Juniper Online
Journal Material Science
ISSN: 2575-856X

Research Article
Volume 9 Issue 5 - August 2025
DOI: 10.19080/JOJMS.2025.09.555775

JOJ Material Sci

New Equations of Atomic Nuclei

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Submitted: August 13, 2025; **Published:** August 24, 2025

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Abstract

We present a new theoretical approach and a new model with new equations of atomic nuclei (new equation of calculating strong nuclear force and constant connecting nuclear radius and atomic mass number) with calculations and results in good agreement with known determined calculations. All nuclei are consisting of nucleons (protons & neutrons) as certain masses with certain diameters at certain distances with certain number of its constituents with certain geometrical shape with certain velocities held together by certain fundamental force (strong nuclear force), so the main equations of nuclei are controlled by these physical parameters. It is found that the distribution of particles in the nuclei is uniform for their masses and diameters. The calculations confirmed that the mass and diameter of any nucleus give certain constant value $(2.2\times10^{-15}\sqrt{kg}/m^2)$. The new equation with a new nuclei constant is used to calculate previously undetermined experimental radii. The new equation of strong nuclear force can be determined by three main physical parameters (mass, distance, velocity of light).

Keywords: Nuclei; Radius; Force; Mass; Distance; Velocity

Introduction

In 1911, Rutherford found that at the center of every atom is a nucleus. Atomic nuclei consisting of electrically positive charged protons and electrically neutral neutrons [1]. The protons and neutrons are held together by the strong nuclear force. The volume of nucleus represents much less than 0.01 % of the volume of the atom and typically contains more than 99.9 % of the atom mass. The essential nature of the atomic nucleus was established with the discovery of the neutron by Chadwick [2]. The uncharged neutron is used as a new tool to probe nuclear structure, leading to important discoveries such as the creation of new radioactive elements by neutron irradiation and the fission of uranium atoms by neutrons. There are some models of the atomic nucleus such as Liquid Drop Model which describes the nucleus as a semiclassical fluid consists of neutrons and protons with an internal repulsive electrostatic force proportional to the number of protons, the Shell model which views protons and neutrons as existing in distinct energy orbitals similar to electrons in an atom and the cluster model which describes the nucleus as a collection of sub nucleonic structures such as alpha particles [3-5].

The nuclear radius is considered to be one of the main quantities that any model must predict and needed in many investigations, such as structure of atomic nuclei [6], shape and odd-even staggering [7], nuclear halos [8], shape coexistence [9], atomic parity violation and studies for permanent electric dipole moments [10], tests of strong-field quantum electrodynamics (QED) [11]. There are two main experimental techniques used to measure the radii of nuclei (Muonic atom X-ray spectroscopy [12] and elastic electron scattering [13]. For stable nuclei the nuclear radius is proportional to the cube root of the atomic mass number of the nucleus, and particularly in nuclei containing many nucleons as they arrange in spherical configurations.

The stable nucleus has nearly a constant density and therefore the nuclear radius can be approximated by the following equation (1)

$$R = r_0 A^{1/3} \quad (1)$$

Where A is the atomic mass number and $r_0 = 1.2\times10^{-15}$ m. In this equation the constant changes by 0.2 femtometer (fm), depending on the nucleus.

The small systems such as nuclei, atoms and molecules have a constant value as a result of their homogenous distribution of their constituents. It is found that the atom as nucleus and electrons at certain distances contained in a certain area with a certain uniform distribution forming certain system (atom) with a certain constant $1.1\times10^{8}\ [\mathrm{m}^2/\mathrm{kg}]$ [14]. Also, it is found that the homogenous distribution of shared electrons in the diatomic homonuclear molecules with specific circumference give a molecular constant value $(5.4\times10^{9}\ \mathrm{m}^{-1})$ [15]. The same result with certain constant is found for atomic nuclei.

Materials and Methods

The Physical relations and laws can be expressed in terms of the main physical parameters responsible for their origin. Protons and neutrons at certain distances contained in a certain area with a certain uniform distribution forming certain system (nucleus) with a certain constant. The strong nuclear force is acting only at certain distance in the range of a few femtometers and its main role is to form and bound the nuclei and is determined by three main physical parameters (mass, distance, velocity of light). The present approach and method to determine the radii of atomic nuclei is different. We treat atomic nuclei as equal in spherical geometrical shape. All radii are then obtained self consistently by using simple equation connecting nuclear radius and atomic mass number. Our approach confirms that the atomic nuclei have spherical shape and its mathematical relation can be used to calculate radii of atomic nuclei and confirm certain constant $(2.2\times10^{15}\ \sqrt{kg/m^2})$.

Results and Discussion

The nuclear shell model uses the Pauli exclusion principle to model the structure of atomic nuclei in terms of energy levels as analogous to the atomic shell model. The shells for protons and neutrons are independent of each other. So, there can exist both magic nuclei, in which one nucleon type or the other is at a magic number, and doubly magic quantum nuclei, where both nucleons are. Due to changes in orbital filling, the upper magic numbers are 126 and 184 for neutrons, but only 114 for protons. Some semi-magic numbers have been found Z = 40, which gives the nuclear shell filling for the various elements; 16 may be a magic number [16]. The empirical proton and neutron shell gaps are numerically obtained from observed binding energies [17].

As a result of the uniform distribution of the particles inside nuclei, the square root of the mass of any nucleus is proportional with its area

$$\sqrt{m} \propto a \qquad (2)$$

$$\sqrt{m} = const\times 4\pi\times r^2 \qquad (3)$$

$$cons = \frac{\sqrt{m}}{4\pi\times r^2} = 2.2\times10^{15}\ \sqrt{kg}/m^2 \qquad (4)$$

from which the following equation (5) can be deduced

$$r^2 = \frac{\sqrt{m}}{4\pi\times cons} \qquad (5)$$

The calculated mass of any nuclei by using equation (3) is identical with actual nuclei mass values and the calculated radius of any nuclei by using equation (5) is consistent and in good agreement with determined experimental values [18] as indicated in Table 1.

Where

a is the area of any nucleus

m is the mass of any nucleus

cons. is constant value for any nucleus

r is the radius of any nucleus

In the present theoretical approach, all atomic nuclei have certain geometrical shape (spherical) with a certain area for each nucleus. It is found that the radii of all nuclei behave linearly as a result of increasing atomic number in periodic table. The present model is based on the proportionality of nuclear mass with its area and both of them are increasing with increasing atomic mass. All calculations confirmed that there is constant value for nuclei relating the square root of the mass of any nucleus and its area. (Table 1) lists the constant value of the nuclei by using equation (4) compared with experimental determined values of nuclear radii [19-21] and determined values by using equation (1). A Comparison of the present calculations and results for radii of atomic nuclei with the available experimental values gives a good agreement between them. The physical meaning of the constant of atomic nuclei represents the mass and area of all of atomic nuclei as spherical geometrical shape.

How to cite this article: MR Sanad. New Equations of Atomic Nuclei. JOJ Material Sci. 2025; 9(5): 555775. DOI: 10.19080/JOJMS.2025.09.555775

Table 1: Physical parameters of atomic nuclei with experimental radii and new radii equation (5).

Atomic Number	Symbol	Name	Square Root Mass Number (kg)	Experimental Radius (m)	New Radius (m) Present Study	Radius Eq. (1) (m)	Constant
1	H	Hydrogen	4.09×10^{-14}	0.88×10^{-15}	1.20×10^{-15}	1.20×10^{-15}	2.2×10^{15}
2	He	Helium	8.17×10^{-14}	1.67×10^{-15}	1.69×10^{-15}	1.90×10^{-15}	2.2×10^{15}
3	Li	Lithium	1.08×10^{-13}	2.44×10^{-15}	1.97×10^{-15}	2.29×10^{-15}	2.2×10^{15}
4	Be	Beryllium	1.23×10^{-13}	2.51×10^{-15}	2.11×10^{-15}	2.49×10^{-15}	2.2×10^{15}
5	B	Boron	1.34×10^{-13}	2.40×10^{-15}	2.21×10^{-15}	2.66×10^{-15}	2.2×10^{15}
6	C	Carbon	1.42×10^{-13}	2.47×10^{-15}	2.25×10^{-15}	2.74×10^{-15}	2.2×10^{15}
7	N	Nitrogen	1.53×10^{-13}	2.55×10^{-15}	2.35×10^{-15}	2.89×10^{-15}	2.2×10^{15}
8	O	Oxygen	1.63×10^{-13}	2.69×10^{-15}	2.43×10^{-15}	3.02×10^{-15}	2.2×10^{15}
9	F	Fluorine	1.78×10^{-13}	2.89×10^{-15}	2.52×10^{-15}	3.20×10^{-15}	2.2×10^{15}
10	Ne	Neon	1.84×10^{-13}	3.00×10^{-15}	2.58×10^{-15}	3.25×10^{-15}	2.2×10^{15}
11	Na	Sodium	1.96×10^{-13}	2.99×10^{-15}	2.65×10^{-15}	3.41×10^{-15}	2.2×10^{15}
12	Mg	Magnesium	2.01×10^{-13}	3.02×10^{-15}	2.69×10^{-15}	3.46×10^{-15}	2.2×10^{15}
13	Al	Aluminum	2.12×10^{-13}	3.06×10^{-15}	2.75×10^{-15}	3.59×10^{-15}	2.2×10^{15}
14	Si	Silicon	2.16×10^{-13}	3.12×10^{-15}	2.79×10^{-15}	3.64×10^{-15}	2.2×10^{15}
15	P	Phosphorus	2.28×10^{-13}	3.18×10^{-15}	2.87×10^{-15}	3.76×10^{-15}	2.2×10^{15}
16	S	Sulfur	2.31×10^{-13}	3.26×10^{-15}	2.90×10^{-15}	3.81×10^{-15}	2.2×10^{15}
17	Cl	Clorine	2.43×10^{-13}	3.36×10^{-15}	2.95×10^{-15}	3.92×10^{-15}	2.2×10^{15}
18	Ar	Argon	2.58×10^{-13}	3.42×10^{-15}	3.04×10^{-15}	4.10×10^{-15}	2.2×10^{15}
19	K	Potassium	2.55×10^{-13}	3.43×10^{-15}	3.02×10^{-15}	4.06×10^{-15}	2.2×10^{15}
20	Ca	Calcium	2.58×10^{-13}	3.47×10^{-15}	3.04×10^{-15}	4.10×10^{-15}	2.2×10^{15}
21	Sc	Scandium	2.74×10^{-13}	3.54×10^{-15}	3.13×10^{-15}	4.26×10^{-15}	2.2×10^{15}
22	Ti	Titanium	2.83×10^{-13}	3.59×10^{-15}	3.21×10^{-15}	4.36×10^{-15}	2.2×10^{15}
23	V	Vanadium	3.92×10^{-13}	3.60×10^{-15}	3.25×10^{-15}	4.45×10^{-15}	2.2×10^{15}
24	Cr	Chromium	2.95×10^{-13}	3.64×10^{-15}	3.28×10^{-15}	4.48×10^{-15}	2.2×10^{15}
25	Mn	Manganese	3.03×10^{-13}	3.03×10^{-15}	3.30×10^{-15}	4.56×10^{-15}	2.2×10^{15}

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26	Fe	Iron	3.06×10^{-13}	3.73×10^{-15}	3.33×10^{-15}	4.59×10^{-15}	2.2×10^{15}
27	Co	Cobalt	3.14×10^{-13}	3.78×10^{-15}	3.38×10^{-15}	4.67×10^{-15}	2.2×10^{15}
28	Ni	Nickel	3.13×10^{-13}	3.77×10^{-15}	3.37×10^{-15}	4.66×10^{-15}	2.2×10^{15}
29	Cu	Copper	3.17×10^{-13}	3.88×10^{-15}	3.42×10^{-15}	4.79×10^{-15}	2.2×10^{15}
30	Zn	Zinc	3.32×10^{-13}	3.92×10^{-15}	3.45×10^{-15}	4.84×10^{-15}	2.2×10^{15}
31	Ga	Gallium	3.42×10^{-13}	3.99×10^{-15}	3.50×10^{-15}	4.94×10^{-15}	2.2×10^{15}
32	Ge	Germanium	3.47×10^{-13}	4.06×10^{-15}	3.54×10^{-15}	5.01×10^{-15}	2.2×10^{15}
33	As	Arsenic	3.54×10^{-13}	4.09×10^{-15}	3.56×10^{-15}	5.06×10^{-15}	2.2×10^{15}
34	Se	Selenium	3.63×10^{-13}	4.14×10^{-15}	3.61×10^{-15}	5.14×10^{-15}	2.2×10^{15}
35	Br	Bromine	3.66×10^{-13}	4.15×10^{-15}	3.63×10^{-15}	5.17×10^{-15}	2.2×10^{15}
36	Kr	Krypton	3.75×10^{-13}	4.18×10^{-15}	3.67×10^{-15}	5.25×10^{-15}	2.2×10^{15}
37	Rb	Rubidium	3.79×10^{-13}	4.20×10^{-15}	3.71×10^{-15}	5.29×10^{-15}	2.2×10^{15}
38	Sr	Strontium	3.83×10^{-13}	4.22×10^{-15}	3.73×10^{-15}	5.33×10^{-15}	2.2×10^{15}
39	Y	Yttrium	3.86×10^{-13}	4.24×10^{-15}	3.75×10^{-15}	5.35×10^{-15}	2.2×10^{15}
40	Zr	Zirconium	3.92×10^{-13}	4.30×10^{-15}	3.77×10^{-15}	5.41×10^{-15}	2.2×10^{15}
41	Nb	Niobium	3.94×10^{-13}	4.32×10^{-15}	3.78×10^{-15}	5.43×10^{-15}	2.2×10^{15}
42	Mo	Molybdenum	4.00×10^{-13}	4.38×10^{-15}	3.81×10^{-15}	5.49×10^{-15}	2.2×10^{15}
43	Tc	Technetium	4.02×10^{-13}		3.82×10^{-15}	5.51×10^{-15}	2.2×10^{15}
44	Ru	Ruthenium	4.11×10^{-13}	4.46×10^{-15}	3.90×10^{-15}	5.58×10^{-15}	2.2×10^{15}
45	Rh	Rhodium	4.15×10^{-13}	3.49×10^{-15}	3.91×10^{-15}	5.62×10^{-15}	2.2×10^{15}
46	Pd	Palladium	4.23×10^{-13}	4.53×10^{-15}	3.94×10^{-15}	5.68×10^{-15}	2.2×10^{15}
47	Ag	Silver	4.25×10^{-13}	4.54×10^{-15}	3.95×10^{-15}	5.71×10^{-15}	2.2×10^{15}
48	Cd	Cadmium	4.34×10^{-13}	4.60×10^{-15}	3.98×10^{-15}	5.78×10^{-15}	2.2×10^{15}
49	In	Indium	4.38×10^{-13}	4.61×10^{-15}	4.02×10^{-15}	5.83×10^{-15}	2.2×10^{15}
50	Sn	Tin	4.46×10^{-13}	4.64×10^{-15}	4.03×10^{-15}	5.90×10^{-15}	2.2×10^{15}
51	An	Antimony	4.51×10^{-13}	4.68×10^{-15}	4.05×10^{-15}	5.95×10^{-15}	2.2×10^{15}
52	Te	Tellurium	4.62×10^{-13}	4.73×10^{-15}	4.10×10^{-15}	6.04×10^{-15}	2.2×10^{15}

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53	I	Iodine	4.60×10^{-13}	4.75×10^{-15}	4.09×10^{-15}	6.03×10^{-15}	2.2×10^{15}
54	Xe	Xenon	4.70×10^{-13}	4.78×10^{-15}	4.13×10^{-15}	6.09×10^{-15}	2.2×10^{15}
55	Cs	Cesium	4.80×10^{-13}	4.80×10^{-15}	4.14×10^{-15}	6.12×10^{-15}	2.2×10^{15}
56	Ba	Barium	4.80×10^{-13}	4.83×10^{-15}	4.15×10^{-15}	6.18×10^{-15}	2.2×10^{15}
57	La	Lanthanum	4.81×10^{-13}	4.85×10^{-15}	4.17×10^{-15}	6.21×10^{-15}	2.2×10^{15}
58	Ce	Cerium	4.85×10^{-13}	4.87×10^{-15}	4.18×10^{-15}	6.23×10^{-15}	2.2×10^{15}
59	Pr	Praseodym-ium	4.86×10^{-13}	4.89×10^{-15}	4.18×10^{-15}	6.25×10^{-15}	2.2×10^{15}
60	Nd	Neodymium	4.92×10^{-13}	4.94×10^{-15}	4.19×10^{-15}	6.28×10^{-15}	2.2×10^{15}
61	Pm	Promethium	4.93×10^{-13}		4.19×10^{-15}	6.30×10^{-15}	2.2×10^{15}
62	Sm	Samarium	5.02×10^{-13}	5.05×10^{-15}	4.21×10^{-15}	6.38×10^{-15}	2.2×10^{15}
63	Eu	Europium	5.04×10^{-13}	5.10×10^{-15}	4.22×10^{-15}	6.40×10^{-15}	2.2×10^{15}
64	Gd	Gadolinium	5.12×10^{-13}	5.14×10^{-15}	4.26×10^{-15}	6.47×10^{-15}	2.2×10^{15}
65	Tb	Terbium	5.15×10^{-13}	5.06×10^{-15}	4.28×10^{-15}	6.50×10^{-15}	2.2×10^{15}
66	Dy	Dysprosium	5.22×10^{-13}	5.20×10^{-15}	4.32×10^{-15}	6.54×10^{-15}	2.2×10^{15}
67	Ho	Holmium	5.25×10^{-13}	5.20×10^{-15}	4.34×10^{-15}	6.58×10^{-15}	2.2×10^{15}
68	Er	Erbium	5.30×10^{-13}	5.26×10^{-15}	4.37×10^{-15}	6.61×10^{-15}	2.2×10^{15}
69	Tm	Thulium	5.31×10^{-13}	5.22×10^{-15}	4.38×10^{-15}	6.63×10^{-15}	2.2×10^{15}
70	Yb	Ytterbium	5.38×10^{-13}	5.30×10^{-15}	4.41×10^{-15}	6.68×10^{-15}	2.2×10^{15}
71	Lu	Lutetium	5.41×10^{-13}	5.37×10^{-15}	4.42×10^{-15}	6.71×10^{-15}	2.2×10^{15}
72	Hf	Hafnium	5.47×10^{-13}	5.34×10^{-15}	4.45×10^{-15}	6.75×10^{-15}	2.2×10^{15}
73	Ta	Tantalum	5.50×10^{-13}	5.35×10^{-15}	4.46×10^{-15}	6.78×10^{-15}	2.2×10^{15}
74	W	Tungsten	5.54×10^{-13}	5.36×10^{-15}	4.48×10^{-15}	6.82×10^{-15}	2.2×10^{15}
75	Re	Rhenium	5.59×10^{-13}	5.35×10^{-15}	4.51×10^{-15}	6.84×10^{-15}	2.2×10^{15}
76	Os	Osmium	5.63×10^{-13}	5.40×10^{-15}	4.53×10^{-15}	6.89×10^{-15}	2.2×10^{15}
77	Ir	Iridium	5.67×10^{-13}	5.39×10^{-15}	4.55×10^{-15}	6.92×10^{-15}	2.2×10^{15}
78	Pt	Platinum	5.71×10^{-13}	5.42×10^{-15}	4.57×10^{-15}	6.95×10^{-15}	2.2×10^{15}
79	Au	Gold	5.74×10^{-13}	5.43×10^{-15}	4.58×10^{-15}	6.98×10^{-15}	2.2×10^{15}
80	Hg	Mercury	5.79×10^{-13}	5.45×10^{-15}	4.60×10^{-15}	7.02×10^{-15}	2.2×10^{15}

81	Ti	Thallium	5.85×10^{-13}	5.47×10^{-15}	4.61×10^{-15}	7.07×10^{-15}	2.2×10^{15}
82	Pb	Lead	5.88×10^{-13}	5.49×10^{-15}	4.63×10^{-15}	7.09×10^{-15}	2.2×10^{15}
83	Bi	Bismuth	5.91×10^{-13}	5.52×10^{-15}	4.65×10^{-15}	7.12×10^{-15}	2.2×10^{15}
84	Po	Polonium	5.91×10^{-13}	5.55×10^{-15}	4.65×10^{-15}	7.12×10^{-15}	2.2×10^{15}
85	At	Astatine	5.92×10^{-13}		4.66×10^{-15}	7.13×10^{-15}	2.2×10^{15}
86	Rd	Radon	6.09×10^{-13}	5.69×10^{-15}	4.69×10^{-15}	7.26×10^{-15}	2.2×10^{15}
87	Fr	Francium	6.10×10^{-13}	5.69×10^{-15}	4.69×10^{-15}	7.28×10^{-15}	2.2×10^{15}
88	Ra	Radium	6.14×10^{-13}	5.72×10^{-15}	4.71×10^{-15}	7.31×10^{-15}	2.2×10^{15}
89	Ac	Actinium	6.16×10^{-13}		4.72×10^{-15}	7.32×10^{-15}	2.2×10^{15}
90	Th	Thorium	6.22×10^{-13}	5.78×10^{-15}	4.75×10^{-15}	7.37×10^{-15}	2.2×10^{15}
91	Pa	Protactinium	6.21×10^{-13}		4.74×10^{-15}	7.36×10^{-15}	2.2×10^{15}
92	U	Uranium	6.30×10^{-13}	5.85×10^{-15}	4.78×10^{-15}	7.43×10^{-15}	2.2×10^{15}
93	Np	Neptunium	6.29×10^{-13}		4.77×10^{-15}	7.42×10^{-15}	2.2×10^{15}
94	Pl	Plutonium	6.38×10^{-13}	5.89×10^{-15}	4.82×10^{-15}	7.49×10^{-15}	2.2×10^{15}
95	Am	Americium	6.37×10^{-13}	5.90×10^{-15}	4.81×10^{-15}	7.48×10^{-15}	2.2×10^{15}
96	Cm	Curium	6.42×10^{-13}	5.85×10^{-15}	4.83×10^{-15}	7.53×10^{-15}	2.2×10^{15}
97	Bk	Berkelium	6.42×10^{-13}		4.83×10^{-15}	7.53×10^{-15}	2.2×10^{15}
98	Cf	Californium	6.47×10^{-13}		4.85×10^{-15}	7.56×10^{-15}	2.2×10^{15}
99	Es	Einsteinium	6.48×10^{-13}		4.86×10^{-15}	7.58×10^{-15}	2.2×10^{15}
100	Fm	Fermium	6.55×10^{-13}		4.89×10^{-15}	7.62×10^{-15}	2.2×10^{15}
101	Md	Mendelevium	6.56×10^{-13}		4.90×10^{-15}	7.63×10^{-15}	2.2×10^{15}
102	No	Nobelium	6.57×10^{-13}		4.91×10^{-15}	7.64×10^{-15}	2.2×10^{15}
103	Lr	Lawrencium	6.66×10^{-13}		4.93×10^{-15}	7.71×10^{-15}	2.2×10^{15}
104	Rf	Rutherford-ium	6.67×10^{-13}		4.94×10^{-15}	7.72×10^{-15}	2.2×10^{15}
105	Db	Dubnium	6.68×10^{-13}		4.95×10^{-15}	7.73×10^{-15}	2.2×10^{15}
106	Sg	Seaborgium	6.69×10^{-13}		4.96×10^{-15}	7.74×10^{-15}	2.2×10^{15}
107	Bh	Bohrium	6.70×10^{-13}		4.97×10^{-15}	7.75×10^{-15}	2.2×10^{15}
108	Hs	Hassium	6.69×10^{-13}		4.97×10^{-15}	7.74×10^{-15}	2.2×10^{15}

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109	Mt	Meitnerium	6.80×10^{-13}		4.98×10^{-15}	7.82×10^{-15}	2.2×10^{15}
110	Ds	Darmstad-tium	6.86×10^{-13}		5.00×10^{-15}	7.86×10^{-15}	2.2×10^{15}
111	Rg	Roentgenium	6.86×10^{-13}		5.00×10^{-15}	7.86×10^{-15}	2.2×10^{15}
112	Cn	Copernicium	6.91×10^{-13}		5.02×10^{-15}	7.90×10^{-15}	2.2×10^{15}
113	Nh	Nihonium	6.91×10^{-13}		5.02×10^{-15}	7.90×10^{-15}	2.2×10^{15}
114	Fi	Flerovium	6.96×10^{-13}		5.03×10^{-15}	7.94×10^{-15}	2.2×10^{15}
115	Mc	Moscovium	6.96×10^{-13}		5.03×10^{-15}	7.94×10^{-15}	2.2×10^{15}
116	Lv	Livermorium	6.99×10^{-13}		5.04×10^{-15}	7.97×10^{-15}	2.2×10^{15}
117	Ts	Tennessine	7.00×10^{-13}		5.04×10^{-15}	7.98×10^{-15}	2.2×10^{15}
118	Og	Oganesson	7.02×10^{-13}		5.04×10^{-15}	7.99×10^{-15}	2.2×10^{15}

According to [18] the experimentally determined nuclear radii contain only the first 96 nuclei in the periodic table. Table (1) demonstrates that the calculated nuclear radii by our new equation (5) is in good agreement for all nuclei with experimentally determined values, but the calculated nuclear radii by using equation (1) are in good agreement with experimentally determined nuclear radii only for the first 17 nuclei and deviated for the remaining nuclei as an example, our calculated radius value of atomic number 26 (Iron) is 3.33×10^{-15} m, and experimentally determined value is 3.73×10^{-15} m, while the calculated value by using equation (1) is 4.59×10^{-15} m.

It is noticed that all atomic nuclei have the same value (2.2×10^{15}). This means and indicate that all atomic nuclei have the same constant value relating the square root of mass and area.

Strong Nuclear Force

The strong nuclear force is formed as a result of existing specific particles (protons & neutrons) at specific distance and this force leading to two motions of nucleons (spin & orbital) with certain velocities comparable to the velocity of light, so the strong nuclear force can be expressed and calculated by the main physical parameters responsible for its formation (mass of nucleons & distance between them & velocity of light) by the following equation as the electromagnetic force [14].

$$F=\frac{4c^2\times m}{d} \qquad (6)$$

$$F=\frac{4c^2\times(m_1+m_2)}{d} \qquad (7)$$

from equation (7)

$$\frac{F\times d}{4\times(m_1+m_2)}=c^2 \qquad (8)$$

This means that the three main physical parameters (strong nuclear force, distance, mass) for any two particles equals square of velocity of light.

Where m is the sum of two particles, m_1 is the mass of the first particle and m_2 is the mass of the second particle, c is the velocity of light, d is the distance between particles.

Calculating strong nuclear force

By using equation (7) for two nucleons with their known determined values:

- proton mass = 1.7×10^{-27} kg,

- distance between proton and proton $\sim 10^{-15}$ m

- c is the velocity of light $\sim 3\times10^{8}$ m/s

it is found that the value of strong nuclear force is approximately 1.2×10^{6} N and by using equation (8)

$$\frac{F\times d}{4\times(m_1+m_2)}=9\times10^{16}=c^2 \text{ (square of velocity of light)}$$

According to the above calculations and results by increasing

 How to cite this article: MR Sanad. New Equations of Atomic Nuclei. JOJ Material Sci. 2025; 9(5): 555775. DOI: 10.19080/JOJMS.2025.09.555775

the number of particles for heavy nuclei, the strong nuclear force is linearly additive as binding energy and the result of three physical parameters (force & distance & mass) in equation (8) for any nucleus gives constant value square of velocity of light.

Acknowledgement

"The author would like to express his sincere appreciation and deepest gratitude to all the staff of the Juniper online Journal Material Science whose contribution and support have greatly enhanced the quality, accuracy and publication of this research"

Conclusion

The uniform distribution of nucleons (protons & neutrons) inside nucleus with certain masses and certain area in each nucleus leads to the existence of a common constant for all nuclei.

The square root of mass and the area of any nucleus give a constant value in calculations and results in nuclei radii in good agreement with known experimental determined values. The new equation of nuclei with new nuclei constant is used to calculate previously undetermined experimental nuclei radii.

The strong nuclear force is produced as a result of existing nucleons at certain distance in the range of femtohm meter and the main role of strong nuclear force is to form and bound the nucleus and can be calculated with physical parameters (masses of any two nucleons, distance between them and the velocity of light).

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DOI: 10.19080/JOJMS.2025.09.555775