# Neutron `Octaves' in the Moon Nuclear Model: A Harmonic Ordering of the Stable Isotopes[1]

Laurence Hecht
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**Summary:** When the stable isotopes are grouped according to the four Platonic solid shells, as described by the Moon model of the nucleus, the number of neutrons is found to fall in "octaves." Thus, for the first 135 stable isotopes:

$^{1}$H to $^{15}$N, number of neutrons = 0 to 8

$^{16}$O to $^{30}$Si , number of neutrons = 8 to 16

$^{31}$P to $^{58}$Fe, number of neutrons = 16 to 32

$^{59}$Co to $^{110}$Pd, number of neutrons = 32 to 64.

The Moon structure of the nucleus thus defines a periodicity in the gross ordering of the stable isotopes, somewhat analogous to the periods of the Mendeleyev table of the elements, but based on an implicit musical harmony.

## Introduction

The ordering of the elements by atomic weight shows a periodicity discovered by Dmitri Mendeleyev in 1869. Mendeleyev found that increase in mass was not a linear property as suggested by Galileo and Newton, but rather evidenced a periodicity. When arranged in rows by order of increasing mass, properties including the propensity to chemical combination, valence, reactivity, melting and boiling points, crystal structure and others show a periodically repeating character, such that elements falling in the same

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[1] *Author's Note:* Although the discovery reported here was subsumed within the previously published item, "A New Approach to the Ordering Principle of the Stable Isotopes" (*21st Century Science & Technology,* Fall 2007), it received insufficient elaboration there for the great majority of readers to grasp. This more complete and contemporaneous account of the discovery of the neutron "octaves" is provided to remedy that shortcoming (December 2, 2008).

column evidence similar properties. As elaborated also by Victor Meyer, quantifiable properties such as melting point and coefficient of compression show maxima and minima across a row (chemical period) which align according to the columns (chemical groups).

However, about 50 years after Mendeleyev's original discovery, it was shown that the atomic weight of most elements is composed of a mixture of several variants of that element, sharing similar chemical properties but differing in weight. The possibility was discussed by Soddy in 1909, and something similar had been proposed by others even earlier. In 1913, J.J. Thomson at Cambridge, finding a second line in the positive ray spectrum of neon, suggested "the possibility that we may be interpreting Mendeleeff's law too rigidly, and that in the neighborhood of the atomic weight of neon there may be a group of two or more elements with similar properties, just as in another part of the table we have the group iron, nickel, and cobalt." That proposal proved incorrect.

In 1915, in a series of papers on the "Whole Number Rule," William Draper Harkins and Ernest D. Wilson of the University of Chicago chemistry department suggested that elements whose exact atomic weight differs by more than 0.1 percent from a whole number consist of mixtures of two or more isotopes. In 1916, Harkins and Turner began an attempt to separate the isotopes of chlorine by means of gaseous diffusion, finally succeeding some years later in producing separate quantities of the gas of atomic weights close to 35 and 37. In 1919, Aston demonstrated the separation of isotopes of neon by magnetic means in a mass spectrometer. These new species came to be known as *isotopes*, the term meaning having the *same position*, and *position* referring to the place in Mendeleyev's table.

As studies in nuclear chemistry proceeded through the 1920s and beyond, it came to be recognized that at each position in the periodic table of Mendeleyev, there may exist up to ten different stable isotopes of the same element, and many others that are radioactive, having a half life that might range from billions of years to picoseconds. After the experimental proof of Harkins's 1921 hypothesis of the existence of the neutron by Chadwick (1932), the isotopes of a given element came to be viewed as atoms having the same number of protons but a different number of neutrons in the nucleus. Gradually, the number of isotopic species (nuclide is the more precise term) known to man increased, until today more than 3,000 are known, most of those being very short-lived, unstable species. Approximately 280 of these are classified as *stable*, that is, showing no evidence of radioactive decay, or in some cases extremely slow decay processes with half lives of $10^{14}$ years and greater.

Nothing in the discovery of the isotopes discredited the fundamental truth of Mendeleyev that the elements, when arranged by atomic weight, show a striking periodicity in physical and chemical properties. However, the ordering principle for this new dimension to the periodic table has never been discovered. Of all the possible isotopes of each element, only some exist as stable species. But the reason why some elements have no variants, others three and others 6, 8, or 10 is unknown. Further, for each stable isotope, there is a characteristic abundance distribution, which is found, with some slight variations, in all samples of the element found anywhere on Earth and even within the solar system. For example, oxygen exists in three stable isotopic forms: oxygen-16 ($^{16}O$, or $O^{16}$) makes up 99.76% , oxygen-17 ($^{17}O$) 0.04%, and oxygen-18 ($^{18}O$) 0.20%. All the oxygen so far examined shows approximately this abundance distribution. Although small variations among samples may be found.[2] The fundamental questions: why some stable isotopes exist and not others, and why they exist in varying ratios of abundance has never been fully answered.

## Moon Model and the Isotopes

That there is an ordering principle to the distribution of the stable isotopes (or "neutron distribution" as it might also be called ) is the underlying assumption of all of the following. In my studies of the Moon nuclear model (the construction is summarized below), I was able to show a certain broad connection of the number of neutrons in the

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[2] With improvements in measuring techniques, slight variations in the abundance distribution of the isotopes have been found. In some cases they appear due to geologic processes. In other cases they show a difference between living and non-living processes.

most stable isotopes to the nuclear structure hypothesized by Dr. Robert J. Moon.[3] However, the detailed distribution of the isotopes remained unexplained.

The completion of phase two of the LaRouche Youth Movement "Kepler project" four months ago, convinced me that I might find the missing ordering principle for the isotopes in the principle of harmonics. Early on in this recent search, I recognized that, by the principle first elaborated for modern times by Louis deBroglie, the proportionate weights of atoms would represent a relationship among frequencies or wave lengths.[4] Thus the number of protons and neutrons in a nucleus, and their relationships among nuclei, would represent a kind of harmony among deBroglie wavelengths. I thought that by examining such relationships, I might find certain simple relationships of whole numbers, such as those which characterize the divisions of string lengths in the systems of Pythagoras and Kepler. Perhaps the more abundant or otherwise characteristic elements, might be those which show the most harmonic sounds.

That search led me down a great number of paths during which I examined the data on stable isotopes which I had assembled over the previous year from various new standpoints. It was possible to find many cases of harmonies of the sort just described, but there was nothing that gave the various cases an ordering principle, or could be considered as having the character of necessity. Recently however, I began to separate the groups of isotopes belonging to the elements which fall within each shell of the Moon model. At first, I merely attempted to characterize the qualities of each of these shells, satisfying myself that the isotopes in each shell expressed a distinctly different ordering principle. Though I had, and still have, no idea of the reason for each distinct ordering, it

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[3] See "Geometric Basis for the Periodicity of the Elements," http://www.21stcenturysciencetech.com/Articles%202004/Spring2004/Periodicity.pdf

[4] That is, from a study of the history of optics, deBroglie had recognized a parallelism between the laws of wave optics and of mechanics. leading him to recognize that the very minute "particles" then under study by physics must possess experimentally demonstrable wave characteristics, as well. Within just a few years of the publication of deBroglie's hypothesis, Davisson and Germer at the Bell Laboratories (1926) demonstrated the interference pattern produced by a beam of electrons, when passed through a thin metallic foil.

proved to me that the geometry of the Moon model in some way governed the way the stable isotopes occur.

After working for several days to assemble the data I had collected into an intelligible form of presentation, one recent evening, as I was reviewing the work, I chose for the first time to look at the number of neutrons expressed in each shell. To my great delight, I saw the fact already noted in the summary to this paper, that the range of neutrons in the first four shells of the Moon model increased as powers of two, from 8 to 16 to 32 to 64, just as if they were expressing the octaves of a scale.

In the following, I first summarize the Moon model of the nucleus, and then summarize the discovery by way of introduction to the appended tables.

## Summary of Moon Model Construction

In 1986, Manhattan project veteran and University of Chicago Professor of Physical Chemistry and Physics Dr. Robert J. Moon, discovered a Keplerian ordering to the arrangement of protons in the atomic nucleus. Moon found that nuclear properties, especially stability as attested by abundance (and to some extent spin and dipole and quadrupole moments of the nuclei), could be correlated to a geometric model of the nucleus, in which the protons assume positions at the vertices of four of the five Platonic solids--cube, octahedron, icosahedron, and dodecahedron, taken in that order.

The four solids are conceived as nested within one another, similarly to Kepler's construction for the mean orbital radii of the planets. The first eight protons, comprising oxygen ($_8$O), the most abundant element in the Earth's crust, fill the vertices of the cube. Six more protons fill the circumscribing octahedron, to produce the nucleus of silicon ($_{14}$Si), the second most abundant element. Surrounding the octahedron is an icosahedron: filling its 12 vertices produces iron ($_{26}$Fe), the most abundant element in its weight class on Earth, and the most abundant in the meteorites. The icosahedron is inscribed in a dodecahedron. When the 20 vertices of the dodecahedron are filled, we have the nucleus of the element palladium ($_{46}$Pd).

The second half of the 92 elements are produced by a process of twinning. First, ten vertices of a dodecahedron, which attaches to a face of the first one like a twinned crystal, are filled. This brings us to barium ($_{56}$Ba). The 14 elements of the lanthanide series are constructed by filling the vertices of a second cube and octahedron, inserted into this partially completed twin dodecahedron. Thus the anomalous filling of the inner electron orbital of the lanthanides is accounted for. The completion of the icosahedron brings us to thallium ($_{81}$Tl). Then, by closing of the last pentagon of the twin dodecahedron we arrive at radon ($_{86}$Rn), the last of the noble gases. To reach uranium ($_{92}$U), the last naturally occurring element, the pair of dodecahedra is opened up, first using an edge as a "hinge," and then breaking the hinge so that the pair are attached at only one vertex. This architectural instability characterizes the actinide elements, and the propensity of uranium to fission.

## Properties of the Isotopes by Shell

When the stable isotopes are grouped by shells of the Moon nucleus, it is found that certain characteristics of the ordering of the isotopes are unique to each shell. Of these, the most unique characteristic seems to be that the number of neutrons of each of the first four shells which produce the first complete dodecahedron, grows by powers of two, from 8 to 16 to 32 to 64.

In the appended tables, I illustrate this property, and a summary of other characteristics unique to each shell. The inclusion of oxygen in shell 2, rather than shell 1, may seem forced. I note however, that I had already assigned oxygen to this shell, based on oxygen obeying the same abundance distribution as the other even elements from atomic number 10 to 14, and having nothing otherwise in common with the Shell 1 elements. This was before I had noted the unique ordering principle of the neutrons by shell. It seems probable that the 7 elements which occur before the cube is fully formed have their own unique set of properties. It may even be possible to discern distinct properties for the "neutron octaves" from $^{2}$H to $^{4}$He (N = 1 to 2), from $^{4}$He to $^{7}$Li (N = 2 to 4) and from $^{7}$Li to $^{15}$N, (N = 4 to 8).

It might be noted that the final “octave” from 64 to 128 cannot be completed by the stable isotopes. The last stable isotope of lead ($^{208}$Pb) possesses just 126 neutrons. Among the radioactive isotopes, I have found none of any even slight stability which have 128 neutrons, which suggests some sort of limiting principle. However, it may also be noted that the second twinned dodecahedron (Shell 5A, as I have denoted it) begins at $_{47}$Ag$^{107}$ which shows 60 neutrons, and not 64.

It is possible that a clearer picture of these laws may allow the prediction of semi-stable isotopes in the range of heavy isotopes only obtainable under high-energy conditions.

**(Appendix follows).**

# Appendix:

# First 135 Stable Isotopes Arranged by the Moon Model Shells

## Shell 1: Cube (First 7 vertices)

**Characteristics:** **N = 0 to 8**

Odd Z/Odd N = 1/1, 3/3, 5/5, 7/7 (unique to this shell). 2 stable isotopes (exc. Be-9).

| Z | N | Nuclide | % Abundance | Odd Z/ Odd N |
|---|---|---|---|---|
| **1** | **0** | **H-1** | **99.98%** | **1/1** |
| 1 | 1 | H-2 | 0.02% | |
| 2 | 1 | He-3 | 0.01% | |
| **2** | **2** | **He-4** | **100.00%** | |
| 3 | 3 | Li-6 | 7.42% | 3/3 |
| **3** | **4** | **Li-7** | **92.58%** | |
| **4** | **5** | **Be-9** | **100.00%** | |
| 5 | 5 | B-10 | 19.78% | 5/5 |
| **5** | **6** | **B-11** | **80.22%** | |
| **6** | **6** | **C-12** | **98.89%** | |
| 6 | 7 | C-13 | 1.11% | |
| **7** | **7** | **N-14** | **99.63%** | **7/7** |
| 7 | 8 | N-15 | 0.37% | |

**(Z = protons; N = neutrons)**

# Shell 2: Cube (last vertex) and Octahedron

**Characteristics: N = 8 to 16**

*Odd elements:* 1 isotope of mass number 2Z + 1.

*Even elements:* 3 isotopes of mass numbers 2Z, 2Z +1, 2Z + 2. Most abundant is 2Z.

| Z | N | Nuclide | % Abun-dance | Number of Isotopes |
|---|---|---|---|---|
| **8** | **8** | **O-16** | **99.76%** | **3** |
| 8 | 9 | O-17 | 0.04% | |
| 8 | 10 | O-18 | 0.20% | |
| **9** | **10** | **F-19** | **100.00%** | **1** |
| **10** | **10** | **Ne-20** | **90.92%** | **3** |
| 10 | 11 | Ne-21 | 0.26% | |
| 10 | 12 | Ne-22 | 8.82% | |
| **11** | **12** | **Na-23** | **100.00%** | **1** |
| **12** | **12** | **Mg-24** | **78.70%** | **3** |
| 12 | 13 | Mg-25 | 10.13% | |
| 12 | 14 | Mg-26 | 11.17% | |
| **13** | **14** | **Al-27** | **100.00%** | **1** |
| **14** | **14** | **Si-28** | **92.23%** | **3** |
| 14 | 15 | Si-29 | 4.67% | |
| 14 | 16 | Si-30 | 3.10% | |

**(Z = protons; N = neutrons)**

## Shell 3: Icosahedron

**Characteristics: N = 16 to 32**

*Odd elements:* Prime atomic number species have 2 isotopes; non-prime have 1.

*Even elements:* Mass number range is 5 (exc. Ca). After Ca, most abundant is 2Z + 4.

| Z | N | Nuclide | % Abundance | Decay Mode | Half Life (years) |
|---|---|---|---|---|---|
| **15** | **16** | **P-31** | **100.00%** | | |
| **16** | **16** | **S-32** | **95.00%** | | |
| 16 | 17 | S-33 | 0.76% | | |
| 16 | 18 | S-34 | 4.22% | | |
| 16 | 20 | S-36 | 0.01% | | |
| **17** | **18** | **Cl-35** | **75.53%** | | |
| 17 | 20 | Cl-37 | 24.47% | | |
| 18 | 18 | Ar-36 | 0.34% | | |
| 18 | 20 | Ar-38 | 0.06% | | |
| **18** | **22** | **Ar-40** | **99.60%** | | |
| **19** | **20** | **K-39** | **93.26%** | | |
| 19 | 22 | K-41 | 6.73% | | |
| **20** | **20** | **Ca-40** | **96.95%** | | |
| 20 | 22 | Ca-42 | 0.65% | | |
| 20 | 23 | Ca-43 | 0.14% | | |
| 20 | 24 | Ca-44 | 2.08% | | |
| 20 | 26 | Ca-46 | 0.01% | | |
| 20 | 28 | Ca-48 | 0.19% | (2β-) | $6 \times 10^{18}$ |
| **21** | **24** | **Sc-45** | **100.00%** | | |
| 22 | 24 | Ti-46 | 7.93% | | |
| 22 | 25 | Ti-47 | 7.28% | | |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| **22** | **26** | **Ti-48** | **73.94%** |  |  |
| 22 | 27 | Ti-49 | 5.51% |  |  |
| 22 | 28 | Ti-50 | 5.34% |  |  |
| *23* | *27* | *V-50* | 0.24% | (EC, β-) | 1.4 x $10^{17}$ |
| **23** | **28** | **V-51** | **99.76%** |  |  |
| 24 | 26 | Cr-50 | 4.31% | 2EC | 1.30 x $10^{18}$ |
| **24** | **28** | **Cr-52** | **83.76%** |  |  |
| 24 | 29 | Cr-53 | 9.55% |  |  |
| 24 | 30 | Cr-54 | 2.38% |  |  |
| **25** | **30** | **Mn-55** | **100.00%** |  |  |
| 26 | 28 | Fe-54 | 5.82% |  |  |
| **26** | **30** | **Fe-56** | **91.66%** |  |  |
| 26 | 31 | Fe-57 | 2.19% |  |  |
| 26 | 32 | Fe-58 | 0.33% |  |  |

**(Z = protons; N = neutrons)**

**Decay Modes:** EC = electron capture; β- = electron emission (beta decay).

# Shell 4: Dodecahedron

**Characteristics: N = 32 to 64**

*Mass number* of lightest isotope is one less than heaviest of preceding element—or three less when radioactivity is present (exception: Zr-90).

| Z | N | Nuclide | % Abun- dance | Decay Mode | Half Life (years) |
|---|---|---|---|---|---|
| **27** | **32** | **Co-59** | **100.00%** | | |
| **28** | **30** | **Ni-58** | **68.27%** | | |
| 28 | 32 | Ni-60 | 26.10% | | |
| 28 | 33 | Ni-61 | 1.13% | | |
| 28 | 34 | Ni-62 | 3.59% | | |
| 28 | 36 | Ni-64 | 0.90% | | |
| **29** | **34** | **Cu-63** | **69.09%** | | |
| 29 | 36 | Cu-65 | 30.91% | | |
| ***30*** | **34** | ***Zn-64*** | **48.89%** | **2EC** | **$2.80 \times 10^{16}$** |
| 30 | 36 | Zn-66 | 27.81% | | |
| 30 | 37 | Zn-67 | 4.11% | | |
| 30 | 38 | Zn-68 | | | |
| *30* | 40 | *Zn-70* | 0.62% | 2β- | $1.30 \times 10^{16}$ |
| **31** | **38** | **Ga-69** | **60.40%** | | |
| 31 | 40 | Ga-71 | 39.60% | | |
| 32 | 38 | Ge-70 | 20.52% | | |
| 32 | 40 | Ge-72 | 27.43% | | |
| 32 | 41 | Ge-73 | 7.63% | | |
| **32** | **42** | **Ge-74** | **36.73%** | | |
| *32* | 44 | *Ge-76* | 7.76% | 2β- | |
| **33** | 42 | **As-75** | 100.00% | | |

| | | | | | |
|---|---|---|---|---|---|
| 34 | 40 | Se-74 | 0.87% | | |
| 34 | 42 | Se-76 | 9.02% | | |
| 34 | 43 | Se-77 | 7.58% | | |
| 34 | 44 | Se-78 | 23.52% | | |
| **34** | **46** | **Se-80** | **49.82%** | | |
| *34* | 48 | *Se-82* | 9.19% | 2β- | $1.08 \times 10^{20}$ |
| 35 | 44 | Br-79 | 50.54% | | |
| 35 | 46 | Br-81 | 49.46% | | |
| *36* | 42 | *Kr-78* | 0.35% | 2EC | $2.00 \times 10^{20}$ |
| 36 | 44 | Kr-80 | 2.27% | | |
| 36 | 46 | Kr-82 | 11.56% | | |
| 36 | 47 | Kr-83 | 11.55% | | |
| 36 | 47 | Kr-83 | | | |
| 36 | 48 | **Kr-84** | 56.90% | | |
| 36 | 50 | Kr-86 | 17.37% | | |
| **37** | **48** | **Rb-85** | **72.15%** | | |
| *37* | 50 | *Rb-87* | 27.85% | β- | $4.75 \times 10^{10}$ |
| 38 | 46 | Sr-84 | 0.56% | | |
| 38 | 48 | Sr-86 | 9.86% | | |
| 38 | 49 | Sr-87 | 7.02% | | |
| **38** | **50** | **Sr-88** | **82.56%** | | |
| **39** | **50** | **Y-89** | **100.00%** | | |
| **40** | **50** | **Zr-90** | **51.46%** | | |
| 40 | 51 | Zr-91 | 11.23% | | |
| 40 | 52 | Zr-92 | 17.11% | | |
| 40 | 54 | Zr-94 | 17.40% | | |
| *40* | 56 | *Zr-96* | 2.80% | 2β- | $3.8 \times 10^{19}$ |
| **41** | **52** | **Nb-93** | **100.00%** | | |

| | | | | | |
|---|---|---|---|---|---|
| 42 | 50 | Mo92 | 15.84% | | |
| 42 | 52 | Mo-94 | 9.04% | | |
| 42 | 53 | Mo-95 | 15.72% | | |
| 42 | 54 | Mo-96 | 16.53% | | |
| 42 | 55 | Mo-97 | 9.46% | | |
| **42** | **56** | **Mo-98** | **24.13%** | | |
| *42* | 58 | *Mo-100* | 9.60% | 2β- | $1.00 \times 10^{19}$ |
| *43* | 54 | *[Tc-97]* | | EC | $2.60 \times 10^{6}$ |
| *43* | 56 | *[Tc-99]* | | β- | $2.12 \times 10^{5}$ |
| 44 | 52 | Ru-96 | 5.51% | | |
| 44 | 54 | Ru-98 | 1.87% | | |
| 44 | 55 | Ru-99 | 12.72% | | |
| 44 | 56 | Ru-100 | 12.62% | | |
| 44 | 57 | Ru-101 | 17.07% | | |
| **44** | **58** | **Ru-102** | **31.61%** | | |
| 44 | 60 | Ru-104 | 18.58% | | |
| 45 | 58 | Rh-103 | 100.00% | | |
| 46 | 56 | Pd-102 | 0.96% | | |
| 46 | 58 | Pd-104 | 10.97% | | |
| 46 | 59 | Pd-105 | 22.23% | | |
| **46** | **60** | **Pd-106** | **27.33%** | | |
| 46 | 62 | Pd-108 | 26.71% | | |
| 46 | 64 | Pd-110 | 11.81% | | |

**(Z = protons; N = neutrons)**

**Decay Modes:** EC = electron capture; β- = electron emission (beta decay).