Computing Unified Atomic Mass Unit and Avogadro Number with Various Nuclear Binding Energy Formulae Coded in Python

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Posted Date: 27 August 2024

doi: 10.20944/preprints202408.1881.v1

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Article

Computing Unified Atomic Mass Unit and Avogadro Number with Various Nuclear Binding Energy Formulae Coded in Python

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Abstract: In this paper, we make an attempt to estimate the famous Avogadro number with programming logics written in Python associated with advanced nuclear binding energy formulae. Average rest mass of nucleon, nuclear binding energy per nucleon and electron rest mass seem to play a vital role in estimating the unified atomic mass unit and Avogadro number. Interesting point to be noted is that, Avogadro number seems to be the inverse of the Unified atomic mass unit. With further study, it seems possible to estimate the unified atomic mass unit and Avogadro number accurately. Our interesting observation is that, short range strong nuclear force seems to have a vital role in deciding the accuracy of Avogadro number. For that purpose one may consider AI techniques along with newly observed atomic nuclides and their nuclear binding energies. For Z=6 to 118 and A_{low}=2Z and A_{upper}=3.5Z, estimated average value of Avogadro number is $N_{Average} \cong 6.01938\times10^{26}$. Considering the saturation of nuclear binding energy, at Z=26, $N_{Z=26} \cong 6.02229$ to 6.02285×10^{26}. At academic level, our proposal can be given a chance as a case study. It is planned to develop a web application for this purpose.

Keywords: protons; neutrons; electrons; nuclear binding energy; various mass formulae; strong and electroweak mass formula; unified atomic mass unit; Avogadro number; mole

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1. Introduction

Avogadro number and Unified atomic mass unit [1–6] play a vital role in every day various branches of physics and chemistry. Scientists are seriously working on estimating them with various methods with advanced engineering techniques. Recently, authors [7–15] have developed a very simple method for estimating the unified atomic mass and Avogadro number by means of nuclear binding energy and mean binding energy per nucleons. In this paper, by considering Python programming language, authors are working on developing simple code for estimating the unified atomic mass unit and Avogadro number with various possible nuclear data inputs like selected proton numbers, their selected lower and upper mass numbers and different nuclear mass formulae. This proposal can be considered as a case study at academic level. It needs a vigorous research at fundamental level.

2. Key Physical Logic for Understanding the Unified Atomic Mass Unit

It seems to be a 4 step procedure. First step is to consider the average of neutron and proton rest energies. It can be called as 'Average nucleon rest energy (ANRE)'. Second step is to estimate the average of nuclear binding energy per nucleon associated with various atomic nuclides starting from Z=2 to 118 and A_{low}=2Z and A_{up}=3.5Z. It can be called as 'average binding energy per nucleon (ABEPN)'. Third step is to deduct the estimated average binding energy per nucleon from the average

 doi:10.20944/preprints202408.1881.v1

rest energy of neutron and proton. It can be called as 'Average nuclear energy unit (ANEU)'. Fourth step is to add the electron rest energy (ERE) to the average nuclear energy unit. It can be called as the 'unified atomic energy unit (UAEU)'. Dividing the unified atomic energy unit by squared speed of light, one can get the 'unified atomic mass unit (UAMU)'. In a very simplified approach,

$$\left.\begin{aligned} UAEU &\cong \left(\frac{m_n c^2 + m_p c^2}{2}\right) - \langle ABEPN \rangle + \left(m_e c^2\right) \\ UAMU &\cong \left(\frac{m_n + m_p}{2}\right) - \left\langle \frac{ABEPN}{c^2} \right\rangle + \left(m_e\right) \end{aligned}\right\} \qquad (1)$$

where m_n, m_p and m_e represent neutron, proton and electron rest masses respectively.

3. Key Physical Logic for Understanding the Avogadro Number

It is a one step procedure. Inverse of the unified atomic mass unit can be called the Avogadro number. If unified atomic mass is expressed in grams, Avogadro number can be represented in 'no. of atoms per gram'. If unified atomic mass is expressed in kg, Avogadro number can be represented in 'no. of atoms per kg'. It may be noted that, 'no. of atoms per gram' can be called as 'gram mole' and 'no. of atoms per kg' can be called as 'kg mole'. We would like to emphasize the point that Avogadro number is not a pure number and it is having dimensions.

$$N_A \cong \left(\frac{1}{UAMU}\right) \frac{\text{No. of atoms}}{\text{kg}} \text{ or } \frac{\text{No. of atoms}}{\text{gram}} \qquad (2)$$

4. Reference Nuclear Binding Energy Formula

In nuclear physics, at present one can find different semi empirical mass formulae (SEMF) with different energy coefficients with different accuracies [16–20].

Let, Z = Proton number, N = Neutron number, A=Mass number or nucleon number

One of the advanced formula is [20],

$$\left.\begin{aligned} BE \cong & \left\{\left[1 + \left(\frac{4k_v}{A^2}\right)|T_z|\left(|T_z|+1\right)\right] a_v * A\right\} + \left\{\left[1 + \left(\frac{4k_s}{A^2}\right)|T_z|\left(|T_z|+1\right)\right] a_s * A^{\frac{2}{3}}\right\} \\ & + \left\{a_c * \left(\frac{Z^2}{A^{1/3}}\right)\right\} + \left\{f_p * \frac{Z^2}{A}\right\} + E_p \end{aligned}\right\} \qquad (3)$$

where, $T_z \cong$ 3rd component of isospin $= \frac{1}{2}(Z - N)$

$$\left\{\begin{aligned} & a_v = -15.4963 \text{ MeV},\ a_s = 17.7937 \text{ MeV} \\ & k_v = -1.8232; k_s = -2.2593 \\ & a_c = 0.7093 \text{ MeV} \\ & f_p = -1.2739 \text{ MeV} \\ & d_n = 4.6919 \text{ MeV}, d_p = 4.7230 \text{ MeV} \\ & d_{np} = -6.4920 \text{ MeV} \end{aligned}\right\} \text{ and } \left\{\begin{aligned} & \text{for } (Z,\ N) \text{ Odd},\ E_p \cong \frac{d_n}{N^{1/3}} + \frac{d_p}{Z^{1/3}} + \frac{d_{np}}{A^{2/3}} \\ & \text{for } (\text{Odd } Z,\ \text{Even } N),\ E_p \cong \frac{d_p}{Z^{1/3}} \\ & \text{for } (\text{Even } Z,\ \text{Odd } N),\ E_p \cong \frac{d_n}{N^{1/3}} \\ & \text{for } (\text{Even } Z,\ \text{Even } N),\ E_p \cong 0 \end{aligned}\right\}$$

Based on relation (3), as explained in section -2, we have presented the data in Table 1 for each atomic number with 2Z and 3.5Z as lower and upper mass numbers respectively.

 doi:10.20944/preprints202408.1881.v1

5. Strong and Electroweak Mass Formula

According to the authors [7–12], Strong and Electroweak Mass Formula (SEWMF) constitutes 4 simple terms and only one energy coefficient of magnitude 10.1 MeV. First term is a volume term, second term seems to be a representation of free nucleons associated with electroweak interaction, third term is a radial term and fourth one is an asymmetry term about the mean stable mass number. It can be expressed as,

$$BE \cong \left\{A - A_{free} - A_{rad} - A_{asy}\right\} 10.1 \text{ MeV} \qquad (4)$$

$A_{free} \cong$ No. of free nucleons associated with Electroweak interaction.

where, $$\cong \left(\frac{1}{2}\right) + 0.0016\left[\left(Z^2 + N^2 + \left(\frac{Z^2}{N}\right)^2\right) - N^2\left(\frac{N-Z}{N+Z}\right)^2\right]$$

$A_{rad} \cong$ Radial term $\cong A^{1/3}$

$A_{asy} \cong$ Asymmetey about the mean stable mass number $\cong \dfrac{\left(A_s - A\right)^2}{A_s}$

$A_s \cong$ Light house like stable mass number

$$\cong \left[\text{RoundOff}\left\{\left(Z + 2.9464\right)^{1.2} - 1.7165\right\} + \left[0,1\right]\right] \qquad (5)$$

where,

1) If Z is even and obtained A_s is odd, then, $A_s \cong A_s + 1$.
2) If Z is even and obtained A_s is even, then, $A_s \cong A_s$.
3) If Z is odd and obtained A_s is odd, then, $A_s \cong A_s$.
4) If Z is odd and obtained A_s is even, then, $A_s \cong A_s + 1$.

Using this relation (5), super heavy atomic nuclides can be estimated very easily [21–25]. Based on relations (4) and (5), as explained in section-2, we have presented the data in Table. 1 for each atomic number with 2Z and 3.5Z as lower (AL) and upper mass numbers (AU) respectively.

6. Comparative Results and Discussion

Based on the above two formulae, Navya Sree and Divya Sree, daughters of author Seshavatharam are working on developing a simple web application. It takes the beginning and ending proton numbers and their corresponding lower and upper mass numbers. Following a background written python program, it estimates the Unified atomic mass unit and Avogadro number. With further study and considering the available binding energy formulae, above procedures can be repeated for each atomic number and its isotopes. By considering observed stable and unstable atomic nuclides and their experimental binding energies as default inputs and considering AI techniques [26–28], various energy coefficients of the available Semi Empirical Mass Formulae (SEMF) can be refined further and thus accuracy of Unified atomic mass unit and Avogadro number can be improved. One very important point to be noted is that, Avogadro number seems to be the inverse of the unified atomic mass unit. This proposal seems to play a crucial role in defining the fundamental units and building blocks of physics and chemistry in a unified approach. 'Gram mole' and 'kg mole' concepts can be understood without any ambiguity. Difficulties involved in this procedure are:

1) At present there is no clear physics for understanding unstable lower and higher mass numbers associated with any proton number. Scientists are working in terms of proton drip lines and neutron drip lines [29–31].
2) Life time of super heavy proton numbers greater than 99 and mass numbers greater than 300 is too small to understand and estimate their ground state binding energies.

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We appeal the scientists to look into these issues for better understanding and best possible accuracy. See the following Table. 1 for the reference formula and see Table 2 for the Strong and Electroweak Mass Formula. In the Silicon-28 experiment [4], formula for estimating the Avogadro number is,

$$N_A \cong \frac{\text{Molar volume of Si-28}}{\text{Volume of unit cell}/8} \cong \frac{8\times\text{Molar mass of Si-28}}{\text{Density of Si-28}\ \times\text{Volume of unit cell}} \qquad (6)$$

where No. of Si atoms in unit cell=8

It may be noted that, considering Silicon-28, recommended value of Avogadro number is 6.022140588×10^{23} mol^{-1}. Following our procedure and by considering so many atomic nuclides and their binding energies, it seems possible to understand and estimate the Average Avogadro number with a marginal error. Interested research scholars can work in this direction. Using AI techniques, accuracy can be improved further. Our approach is completely different from Si-28 experiential concepts. See the following two figures obtained from relation (3). From these two figures, it is very clear that, at Z=26 to 28, as they seem to have high binding energy per nucleon, estimated Unified Atomic Energy Unit seems to be close to (931.37 to 931.5) MeV and Avogadro number seems to be close to $(6.022 \text{ to } 6.023)\times10^{26}$. We would like to emphasize the point that,

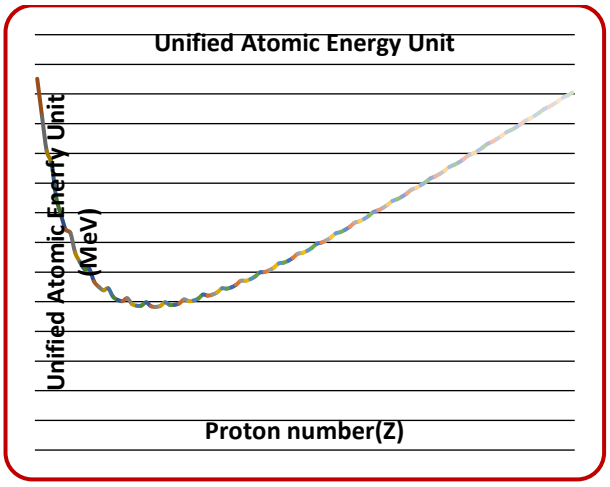

Fig.1: Estimated Unified Atomic Energy Unit [relation (3)]

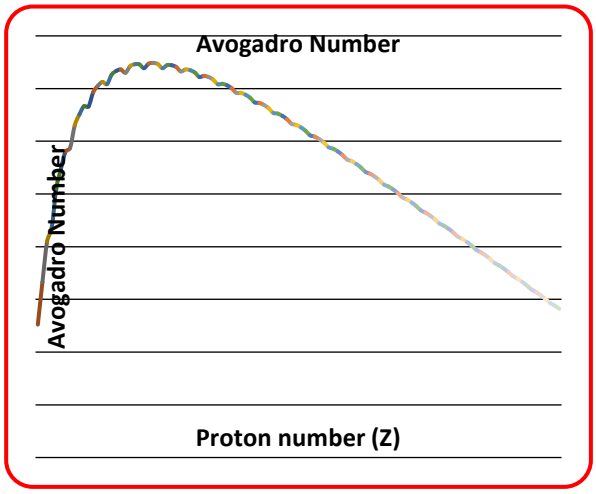

Fig. 2: Estimated Avogadro number [relation (3)]

Avogadro number is having inherent connection with saturation of nuclear binding energy. In addition to that, there is a chance to consider Avogadro number as a variable within a short range, $N_{range} \approx (6.012 \text{ to } 6.023)\times10^{26}$. Clearly speaking, short range strong nuclear force seems to have a vital role in deciding the accuracy of Avogadro number. We are working in this direction. Following relations (3) and (5), for Z=5 to 118 and A_{low}=2Z and A_{upper}=3.5Z, estimated average value of Avogadro number is $N_{Average} \cong 6.01938\times10^{26}$.

Proceeding further, currently believed "mole" can be called as 'gram mole' and its corresponding SI unit can be called as 'kg mole'. In CGS system of units, 'Number of atoms per gram' can be called as 'per gram mole' and in SI system of units, 'Number of atoms per kg' can be called as 'per kg mole'. In this way, 'mole' concept can be understood clearly. Considering system of units, currently believed 'molar mass' can be called as 'gram molar mass' and 'kg molar mass'. In CGS units, 'gram molar mass' of any substance can be assumed to have $\approx 6.022\times10^{23}$ atoms and in SI units, 'kg molar mass' of any substance can be assumed to have $\approx 6.022\times10^{26}$ atoms. Thinking in this way and by considering proton drip lines and neutron drip lines and by fixing the lower and

 doi:10.20944/preprints202408.1881.v1

upper mass numbers of Z=2 to 118, Avogadro number can be estimated with a better understanding and best accuracy

Table 1. Nuclear binding energy based estimation of unified atomic mass unit and Avogadro number.

Z	AL	AU	As	Relation (5)				Relation (3)			
				ABEPN (MeV)	UAEU (MeV)	UAMU (kg)	N_A No. of atoms/kg	ABEPN (MeV)	UAEU (MeV)	UAMU (kg)	N_A No. of atoms/kg
6	12	21	12	6.779	932.651	1.66260E-27	6.01467E+26	6.527	932.903	1.66305E-27	6.01304E+26
7	14	24	15	7.411	932.019	1.66147E-27	6.01875E+26	6.777	932.653	1.66260E-27	6.01466E+26
8	16	28	16	7.097	932.333	1.66203E-27	6.01672E+26	7.014	932.416	1.66218E-27	6.01619E+26
9	18	32	19	7.454	931.975	1.66140E-27	6.01903E+26	7.095	932.335	1.66204E-27	6.01671E+26
10	20	35	20	7.283	932.147	1.66170E-27	6.01792E+26	7.326	932.104	1.66163E-27	6.01820E+26
11	22	38	23	7.656	931.774	1.66104E-27	6.02033E+26	7.442	931.988	1.66142E-27	6.01895E+26
12	24	42	24	7.398	932.032	1.66150E-27	6.01867E+26	7.544	931.886	1.66124E-27	6.01961E+26
13	26	46	27	7.619	931.811	1.66110E-27	6.02009E+26	7.566	931.864	1.66120E-27	6.01975E+26
14	28	49	28	7.471	931.959	1.66137E-27	6.01914E+26	7.698	931.732	1.66096E-27	6.02060E+26
15	30	52	31	7.732	931.698	1.66090E-27	6.02082E+26	7.762	931.668	1.66085E-27	6.02101E+26
16	32	56	32	7.517	931.913	1.66129E-27	6.01944E+26	7.811	931.619	1.66076E-27	6.02133E+26
17	34	60	35	7.672	931.758	1.66101E-27	6.02044E+26	7.809	931.621	1.66076E-27	6.02132E+26
18	36	63	38	7.856	931.574	1.66068E-27	6.02162E+26	7.893	931.537	1.66062E-27	6.02186E+26
19	38	66	39	7.742	931.688	1.66088E-27	6.02089E+26	7.930	931.500	1.66055E-27	6.02210E+26
20	40	70	42	7.842	931.588	1.66071E-27	6.02153E+26	7.953	931.477	1.66051E-27	6.02225E+26
21	42	74	43	7.675	931.755	1.66100E-27	6.02045E+26	7.940	931.490	1.66053E-27	6.02217E+26

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22	44	77	46	7.822	931.608	1.66074E-27	6.02141E+26	7.996	931.434	1.66043E-27	6.02253E+26
23	46	80	49	7.942	931.488	1.66053E-27	6.02218E+26	8.018	931.412	1.66039E-27	6.02267E+26
24	48	84	50	7.798	931.632	1.66078E-27	6.02125E+26	8.026	931.404	1.66038E-27	6.02272E+26
25	50	88	53	7.863	931.567	1.66067E-27	6.02167E+26	8.007	931.423	1.66041E-27	6.02260E+26
26	52	91	56	7.958	931.472	1.66050E-27	6.02229E+26	8.045	931.385	1.66034E-27	6.02285E+26
27	54	94	57	7.873	931.557	1.66065E-27	6.02173E+26	8.057	931.373	1.66032E-27	6.02292E+26
28	56	98	60	7.918	931.512	1.66057E-27	6.02203E+26	8.056	931.374	1.66032E-27	6.02292E+26
29	58	102	63	7.956	931.474	1.66050E-27	6.02227E+26	8.034	931.396	1.66036E-27	6.02277E+26
30	60	105	66	8.020	931.410	1.66039E-27	6.02269E+26	8.060	931.370	1.66032E-27	6.02294E+26
31	62	108	67	7.946	931.484	1.66052E-27	6.02221E+26	8.065	931.365	1.66031E-27	6.02297E+26
32	64	112	70	7.972	931.458	1.66047E-27	6.02238E+26	8.058	931.372	1.66032E-27	6.02293E+26
33	66	116	73	7.993	931.437	1.66044E-27	6.02251E+26	8.034	931.396	1.66036E-27	6.02277E+26
34	68	119	74	7.924	931.506	1.66056E-27	6.02207E+26	8.051	931.379	1.66033E-27	6.02289E+26
35	70	122	77	7.973	931.457	1.66047E-27	6.02238E+26	8.051	931.379	1.66033E-27	6.02289E+26
36	72	126	80	7.986	931.444	1.66045E-27	6.02247E+26	8.041	931.389	1.66035E-27	6.02282E+26
37	74	130	83	7.996	931.434	1.66043E-27	6.02253E+26	8.015	931.415	1.66040E-27	6.02265E+26
38	76	133	84	7.935	931.495	1.66054E-27	6.02213E+26	8.026	931.404	1.66038E-27	6.02272E+26
39	78	136	87	7.969	931.461	1.66048E-27	6.02236E+26	8.022	931.408	1.66039E-27	6.02270E+26
40	80	140	90	7.975	931.455	1.66047E-27	6.02239E+26	8.009	931.421	1.66041E-27	6.02261E+26
41	82	144	93	7.977	931.453	1.66047E-27	6.02241E+26	7.982	931.448	1.66046E-27	6.02244E+26

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42	84	147	94	7.921	931.509	1.66057E-27	6.02204E+26	7.989	931.441	1.66044E-27	6.02248E+26
43	86	150	97	7.945	931.485	1.66052E-27	6.02220E+26	7.982	931.448	1.66046E-27	6.02244E+26
44	88	154	100	7.945	931.485	1.66052E-27	6.02220E+26	7.966	931.463	1.66048E-27	6.02234E+26
45	90	158	103	7.942	931.488	1.66053E-27	6.02218E+26	7.940	931.490	1.66053E-27	6.02216E+26
46	92	161	106	7.957	931.472	1.66050E-27	6.02228E+26	7.942	931.488	1.66053E-27	6.02218E+26
47	94	164	107	7.907	931.523	1.66059E-27	6.02196E+26	7.933	931.497	1.66054E-27	6.02212E+26
48	96	168	110	7.902	931.528	1.66060E-27	6.02192E+26	7.916	931.514	1.66057E-27	6.02201E+26
49	98	172	113	7.895	931.535	1.66061E-27	6.02188E+26	7.889	931.541	1.66062E-27	6.02184E+26
50	100	175	116	7.906	931.524	1.66059E-27	6.02194E+26	7.889	931.541	1.66062E-27	6.02184E+26
51	102	178	119	7.913	931.517	1.66058E-27	6.02199E+26	7.878	931.552	1.66064E-27	6.02177E+26
52	104	182	122	7.902	931.528	1.66060E-27	6.02192E+26	7.860	931.570	1.66067E-27	6.02165E+26
53	106	186	123	7.840	931.590	1.66071E-27	6.02152E+26	7.833	931.597	1.66072E-27	6.02148E+26
54	108	189	126	7.846	931.584	1.66070E-27	6.02156E+26	7.830	931.600	1.66073E-27	6.02146E+26
55	110	192	129	7.850	931.580	1.66069E-27	6.02159E+26	7.818	931.612	1.66075E-27	6.02138E+26
56	112	196	132	7.837	931.593	1.66072E-27	6.02150E+26	7.799	931.631	1.66078E-27	6.02126E+26
57	114	200	135	7.823	931.607	1.66074E-27	6.02141E+26	7.772	931.658	1.66083E-27	6.02108E+26
58	116	203	138	7.823	931.607	1.66074E-27	6.02141E+26	7.767	931.663	1.66084E-27	6.02105E+26
59	118	206	141	7.821	931.609	1.66074E-27	6.02140E+26	7.754	931.676	1.66086E-27	6.02096E+26
60	120	210	142	7.767	931.663	1.66084E-27	6.02105E+26	7.734	931.696	1.66090E-27	6.02084E+26
61	122	214	145	7.751	931.679	1.66087E-27	6.02095E+26	7.707	931.723	1.66095E-27	6.02066E+26

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62	124	217	148	7.749	931.681	1.66087E-27	6.02093E+26	7.701	931.729	1.66096E-27	6.02062E+26
63	126	220	151	7.745	931.685	1.66088E-27	6.02091E+26	7.687	931.743	1.66098E-27	6.02053E+26
64	128	224	154	7.727	931.703	1.66091E-27	6.02079E+26	7.667	931.763	1.66102E-27	6.02040E+26
65	130	228	157	7.709	931.721	1.66094E-27	6.02068E+26	7.640	931.790	1.66107E-27	6.02023E+26
66	132	231	160	7.703	931.727	1.66095E-27	6.02063E+26	7.632	931.798	1.66108E-27	6.02018E+26
67	134	234	163	7.695	931.735	1.66097E-27	6.02059E+26	7.617	931.813	1.66111E-27	6.02008E+26
68	136	238	166	7.676	931.754	1.66100E-27	6.02046E+26	7.597	931.833	1.66114E-27	6.01995E+26
69	138	242	167	7.629	931.801	1.66109E-27	6.02016E+26	7.570	931.860	1.66119E-27	6.01978E+26
70	140	245	170	7.621	931.809	1.66110E-27	6.02011E+26	7.561	931.869	1.66121E-27	6.01972E+26
71	142	248	173	7.612	931.818	1.66112E-27	6.02005E+26	7.545	931.885	1.66124E-27	6.01962E+26
72	144	252	176	7.592	931.838	1.66115E-27	6.01992E+26	7.525	931.905	1.66127E-27	6.01948E+26
73	146	256	179	7.571	931.859	1.66119E-27	6.01979E+26	7.498	931.932	1.66132E-27	6.01931E+26
74	148	259	182	7.561	931.869	1.66121E-27	6.01972E+26	7.488	931.942	1.66134E-27	6.01925E+26
75	150	262	185	7.550	931.880	1.66123E-27	6.01965E+26	7.472	931.958	1.66137E-27	6.01914E+26
76	152	266	188	7.528	931.902	1.66127E-27	6.01951E+26	7.451	931.979	1.66140E-27	6.01901E+26
77	154	270	191	7.506	931.924	1.66130E-27	6.01937E+26	7.425	932.005	1.66145E-27	6.01884E+26
78	156	273	194	7.494	931.936	1.66133E-27	6.01929E+26	7.414	932.016	1.66147E-27	6.01877E+26
79	158	276	197	7.481	931.949	1.66135E-27	6.01920E+26	7.397	932.033	1.66150E-27	6.01866E+26
80	160	280	200	7.458	931.972	1.66139E-27	6.01906E+26	7.376	932.054	1.66154E-27	6.01853E+26
81	162	284	203	7.436	931.994	1.66143E-27	6.01891E+26	7.350	932.079	1.66158E-27	6.01836E+26

 doi:10.20944/preprints202408.1881.v1

82	164	287	206	7.422	932.008	1.66146E-27	6.01882E+26	7.339	932.091	1.66160E-27	6.01828E+26
83	166	290	209	7.407	932.023	1.66148E-27	6.01872E+26	7.322	932.108	1.66163E-27	6.01817E+26
84	168	294	212	7.384	932.046	1.66152E-27	6.01857E+26	7.301	932.129	1.66167E-27	6.01804E+26
85	170	298	215	7.360	932.070	1.66157E-27	6.01842E+26	7.275	932.155	1.66172E-27	6.01787E+26
86	172	301	218	7.345	932.085	1.66159E-27	6.01832E+26	7.263	932.167	1.66174E-27	6.01779E+26
87	174	304	219	7.316	932.114	1.66164E-27	6.01814E+26	7.245	932.185	1.66177E-27	6.01768E+26
88	176	308	222	7.293	932.137	1.66169E-27	6.01798E+26	7.224	932.206	1.66181E-27	6.01754E+26
89	178	312	225	7.269	932.161	1.66173E-27	6.01783E+26	7.199	932.231	1.66185E-27	6.01738E+26
90	180	315	228	7.253	932.177	1.66176E-27	6.01773E+26	7.186	932.244	1.66188E-27	6.01730E+26
91	182	318	231	7.237	932.193	1.66179E-27	6.01763E+26	7.168	932.262	1.66191E-27	6.01718E+26
92	184	322	234	7.213	932.217	1.66183E-27	6.01747E+26	7.147	932.283	1.66195E-27	6.01705E+26
93	186	326	237	7.189	932.241	1.66187E-27	6.01731E+26	7.122	932.308	1.66199E-27	6.01688E+26
94	188	329	240	7.172	932.258	1.66190E-27	6.01721E+26	7.108	932.322	1.66201E-27	6.01680E+26
95	190	332	243	7.155	932.275	1.66193E-27	6.01710E+26	7.091	932.339	1.66205E-27	6.01668E+26
96	192	336	246	7.130	932.300	1.66198E-27	6.01694E+26	7.070	932.360	1.66208E-27	6.01655E+26
97	194	340	249	7.106	932.324	1.66202E-27	6.01678E+26	7.045	932.385	1.66213E-27	6.01638E+26
98	196	343	252	7.088	932.342	1.66205E-27	6.01667E+26	7.031	932.399	1.66215E-27	6.01629E+26
99	198	346	255	7.070	932.360	1.66208E-27	6.01655E+26	7.013	932.417	1.66218E-27	6.01618E+26
100	200	350	258	7.045	932.385	1.66213E-27	6.01639E+26	6.992	932.438	1.66222E-27	6.01604E+26
101	202	354	261	7.021	932.409	1.66217E-27	6.01623E+26	6.967	932.463	1.66227E-27	6.01588E+26

 doi:10.20944/preprints202408.1881.v1

102	204	357	264	7.002	932.428	1.66220E-27	6.01611E+26	6.953	932.477	1.66229E-27	6.01579E+26
103	206	360	269	6.990	932.440	1.66223E-27	6.01603E+26	6.934	932.496	1.66232E-27	6.01567E+26
104	208	364	272	6.965	932.465	1.66227E-27	6.01587E+26	6.913	932.517	1.66236E-27	6.01554E+26
105	210	368	275	6.939	932.491	1.66232E-27	6.01571E+26	6.889	932.541	1.66241E-27	6.01538E+26
106	212	371	278	6.920	932.510	1.66235E-27	6.01558E+26	6.874	932.556	1.66243E-27	6.01529E+26
107	214	374	281	6.901	932.529	1.66238E-27	6.01546E+26	6.856	932.574	1.66246E-27	6.01517E+26
108	216	378	284	6.875	932.555	1.66243E-27	6.01529E+26	6.835	932.595	1.66250E-27	6.01503E+26
109	218	382	287	6.850	932.580	1.66248E-27	6.01513E+26	6.811	932.619	1.66254E-27	6.01488E+26
110	220	385	290	6.830	932.600	1.66251E-27	6.01500E+26	6.796	932.634	1.66257E-27	6.01478E+26
111	222	388	293	6.810	932.620	1.66255E-27	6.01487E+26	6.777	932.653	1.66260E-27	6.01466E+26
112	224	392	296	6.784	932.646	1.66259E-27	6.01471E+26	6.756	932.674	1.66264E-27	6.01453E+26
113	226	396	299	6.759	932.671	1.66264E-27	6.01454E+26	6.732	932.698	1.66268E-27	6.01437E+26
114	228	399	302	6.739	932.691	1.66267E-27	6.01441E+26	6.717	932.713	1.66271E-27	6.01427E+26
115	230	402	305	6.718	932.712	1.66271E-27	6.01428E+26	6.698	932.731	1.66274E-27	6.01415E+26
116	232	406	308	6.692	932.738	1.66276E-27	6.01411E+26	6.678	932.752	1.66278E-27	6.01402E+26
117	234	410	311	6.667	932.763	1.66280E-27	6.01395E+26	6.654	932.776	1.66282E-27	6.01387E+26
118	236	413	314	6.646	932.784	1.66284E-27	6.01381E+26	6.638	932.791	1.66285E-27	6.01377E+26

7. Conclusions

Our proposed method of estimating unified atomic mass unit and Avogadro number seems to be quite different from existing methods and there is a possibility for increasing the accuracy with newly observed atomic nuclides and their binding energy per nucleons. Thus, by fitting them with the available semi empirical mass formulae, binding energy coefficients can be refined. Repeating this process with AI logics, further refinement can be achieved in all aspects. For the time being, our proposal can be given a chance at academic level.

 doi:10.20944/preprints202408.1881.v1

Acknowledgments: Authors are very much thankful to professors shri M. Nagaphani Sarma, Chairman, shri K.V. Krishna Murthy, founder Chairman, Institute of Scientific Research in Vedas (I-SERVE), Hyderabad, India and Shri K.V.R.S. Murthy, former scientist IICT (CSIR), Govt. of India, Director, Research and Development, I-SERVE, for their valuable guidance and great support in developing this subject.

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