino. Another victim is the definition of a baryon consisting of three quarks; the presence of an anti-electron equivalent in both the proton and neutron family and the three types of neutrons will disturb the symmetries of the Standard Model. My next paper will continue to show applications of the Modified Standard Model in other nuclear reactions.