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The Radii and Densities of Elementary Particles and Periodic Table Nucleons

Ardeshir Irani

ABSTRACT

We calculate the size as the radius of a sphere, along with the density of all the elementary particles of the first column of the Standard Model of Particle Physics viz. the Up and Down quarks, the electron, the electron neutrino, the proton, the neutron, and the nuclei of all the elements and isotopes of the Periodic Table, using their known masses and the previously calculated radii (r) of the electron and the electron neutrino since $r_e/r_{\nu_e} = m_e/m_{\nu_e}$, can be extended further to calculate $r_p, r_n, r_{Up}, r_{Down}$ and their densities, and $r_{Nucleon\ Number}$ with a Table of nucleon radii that increase and nucleon density that decrease as the number of nucleons increase. The radii of the largest size nuclei can be observed experimentally by electron microscopes as confirmation of the theoretical calculations.

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I. INTRODUCTION

We consider only the elementary particles of the first column of the Standard Model of Particle Physics because the elementary particles of the second and third columns are all unstable except for the three neutrinos of all three columns that are known to change flavor. The unstable elementary particles of the second and third columns decay into the elementary particles of the first column, and that is the reason the atoms that make up the four states of matter and the elements of the Periodic Table consist of protons, neutrons, and electrons as the building blocks of the Universe. We calculate for only stable nuclei and their isotopes, not considering unstable nuclei with exceptions made either because of their abundance, longevity or importance to calculate their radii and densities.

II. RADIUS CALCULATIONS

Starting with the radius of the electron = 4.68×10^{-16} m (Reference 1) and the radius of the electron neutrino = 2×10^{-21} m (Reference 2) and the mass of the electron = $0.511 \text{ MeV}/c^2$ and the mass of the electron neutrino = $2.2 \text{ eV}/c^2$ from the Standard Model of Particle Physics we see that the ratio of their radii is equal to the ratio of their masses. $r_e/r_{\nu_e} = m_e/m_{\nu_e} = 4.68 \times 10^{-16} / 2 \times 10^{-21} = 0.511 \times 10^6 / 2.2 = 2.3 \times 10^5$. We use this equality ratio of the radius and mass to calculate the radius of the proton, the neutron, the Up and Down Quarks, and the elements of the Periodic Table.

For the Proton: $r_p/r_e = m_p/m_e, r_p = (938.27/0.511) \times 4.68 \times 10^{-16} = 8.593 \times 10^{-13} \text{ m}$ $8.59 \times 10^{-13} \text{ m}$.

For the Neutron: $r_n/r_e = m_n/m_e, r_n = (939.57/0.511) \times 4.68 \times 10^{-16} = 8.605 \times 10^{-13} \text{ m}$ $8.61 \times 10^{-13} \text{ m}$.

For the Up Quark: $r_{Up}/r_e = m_{Up}/m_e$, $r_{Up} = (2.3/0.511) \times 4.68 \times 10^{-16} = 2.1 \times 10^{-15}$ m.

For the Down Quark: $r_{Down}/r_e = m_{Down}/m_e$, $r_{Down} = (4.8/0.511) \times 4.68 \times 10^{-16} = 4.4 \times 10^{-15}$ m.

We change the unit of calculation from MeV/c² to atomic mass units (u) for convenience while calculating the sizes of the stable nuclei and their stable isotopes.

$r_{H1}/r_e = m_{H1}/m_e$, $r_{H1} = (1.0078u/5.49 \times 10^{-4}u) \times 4.68 \times 10^{-16} \text{ m} = .859 \times 10^{-12} \text{ m} = 8.59 \times 10^{-13}$ m. The formula we use is $r_x = 8.52 \times 10^{-13} m_x$ and we use the Tables of Nuclear Data (Reference 3) to determine m_x where x refers to the nucleon number and m_x refers to the mass of that nucleus in amu (u) to calculate the radius r_x of its nucleus in meters.

1. Hydrogen H ($r_{1,2}$) $m_{H1} \rightarrow 8.59 \times 10^{-13}$ m, $m_{H2} \rightarrow 1.72 \times 10^{-12}$ m.

Implying $r_{H1} = 8.59 \times 10^{-13}$ m, $r_{H2} = 1.72 \times 10^{-12}$ m, and so on for all the remaining elements that have been calculated below:

2. Helium He ($r_{3,4}$) $m_{He3} \rightarrow 2.57 \times 10^{-12}$ m, $m_{He4} \rightarrow 3.41 \times 10^{-12}$ m.

3. Lithium Li ($r_{6,7}$) $m_{Li6} \rightarrow 5.13 \times 10^{-12}$ m, $m_{Li7} \rightarrow 5.98 \times 10^{-12}$ m.

4. Beryllium Be ($r_{8,9}$) $m_{Be8} \rightarrow 6.82 \times 10^{-12}$ m, $m_{Be9} \rightarrow 7.68 \times 10^{-12}$ m.

5. Boron B ($r_{10,11}$) $m_{B10} \rightarrow 8.53 \times 10^{-12}$ m, $m_{B11} \rightarrow 9.38 \times 10^{-12}$ m.

6. Carbon C ($r_{12,13}$) $m_{C12} \rightarrow 1.02 \times 10^{-11}$ m, $m_{C13} \rightarrow 1.11 \times 10^{-11}$ m.

7. Nitrogen N ($r_{14,15}$) $m_{N14} \rightarrow 1.19 \times 10^{-11}$ m, $m_{N15} \rightarrow 1.28 \times 10^{-11}$ m.

8. Oxygen O ($r_{16,17,18}$) $m_{O16} \rightarrow 1.36 \times 10^{-11}$ m, $m_{O17} \rightarrow 1.45 \times 10^{-11}$ m, $m_{O18} \rightarrow 1.53 \times 10^{-11}$ m.

9. Fluorine F (r_{19}) $m_{F19} \rightarrow 1.62 \times 10^{-11}$ m.

10. Neon Ne ($r_{20,21,22}$) $m_{Ne20} \rightarrow 1.70 \times 10^{-11}$ m, $m_{Ne21} \rightarrow 1.79 \times 10^{-11}$ m, $m_{Ne22} \rightarrow 1.87 \times 10^{-11}$ m.

11. Sodium Na (r_{23}) $m_{Na23} \rightarrow 1.96 \times 10^{-11}$ m.

12. Magnesium Mg ($r_{23,25,26}$) $m_{Mg24} \rightarrow 2.04 \times 10^{-11}$ m, $m_{Mg25} \rightarrow 2.13 \times 10^{-11}$ m, $m_{Mg26} \rightarrow 2.21 \times 10^{-11}$ m.

13. Aluminium Al (r_{27}) $m_{Al27} \rightarrow 2.30 \times 10^{-11}$ m.

14. Silicon Si ($r_{28,29,30}$) $m_{Si28} \rightarrow 2.38 \times 10^{-11}$ m, $m_{Si29} \rightarrow 2.47 \times 10^{-11}$ m, $m_{Si30} \rightarrow 2.55 \times 10^{-11}$ m.

15. Phosphorous P (r_{31}) $m_{P31} \rightarrow 2.64 \times 10^{-11}$ m.

16. Sulphur S ($r_{32,33,34,36}$) $m_{S32} \rightarrow 2.72 \times 10^{-11}$ m, $m_{S33} \rightarrow 2.81 \times 10^{-11}$ m, $m_{S34} \rightarrow 2.89 \times 10^{-11}$ m, $m_{S36} \rightarrow 3.06 \times 10^{-11}$ m.

17. Chlorine Cl ($r_{35,37}$) $m_{Cl35} \rightarrow 2.98 \times 10^{-11}$ m, $m_{Cl37} \rightarrow 3.15 \times 10^{-11}$ m.

18. Argon Ar ($r_{36,38,40}$) $m_{Ar36} \rightarrow 3.06 \times 10^{-11} \text{ m}$, $m_{Ar38} \rightarrow 3.23 \times 10^{-11} \text{ m}$, $m_{Ar40} \rightarrow 3.40 \times 10^{-11} \text{ m}$.
19. Potassium K ($r_{39,40,41}$) $m_{K39} \rightarrow 3.32 \times 10^{-11} \text{ m}$, $m_{K40} \rightarrow 3.41 \times 10^{-11} \text{ m}$, $m_{K41} \rightarrow 3.49 \times 10^{-11} \text{ m}$.
20. Calcium Ca ($r_{40,42,43,44,46,48}$) $m_{Ca40} \rightarrow 3.40 \times 10^{-11} \text{ m}$, $m_{Ca42} \rightarrow 3.58 \times 10^{-11} \text{ m}$, $m_{Ca43} \rightarrow 3.66 \times 10^{-11} \text{ m}$,
 $m_{Ca44} \rightarrow 3.75 \times 10^{-11} \text{ m}$, $m_{Ca46} \rightarrow 3.92 \times 10^{-11} \text{ m}$, $m_{Ca48} \rightarrow 4.09 \times 10^{-11} \text{ m}$.
21. Scandium Sc (r_{45}) $m_{Sc45} \rightarrow 3.83 \times 10^{-11} \text{ m}$.
22. Titanium Ti ($r_{46,47,48,49,50}$) $m_{Ti46} \rightarrow 3.92 \times 10^{-11} \text{ m}$, $m_{Ti47} \rightarrow 4.00 \times 10^{-11} \text{ m}$, $m_{Ti48} \rightarrow 4.09 \times 10^{-11} \text{ m}$,
 $m_{Ti49} \rightarrow 4.17 \times 10^{-11} \text{ m}$, $m_{Ti50} \rightarrow 4.26 \times 10^{-11} \text{ m}$.
23. Vanadium V ($r_{50,51}$) $m_{V50} \rightarrow 4.26 \times 10^{-11} \text{ m}$, $m_{V51} \rightarrow 4.34 \times 10^{-11} \text{ m}$.
24. Chromium Cr ($r_{50,52,53,54}$) $m_{Cr50} \rightarrow 4.26 \times 10^{-11} \text{ m}$, $m_{Cr52} \rightarrow 4.43 \times 10^{-11} \text{ m}$, $m_{Cr53} \rightarrow 4.51 \times 10^{-11} \text{ m}$,
 $m_{Cr54} \rightarrow 4.60 \times 10^{-11} \text{ m}$.
25. Manganese Mn (r_{55}) $m_{Mn55} \rightarrow 4.68 \times 10^{-11} \text{ m}$.
26. Iron Fe ($r_{54,56,57,58}$) $m_{Fe54} \rightarrow 4.60 \times 10^{-11} \text{ m}$, $m_{Fe56} \rightarrow 4.77 \times 10^{-11} \text{ m}$, $m_{Fe57} \rightarrow 4.85 \times 10^{-11} \text{ m}$, $m_{Fe58} \rightarrow$
 $4.94 \times 10^{-11} \text{ m}$.
27. Cobalt Co (r_{59}) $m_{Co59} \rightarrow 5.02 \times 10^{-11} \text{ m}$.
28. Nickel Ni ($r_{58,60,61,62,64}$) $m_{Ni58} \rightarrow 4.94 \times 10^{-11} \text{ m}$, $m_{Ni60} \rightarrow 5.11 \times 10^{-11} \text{ m}$, $m_{Ni61} \rightarrow 5.19 \times 10^{-11} \text{ m}$, $m_{Ni62} \rightarrow$
 $5.28 \times 10^{-11} \text{ m}$, $m_{Ni64} \rightarrow 5.45 \times 10^{-11} \text{ m}$.
29. Copper Cu ($r_{63,65}$) $m_{Cu63} \rightarrow 5.36 \times 10^{-11} \text{ m}$, $m_{Cu65} \rightarrow 5.53 \times 10^{-11} \text{ m}$.
30. Zinc Zn ($r_{64,66,67,68,70}$) $m_{Zn64} \rightarrow 5.45 \times 10^{-11} \text{ m}$, $m_{Zn66} \rightarrow 5.62 \times 10^{-11} \text{ m}$, $m_{Zn67} \rightarrow 5.70 \times 10^{-11} \text{ m}$,
 $m_{Zn68} \rightarrow 5.79 \times 10^{-11} \text{ m}$, $m_{Zn70} \rightarrow 5.96 \times 10^{-11} \text{ m}$.
31. Gallium Ga ($r_{69,71}$) $m_{Ga69} \rightarrow 5.87 \times 10^{-11} \text{ m}$, $m_{Ga71} \rightarrow 6.04 \times 10^{-11} \text{ m}$.
32. Germanium Ge ($r_{70,72,73,74,76}$) $m_{Ge70} \rightarrow 5.96 \times 10^{-11} \text{ m}$, $m_{Ge72} \rightarrow 6.13 \times 10^{-11} \text{ m}$, $m_{Ge73} \rightarrow 6.21 \times 10^{-11} \text{ m}$,
 $m_{Ge74} \rightarrow 6.30 \times 10^{-11} \text{ m}$, $m_{Ge76} \rightarrow 6.47 \times 10^{-11} \text{ m}$.
33. Arsenic As (r_{75}) $m_{As75} \rightarrow 6.38 \times 10^{-11} \text{ m}$.
34. Selenium Se ($r_{74,76,77,78,80,82}$) $m_{Se74} \rightarrow 6.30 \times 10^{-11} \text{ m}$, $m_{Se76} \rightarrow 6.47 \times 10^{-11} \text{ m}$, $m_{Se77} \rightarrow 6.55 \times 10^{-11} \text{ m}$,
 $m_{Se78} \rightarrow 6.64 \times 10^{-11} \text{ m}$, $m_{Se80} \rightarrow 6.81 \times 10^{-11} \text{ m}$, $m_{Se82} \rightarrow 6.98 \times 10^{-11} \text{ m}$.

35. Bromine Br ($r_{79,81}$) $m_{Br79} \rightarrow 6.72 \times 10^{-11}$ m, $m_{Br81} \rightarrow 6.89 \times 10^{-11}$ m.

36. Krypton Kr ($r_{78,80,82,83,84,86}$) $m_{Kr78} \rightarrow 6.64 \times 10^{-11}$ m, $m_{Kr80} \rightarrow 6.81 \times 10^{-11}$ m, $m_{Kr82} \rightarrow 6.98 \times 10^{-11}$ m, $m_{Kr83} \rightarrow 7.06 \times 10^{-11}$ m, $m_{Kr84} \rightarrow 7.15 \times 10^{-11}$ m, $m_{Kr86} \rightarrow 7.32 \times 10^{-11}$ m.

37. Rubidium Rb ($r_{85,87}$) $m_{Rb85} \rightarrow 7.23 \times 10^{-11}$ m, $m_{Rb87} \rightarrow 7.40 \times 10^{-11}$ m.

38. Strontium Sr ($r_{84,86,87,88}$) $m_{Sr84} \rightarrow 7.15 \times 10^{-11}$ m, $m_{Sr86} \rightarrow 7.32 \times 10^{-11}$ m, $m_{Sr87} \rightarrow 7.40 \times 10^{-11}$ m, $m_{Sr88} \rightarrow 7.49 \times 10^{-11}$ m.

39. Yttrium Y (r_{89}) $m_{Y89} \rightarrow 7.57 \times 10^{-11}$ m.

40. Zirconium Zr ($r_{90,91,92,94,96}$) $m_{Zr90} \rightarrow 7.66 \times 10^{-11}$ m, $m_{Zr91} \rightarrow 7.75 \times 10^{-11}$ m, $m_{Zr92} \rightarrow 7.83 \times 10^{-11}$ m, $m_{Zr94} \rightarrow 8.00 \times 10^{-11}$ m, $m_{Zr96} \rightarrow 8.17 \times 10^{-11}$ m.

41. Niobium Nb (r_{93}) $m_{Nb93} \rightarrow 7.92 \times 10^{-11}$ m.

42. Molybdenum Mo ($r_{92,94,95,96,97,98,100}$) $m_{Mo92} \rightarrow 7.83 \times 10^{-11}$ m, $m_{Mo94} \rightarrow 8.00 \times 10^{-11}$ m, $m_{Mo95} \rightarrow 8.09 \times 10^{-11}$ m, $m_{Mo96} \rightarrow 8.17 \times 10^{-11}$ m, $m_{Mo97} \rightarrow 8.26 \times 10^{-11}$ m, $m_{Mo98} \rightarrow 8.34 \times 10^{-11}$ m, $m_{Mo100} \rightarrow 8.51 \times 10^{-11}$ m.

43. Technetium Tc ($r_{97,98,99}$) $m_{Tc97} \rightarrow 8.26 \times 10^{-11}$ m, $m_{Tc98} \rightarrow 8.34 \times 10^{-11}$ m, $m_{Tc99} \rightarrow 8.43 \times 10^{-11}$ m.

44. Ruthenium Ru ($r_{96,98,99,100,101,102,104}$) $m_{Ru96} \rightarrow 8.17 \times 10^{-11}$ m, $m_{Ru98} \rightarrow 8.34 \times 10^{-11}$ m, $m_{Ru99} \rightarrow 8.43 \times 10^{-11}$ m, $m_{Ru100} \rightarrow 8.51 \times 10^{-11}$ m, $m_{Ru101} \rightarrow 8.60 \times 10^{-11}$ m, $m_{Ru102} \rightarrow 8.68 \times 10^{-11}$ m, $m_{Ru104} \rightarrow 8.86 \times 10^{-11}$ m.

45. Rhodium Rh (r_{103}) $m_{Rh103} \rightarrow 8.77 \times 10^{-11}$ m.

46 Palladium Pd ($r_{102,104,105,106,107,108,110}$)

$m_{Pd102} \rightarrow 8.68 \times 10^{-11}$ m, $m_{Pd104} \rightarrow 8.86 \times 10^{-11}$ m, $m_{Pd105} \rightarrow 8.94 \times 10^{-11}$ m, $m_{Pd106} \rightarrow 9.02 \times 10^{-11}$ m, $m_{Pd107} \rightarrow 9.11 \times 10^{-11}$ m, $m_{Pd108} \rightarrow 9.19 \times 10^{-11}$ m, $m_{Pd110} \rightarrow 9.36 \times 10^{-11}$ m.

47. Silver Ag ($r_{107,109}$) $m_{Ag107} \rightarrow 9.11 \times 10^{-11}$ m, $m_{Ag109} \rightarrow 9.28 \times 10^{-11}$ m.

48. Cadmium Cd ($r_{106,108,110,111,112,113,114,116}$) $m_{Cd106} \rightarrow 9.02 \times 10^{-11}$ m, $m_{Cd108} \rightarrow 9.19 \times 10^{-11}$ m, $m_{Cd110} \rightarrow 9.36 \times 10^{-11}$ m, $m_{Cd111} \rightarrow 9.45 \times 10^{-11}$ m, $m_{Cd112} \rightarrow 9.53 \times 10^{-11}$ m, $m_{Cd113} \rightarrow 9.62 \times 10^{-11}$ m, $m_{Cd114} \rightarrow 9.70 \times 10^{-11}$ m, $m_{Cd116} \rightarrow 9.88 \times 10^{-11}$ m.

49. Indium In ($r_{113,115}$) $m_{In113} \rightarrow 9.62 \times 10^{-11}$ m, $m_{In115} \rightarrow 9.79 \times 10^{-11}$ m.

50. Tin Sn ($r_{112,114,115,116,117,118,119,120,122,124}$) $m_{Sn112} \rightarrow 9.53 \times 10^{-11}$ m, $m_{Sn114} \rightarrow 9.70 \times 10^{-11}$ m, $m_{Sn115} \rightarrow 9.79 \times 10^{-11}$ m, $m_{Sn116} \rightarrow 9.88 \times 10^{-11}$ m, $m_{Sn117} \rightarrow 9.96 \times 10^{-11}$ m, $m_{Sn118} \rightarrow 10.05 \times 10^{-11}$ m, $m_{Sn119} \rightarrow 10.13 \times 10^{-11}$ m, $m_{Sn120} \rightarrow 10.22 \times 10^{-11}$ m, $m_{Sn122} \rightarrow 10.39 \times 10^{-11}$ m, $m_{Sn124} \rightarrow 10.56 \times 10^{-11}$ m.

51. Antimony Sb ($r_{121,123,125}$) $m_{Sb121} \rightarrow 10.30 \times 10^{-11}$ m, $m_{Sb123} \rightarrow 10.47 \times 10^{-11}$ m, $m_{Sb125} \rightarrow 10.64 \times 10^{-11}$ m.

52. Tellurium Te ($r_{120,122,123,124,125,126,128,130}$)

$m_{Te120} \rightarrow 10.22 \times 10^{-11}$ m, $m_{Te122} \rightarrow 10.39 \times 10^{-11}$ m, $m_{Te123} \rightarrow 10.47 \times 10^{-11}$ m, $m_{Te124} \rightarrow 10.56 \times 10^{-11}$ m, $m_{Te125} \rightarrow 10.64 \times 10^{-11}$ m, $m_{Te126} \rightarrow 10.73 \times 10^{-11}$ m, $m_{Te128} \rightarrow 10.90 \times 10^{-11}$ m, $m_{Te130} \rightarrow 11.07 \times 10^{-11}$ m.

53. Iodine I (r_{127}) $m_{I127} \rightarrow 10.81 \times 10^{-11}$ m.

54. Xenon Xe ($r_{124,126,128,129,130,131,132,134,136}$) $m_{Xe124} \rightarrow 10.56 \times 10^{-11}$ m, $m_{Xe126} \rightarrow 10.73 \times 10^{-11}$ m, $m_{Xe128} \rightarrow 10.91 \times 10^{-11}$ m, $m_{Xe129} \rightarrow 10.98 \times 10^{-11}$ m, $m_{Xe130} \rightarrow 11.07 \times 10^{-11}$ m, $m_{Xe131} \rightarrow 11.15 \times 10^{-11}$ m, $m_{Xe132} \rightarrow 11.24 \times 10^{-11}$ m, $m_{Xe134} \rightarrow 11.41 \times 10^{-11}$ m, $m_{Xe136} \rightarrow 11.58 \times 10^{-11}$ m.

55. Cesium Cs (r_{133}) $m_{Cs133} \rightarrow 11.32 \times 10^{-11}$ m.

56. Barium Ba ($r_{130,132,134,135,136,137,138}$) $m_{Ba130} \rightarrow 11.07 \times 10^{-11}$ m, $m_{Ba132} \rightarrow 11.24 \times 10^{-11}$ m, $m_{Ba134} \rightarrow 11.41 \times 10^{-11}$ m, $m_{Ba135} \rightarrow 11.49 \times 10^{-11}$ m, $m_{Ba136} \rightarrow 11.58 \times 10^{-11}$ m, $m_{Ba137} \rightarrow 11.66 \times 10^{-11}$ m, $m_{Ba138} \rightarrow 11.75 \times 10^{-11}$ m.

57. Lanthanum La ($r_{138,139}$) $m_{La138} \rightarrow 11.75 \times 10^{-11}$ m, $m_{La139} \rightarrow 11.83 \times 10^{-11}$ m.

58. Cesium Ce ($r_{136,138,140,142}$) $m_{Ce136} \rightarrow 11.58 \times 10^{-11}$ m, $m_{Ce138} \rightarrow 11.75 \times 10^{-11}$ m, $m_{Ce140} \rightarrow 11.92 \times 10^{-11}$ m, $m_{Ce142} \rightarrow 12.09 \times 10^{-11}$ m.

59. Praseodymium Pr (r_{141}) $m_{Pr141} \rightarrow 12.01 \times 10^{-11}$ m.

60. Neodymium Nd ($r_{142,143,144,145,146,148,150}$) $m_{Nd142} \rightarrow 12.09 \times 10^{-11}$ m, $m_{Nd143} \rightarrow 12.18 \times 10^{-11}$ m, $m_{Nd144} \rightarrow 12.26 \times 10^{-11}$ m, $m_{Nd145} \rightarrow 12.35 \times 10^{-11}$ m, $m_{Nd146} \rightarrow 12.43 \times 10^{-11}$ m, $m_{Nd148} \rightarrow 12.60 \times 10^{-11}$ m, $m_{Nd150} \rightarrow 12.77 \times 10^{-11}$ m.

61. Promethium Pm ($r_{145,146,147}$) $m_{Pm145} \rightarrow 12.35 \times 10^{-11}$ m, $m_{Pm146} \rightarrow 12.43 \times 10^{-11}$ m, $m_{Pm147} \rightarrow 12.52 \times 10^{-11}$ m.

62. Samarium Sm ($r_{144,147,148,149,150,152,154}$) $m_{Sm144} \rightarrow 12.26 \times 10^{-11}$ m, $m_{Sm147} \rightarrow 12.52 \times 10^{-11}$ m, $m_{Sm148} \rightarrow 12.60 \times 10^{-11}$ m, $m_{Sm149} \rightarrow 12.69 \times 10^{-11}$ m, $m_{Sm150} \rightarrow 12.77 \times 10^{-11}$ m, $m_{Sm152} \rightarrow 12.94 \times 10^{-11}$ m, $m_{Sm154} \rightarrow 13.11 \times 10^{-11}$ m.

63. Europium Eu ($r_{151,153}$) $m_{Eu151} \rightarrow 12.86 \times 10^{-11} \text{ m}$, $m_{Eu153} \rightarrow 13.03 \times 10^{-11} \text{ m}$.

64. Gadolinium Gd ($r_{152,154,155,156,157,158,160}$) $m_{Gd152} \rightarrow 12.94 \times 10^{-11} \text{ m}$, $m_{Gd154} \rightarrow 13.11 \times 10^{-11} \text{ m}$, $m_{Gd155} \rightarrow 13.20 \times 10^{-11} \text{ m}$, $m_{Gd156} \rightarrow 13.28 \times 10^{-11} \text{ m}$, $m_{Gd157} \rightarrow 13.37 \times 10^{-11} \text{ m}$, $m_{Gd158} \rightarrow 13.46 \times 10^{-11} \text{ m}$, $m_{Gd160} \rightarrow 13.63 \times 10^{-11} \text{ m}$.

65. Terbium Tb (r_{159}) $m_{Tb159} \rightarrow 13.54 \times 10^{-11} \text{ m}$.

66. Dysprosium Dy ($r_{156,158,160,161,162,163,164}$) $m_{Dy156} \rightarrow 13.28 \times 10^{-11} \text{ m}$, $m_{Dy158} \rightarrow 13.46 \times 10^{-11} \text{ m}$, $m_{Dy160} \rightarrow 13.63 \times 10^{-11} \text{ m}$, $m_{Dy161} \rightarrow 13.71 \times 10^{-11} \text{ m}$, $m_{Dy162} \rightarrow 13.80 \times 10^{-11} \text{ m}$, $m_{Dy163} \rightarrow 13.88 \times 10^{-11} \text{ m}$, $m_{Dy164} \rightarrow 13.97 \times 10^{-11} \text{ m}$.

67. Holmium Ho (r_{165}) $m_{Ho165} \rightarrow 14.05 \times 10^{-11} \text{ m}$.

68. Erbium Er ($r_{162,164,166,167,168,170}$) $m_{Er162} \rightarrow 13.80 \times 10^{-11} \text{ m}$, $m_{Er164} \rightarrow 13.97 \times 10^{-11} \text{ m}$, $m_{Er166} \rightarrow 14.14 \times 10^{-11} \text{ m}$, $m_{Er167} \rightarrow 14.22 \times 10^{-11} \text{ m}$, $m_{Er168} \rightarrow 14.31 \times 10^{-11} \text{ m}$, $m_{Er170} \rightarrow 14.48 \times 10^{-11} \text{ m}$.

69. Thulium Tm (r_{169}) $m_{Tm169} \rightarrow 14.39 \times 10^{-11} \text{ m}$.

70. Ytterbium Yb ($r_{168,170,171,172,173,174,176}$) $m_{Yb168} \rightarrow 14.31 \times 10^{-11} \text{ m}$, $m_{Yb170} \rightarrow 14.48 \times 10^{-11} \text{ m}$, $m_{Yb171} \rightarrow 14.56 \times 10^{-11} \text{ m}$, $m_{Yb172} \rightarrow 14.65 \times 10^{-11} \text{ m}$, $m_{Yb173} \rightarrow 14.73 \times 10^{-11} \text{ m}$, $m_{Yb174} \rightarrow 14.82 \times 10^{-11} \text{ m}$, $m_{Yb176} \rightarrow 14.99 \times 10^{-11} \text{ m}$.

71. Lutetium Lu ($r_{175,176}$) $m_{Lu175} \rightarrow 14.90 \times 10^{-11} \text{ m}$, $m_{Lu176} \rightarrow 14.99 \times 10^{-11} \text{ m}$.

72. Hafnium Hf ($r_{174,176,177,178,179,180}$) $m_{Hf174} \rightarrow 14.82 \times 10^{-11} \text{ m}$, $m_{Hf176} \rightarrow 14.99 \times 10^{-11} \text{ m}$, $m_{Hf177} \rightarrow 15.08 \times 10^{-11} \text{ m}$, $m_{Hf178} \rightarrow 15.16 \times 10^{-11} \text{ m}$, $m_{Hf179} \rightarrow 15.25 \times 10^{-11} \text{ m}$, $m_{Hf180} \rightarrow 15.33 \times 10^{-11} \text{ m}$.

73. Tantalum Ta ($r_{180,181}$) $m_{Ta180} \rightarrow 15.33 \times 10^{-11} \text{ m}$, $m_{Ta181} \rightarrow 15.42 \times 10^{-11} \text{ m}$.

74. Tungsten W ($r_{180,182,183,184,186}$) $m_{W180} \rightarrow 15.33 \times 10^{-11} \text{ m}$, $m_{W182} \rightarrow 15.50 \times 10^{-11} \text{ m}$, $m_{W183} \rightarrow 15.59 \times 10^{-11} \text{ m}$, $m_{W184} \rightarrow 15.67 \times 10^{-11} \text{ m}$, $m_{W186} \rightarrow 15.84 \times 10^{-11} \text{ m}$.

75. Rhenium Re ($r_{185,187}$) $m_{Re185} \rightarrow 15.76 \times 10^{-11} \text{ m}$, $m_{Re187} \rightarrow 15.93 \times 10^{-11} \text{ m}$.

76. Osmium Os ($r_{184,186,187,188,189,190,192}$) $m_{Os184} \rightarrow 15.67 \times 10^{-11} \text{ m}$, $m_{Os186} \rightarrow 15.84 \times 10^{-11} \text{ m}$, $m_{Os187} \rightarrow 15.93 \times 10^{-11} \text{ m}$, $m_{Os188} \rightarrow 16.01 \times 10^{-11} \text{ m}$, $m_{Os189} \rightarrow 16.10 \times 10^{-11} \text{ m}$, $m_{Os190} \rightarrow 16.18 \times 10^{-11} \text{ m}$, $m_{Os192} \rightarrow 16.36 \times 10^{-11} \text{ m}$.

77. Iridium Ir ($r_{191,193}$) $m_{Ir191} \rightarrow 16.27 \times 10^{-11} \text{ m}$, $m_{Ir193} \rightarrow 16.44 \times 10^{-11} \text{ m}$.

78. Plutonium Pt ($r_{190,192,194,195,196,198}$) $m_{Pt190} \rightarrow 16.18 \times 10^{-11} \text{ m}$, $m_{Pt192} \rightarrow 16.36 \times 10^{-11} \text{ m}$, $m_{Pt194} \rightarrow 16.53 \times 10^{-11} \text{ m}$, $m_{Pt195} \rightarrow 16.61 \times 10^{-11} \text{ m}$, $m_{Pt196} \rightarrow 16.70 \times 10^{-11} \text{ m}$, $m_{Pt198} \rightarrow 16.87 \times 10^{-11} \text{ m}$.

79. Gold Au (r_{197}) $m_{Au197} \rightarrow 16.78 \times 10^{-11} \text{ m}$.

80. Mercury Hg ($r_{196,198,199,200,201,202,204}$) $m_{Hg196} \rightarrow 16.70 \times 10^{-11} \text{ m}$, $m_{Hg198} \rightarrow 16.87 \times 10^{-11} \text{ m}$, $m_{Hg199} \rightarrow 16.95 \times 10^{-11} \text{ m}$, $m_{Hg200} \rightarrow 17.04 \times 10^{-11} \text{ m}$, $m_{Hg201} \rightarrow 17.12 \times 10^{-11} \text{ m}$, $m_{Hg202} \rightarrow 17.21 \times 10^{-11} \text{ m}$, $m_{Hg204} \rightarrow 17.38 \times 10^{-11} \text{ m}$.

81. Thallium Tl ($r_{203,205}$) $m_{Tl203} \rightarrow 17.29 \times 10^{-11} \text{ m}$, $m_{Tl205} \rightarrow 17.46 \times 10^{-11} \text{ m}$.

82. Lead Pb ($r_{204,206,207,208}$) $m_{Pb204} \rightarrow 17.38 \times 10^{-11} \text{ m}$, $m_{Pb206} \rightarrow 17.55 \times 10^{-11} \text{ m}$, $m_{Pb207} \rightarrow 17.63 \times 10^{-11} \text{ m}$, $m_{Pb208} \rightarrow 17.72 \times 10^{-11} \text{ m}$, which is the last of the Stable Nuclides.

83. Bismuth Bi (r_{209}) $m_{Bi209} \rightarrow 17.81 \times 10^{-11} \text{ m}$.

84. Polonium Po ($r_{208,209}$) $m_{Po208} \rightarrow 17.72 \times 10^{-11} \text{ m}$, $m_{Po209} \rightarrow 17.81 \times 10^{-11} \text{ m}$.

85. Astatine At ($r_{207,208,209,210,211}$) $m_{At207} \rightarrow 17.63 \times 10^{-11} \text{ m}$, $m_{At208} \rightarrow 17.72 \times 10^{-11} \text{ m}$, $m_{At209} \rightarrow 17.81 \times 10^{-11} \text{ m}$, $m_{At210} \rightarrow 17.89 \times 10^{-11} \text{ m}$, $m_{At211} \rightarrow 17.98 \times 10^{-11} \text{ m}$.

86. Radon Rn (r_{222}) $m_{Rn222} \rightarrow 18.92 \times 10^{-11} \text{ m}$.

87. Francium Fr ($r_{223,224,225}$) $m_{Fr223} \rightarrow 19.01 \times 10^{-11} \text{ m}$, $m_{Fr224} \rightarrow 19.09 \times 10^{-11} \text{ m}$, $m_{Fr225} \rightarrow 19.17 \times 10^{-11} \text{ m}$.

88. Radium Ra ($r_{226,228}$) $m_{Ra226} \rightarrow 19.26 \times 10^{-11} \text{ m}$, $m_{Ra228} \rightarrow 19.43 \times 10^{-11} \text{ m}$.

89. Actinium Ac (r_{227}) $m_{Ac227} \rightarrow 19.34 \times 10^{-11} \text{ m}$.

90. Thorium Th ($r_{229,230,232}$) $m_{Th229} \rightarrow 19.51 \times 10^{-11} \text{ m}$, $m_{Th230} \rightarrow 19.60 \times 10^{-11} \text{ m}$, $m_{Th232} \rightarrow 19.77 \times 10^{-11} \text{ m}$.

91. Protactinium Pa (r_{231}) $m_{Pa231} \rightarrow 19.68 \times 10^{-11} \text{ m}$.

92. Uranium U or Ur ($r_{232,233,234,235,236,238}$) $m_{U232} \rightarrow 19.77 \times 10^{-11} \text{ m}$, $m_{U233} \rightarrow 19.86 \times 10^{-11} \text{ m}$, $m_{U234} \rightarrow 19.94 \times 10^{-11} \text{ m}$, $m_{U235} \rightarrow 20.03 \times 10^{-11} \text{ m}$, $m_{U236} \rightarrow 20.11 \times 10^{-11} \text{ m}$, $m_{U238} \rightarrow 20.28 \times 10^{-11} \text{ m}$.

93. Neptunium Np ($r_{236,237}$) $m_{Np236} \rightarrow 20.11 \times 10^{-11} \text{ m}$, $m_{Np237} \rightarrow 20.20 \times 10^{-11} \text{ m}$.

94. Plutonium Pu ($r_{236,238,239,240,241,242,244}$) $m_{Pu236} \rightarrow 20.11 \times 10^{-11} \text{ m}$, $m_{Pu238} \rightarrow 20.28 \times 10^{-11} \text{ m}$, $m_{Pu239} \rightarrow 20.37 \times 10^{-11} \text{ m}$, $m_{Pu240} \rightarrow 20.45 \times 10^{-11} \text{ m}$, $m_{Pu241} \rightarrow 20.54 \times 10^{-11} \text{ m}$, $m_{Pu242} \rightarrow 20.62 \times 10^{-11} \text{ m}$, $m_{Pu244} \rightarrow 20.79 \times 10^{-11} \text{ m}$.

95. Americium Am ($r_{241,242,243}$) $m_{Am241} \rightarrow 20.54 \times 10^{-11} \text{m}$, $m_{Am242} \rightarrow 20.62 \times 10^{-11} \text{m}$, $m_{Am243} \rightarrow 20.71 \times 10^{-11} \text{m}$.

96. Curium Cm ($r_{245,246,247,248}$) $m_{Cm245} \rightarrow 20.88 \times 10^{-11} \text{m}$, $m_{Cm246} \rightarrow 20.96 \times 10^{-11} \text{m}$, $m_{Cm247} \rightarrow 21.05 \times 10^{-11} \text{m}$, $m_{Cm248} \rightarrow 21.14 \times 10^{-11} \text{m}$.

97. Berkelium Bk (r_{247}) $m_{Bk247} \rightarrow 21.05 \times 10^{-11} \text{m}$.

98. Californium Cf ($r_{249,250,251,252}$) $m_{Cf249} \rightarrow 21.22 \times 10^{-11} \text{m}$, $m_{Cf250} \rightarrow 21.31 \times 10^{-11} \text{m}$, $m_{Cf251} \rightarrow 21.39 \times 10^{-11} \text{m}$, $m_{Cf252} \rightarrow 21.48 \times 10^{-11} \text{m}$.

99. Einsteinium Es ($r_{252,253,254,255,256,257}$) $m_{Es252} \rightarrow 21.48 \times 10^{-11} \text{m}$, $m_{Es253} \rightarrow 21.56 \times 10^{-11} \text{m}$, $m_{Es254} \rightarrow 21.64 \times 10^{-11} \text{m}$, $m_{Es255} \rightarrow 21.73 \times 10^{-11} \text{m}$, $m_{Es256} \rightarrow 21.82 \times 10^{-11} \text{m}$, $m_{Es257} \rightarrow 21.90 \times 10^{-11} \text{m}$.

100. Fermion Fm ($r_{253,257}$) $m_{Fm253} \rightarrow 21.56 \times 10^{-11} \text{m}$, $m_{Fm257} \rightarrow 21.90 \times 10^{-11} \text{m}$.

101. Mendeleevium Md ($r_{257,258,259,260}$) $m_{Md257} \rightarrow 21.90 \times 10^{-11} \text{m}$, $m_{Md258} \rightarrow 21.99 \times 10^{-11} \text{m}$, $m_{Md259} \rightarrow 22.08 \times 10^{-11} \text{m}$, $m_{Md260} \rightarrow 22.16 \times 10^{-11} \text{m}$.

All nuclei beyond nuclear number 260 are very unstable (have very short half-lives) and therefore are not being considered. The same instability applies to nuclei numbers between 212 and 221 that will also be left out of the Table. The reason for the instability pertains to their large number and the way the protons and neutrons are situated within the nucleus. Since the nucleon binding forces act over short distances as the nucleus gets larger in size the binding forces which acts over only a few neighboring nucleons cannot compete with the longer range electrical repulsive forces between protons, hence the nucleus becomes unstable.

III. DENSITY CALCULATIONS

Density (ρ) = Mass/Volume = Mass / $(4\pi r^3/3)$ using the values of r from the Radius Calculations and the known values of Mass.

$$\text{Electron } \rho = 2.12 \times 10^{15} \text{ Kg/m}^3.$$

$$\text{Electron Neutrino } \rho = 1.18 \times 10^{26} \text{ Kg/m}^3.$$

$$\text{Up Quark } \rho = 1.06 \times 10^{14} \text{ Kg/m}^3.$$

$$\text{Down Quark } \rho = 2.41 \times 10^{13} \text{ Kg/m}^3.$$

$$\text{Proton and Neutron Density } \rho = 6.30 \times 10^8 \text{ Kg/m}^3.$$

The Radius and Density Table of the Nucleons of the Periodic Table are used to correct the mistakes made in Physics Textbooks that all sized nuclei have the same Density (Reference 4) of $2.3 \times 10^{17} \text{ kg/m}^3$

based on the incorrect assumption that the radius of all nuclei is proportional to $A^{\frac{1}{3}}$ where A is their Mass Number, and therefore their Density is independent of their Mass Number.

. Within the Table S = Stable Nucleus and U = Unstable Nucleus. Simplifying the formula $\rho = M/V$ to: $\rho = (\text{No. of Nucleons} \times 3.99 \times 10^{-28}) / r^3 \text{ Kg/m}^3$ we get:

Number of Nucleons.	Radius in m.	Density in Kg/m^3 .
1 H-S	8.59×10^{-13}	6.30×10^8
2 H-S	1.72×10^{-12}	1.57×10^8
3 He-S	2.57×10^{-12}	7.05×10^7
4 He-S	3.41×10^{-12}	4.03×10^7
5 -----	Does Not Exist.	-----
6 Li-S	5.13×10^{-12}	1.77×10^7
7 Li-S	5.98×10^{-12}	1.31×10^7
8 Be-U	6.82×10^{-12}	1.01×10^7
9 Be-S	7.68×10^{-12}	7.93×10^6
10 B-S	8.53×10^{-12}	6.43×10^6
11 B-S	9.38×10^{-12}	5.32×10^6
12 C-S	1.02×10^{-11}	4.51×10^6
13 C-S	1.11×10^{-11}	3.79×10^6
14 N-S	1.19×10^{-11}	3.31×10^6
15 N-S	1.28×10^{-11}	2.85×10^6
16 O-S	1.36×10^{-11}	2.54×10^6
17 O-S	1.45×10^{-11}	2.22×10^6
18 O-S	1.53×10^{-11}	2.01×10^6
19 F-S	1.62×10^{-11}	1.78×10^6
20 Ne-S	1.70×10^{-11}	1.62×10^6
21 Ne-S	1.79×10^{-11}	1.46×10^6
22 Ne-S	1.87×10^{-11}	1.34×10^6
23 Na-S	1.96×10^{-11}	1.22×10^6
24 Mg-S	2.04×10^{-11}	1.13×10^6
25 Mg-S	2.13×10^{-11}	1.03×10^6
26 Mg-S	2.21×10^{-11}	9.61×10^5
27 Al-S	2.30×10^{-11}	8.85×10^5
28 Si-S	2.38×10^{-11}	8.29×10^5
29 Si-S	2.47×10^{-11}	7.68×10^5
30 Si-S	2.55×10^{-11}	7.22×10^5
31 P-S	2.64×10^{-11}	6.72×10^5
32 Sulphur-S	2.72×10^{-11}	6.34×10^5
33 Sulphur-S	2.81×10^{-11}	5.93×10^5
34 Sulphur-S	2.89×10^{-11}	5.62×10^5

35 Cl-S	2.98×10^{-11}	5.28×10^5
36 Sulphur, Ar-S	3.06×10^{-11}	5.01×10^5
37 Cl-S	3.15×10^{-11}	4.72×10^5
38 Ar-S	3.23×10^{-11}	4.50×10^5
39 K-S	3.32×10^{-11}	4.25×10^5
40 Ar, Ca-S	3.40×10^{-11}	4.06×10^5
41 K-S	3.49×10^{-11}	3.85×10^5
42 Ca-S	3.58×10^{-11}	3.65×10^5
43 Ca-S	3.66×10^{-11}	3.50×10^5
44 Ca-S	3.75×10^{-11}	3.33×10^5
45 Sc-S	3.83×10^{-11}	3.20×10^5
46 Ca, Ti-S	3.92×10^{-11}	3.05×10^5
47 Ti-S	4.00×10^{-11}	2.93×10^5
48 Ti-S	4.09×10^{-11}	2.80×10^5
49 Ti-S	4.17×10^{-11}	2.70×10^5
50 Ti-S	4.26×10^{-11}	2.58×10^5
51 V-S	4.34×10^{-11}	2.49×10^5
52 Cr-S	4.43×10^{-11}	2.39×10^5
53 Cr-S	4.51×10^{-11}	2.31×10^5
54 Cr, Fe-S	4.60×10^{-11}	2.21×10^5
55 Mn-S	4.68×10^{-11}	2.14×10^5
56 Fe-S	4.77×10^{-11}	2.06×10^5
57 Fe-S	4.85×10^{-11}	1.99×10^5
58 Fe, Ni-S	4.94×10^{-11}	1.92×10^5
59 Co-S	5.02×10^{-11}	1.86×10^5
60 Ni-S	5.11×10^{-11}	1.79×10^5
61 Ni-S	5.19×10^{-11}	1.74×10^5
62 Ni-S	5.28×10^{-11}	1.68×10^5
63 Cu-S	5.36×10^{-11}	1.63×10^5
64 Ni, Zn-S	5.45×10^{-11}	1.58×10^5
65 Cu-S	5.53×10^{-11}	1.53×10^5
66 Zn-S	5.62×10^{-11}	1.48×10^5
67 Zn-S	5.70×10^{-11}	1.44×10^5
68 Zn-S	5.79×10^{-11}	1.40×10^5
69 Ga-S	5.87×10^{-11}	1.36×10^5
70 Zn, Ge-S	5.96×10^{-11}	1.32×10^5
71 Ga-S	6.04×10^{-11}	1.29×10^5
72 Ge-S	6.13×10^{-11}	1.25×10^5

73 Ge-S	6.21×10^{-11}	1.22×10^5
74 Ge, Se-S	6.30×10^{-11}	1.18×10^5
75 As-S	6.38×10^{-11}	1.15×10^5
76 Ge, Se-S	6.47×10^{-11}	1.12×10^5
77 Se-S	6.55×10^{-11}	1.09×10^5
78 Se-S	6.64×10^{-11}	1.06×10^5
79 Br-S	6.72×10^{-11}	1.04×10^5
80 Se, Kr-S	6.81×10^{-11}	1.01×10^5
81 Br-S	6.89×10^{-11}	9.88×10^4
82 Kr-S	6.98×10^{-11}	9.62×10^4
83 Kr-S	7.06×10^{-11}	9.41×10^4
84 Kr, Sr-S	7.15×10^{-11}	9.17×10^4
85 Rb-S	7.23×10^{-11}	8.97×10^4
86 Kr, Sr-S	7.32×10^{-11}	8.75×10^4
87 Sr-S	7.40×10^{-11}	8.57×10^4
88 Sr-S	7.49×10^{-11}	8.36×10^4
89 Y-S	7.57×10^{-11}	8.19×10^4
90 Zr-S	7.66×10^{-11}	7.99×10^4
91 Zr-S	7.75×10^{-11}	7.80×10^4
92 Zr, Mo-S	7.83×10^{-11}	7.65×10^4
93 Nb-S	7.92×10^{-11}	7.47×10^4
94 Zr, Mo-S	8.00×10^{-11}	7.33×10^4
95 Mo-S	8.09×10^{-11}	7.16×10^4
96 Mo, Ru-S	8.17×10^{-11}	7.02×10^4
97 Mo-S	8.26×10^{-11}	6.87×10^4
98 Mo, Ru-S	8.34×10^{-11}	6.74×10^4
99 Tc-U, Ru-S	8.43×10^{-11}	6.59×10^4
100 Ru-S	8.51×10^{-11}	6.47×10^4
101 Ru-S	8.60×10^{-11}	6.34×10^4
102 Ru, Pd-S	8.68×10^{-11}	6.22×10^4
103 Rh-S	8.77×10^{-11}	6.09×10^4
104 Ru, Pd-S	8.86×10^{-11}	5.97×10^4

105 Pd-S	8.94×10^{-11}	5.86×10^4
106 Pd, Cd-S	9.02×10^{-11}	5.76×10^4
107 Ag-S	9.11×10^{-11}	5.65×10^4
108 Pd, Cd-S	9.19×10^{-11}	5.55×10^4
109 Ag-S	9.28×10^{-11}	5.44×10^4
110 Pd, Cd-S	9.36×10^{-11}	5.35×10^4
111 Cd-S	9.45×10^{-11}	5.25×10^4
112 Cd, Sn-S	9.53×10^{-11}	5.16×10^4
113 In-S	9.62×10^{-11}	5.06×10^4
114 Cd, Sn-S	9.70×10^{-11}	4.98×10^4
115 Sn-S	9.79×10^{-11}	4.89×10^4
116 Sn-S	9.88×10^{-11}	4.80×10^4
117 Sn-S	9.96×10^{-11}	4.72×10^4
118 Sn-S	10.05×10^{-11}	4.64×10^4
119 Sn-S	10.13×10^{-11}	4.57×10^4
120 Sn, Te-S	10.22×10^{-11}	4.49×10^4
121 Sb-S	10.30×10^{-11}	4.42×10^4
122 Sn, Te-S	10.39×10^{-11}	4.34×10^4
123 Sb-S	10.47×10^{-11}	4.28×10^4
124 Sn, Te, Xe-S	10.56×10^{-11}	4.20×10^4
125 Te-S	10.64×10^{-11}	4.14×10^4
126 Te, Xe-S	10.73×10^{-11}	4.07×10^4
127 I-S	10.81×10^{-11}	4.01×10^4
128 Xe-S	10.91×10^{-11}	3.93×10^4
129 Xe-S	10.98×10^{-11}	3.89×10^4
130 Xe, Ba-S	11.07×10^{-11}	3.82×10^4
131 Xe-S	11.15×10^{-11}	3.77×10^4
132 Xe, Ba-S	11.24×10^{-11}	3.71×10^4
133 Cs-S	11.32×10^{-11}	3.66×10^4
134 Xe, Ba-S	11.41×10^{-11}	3.60×10^4
135 Ba-S	11.49×10^{-11}	3.55×10^4
136 Ba, Ce-S	11.58×10^{-11}	3.49×10^4

137 Ba-S	11.66×10^{-11}	3.45×10^4
138 Ba, Ce-S	11.75×10^{-11}	3.39×10^4
139 La-S	11.83×10^{-11}	3.35×10^4
140 Ce-S	11.92×10^{-11}	3.30×10^4
141 Pr-S	12.01×10^{-11}	3.25×10^4
142 Nd-S	12.09×10^{-11}	3.21×10^4
143 Nd-S	12.18×10^{-11}	3.16×10^4
144 Sm-S	12.26×10^{-11}	3.12×10^4
145 Nd-S	12.35×10^{-11}	3.07×10^4
146 Nd-S	12.43×10^{-11}	3.03×10^4
147 Pm-U	12.52×10^{-11}	2.99×10^4
148 Nd-S	12.60×10^{-11}	2.95×10^4
149 Sm-U	12.69×10^{-11}	2.91×10^4
150 Sm-S	12.77×10^{-11}	2.87×10^4
151 Eu-S	12.86×10^{-11}	2.83×10^4
152 Sm-S	12.94×10^{-11}	2.80×10^4
153 Eu-S	13.03×10^{-11}	2.76×10^4
154 Sm, Gd-S	13.11×10^{-11}	2.73×10^4
155 Gd-S	13.20×10^{-11}	2.69×10^4
156 Gd, Dy-S	13.28×10^{-11}	2.66×10^4
157 Gd-S	13.37×10^{-11}	2.62×10^4
158 Gd, Dy-S	13.46×10^{-11}	2.59×10^4
159 Tb-S	13.54×10^{-11}	2.56×10^4
160 Gd, Dy-S	13.63×10^{-11}	2.52×10^4
161 Dy-S	13.71×10^{-11}	2.49×10^4
162 Dy, Er-S	13.80×10^{-11}	2.46×10^4
163 Dy-S	13.88×10^{-11}	2.43×10^4
164 Dy, Er-S	13.97×10^{-11}	2.40×10^4
165 Ho-S	14.05×10^{-11}	2.37×10^4
166 Er-S	14.14×10^{-11}	2.34×10^4
167 Er-S	14.22×10^{-11}	2.32×10^4
168 Er, Yb-S	14.31×10^{-11}	2.29×10^4

169 Tm-S	14.39×10^{-11}	2.26×10^4
170 Er, Yb-S	14.48×10^{-11}	2.23×10^4
171 Yb-S	14.56×10^{-11}	2.21×10^4
172 Yb-S	14.65×10^{-11}	2.18×10^4
173 Yb-S	14.73×10^{-11}	2.16×10^4
174 Yb-S	14.82×10^{-11}	2.13×10^4
175 Lu-S	14.90×10^{-11}	2.11×10^4
176 Yb, Hf-S	14.99×10^{-11}	2.08×10^4
177 Hf-S	15.08×10^{-11}	2.06×10^4
178 Hf-S	15.16×10^{-11}	2.04×10^4
179 Hf-S	15.25×10^{-11}	2.01×10^4
180 Hf, W-S	15.33×10^{-11}	1.99×10^4
181 Ta-S	15.42×10^{-11}	1.97×10^4
182 W-S	15.50×10^{-11}	1.95×10^4
183 W-S	15.59×10^{-11}	1.93×10^4
184 W, Os-S	15.67×10^{-11}	1.91×10^4
185 W, Re-S	15.76×10^{-11}	1.89×10^4
186 Os-U	15.84×10^{-11}	1.87×10^4
187 Re-U, Os-S	15.93×10^{-11}	1.85×10^4
188 Os-S	16.01×10^{-11}	1.83×10^4
189 Os-S	16.10×10^{-11}	1.81×10^4
190 Os-S	16.18×10^{-11}	1.79×10^4
191 Ir-S	16.27×10^{-11}	1.77×10^4
192 Os, Pt-S	16.36×10^{-11}	1.75×10^4
193 Ir-S	16.44×10^{-11}	1.73×10^4
194 Pt-S	16.53×10^{-11}	1.71×10^4
195 Pt-S	16.61×10^{-11}	1.70×10^4
196 Pt, Hg-S	16.70×10^{-11}	1.68×10^4
197 Au-S	16.78×10^{-11}	1.66×10^4
198 Pt, Hg-S	16.87×10^{-11}	1.65×10^4
199 Hg-S	16.95×10^{-11}	1.63×10^4
200 Hg-S	17.04×10^{-11}	1.61×10^4

201 Hg-S	17.12×10^{-11}	1.60×10^4
202 Hg-S	17.21×10^{-11}	1.58×10^4
203 Tl-S	17.29×10^{-11}	1.57×10^4
204 Hg-S	17.38×10^{-11}	1.55×10^4
205 Tl-S	17.46×10^{-11}	1.54×10^4
206 Pb-S	17.55×10^{-11}	1.52×10^4
207 Pb-S, At-U	17.63×10^{-11}	1.51×10^4
208 Pb-S; All nuclei > 208 are Unstable.	17.72×10^{-11}	1.49×10^4
209 Bi, Po, At-U	17.81×10^{-11}	1.48×10^4
210 At-U	17.89×10^{-11}	1.46×10^4
211 At-U	17.98×10^{-11}	1.45×10^4
222 Rn-U	18.92×10^{-11}	1.31×10^4
223 Fr-U	19.01×10^{-11}	1.30×10^4
224 Fr-U	19.09×10^{-11}	1.28×10^4
225 Fr-U	19.17×10^{-11}	1.27×10^4
226 Ra-U	19.26×10^{-11}	1.26×10^4
227 Ac-U	19.34×10^{-11}	1.25×10^4
228 Ra-U	19.43×10^{-11}	1.24×10^4
229 Th-U	19.51×10^{-11}	1.23×10^4
230 Th-U	19.60×10^{-11}	1.22×10^4
231 Pa-U	19.68×10^{-11}	1.21×10^4
232 Th, Ur-U	19.77×10^{-11}	1.20×10^4
233 Ur-U	19.86×10^{-11}	1.19×10^4
234 Ur-U	19.94×10^{-11}	1.18×10^4
235 Ur-U	20.03×10^{-11}	1.17×10^4
236 Ur, Np, Pu-U	20.11×10^{-11}	1.16×10^4
237 Ur, Np-U	20.20×10^{-11}	1.15×10^4
238 Ur, Pu-U	20.28×10^{-11}	1.14×10^4
239 Pu-U	20.37×10^{-11}	1.13×10^4
240 Pu-U	20.45×10^{-11}	1.12×10^4
241 Pu, Am-U	20.54×10^{-11}	1.11×10^4

242 Pu, Am-U	20.62×10^{-11}	1.10×10^4
243 Am-U	20.71×10^{-11}	1.09×10^4
244 Pu-U	20.79×10^{-11}	1.08×10^4
245 Cm-U	20.88×10^{-11}	1.074×10^4
246 Cm-U	20.96×10^{-11}	1.066×10^4
247 Cm, Bk-U	21.05×10^{-11}	1.06×10^4
248 Cm-U	21.14×10^{-11}	1.05×10^4
249 Cf-U	21.22×10^{-11}	1.04×10^4
250 Cf-U	21.31×10^{-11}	1.03×10^4
251 Cf-U	21.39×10^{-11}	1.02×10^4
252 Cf, Es-U	21.48×10^{-11}	1.01×10^4
253 Es, Fm-U	21.56×10^{-11}	10.07×10^3
254 Es-U	21.64×10^{-11}	10.00×10^3
255 Es-U	21.73×10^{-11}	9.92×10^3
256 Es-U	21.82×10^{-11}	9.83×10^3
257 Es, Fm, Md-U	21.90×10^{-11}	9.76×10^3
258 Md-U	21.99×10^{-11}	9.68×10^3
259 Md-U	22.08×10^{-11}	9.60×10^3
260 Md-U	22.16×10^{-11}	9.53×10^3

The density of stable nuclei varies from $6.30 \times 10^8 \text{ Kg/m}^3$ for 1 nucleus to $1.49 \times 10^4 \text{ Kg/m}^3$ for 208 nucleons.

IV. CONCLUSION

All the radii of the elementary particles are fundamental and therefore they should be included, along with the radii and charges of the three neutrinos, in the Table at the end of a University Physics Book in conjunction with the other Physical Constants of nature. The sizes of the nuclei of the elements depend only on the total number of nucleons. If there is an overlap of the number of nucleons between two or more elements their size will be the same. As an example, Barium, Lanthanum, and Cesium can all carry 138 nucleons of the same radius of $11.75 \times 10^{-11} \text{ m}$. Another example would be Hafnium carrying 176 nucleons of radius $14.99 \times 10^{-11} \text{ m}$ with Ytterbium and Lutetium; and Hafnium carrying 180 nucleons of radius $15.33 \times 10^{-11} \text{ m}$ with Tantalum and Tungsten. The radii and densities of all the nuclei of all the elements of the Periodic Table should be included in Chemistry Textbooks. Densities decrease as the number of nucleons and their radii increase. The strong nuclear attractive force between the nucleons that is short ranged begins to become weaker than the repulsive electric force between the protons that is long ranged until nucleons with higher mass number become unstable.

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