Rotational wave velocity of protons

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Abstract

The angular momentum of particles is the result of rotational waves, which are believed not to rotate in a classical sense. Therefore, the rotational wave properties of protons or nucleons, which should be comparable to De Broglie matter waves, have never been attributed to a wavelength, frequency or energy, but solely to their spin, which is a quantized property and probably does not reflect the true angular momentum as the product of radius and true rotational impulse of a particle. Using data that originates from the hadron accelerator CERN in Switzerland, the true, not quantized velocity of the rotational wave of protons could be, however, measured. Thereby, its frequency is $2072.180437\ Hz$, hence, it is unexpectedly low. Scientists from NIST, Colorado were even able to directly observe the nucleon rotation in a confined 9Be+ ion and to measure the oscillation frequency of the ion. The spike in the polarizability curve of protons at $Q^2 = 0.33\ GeV^2$, published currently in the journal Nature, together with the rotational wave frequency obtained from CERN data, provides reliable evidence that this might be an interference in terms of superposition of the particle wave of the scattered electrons with the rotational wave of the protons at the same energy level, doubling the expected curve value, which, since there are no other possible explanations, proves the calculated rotating wave energy of protons.

In particle physics, spin is the intrinsic angular momentum of particles. In the case of the fundamental particles, like the mass, it is an invariable inner particle property. It is a half or whole number multiple (spin quantum number) of the reduced Planck constant. Apart from the fact that it is thought not to be caused by the rotary movement of a mass (1-6), it has all the properties of a classic mechanical intrinsic angular momentum, in particular with regard

to conservation of angular momentum and coordinate transformations. The rotational wave in protons as the cause of the angular momentum is comparable to matter waves with a De Broglie wavelength of

$$\lambda = \frac{c}{f} = \frac{h}{p} \quad [1]$$

The angular momentum of particles is the result of rotational waves, which are believed not to rotate in a classical sense. Therefore, the rotational wave of protons or nucleons has never been attributed to a rotational wave wavelength, frequency or energy, but solely to their spin, which is a quantized property and does not reflect the true velocity or angular momentum as the product of radius and impulse of a particle. If the rotational velocity were quantized or oversized as h/4πmr due to the quantized angular momentum, the rotational energy would not be proportional to the mass of a particle but inversely proportional to it, since

$$if\ v := \frac{h}{4\pi mr} \rightarrow \quad E_{rot} = mv^2 \ = \frac{mh^2}{16\pi^2 m^2 r^2} = \frac{h^2}{32\pi^2 mr^2} \quad [2]$$

which is not possible. Hence, the rotational wave of protons very probably has a velocity with a different (smaller) value as calculated by its spin. In this context, the value of the rotating wave velocity could increase e.g., by means of magnetic fields. In order to determine the presumed wave frequency value for protons we used data from CERN in Switzerland. The key point of the determination is that from the so-called Larmor frequency f'/B, which has a constant value, the excited frequency of the protons in the synchrotron can be calculated, since the field strength B of the magnets is known. By determining the factors by how much the frequency in the pre-accelerator and synchrotron has increased compared to the original value, the original, unexcited frequency of the proton rotation wave can be determined by simple division. Using these measurements, the rotation wave frequency of protons is approximately 2072.18 Hz. The results obtained here can be also confirmed by the rotational wave velocity of protons mediated by the gravitation within the proton:

$$\frac{mv^2}{r} = \frac{m^2 G}{r^2}, f = \frac{v}{2\pi r} = \frac{\left(\frac{mG}{r}\right)^{1/2}}{2\pi r} = 2071.87\ Hz \quad [3]$$

which matches with the frequency determined by CERN data.

The used data from CERN and the calculations are described in the following. In the hadron accelerator in Geneva (CERN), protons are accelerated from 450 GeV pre-acceleration to 7 TeV through 8 cavity resonators from 5.5 MV/m and on the main orbit of the LHC through 154 main magnets in the 8 partial orbits (radius 445 m) of the magnetic flux density of 8.33 Tesla each in a circle, with a defined energy loss due to the synchrotron radiation, which occurs when a particle is accelerated in a synchrotron. The protons are accelerated during each circulation with an energy of 485 keV in the lines of 825 meters between the 8 partial circuits and circulated 11,245 main lanes per second. The pre-acceleration to 450 GeV leads to a proton velocity of 0.999997826c. The time to full velocity in the LHC (0.999999991c) is 1200.99 seconds (10).

First of all, if the proton wave rotation velocity is < c, I considered that the used magnets in the LHC would probably raise this rotating wave frequency. Magnetic resonance tomography (MRI), which uses magnetic fields to excite the proton spin, provides evidence of this. But to what extent does an external magnetic field increase the intrinsic rotation of the particles? It is known that protons have a small magnetic field. However, the magnetic flux density of such a proton magnetic field has never been measured or calculated.

The next thing I thought about was how such a magnetic field occurs. Given the rotating waves, the explanation is relatively simple. The rotating, moving charged particle creates a magnetic field, as do all moving charges. It turned out that the natural rotational wave frequency fr increases proportionally to the external magnetic field B_0.

$$\frac{m_p' v'^2}{m_p v_r^2} = \frac{q r_0 v' B_0}{q r_0 v_r B_0'}; \frac{v'}{v_r} = \frac{B_0}{B_0'} = \frac{f'}{f_r} \quad [4]$$

m_p is the proton mass, r_0 is the proton radius, q is the proton charge, v_r is the unaffected rotational wave velocity of the protons, B_0' is the magnetic flux density of an external magnetic field before a deflection has taken place, f' is the rotational wave frequency of the protons influenced by the external magnetic field and v' is the rotating wave velocity of the protons influenced by the external magnetic field, which is caused by that the external magnetic field increases the angular momentum on the proton. This fixed ratio of the precession frequency and the external magnetic flux density is the so-called Larmor frequency (11) named after the Irish physicist Joseph Larmor, who was able to show that the angular momentum of a particle is proportional to a magnetic dipole moment around the direction of an externally applied magnetic field B_0.

$$\frac{f'}{B_0} = 42{,}577\,\frac{MHz}{T} = constant \quad [5]$$

(f' is the excited rotational wave frequency of the protons). In order to determine the unaffected rotational wave frequency of a proton, I therefore first had to calculate the individual factors by which the natural rotational wave frequency of a proton increases in the LHC, which, when multiplied together, result in the total factor a. An important factor is the deflection of the protons in the LHC by the main magnets used. Another factor that should not be neglected is the generation of a magnetic field due to the very fast forward motion of the protons (which is a charged particle) in the LHC and in the pre-accelerating sections of the LHC (several synchrotrons that pre-accelerate the protons to an energy of 450 GeV before the protons enter the LHC).

When the proton reaches the end of the linear accelerator, first it does not have a higher rotating wave frequency, since the proton's direction of motion is parallel to the force effect and therefore no magnetic field is induced. A first factor a_1 arises from the fact that the proton enters from the linear accelerator LINAC2 with a length l of 30 m in the booster, which is no longer linear but circular and build of 4 superimposed tubes with a radius r_B of 25 m. Here it experiences a change in angular momentum right at the beginning, since $\Delta Ft = \Delta p$.

The force change happens because at the end of LINAC2 and at the beginning in the booster before the deflection through the magnets the force acting on the proton is 2.4 times smaller than the centripetal force created by the magnets in the Booster which is generated on the proton.

$$a_1 = \frac{\frac{m_B v_B^2}{r_B}}{\frac{\frac{1}{2} m_B v_B^2}{l}} = \frac{2l}{r_B} = 2{,}4 \quad [6]$$

In the synchrotrons (booster, PS and main circuit of the LHCs) the magnetic field of the main magnets and at the same time the magnetic field generated by the high velocity, whose magnetic flux density is the same as that in the main magnet and its field lines show in the same direction as the magnetic field of the main magnets. Because in the first case a circular motion in a synchrotron takes place, half the Landé factor (12) must be taken into account for the sum of the two magnetic fields for the first case, since with a charged particle the Larmor frequency from the synchrotron frequency at the same magnetic field differs by half the Landé factor.

$$a_2 = \frac{B_0}{B_B} = 201{,}1006413; \; a_3 = \frac{g_2}{2} + 1 = (2{,}7929 + 1) = 3{,}7929 \quad [7]$$

(B_B is the magnetic flux density at the start of proton acceleration in the circular booster, g_2 is the Landé factor for protons). Another factor arises from the increase of the magnetic moment of the proton, causing the rotational wave frequency also to increase compared to the magnetic field increase, starting from the booster to the main circulation circuit of the LHC.

$$\frac{M_{Sm}}{M_{Bm}} = \frac{\frac{D_0}{B_0}}{\frac{D_B}{B_B}} = \frac{\frac{m_S v_{Sr}^2}{r_0} r_0}{\frac{m_B v_{Br}^2}{r_0} r_0} \frac{\frac{m_B v_B^2}{r_B q v_B}}{\frac{m_S v^2}{rqv}} = \frac{v}{v_B} \frac{r}{r_B} = \frac{f'}{f_B} \frac{r}{r_B} = \frac{f'}{f_B} \frac{r}{l} \frac{l}{r_B} = \frac{f'}{f_{Br}} \cdot 1{,}2 \cdot 93{,}466667 \quad [8]$$

m_S is the mass at the end of proton acceleration, m_B is the mass at the beginning of the acceleration in the booster, v is the final velocity, v_B is the initial velocity in the booster, r_B is the radius of the booster, r is the radius of the main circle of the LHC, M_{Sm} is the magnetic Moment of the proton at the end of the acceleration, M_{Bm} is the magnetic moment of the proton at the beginning in the booster, D is the angular momentum of the proton, B_B and B_0 are the magnetic flux density of the external magnetic fields and r_0 is the radius of the proton. Those variables denoted by the index r refer to the intrinsic rotational wave of the proton. The fact that the factor f'/f_B and the factor l/r_B are already included in a_3 and a_1 was taken into account, and the result is

$$a_4 = 93.4666667 \quad [9]$$

Only the factor a_3 indicates the factor by which the external and the induced magnetic field in the LHC is larger compared to the magnetic field at the beginning of the booster.

$$\frac{f'}{f_B} = \frac{B_0}{B_B} = a_2 \quad [10]$$

Finally, one obtains the unaffected rotational wave frequency fr of a proton, if one considers that the induced rotational wave frequency increase additionally by the factors independent of the external magnetic field a_1, a_3 and a_4:

$$\frac{f_r}{B_B} = \frac{f'}{a_1 a_3 a_4 B_0} = 42.577 \cdot 10^6 \frac{Hz}{T}$$

$$f_r = \frac{B_B}{a_1 a_3 a_4} \cdot \frac{f'}{B_0} = \frac{42.577 \cdot 10^6 \frac{Hz}{T} \cdot 4{,}14\, 10^{-2} T}{2 \cdot 3{,}7929 \cdot 93{,}466667} = 2072{,}180437 Hz \quad [11]$$

The natural rotation wave frequency of a proton is accordingly 2072.180437 Hertz. Hence, the rotation wave velocity, which is calculated using the formula $2\pi fr = 1.13271 \cdot 10^{-11}$ m/s is much lower than the speed of light.

As a proof of this wave frequency value, the main thing is that if the centripetal force is equated with the gravitational force and resolved to G by inserting the calculated frequency into the formula

$$G = 4\pi^2 f^2 r^3 m = 6{,}7401 \cdot 10^{-11} \frac{m^3}{kgs^2} \qquad [12]$$

the value of $6{,}7401 \cdot 10^{-11} \frac{m^3}{kgs^2}$ comes out, almost the exact value of the gravitational constant G, proving the value of the rotational wave frequency calculated using the data from CERN.

The following proofs for the particle wave rotation can be presented: 1) The natural particle rotation $f = 2mv^2/h$ $(= 4\pi mvrf/h = 4\pi mvfh/4\pi mvh = f)$ can theoretically be converted into an ultrafast zitterbewegung $2mv^2/h$, $v \rightarrow c$, if theoretically determined the radius cannot increase (cannot be quantized) and instead the speed increases accordingly up to the maximum speed c. Conversely, the hypothetical zitterbewegung derived from the Schrödinger equation implies the existence of a fast, oscillatory motion of particles with variable effective radius and thus a self-rotation of the particles with the frequency $2mv^2/h$. Confined ions used to demonstrate the zitterbewegung were placed such that the non-relativistic Schrödinger equation for the ion has the same mathematical form as the Dirac equation. The tremor movement would then become measurable, according to the physicists' hypothesis. However, an oscillation of 10-80 kHz was measured, which corresponds exactly to the rotation frequency of the electron in the outermost orbit in different excitation levels for the 1D confined 40Ca+ ions used. This indicates that the electron rotation frequency of $2mv^2/h$ could be directly observed for trapped Ca+ ions.

2) The unexcited molecular rotations of a hexa-(tert-butyl)decacyclene molecule adsorbed on a Cu(100) surface could be directly observed with a rotation frequency of 9 Hz using scanning tunneling microscopy. Also worth emphasizing is the fact that there is no solid experimental evidence that particle waves do not rotate at a specific frequency.

Furthermore, if the particle is charged, rotation would mean an acceleration of the charge. Rotation means constantly changing the direction of velocity, that is, accelerating. An

accelerating charge would radiate (emit photons) so this state would not be stable. The idea of spin arose because we observed stable charged particles interacting with magnetic fields as if spinning, but not emitting photons. This classic interpretation, however, does not lead to a contradiction, since accelerating charges do not have to radiate, an item, which has been discussed extensively (13). Also, the power of such a radiation would be in the 10^{-68} W range, which would be almost undetectable.

According to Heisenberg, the position and the speed of a circling particle cannot be measured with any degree of precision, but this only applies to $pr < h/4\pi$ and only to spin interactions or to measurements. The electrons in their orbitals form a standing wave, because the particle wave keeps circling around the same particle radius. This means that the electron has a certain probability of being in one place in the orbital. Scientists from the University of Virginia in Charlottesville (17) have now been able to cause electrons to revolve around the atomic nucleus in the classical sense by means of high levels of excitation. At these high energies, the electrons lose their wave properties in favor of solid particle properties. In the case of nucleons, however, the rotational velocity is canceled out of the spin formula, so that only the radius is quantized in this process ($h/4\pi mv$). In addition, the mass points in the proton do not form a standing wave, since they are effectively rotating around the much larger quantized radius. Accordingly, a defined rotational frequency can very well be assigned to the nucleon rotation waves.

A fundamental property of the proton represents the system's response to an external electromagnetic field (EM). It is characterized by the EM polarizabilities, which shows how the charge and magnetization distributions inside the system are distorted by the EM field (14). Moreover, the generalized polarizabilities outline the deformation of the densities in a proton subjected to an EM field. They reveal essential information of the system dynamics and provide a key for deciphering the proton structure and the strong interaction with its elementary quark and gluon constituents (14). Of particular interest is a puzzle in the proton's electric generalized polarizability that remains unresolved for two decades (14). R. Li et al. (15) currently reported about measurements of the proton's EM generalized polarizabilities at low four-momentum transfer squared. They show evidence of an anomaly to the behavior of the proton's electric generalized polarizability with a spike in the curve that contradicts the predictions of nuclear theory. The reported measurements suggest the

presence of a novel mechanism in the proton, which was reported before (13-15) and which might be associated with the presence of a rotation wave in the proton that behaves like a usual particle wave.

In the case of the elastic scattering of an electron on a nucleon, only one parameter remains:

$$W^2 = M^2 + 2M \cdot v - Q^2$$

$$W = M;\ 2M \cdot v - Q^2 = 0;\ E_e = \frac{Q^2}{2} = \frac{0.336\ GeV^2}{2} = 4.3124 \cdot 10^{-30}\ J \quad [13]$$

(E_e is the wave energy of the scattered electron, $0.336\ GeV^2$ is the maximal value of the spike determined from the enlarged published figure (15)). The rotational wave energy of the proton E_p with its frequency $f_r = 2072\ Hz$ [5] is calculated according to DeBroglie (9) as:

$$E_p = mv^2 = 2\,\pi mvrf_r = \pi \cdot \frac{h}{2} \cdot f_r = \pi h f_r = \pi h \cdot 2072\ Hz = 4.3134 \cdot 10^{-30}\ J \quad [14]$$

Due to the same wave energy hf of the electron and proton, both waves are superimposed during scattering, which leads to the spike in the polarizability curve in the experiments. The maximum of the spike corresponds to about twice the value expected by extrapolation for Q^2 = 0.336 GeV^2, which is caused by the interference of two waves of the same size. Hence, especially since other explanations are missing, the observed spike (15) is most probably due to the rotating wave energy of the proton.

The angular momentum of elementary particles is very small due to the small radius and mass of elementary particles and would not be measurable, if the spin measurements were not influenced by conditions described in the following. According to the Heisenberg-Millette ($mvr \geq h/2$) uncertainty principle, particles with a substructure like protons, electrons, neutrons, quarks and neutrinos have a measurable angular momentum (spin) s of:

$$\Delta L\, \Delta \varphi \geq \frac{h}{2};\ \Delta\varphi_{max} = 2\,\pi\ ;\ \Delta L = \frac{\Delta E_{rot}}{\frac{1}{2}\omega} = \frac{\frac{1}{2} h f_{rw}}{\frac{v_r}{2r}} = \frac{h\bar{v_r}}{\lambda_{rw}} \cdot \frac{r}{v_r} = \frac{hv_r}{2\lambda_{rw}} \cdot \frac{r}{v_r}$$

$$\frac{hr}{2\lambda_{rw}} < \frac{h}{4\pi} \rightarrow \frac{hr}{2\lambda_{rw}} \coloneqq \frac{h}{4\pi r'}$$

$$r' = \frac{\lambda_{rw}}{2\pi} \rightarrow \Delta L = \frac{\hbar}{2};\ s = \frac{\hbar}{2} \quad [15]$$

(v_r is the mean rotation velocity, $\Delta\varphi$ is the error of the measurements of the rotation angle, s is the spin of the particle, λ_{rw} is the wavelength of the rotation wave, f is the frequency of the particle). Hence, the spin is solely determined by the Heisenberg-Millette principle and not by an intrinsic quantized particle property, like assumed for one century. Moreover, the velocity v_r cuts out from the equation [15], hence, the particle radius, as shown (21), and not the velocity is quantized.

Dietrich Leibfried from NIST, Colorado (16) was even able to directly observe the nucleon rotation in a confined 9Be+ ion and to measure the oscillation frequency of the ion. The measured oscillation frequency of 7.2 MHz in the ground state corresponds almost exactly to the nucleon rotation frequency determined using CERN data. For a beryllium ion, the quantized radius is h/4πmv = h/72π2mpfr = $7.374 \cdot 10^{-7}$ m. Translated to the oscillating atomic diameter of the confined beryllium ion, this is 7022.904 times smaller than the quantized radius of the ion, which is one 7022.904 times greater oscillation frequency of the trapped beryllium ion compared to the rotation frequency of a nucleon (spin 1/2) of the ion. The unaffected rotational frequency of a nucleon is then calculated as 7.2 MHz divided by 7022.904 times 2 (the ion oscillates around the atomic diameter, not the radius) = 2050.4338 Hz (deviation 1% due to the imprecise, empirically determined atomic radius of 105 pm according to Slater).

In conclusions, due to the Heisenberg inequality modified by Millette $\Delta x \Delta p \geq h/2$, the spin of the particles, which is a quantized property in case of measurements or energy exchange of the spin, can only be measured as a multiple of $h/4\pi$ (20), the correct unquantized angular momentum depends on the actually existing wave rotation velocity of the particles and should usually be much lower. For photons with no rest mass, the angular momentum can be derived in a different way as $h/2\pi$ (20) and it just happens to be twice the angular momentum of fermions (20). In measurements and in the case of energetic relevance or exchange, the angular momentum is namely always quantized to a multiple of $h/4\pi$ or $h/2\pi$ and does not mean that a rotational wave frequency or velocity cannot be attributed to protons. Rotational motion has been demonstrated by electron microscopy in molecules (21,22). In the case of the Einstein-de-Haas effect, which is based on this effect, a macroscopically visible rotational

movement can even be observed. The quantized proton radius is calculated as 0.8412 fm only under the assumption of a proton wave rotation (23). The gravitation inside the proton leads to the same result for the rotation wave frequency compared to the result from the CERN data [9]. From the Zitterbewegung $\omega = 2mc^2/h$ multiplied by the quantization factor v/c, which corresponds to the particle wave rotation frequency, one obtains exactly the proton radius of 0.8412 fm (17). The magnetic field density of a proton is 43 µT (17), since this is in the order of magnitude of the earth's magnetic field, the gravitational constant is influenced by varying earth's magnetic field values (24,25), as observed. The spike in the polarizability curve of protons at Q^2 = 0.33 GeV^2 (14-16,19), together with the rotation frequency calculated using data from CERN, provides reliable evidence that this might be an interference in terms of superposition of the particle wave of the scattered electrons with the rotational wave of the protons with the same energy level, doubling the expected curve value, which, since there are no other possible explanations, proves its cause in the rotating wave of the proton. Based on these results, a substantial rethinking in quantum physics and spin mechanics and the search for further reliable data on the rotating waves of particles is mandatory.

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