# Recipe for calculating nuclear energy in modern physics

Sjaak Uitterdijk
SjaakenLutske@hetnet.nl

*Abstract – A few years ago about five nuclear physicists were asked for such a recipe. No one answered the question. But what is under increasing pressure will eventually burst open. A science historian recently informed me of this recipe. Closer examination of it shows that Einstein indeed ruined real physics by introducing his theories of relativity.*

## 1 Introduction

The following property of $E = mc^2$ is generally accepted, often even adored, by physicists:

> $E = mc^2$ is the equation meant to expresses that mass and energy are the same physical entity and can be changed into each other.

Einstein closes of his Special Theory of Relativity with the expression: $W = mc^2\{1/\sqrt{(1-v^2/c^2)} -1\}$, shown in reference [1] at page 22. The text prior to this formula reads:

> "If an electron moves from rest at the origin of co-ordinates of the system K along the axis of X under the action of an electrostatic force X, it is clear that the energy withdrawn from the electrostatic field has the value $W = \int \varepsilon X dx$"
> N.B. The same symbol X is used for mutual fundamentally different variables!

He refers as follows to this outcome in his book: RELATIVITY The Special and General Theory, reference [2], page 53:

> "In accordance with the theory of relativity the kinetic energy of a material point of mass *m* is no longer given by the well-known expression $½mv^2$, but by the expression $mc^2/\sqrt{(1-v^2/c^2)}$."

After having presented the series of this expression he continues with:

> "The first term $mc^2$ does not contain the velocity, and requires no consideration if we are dealing with the question as to how the energy of a point-mass depends on the velocity."

At page 55 is found:

> "A body moving with the velocity, which absorbs [1] an amount of energy $E_0$ in the form of radiation without suffering an alteration in velocity in the process, has, as a consequence, its energy increased by an amount $E_0/\sqrt{(1-v^2/c^2)}$."
> [1] "$E_0$ is the energy taken up, as judged from a co-ordinate system moving with the body."

At page 56 Einstein states:

> "Writing the expression for the energy in the form $(mc^2 +E_0)/\sqrt{(1-v^2/c^2)}$, we see that the term $mc^2$, which hitherto attracted our attention, is nothing else than the energy possessed by the body [1] before it absorbed the energy $E_0$."
> [1] Similar to [1] on page 55: "As judged from a co-ordinate system moving with the body."

In the context of the problem to be considered here, note [1] casts doubt on his theory in advance, because what would be the outcome if that judgement is *not* carried out "from a co-ordinate system moving with the body", as is usually the case in experiments?

Anyway, the final result is Einstein's statement that "a material point of mass *m* " has (intrinsically) an energy $E = mc^2$. When it gets moving with velocity v the kinetic energy $½mv^2$ has to be added to it. Einstein most likely didn't realize himself that $E = mc^2$ implies that, whatever (kind of) mass is chosen, its energy density E/m, in terms of J/kg, is $c^2$. A fully unrealistic high value, for any "material point of mass"!

## 2 The recipe

The easiest way to show and explain the recipe is to take an example. In this case a $^{235}_{92}$Uranium atom that is bombarded by 1 neutron and split as shown in reference [3]:

$$^{235}_{92}U + n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3n + 202.5\ MeV$$

The recipe is that the amu's of all elements in the left resp. right side of the displayed expression, are summed. The difference between these totals, called "mass defect", is used in $E = m_d c^2$ in order to calculate the released energy.

The amu's, found by separately searching for the amu of the element on Internet, are:

$^{235}$U: 235.0439 $^{141}$Ba: 140.9144 $^{92}$Kr: 91.9262 n: 1.0087

| | | | |
|---|---|---|---|
| Applied in the example: | total left side | | 235.044 amu |
| | total right side | 140.914 + 91.926 + (3-1) * 1.0087 = | 234.857 amu |
| | difference | | +0.187 amu |
| | difference in kg (1 amu = $1.66 \cdot 10^{-27}$ kg [4]): | | $3.1 \cdot 10^{-28}$ kg |
| | $E = m_d c^2$ | $2.79 \cdot 10^{-11}$ Joule = | 174 MeV |

The difference from 202.5 MeV is explained as follows in [3]:

| | |
|---|---|
| "Instantaneously released energy | |
| Kinetic energy of fission fragments | 169.1 |
| Kinetic energy of prompt neutrons * | 4.8 |
| Energy carried by prompt γ-rays | 7.0 |
| Energy from decaying fission products | |
| Energy of β− -particles | 6.5 |
| Energy of delayed γ-rays | 6.3 |
| Energy released when those prompt neutrons, which don't (re)produce fission, are captured | 8.8 |
| Total energy converted into heat in an operating thermal nuclear reactor | 202.5" |

The sum of the first 2 mentioned kinds of energy are in perfect accordance with 174 MeV. So seemingly only kinetic energy is assumed to be generated out of mass defect.

* [3]: "In nuclear engineering, a prompt neutron is a neutron immediately emitted by a nuclear fission event, ..........."

## 3 Objections to the recipe

Copied from chapter XX in https://vixra.org/abs/2107.0027:

Ultimately the foundation of the amu is a combination of the neutron, proton and electron mass:

$m_N = 1.674927471 \cdot 10^{-27}$ $m_P = 1.672621898 \cdot 10^{-27}$ $m_e = 9.10938356 \cdot 10^{-31}$ kg

All these masses are claimed to have a *relative* uncertainty of $10^{-10}$!

Presented in [4]:

"Amu is defined as one twelfth of the mass of an *unbound* neutral atom of carbon-12 in its nuclear and electronic ground state and at rest, and has a value of $1.66053906660(50) \cdot 10^{-27}$ kg."

The mass of these particles is defined in the so-called unbound state, meaning: not bound to other elements / particles. For example: an unbound atom is an atom not *chemically* bound to other atoms.

The opposite of this state, the 'bound' state, has been introduced as a means of explaining the stability of atomic nuclei, despite the enormous repulsive forces between the protons in these nuclei. It led to the phenomena “strong and weak forces” in atomic nuclei and as a result to the phenomenon “binding energy”, see reference [5], but also to the phenomenon “separation energy”, described in reference [6] as:

> “In nuclear physics, separation energy is the energy needed to remove one nucleon (or other specified particle or particles) from an atomic nucleus.”

Applying such a definition to the fission equation in section 2 leads to the conclusion that, with respect to the element Krypton, 235-92+2 = 145 nucleons have been removed from the Uranium nucleus, but seen from the element Barium 235-141+2 = 96, showing an unacceptable conflicting situation.

Besides that: what is the binding/separation energy per nucleon? And does it matter whether it is a proton or a neutron? In the example 36 protons and 109 neutrons, *with respect to Krypton*, have been separated.

The phenomenon “mass defect” is explained in [5] (The addition *unbound* in the “i.e.” is of the author.):

> “Mass defect = (unbound system calculated mass) − (measured mass of system)
> i.e. (sum of *unbound* masses of protons and neutrons) − (measured mass of nucleus)”

Remark:
The word “defect” in [5] has been replaced by the word “change” in the edition of 5 October 2021, or earlier. The elucidation sounds: “Mass change (decrease) in bound systems, particularly atomic nuclei, has also been termed mass defect, mass deficit, or mass packing fraction.”
The word “deficit” unambiguously means “shortage”, so “mass defect/deficit” is unambiguously meant to be negative. However the words “change” and “mass packing fraction” can be interpreted as positive as well as negative. This ambiguity has been investigated closer.

Given the example in section 2, *unbound* nucleons with a total mass of $m_u$ (in the example expressed by 234.857 amu on the right side) did have before fission in the U-nucleus a total mass of *bound* nucleons of 235.044 amu, here indicated as $m_b$ [1]. So the unambiguous positive assigned mass change ($m_b$ - $m_u$) is supposed to be stored in the nucleus as *binding* energy, represented by $E_b = (m_b - m_u)\cdot c^2$, so $E_b$ is positive.
The correctness of the presented mass values in amu’s cannot be checked fundamentally. The values as shown on Internet have to be accepted as correct.

Another approach is to take the hypothetical *complete* fission of the atom of isotope $^{12}C$. This isotope is chosen for its role in the determination of the amu/u/Da.

The examination of this hypothetical fission will start with the determination of the total mass of all the constituent particles. Reference [7] shows the *unbound* masses of the neutron, proton and electron [2] as:

| | | |
|---|---|---|
| $m_n$ | $1.67492749804\cdot10^{-27}$ | kg |
| $m_p$ | $1.67262192369\cdot10^{-27}$ | kg |
| $m_e$ | $9.1093837\cdot10^{-31}$ | kg |
| totally | $3.34846036010\cdot10^{-27}$ | kg |

The isotope $^{12}C$ is built up by 18 particles in the configuration: 6 * (a proton, a neutron and an electron). The total *unbound* mass of this configuration thus is $6 * 3.34846036010\cdot10^{-27} = 2.00907621606\cdot10^{-26}$ kg.

The hypothetical fission, in advance directly expressed in mass, is shown as follows:

$m(^{12}C) \rightarrow$ mass of 6 times an *unbound* (proton + neutron + electron) + E = $6 * (m_p + m_n + m_e) + E$

1 The definition of mass defect explicitly states that $m_b$ has been measured, in whatever way.
2 The atomic mass unit refers to the mass of the whole atom, not of only its nucleus!

Reference [7] defines the 'unified atomic mass unit' (u) as $1.66053906660 \cdot 10^{-27}$ kg, but also claims that the 'atomic mass constant' ($m_u$), presented as $m_u = (1/12)m(^{12}C)$, has the same mass. The variable $m(^{12}C)$ is defined as the "*measured* mass of the system". For $m_u = 1.66053906660 \cdot 10^{-27}$ kg the mass of $m(^{12}C)$ thus is: $1.99264687992 \cdot 10^{-26}$ kg.

As a result the following two conclusions have to be drawn:
Based on the definition of "mass defect" the mass change is $2.00907621606 \cdot 10^{-26} - 1.99264687992 \cdot 10^{-26} = +1.64293361401 \cdot 10^{-28}$ kg. Converted to energy: $E = +1.47659509391 \cdot 10^{-11}$ J.

Based on the hypothetical fission equation, the mass change is $1.99264687992 \cdot 10^{-26} - 2.00907621606 \cdot 10^{-26} = +1.64293361401 \cdot 10^{-28}$ kg. Converted to energy: $E = -1.47659509391 \cdot 10^{-11}$ J.

Surprisingly the following quote from reference [8] confirms this contradiction in a manner as if it has to be considered as real physics!

> "Nuclear binding energy in experimental physics is the minimum energy that is required to disassemble the nucleus of an atom into its constituent protons and neutrons, known collectively as nucleons. *The binding energy for stable nuclei is always a positive number*, as the nucleus must gain energy for the nucleons to move apart from each other. Nucleons are attracted to each other by the strong nuclear force. *In theoretical nuclear physics, the nuclear binding energy is considered a negative number*. In this context it represents the energy of the nucleus relative to the energy of the constituent nucleons when they are infinitely far apart."

Apparently the negative energy resulting from the hypothetical fission of $^{12}C$ is considered as theoretical nuclear physics.

The blunder did not go unnoticed, but then downplayed to an embarrassingly low level of science, with the words:
*"Both the experimental and theoretical views are equivalent, with slightly different emphasis on what binding energy means."*

The last, but not least, objection against the prevailing recipe is that it doesn't contain any ingredient that causes the high-frequency (radioactive) EM radiation, neither during nor after fission! The observed radiation is simply added as text.

## 4 Revolutionary solution

In chapter XXIII in https://vixra.org/abs/2107.0027 it is argued that the introduction of a neutron, modelled as a proton around which an electron orbits at an extremely short distance, offers many, if not all, solutions to the problems encountered in the current model of the atomic nucleus. Such a neutron has been named newtron.

The model of the atomic *nucleus* is proposed as follows:

- *a neutron is a proton around which an electron orbits at very short distance,*
- *a proton in the nucleus orbits a newtron at a much larger distance*

It has been mathematically proven that in this nuclear model, up to atomic number 118, there is enough space to store 118 protons and 118 newtrons, and that in such a case the radius of the orbiting electron in the newtron can vary between $10^{-15}$ and $10^{-14}$ meter. It has also been shown that the lower the atom number the more the orbiting radius of the electron in the newtron can increase. For example:
In a $^2{}_1H$ atom the volume of the nucleus is restricted to a sphere with radius $\sim 5 \cdot 10^{-11}$ m, meaning that the newtron is roughly restricted to a sphere with a radius of $10^{-12}$ m, given the proton assumed to orbit the newtron at its turn.

Two properties of the newtron emphasize the reliability of its model:

1. Its high energy density, up to 70 TJ/kg occurring at an orbital radius of $10^{-15}$ m, decreasing linearly with this radius to 7 TJ/kg for $10^{-14}$ m, in elements around atom number 100.
2. The high frequency and energy of a (nuclear) photon, emitted by a newtron in case its orbiting electron jumps out of its orbit, mutually related by $E^2 = \eta f$, with $\eta = 2\pi^2 m_e \kappa^2 q^4/h = 1.45{\cdot}10^{-51}$ $J^2s$.

For example:
Orbiting radius: $2{\cdot}10^{-15}$ m, resulting in an orbiting velocity of $3.6{\cdot}10^{8}$ m/s*, an energy of the radiated photon of $5.8{\cdot}10^{-14}$ J, (equal to the kinetic energy of the orbiting electron), with a frequency of $2.3{\cdot}10^{24}$ Hz and a pulse width/duration of $1.9{\cdot}10^{-23}$ seconds of the photon.

* As has been proven in chapter I in https://vixra.org/abs/2107.0027 that Einstein's Special Theory of Relativity has to be rejected, thus also the restriction that velocities higher than *c* cannot exist.

## Conclusions

1. The prevailing model of atomic nuclei is based on the compulsive application of $E = mc^2$. Even a remarkable contradictory outcome of theory and measurement in nuclear physics has failed to eradicate this undignified way of performing science.
2. Said model shows no source at all for the unavoidable phenomenon associated with nuclear fission: high-frequency (strong) EM radiation.
3. Rejection of $E = mc^2$ and the introduction of the neutron as an electron orbiting a proton at very short distances eliminates these fundamental problems.
4. Dingle's warning, shown in [9], must evidently yet be taken seriously: "Since this theory '(STR)' is basic to practically all physical experiments, the consequences if it is false, modern atomic experiments being what they are, may be immeasurably calamitous."

## References

[1] Electromagnetic phenomena in a system moving with any velocity smaller than that of light, Prof. H. A. Lorentz, Proceedings of the Royal Netherlands Academy of Arts and Sciences, 1904, 6: 809–831. Copy of original text found at: http://www.dwc.knaw.nl/DL/publications/PU00014148.pdf

[2] https://www.f.waseda.jp/sidoli/Einstein_Relativity.pdf

[3] https://en.wikipedia.org/wiki/Uranium-235

[4] https://en.wikipedia.org/wiki/Dalton_(unit)

[5] https://en.wikipedia.org/wiki/Binding_energy

[6] https://en.wikipedia.org/wiki/Separation_energy

[7] https://physics.nist.gov/cuu/Constants Last Update to Data Content: May 2019

[8] https://en.wikipedia.org/wiki/Nuclear_binding_energy

[9] https://en.wikipedia.org/wiki/Herbert_Dingle