Experimental versus theoretical mass of u- and d-quarks

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Abstract- A theoretical study on the subject led to the discovery of even more discrepancies and strange results in modern physics.

1 Experimental masses

The measured masses of u- and d-quarks have been found in reference [1]. The relevant part of the table: “Quark flavor properties” has been copied below. The mentioned uncertainties represent the statistical, respectively systemic ones.

Particle		Mass* (MeV/c^2)
Name	Symbol	
up	u	2.3 ±0.7 ± 0.5
down	d	4.8 ±0.5 ± 0.3

Table I

Reference [2] presents the information that a proton is composed of two up-quarks, one down-quark, and that the “gluons mediate the forces "binding" them together.” According to reference [3] a neutron is composed of one up-quark, two down-quarks, also with gluons "binding" them together.

The mass of an *unbound* proton m_p is $1.6726 \cdot 10^{-27}$ kg, resp. 938.27 MeV/c^2, according to [2].
The mass of an *unbound* neutron m_n is $1.6749 \cdot 10^{-27}$ kg, resp. 939.57 MeV/c^2, according to [3].
The difference is ~ 2.5 times the mass m_e of an electron, so $m_n \sim m_p + 2.5m_e$.

The mass of a gluon is: “Mass 0 (theoretical value), < 1.3 MeV/c^2 (experimental limit)“, according to [4].

Approximating the total mass of the three gluons in both the proton and the neutron by 3 MeV/c^2, the total ***experimental*** mass of the proton as well as of the neutron thus is roughly 9+3 = 12 MeV/c^2.

This outcome is, by 2 orders of magnitude, in flagrant contradiction with the values found in [2] and [3].

2 Theoretical masses

Ignoring *in first instance* the (binding) mass of the three gluons in both the proton and the neutron, the following equations can be drawn, $m_p = 2m_u + m_d$ and $m_n = m_u + 2m_d$, with m_u the mass of the up-quark and m_d of the down-quark. The final result is: $\mathbf{m_d = 1/3m_p + 5/3m_e}$ and $\mathbf{m_u = 1/3m_p - 5/6m_e}$.

Table I has been extended with the theoretical values of m_d and m_u, as just presented, into table II.
The masses of the electron, proton and neutron have been added for information only. The applied multiplication factor from MeV/c^2 to kg is $1.78269 \cdot 10^{-30}$.

Particle		Experimental	Theoretical	Experimental	Theoretical
Name	Symbol	Mass	mass	Mass	mass
		MeV/c^2	MeV/c^2	kg	kg
up	u	2,3	312,3	4,1E-30	5,57E-28
down	d	4,8	313,6	8,6E-30	5,59E-28
electron	e	0,51		9,100E-31	
proton	p	938,2		1,6726E-27	
neutron	n	939,5		1,6749E-27	

Table II

Of course, the same flagrant discrepancy between experimental and theoretical values appears again.

3 Comments

Modern physics does not consider this as a problem. On the contrary: it has been made this way, witness the text below, copied from [1].

> "Two terms are used in referring to a quark's mass: current quark mass refers to the mass of a quark by itself, while constituent quark mass refers to the current quark mass plus the mass of the gluon particle field surrounding the quark. These masses typically have very different values."

Strange that this statement was not presented as usual:

> Two terms are used in referring to a quark's mass: *unbound* quark mass that refers to the mass of a quark by itself, while *bound* quark mass refers to the *unbound* quark mass plus the *binding* mass of the gluon particle.

Besides that the remark: "These masses typically have very different values." is at least weird, but more likely incorrect. Typical differences between unbound and bound masses are relatively very small. Anyway, such a discrepancy can in modern physics simply be eliminated by declaring the transformation of an unbound to a bound *quark* as of a special kind.

Magical physics "to the fourth power" is accomplished here:

1. An unbound gluon, *with a theoretical mass zero*, changes into a "gluon particle field".
2. That field surrounds a quark, resulting in a modified quark, so not a bound quark!
3. Three of such modified quarks get now bounded, *for unexplained reasons*.
4. The total mass of this creature is about 100 times greater than the total mass of the unbound/unmodified quarks.

A perfect perpetuum mobile has been created, given the infinitely high efficiency it has been awarded.

The "explanation" of this perpetuum mobile is continued as follows:

> "Most of a hadron's mass (A hadron is defined as a composite particle made of two or more quarks held together by the strong interaction.) comes from the gluons that bind the constituent quarks together, rather than from the quarks themselves. While gluons are inherently massless, they possess energy .... and it is this that contributes so greatly to the overall mass of the hadron."

Indeed, a *massless* particle has been introduced, possessing energy. Seemingly the expression $E = mc^2$ is not valid for this particle.

This magic physics has been fantasized to solve the problem of the explosive nuclei, due the repulsive forces between protons and to solve the question how to explain the enormous intrinsic energy of an atom's nucleus. What has apparently been overlooked in the presented solution is that such a proton, seen from the outside, is still the same: a mass, electrically charged with one positive e Coulomb, so just as repulsive with respect to other protons as without those fantasies. But ignoring this problem, at least the creation of a high intrinsic energy in the protons, i.e. in the nuclei, has been achieved.

To close of this disaster: there is a very fundamental problem regarding the sign of binding energy and thus of the supposedly related mass. Reference [5] describes the prevailing contradiction between its experimental and theoretical determination in a way as if it has to be considered as genuine 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."

But of course, in modern physics such a consideration does not apply to the special transformation of an unbound quark into a bound quark, to express it ironically.

4 An alternative solution to the magic physics

Reference [7] provides a simple and realistic solution to both the problem of the enormous intrinsic energy of an atomic nucleus and the problem of the repulsive forces between the protons in the nucleus. This solution is summarized hereafter.

If a neutron were modelled as a proton around which an electron orbits at a very short distance, such a neutron (from now on referred to as 'newtron') is also charged electrically neutral. Its mass is the mass of a proton plus 1 (instead of 2.5) times the mass of an electron. The meant "very short distance" varies in this model from just outside the proton until smaller than the smallest radius (a_0/Z) with which an electron orbits in the atom under consideration. a_0 is the Bohr radius and Z the related atom number.

The *kinetic energy* of an electron orbiting just outside the proton at a radius of $8.9 \cdot 10^{-16}$ m, so $0.2 \cdot 10^{-16}$ m from the proton's surface, is $1.3 \cdot 10^{-13}$ J = 0.78 MeV. In reference [6], under "Energy budget", the following text is found.

> "For the free neutron, the decay energy for this process (based on the rest masses of the neutron, proton and electron) is 0.78 MeV. That is the difference between the rest mass of the neutron and the sum of the rest masses of the products. That difference has to be carried away as *kinetic energy*. The maximal energy of the beta decay electron ....has been measured at 0.78±0.01 MeV."

This text is based on the reaction equation: $n^0 \rightarrow p^+ + e^- + \nu_e + \gamma$, with γ described as: "an emitted gamma ray, to be thought of as a sort of "internal bremsstrahlung" that arises as the emitted beta particle (electron) interacts with the charge of the proton in an electromagnetic way. In this process, some of the decay energy is carried away as photon energy." The description of ν_e is even more esoteric and extensive.

This explanation thus introduces an "emitted beta particle" when only the electron, as shown already in the equation, is meant. Such an approach is typical in modern physics, where measured energies are used to create particles by means of $m = E/c^2$. The result is a countless number of exotic particles. In most cases these energies have to be interpreted as nuclear-photon energies, as predicted in the newtron modelling.

The newtron predicts: $n^0 \rightarrow p^+ + e^- + \gamma$, with γ a so-called nuclear-photon. The electron evidently escapes from the newtron, so, as presented in reference [7] with mathematical justifications, the predicted frequency of this nuclear-photon is $1.2 \cdot 10^{25}$ Hz and its predicted pulse length $4 \cdot 10^{-24}$ seconds. The relation between energy and frequency of a nuclear-photon is found to be $E^2 = \eta f$, with $\eta = 1.45 \cdot 10^{-51}$ J^2s.

The newtron doesn't solve the problem of the "explosive" nucleus. Two solutions have been suggested:

1. Each single proton in the nucleus orbits a newtron at a much larger distance than the radius of the newtron. N.B. In an atomic nucleus the number of newtrons is for any element greater or equal to the number of protons. So each single proton can orbit a newtron.
2. All newtrons are clustered and a cloud of "free" protons orbits this cluster, for example like the electrons orbit the nucleus in Bohr's atomic model. The first possibility has been investigated in detail in reference [7] and turns out, in principle, to be possible.

5 Contemplation about mass and electrical charge of the electron and proton

In fact, both phenomena are very mysterious, because we have no more detailed idea of them than as they have been observed. Their properties have been established with mathematical models, which are widely and successfully applied in practice. Trying to explain these phenomena in more detail by creating exotic particles and magic forces only leads to even more insane results.

References

[1] https://en.wikipedia.org/wiki/Quark
[2] https://en.wikipedia.org/wiki/Proton
[3] https://en.wikipedia.org/wiki/Neutron
[4] https://en.wikipedia.org/wiki/Gluon
[5] https://en.wikipedia.org/wiki/Nuclear_binding_energy
[6] https://en.wikipedia.org/wiki/Free_neutron_decay#Neutron_lifetime_puzzle
[7] https://vixra.org/abs/2107.0027 Chapter XXIII page 85
Atomic nuclei modelled without exotic particles and magic forces