NEW PROTON AND NEUTRON MODELS

T. G. BARNES*

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This article extends the concepts developed in previous papers, alternatives to special theory of relativity, to generate magnetic forces of sufficient magnitude to replace the conventional concepts of the strong forces in nuclear physics.

The proton model consists of a spinning sphere of extremely small radius and extremely high perimeter speed, speed exceeding the speed of light. This speed is shown to be permissible in a sphere with constant rate of rotation. The result is a large magnetic flux and an intense magnetic field. This field provides binding force attraction between protons.

The proton's magnetic flux induces a spin in an electron deforming the electron into a rotating ring. The rotating electron ring encircles the spinning proton to form a neutron. The magnetic force keeps the plus and minus charges apart.

This paper makes use of published values of spin angular momentum, magnetic moments, and beta decay energy. It also uses the classical laws of conservation of angular momentum and energy and the equivalence of mass and energy.

1. Nuclear Forces

One of the unsolved problems in physics is the nuclear force, the force that holds the nucleus together. The nuclear force has been considered to be different from the electric, magnetic, and gravitational forces. The nuclear force is the strongest of these forces. The nuclear force is a short range force that is strongly attractive between two neutrons, two protons, or a neutron and a proton when these pairs of particles almost touch. This paper introduces new concepts that provide the conditions for stronger electromagnetic forces. The nuclear force is then developed in terms of strong electromagnetic forces.

2. A Magnetic Stabilizing Force

Earnshaw's theorem states that there is no stable electrostatic configuration. Like charges repel each other and unlike charges attract. These charges will move apart or come together, as the case may be, unless some counter force acts on them. Some nonelectrostatic forces must be added to achieve a stable state. This paper introduces a magnetic force to achieve a stable configuration of charges. In conventional theory the problem with the particle stability has been that the electric force is stronger than the magnetic force. It is only when moving with the speed of light that the magnetic force between two charges equals the electric force. According to special relativity charges can not move with speeds greater than the speed of light. If that were indeed so the magnetic force between the two charges could not exceed the electric force.

If, however, it can be shown that a rotating charged body can have speeds in excess of the speed of light a greater magnetic force is possible. This can account for the requisite forces to hold charges in a stable state. It will be shown that speeds in excess of light speed are feasible under certain conditions.

3. Rotational Speeds Exceeding the Speed of Light

A previous paper developed an alternative to special theory of relativity.[1] An adaptation of that theory shows that there can be a rotating speed of a charged body that exceeds the speed of light c. The limitation of velocity to the speed of light c, according to that theory, resulted from the feedback effect on a finite charged particle in motion. As a finite particle moves along it causes a rate of change $\dot{B}$ in the magnetic field at a fixed point in the medium. This $\dot{B}$ in that region of the ambient medium generates an electric field that is fed back. This feedback enhances both the electric field E and magnetic induction B of the moving charge. This feedback enhancement causes the E and B fields to approach infinite magnitude, putting a limit on the translation speed of a charged particle.

If there is no fluctuation in the B field, as for example in uniform rotational motion of a charged particle, there is no feedback. With no-feedback there is no increase in the electric field, only the nonrelativistic increase in the magnetic field. Under this no-feedback condition it is possible to exceed the speed c and to achieve an increase in the ratio of magnetic to electric field.

The increase in the magnetic field H is brought about by the fundamental relation

$$\mathbf{H} = \mathbf{v} \times \mathbf{D} \tag{1}$$

From that equation and the relation $\mathbf{B} = \mu\mathbf{H}$, and the Maxwell equation for the speed of light, $c = (\mu\epsilon)^{-1/2}$, one may deduce the equation

$$\mathbf{B} = \frac{\mathbf{v} \times \mathbf{E}}{c^2} \tag{2}$$

In the right angle case and where a second charge q_0 is moving with speed v_0 with respect to this **B** field, the magnitude of the force on that charge is

$$F = \frac{q_0 v_0 v E}{c^2} \tag{3}$$

In the case of a positively charged sphere spinning with uniform angular speed there is no rate of change of **B**, no $\dot{\mathbf{B}}$. The rotational speed v of its rim can exceed the speed of light c. Equation (2) still applies to the **B** field. When v exceeds c there is a greater increase in the ratio of **B** to **E** than would be possible in the feedback case. Now consider a negative charge moving with speed v_0 through this stronger magnetic field. It is possible for the magnetic force to exceed the electric force on that charge, repelling it instead of attracting it. That relative increase of magnetic to electric force is, of course, also a

*T. G. Barnes, D.Sc., is Professor of Physics at the University of Texas, El Paso, Texas 79968.

function of the speed v_0. The greater v_0 the greater that ratio of magnetic to electric force. Here then is a possible mechanism to achieve a large enough magnetic field to hold apart a spinning proton and a revolving electron.

4. The Proton Model

A proton is assumed to consist of a small spinning sphere with a positive charge. From published values of the magnetic moment of a proton and its radius (approximately 10^{-15} meter) one can compute the magnetic field. It is not large enough to meet the required nuclear force magnitude. The need for a very strong magnetic field around the proton is met in the following way. Having fixed the value of the magnetic moment of the proton one looks for a means of increasing its magnetic field strength in the region near the proton. That can be done by assuming that the radius of the proton is much smaller than the afore-mentioned value which is usually assigned to it.

If one makes the radius of the proton small enough while keeping the magnetic moment fixed, the required magnetic field strength can be achieved. This does require the outer portion of the spherical proton to move faster than the speed of light.

The proton is assumed to be a spinning sphere with its charge uniformly distributed over the surface of this sphere. Denoting its radius as a_p, charge as q, and angular velocity as ω it can be shown that its magnetic moment is

$$M = \frac{q a_p^2 \omega}{3} \tag{4}$$

The value of the magnetic moment of the proton is taken from the literature, as $M = 1.4106 \times 10^{-26}$ ampere meter^2. The two unknowns in Eq. (4) are the proton radius a_p and angular velocity ω. A means of determining an appropriate value of the radius was considered next. After making some preliminary computations on the magnetic flux needed from the proton it was seen that the proton radius must be very small, of the order of magnitude of 10^{-18} meter. That is much smaller than conventional 10^{-15} meter value for the proton radius. However the following means of computing the proton radius adds some credence to this very small value employed in this proton model.

In another previous paper the following equation was derived for the rest mass of the electron.[2]

$$m = \frac{q^2}{6\pi\epsilon a c^2} \tag{5}$$

A large percentage of that mass was due to the electric field surrounding the electron. If the same theory is extended to the proton one can then compute the proton radius from the known mass of the proton. Substituting the proton mass $m = 1.67626 \times 10^{-27}$kg into Eq. (5) yields the proton radius $a_p = 1.023 \times 10^{-18}$meter. Substituting that value of a_p into Eq. (4) yields a proton angular spin velocity $\omega = 2.52 \times 10^{29}$ rad/sec and the rim speed $v = 2.58 \times 10^{11}$ meter/sec. This is 861 times the speed of light. That high speed rotation produces an exceedingly strong magnetic field near the proton, a magnetic barrier that the rotating electron can not penetrate.

5. A Ring Electron

The concept of a deformable electron was included in a previous paper.[3] That concept is now extended to include deformation from a spherical electron to a ring electron. The electron has the spherical shape in its free non-rotating state and the ring shape in its rapidly rotating state. The mechanism for deforming an electron into a ring is the centrifugal force associated with the magnetically induced spin of the electron as it moves into the magnetic field of a spinning proton.

The rotating ring electron is used here in connection with the spinning proton to develop a model of the *neutron*. The ring electron is also employed in a companion paper to develop a model of the hydrogen atom. The ring electron has an advantage over the Bohr orbital electron in that the steady rotation of a ring electron does not radiate energy. Whereas the Bohr orbital electron has that fundamental defect of either violating the radiation law or allowing the hydrogen atom to die from loss of energy.

6. Magnetic Boundary Force

The positive charge of the proton attracts the electron but the proton's magnetic field exerts a repulsion force on the rotating ring electron. As an illustration of the barrier provided by the strong magnetic field of the spinning proton consider the magnetic force dF_m on an elementary charge dq of the ring electron near the rim of the proton. Assume that the electron ring has the same speed as the speed of the Bohr electron. That is an electron rim speed of $v_0 = 2.19 \times 10^6$meter/sec.

Substituting the differential element notation into Eq. (3) the magnetic repulsion force on that small adjacent portion of the ring

$$dF_m = \frac{dq v_0 v E}{c^2} \tag{6}$$

The associated Coulomb attraction force is

$$dF_e = dq\,E \tag{7}$$

Substituting for the proton rim speed $v = 861\,c$ and the electron ring rim speed $v_0 = 2.19 \times 10^6$ one has the ratio of magnetic repulsion to electric attraction on this incremental charge element

$$dF_m/dF_e = 6.3 \tag{8}$$

This indicates that at least for that portion of the ring the electron will not penetrate into the proton if it is moving, in the same direction as the proton rim. The positive and negative charges will remain separated.

7. Proton-Proton Magnetic Attraction

One of the mysteries of nuclear forces has been how two positive protons can be held together in the nucleus of an atom. The electro-static repulsion between those charges is very large. That problem is solved in this new model of the proton by the extremely large magnetic attraction between the protons.

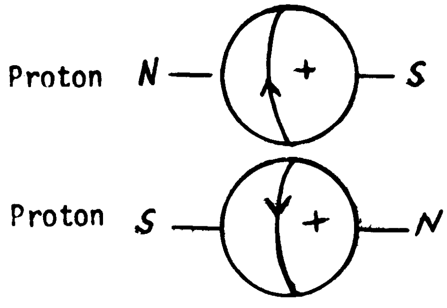

Figure 1. Spin directions for two magnetically bound protons.

Consider two adjacent protons spinning as shown in Fig. 1 with their magnetic moments parallel but in opposite directions. The magnetic attraction force between these two protons will be computed for the idealized case of two magnetic dipoles, each with magnetic moment M.

The attraction force[4] on one proton of the magnetic moment M is

$$F_m = \frac{\partial B}{\partial r} M \tag{9}$$

where the B field[5] due to the other proton is

$$B = \frac{\mu M}{4\pi r^3} \tag{10}$$

yielding attraction force

$$F_m = \frac{3\mu M^2}{4\pi r^4} \tag{11}$$

Using the value for magnetic moment of the proton $M = 1.41 \times 10^{-26}$ampere meter^2 and the distance r between their centers equal to twice the proton radius, namely $r = 2.046 \times 10^{-18}$meter, yields the attraction force $F_m = 3.404 \times 10^{12}$newton. This is a much larger force than the electric repulsion force F_e. That force is easily shown from Coulomb's law to have the value $F_e = 5.52 \times 10^7$newton.

Hence in this illustration the protons are held together by a *magnetic attraction force* that can be as large as 62 thousand times the electric repulsion force. For the balance condition between the electric and magnetic force the protons would be spaced further apart. This shows the plausibility of interpreting the so-called nuclear forces as electromagnetic forces, removing some of the mystery about nuclear forces.

A more stable configuration of the proton-proton combination is shown in Fig. 2. This is an in-line arrangement with both protons spinning about the same axis, in the same direction, and with their magnetic moments adding.

The same equations for the magnetic attraction and electric repulsion are applicable. But the expression for B is twice as large in the polar position. The net result is that in this configuration the ratio of the magnetic attraction to the electric repulsion is twice as large, a very strong binding force.

8. Strong Forces, Electromagnetic Forces, and Weak Forces

Modern physics classifies four types of forces: strong forces, electromagnetic forces, weak forces, and gravitational forces. The strength of these forces is rated in the same sequential order, the strong forces being about 137 times as strong as the electromagnetic forces. The forces in the nucleus are the strong forces. Under the conditions set forth in this paper it has been shown that electromagnetic forces associated with the proton and neutron combinations can be as large as the so-called strong forces. Hence it appears that the strong forces are not so mysterious.

No claim is being made in this paper for a complete theory of the nucleus of the atom. The figures simply illustrate the reasonableness of stronger electromagnetic binding forces in the nucleus than previous theories have considered possible. The forces in the pair combinations were illustrations of extremely strong electromagnetic binding forces. In the actual nucleus of an atom it is unlikely that these pairs would have this same configuration because one never has just two protons or two neutrons in a nucleus. Except for hydrogen there would always be more than two of these particles in the nucleus and hence a more complex arrangement than with just a pair. Nevertheless the plausibility of sufficiently strong electromagnetic binding forces in the nucleus has been made possible by these concepts of the proton and neutron, the components of the nuclei of atoms.

It also appears that one could make a case for the weak force as being of the electromagnetic type between the electron ring and proton sphere in the new model of the neutron. The weak forces are associated with the type of decay that exists in the neutron when it is outside the nucleus of an atom. It appears then that both the strong forces and the weak forces may be only electromagnetic forces associated with the electromagnetic configurations of the proton and electron ring phenomena.

9. Neutron Model

The concept of an electron ring is based on the assumption that the electron spin is strong enough in the vicinity of a proton to deform the electron into a ring. If a free spherical electron falls into the magnetic field of a proton, the electron will certainly have a spin induced into it. With the new concept of an extremely strong magnetic field of a proton there should be sufficient magnetic flux linkage with this nearby electron to produce sufficient spin to deform the electron into a ring.

In the aforementioned companion paper the author has proposed a rotating ring electron to meet the non-radiating condition for a classical model of the hydrogen atom. As previously mentioned this is superior to the orbital electron model in the Bohr atom, the defect in the orbital model being loss of energy through radia-

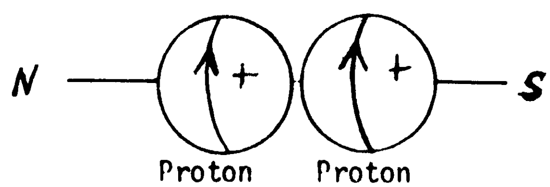

Figure 2. A more stable configuration of two magnetically bound protons.

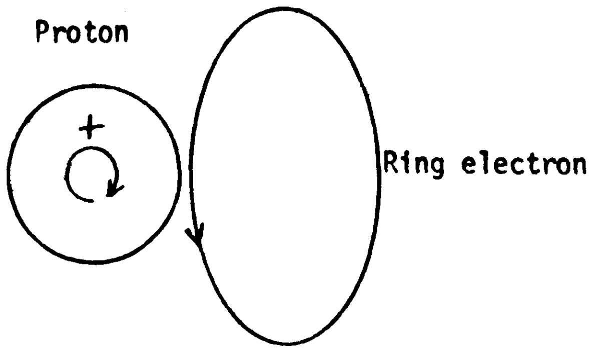

Figure 3. Hydrogen atom components. An electron ring and a proton spinning in the directions shown have the positive and negative charges held apart, despite their mutual attraction, by the magnetic repulsive force.

tion. In the hydrogen atom a stable state is achieved when the magnetic moments of the adjacent spinning proton and rotating ring electron are parallel, pointing in the same direction as shown in Fig. 3. The actual configuration of the electron is more complex than shown in Fig. 3 but the orientation of the magnetic moments is as shown in that figure.

The interest in this present paper is in an application of the electron ring and the associated proton sphere to the new model of the neutron. Even though the neutron has no net charge it has a magnetic moment. That implies a rotation of charges. Hence it is logical to assume that it does not contain an electron and proton in some type of rotational motion. The electron and proton must be held apart, not discharged together.

Assume that the electron ring in Fig. 3 is forceably flipped over 180 degrees so as to be concentric with the proton as shown in Fig. 4. The direction of rotation is the same for the electron ring and the proton. Because one charge is plus and the other minus their magnetic moments have opposite directions. The electrostatic attraction would shrink the electron ring size down somewhat but it would achieve a balance condition still larger than the proton radius. The adjacent portions of the electron and proton currents have opposite directions, providing a strong magnetic repulsion to prevent the merging of the plus and the minus charges.

The non-radiating condition would also hold for the electron ring in the stable neutron within the atom. This

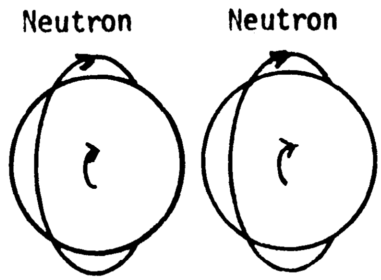

Figure 5. Neutron-neutron bound together by the net magnetic moments of each neutron.

combination of electron and proton satisfies the following requirements for a neutron: 1) no net charge, 2) extremely small size, 3) has a magnetic moment, 4) has less stability in the free state than the stability of an electron and proton in the hydrogen atom, and 5) releases energy when the neutron decays into an electron and proton.

10. Attraction Between Other Nuclear Combinations

The magnetic force can hold other nuclear pairs together. Fig. 5 illustrates an orientation of a neutron-neutron pair that can be held together by the magnetic force. The neutrons are in-line and their charge components spin about the common axis. The magnetic moments provide the basis for the net electromagnetic force being a magnetic attraction. Although there is no net charge the distribution is such that there will be some electric repulsion in the near field, but there is sufficient magnetic attraction to provide the required binding force.

Fig. 6 illustrates the orientation of a neutron-proton pair. There is a strong enough magnetic force in this combination also to bind the proton and neutron.

11. Momentum and Magnetic Moment Considerations

One of the most basic laws of physics is the conservation of angular momentum. The total angular momentum of an isolated system is constant. For the neutron the total angular momentum, the spin, $S_n = \hbar/2$ where $\hbar$ is Planck's constant divided by 2π.

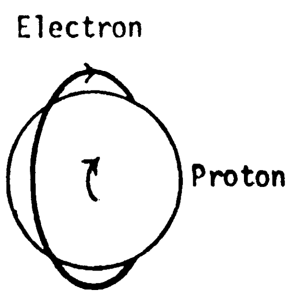

Figure 4. A neutron, its electron ring and proton spinning in the directions shown. The magnetic repulsive force holds the positive and negative charges apart.

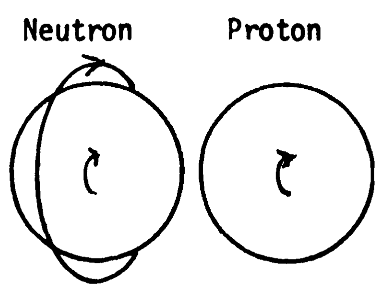

Figure 6. Neutron-proton bound together by the net magnetic moments of each.

The angular momentum equation for this neutron model is

$$m_e a_e^2 \omega_e + \frac{2}{5} m_p a_p^2 \omega_p = \hbar/2 \qquad (12)$$

The first term on the left side of the equation is the angular momentum of the circular electron ring of mass m_e, radius a_e, and angular velocity ω_e. The second term is the angular momentum of the spherical proton of mass m_p, radius a_p, and angular velocity ω_p. Because the electron and proton spin in the same direction these angular momenta add up to give the total angular momentum $\hbar/2$ of the neutron.

The magnetic moment M_n of the neutron is known. The magnetic moment equation for this neutron model is

$$\frac{-q a_e^2 \omega_e}{2} + \frac{q a_p^2 \omega_p}{3} = -M_n \qquad (13)$$

in which q is the numeric value of the electric charge. The first term on the left is the magnetic moment of the rotating ring electron and the second is the magnetic moment of the spinning proton. The minus signs in Eq. (13) indicate magnetic moments that have the opposite direction from the spin direction. Since the net value of the neutron's magnetic moment is negative it means that the rotating electron ring's contribution to the magnetic moment is greater than that of the proton.

12. Beta Decay of the Neutron

Outside the atom the neutron is unstable. This instability is consistent with the electron-proton configuration in this model. That configuration is one of unstable equilibrium. A displacement along the axis would, through the action of the magnetic repulsion, eject the electron from the neutron. That decay is an example of beta decay. The neutron has a half life of 960 second and beta decay energy[6] of 1.2536×10^{-13}joule.

One may use that value of beta decay energy to compute the radius of the electron ring in the neutron. Consider the neutron as having been formed by bringing the electron in from its free state to its position in the neutron at distance a_e from the center of the proton. The potential energy delivered to the electron to accomplish this is

$$\text{P.E.} = \frac{q^2}{4\pi\epsilon a_e} \qquad (14)$$

The beta decay is just the reverse process. Hence the beta decay energy is equal to that value of potential energy. Substituting the value of beta decay energy into Eq. (14) in place of the P.E. one obtains for the radius of the electron ring $a_e = 1.8404 \times 10^{-15}$ meter.

13. Angular Velocities

Solving simultaneous Eqs. (12) and (13) for the electron and proton angular velocities:

$$\omega_e = \frac{5q\hbar + 12 m_p M_n}{(10 m_e + 6\, m_p) q a_e^2} \qquad (15)$$

$$\omega_p = \frac{15 q\hbar - 60\, m_e M_n}{(20 m_e + 12 m_p) q a_p^2} \qquad (16)$$

Table 1.

q	$= 1.602191 \times 10^{-19}$ coul
$\hbar$	$= 1.0545919 \times 10^{-34}$ Js
M_n	$= 9.66318 \times 10^{-27}$ amp m^2
a_e	$= 1.8404 \times 10^{-15}$ m
a_p	$= 1.02316 \times 10^{-18}$ m
m_p	$= 1.672614 \times 10^{-27}$ kg
m_e	$= 9.109558 \times 10^{-31}$ kg
m_n	$= 1.674920 \times 10^{-27}$ kg

The angular velocities may be computed by aid of the values in Table 1. There is, however, a problem with the masses. The mass of the neutron exceeds the sum of the proton and electron mass by 1.39504×10^{-30}kg. Converting this to energy equivalent mc^2 one sees that this is the same as the beta decay energy, and likewise the potential energy given up by the electron in "forming" the neutron. Hence it appears that this mass 1.39504×10^{-30}kg., should be added to the electron mass when it is in the neutron, yielding the value $m_e' = 2.306 \times 10^{-30}$kg. Using that value for the mass of the electron and the other values from Table 1 in Eqs. (15) and (16) yields angular velocities: $\omega_e = 5.091 \times 10^{22}$radian/sec, and $\omega_p = 7.473 \times 10^{28}$radian/sec. In accordance with conservation of angular momentum if the electron is ejected to its free state (no spin) the total angular momentum would then reside in the proton. The free state proton has the angular momentum $S_p = \hbar/2$, which is in agreement with conventional theory. The proton's free state angular velocity can be computed from

$$\frac{2}{5} m_p \omega_p a_p^2 = \hbar/2 \qquad (17)$$

yielding $\omega_p = 3.0114 \times 10^{29}$rad/sec. Using that angular velocity and $M_p = (q a_p^2 \omega_p)/3$, the proton's free state magnetic moment is $M_p = 1.6836 \times 10^{-26}$ amp m^2.

14. Refinements of the Model

The electron ring would have some radial depth, its inner radius being smaller than a_e and outer radius larger. This width of the charge in the ring would also have an effect on the magnetic flux distribution, increasing the magnetic repulsion force over and above the magnetic dipole field effect.

The force balance equation on the ring includes the coulomb attraction between the unlike charges, the magnetic repulsion, the tension in the ring, and the centripetal force.

The mean radius can be computed from the beta decay energy in precisely the same way as the idealized ring electron. The equivalent radius for the electrostatic force equation must take into account the inverse square effect.

If the beta decay is to yield a free electron with nonzero kinetic energy, that can be achieved in the neutron model by increasing the magnetic induction. It would require additional energy in forming the neutron from a free electron and a free proton, over and above the aforementioned potential energy transition. The decay would then include a stronger repulsion force and yield kinetic energy in the separated electron, in an amount equal to that excess energy introduced in the formation of the neutron.

The present paper simply introduces the basic concepts. Some of the computed values will perhaps have to be altered somewhat as more information is obtained on the electron ring configuration.

15. Problems with Experimental Verification

Modern physics has developed a very complex hierarchy of particles and anti-particles to "explain" almost every type of phenomenon associated with particle physics. A tremendous number of experiments have been made to discover and confirm these particles. Had it not been for the past experimental work the numerical values in Table 1 would not have been available for the development of this present paper.

It is, however, still the business of physicists to look for new approaches in the hope of generalizing the base. It would take something quite different from the present approach in modern physics to ever achieve a more generalized base for consolidating the concepts. It is believed that the concepts developed in this paper, which also go back to the alternative to special relativity developed in previous papers, have some promise of reducing the number of basic forces from four to two.

There is always the problem of trying to determine whether or not the theory is consistent with experiment. That is not a simple problem because no one really is familiar with all of the experiments. Textbooks never give all of the details of the experiments. Neither do they give all of the pertinent experiments. So a lot of this hierarchy of particle physics rests on the confidence that our inheritance of experimental and theoretical development has been dependable. But the basic problem really is the possibility of alternate interpretation of any and every experiment.

16. Summary

Some quite new concepts have been incorporated into the proton and neutron models. The modern physics assumption of equal fixed intrinsic spin angular momentum of $\hbar/2$ for the electron, proton, and neutron have been abandoned. It is believed that the spin will indeed be altered by magnetic induction when these elementary particles move into or out of a magnetic field. A recent paper gives evidence that the proton's spin may not be constant.[7] The reasoning is that: "the energy associated with a proton's spin is constant, and so it becomes more violent.—Only in the past few years have experimental techniques been devised for testing this assumption. It has turned out to be quite wrong. The influence of spin does not diminish as the energy of a collision increases; on the contrary, spin seems to become more important as the collision becomes more violent." This effect seems to be consistent with the angular momentum concepts employed in the new models of the proton and neutron.

Acknowledgment

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[3]*Ibid.*

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THE TRIPLETS' PARADOX

JEFFREY LEE*

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Relativity is more than adequately acquainted with the "Clock Paradox" or "Twins Paradox". In this familiar argument one of the two twins boards a rocket and journeys to a distant star at a velocity near that of light, c, only to find that upon returning his "stay at home" twin is much older than he. While years passed for the twin on Earth, only days or weeks passed for the twin who journeyed in the rocket.

The cause for this is the relativistic time dilation effect brought about by the moving twin's velocity with respect to the Earth's still frame of reference. The paradox which arises leads to several questions: Who actually moved? Who will actually experience the time dilation? Will a clock riding along with the twin in the rocket actually slow down and our astronaut twin physically age less? Will clocks on the Earth slow down from the viewpoint of the still frame of our astronaut twin and the "stay at home" twin age less? Or will both clocks of both observers slow down symmetrically?

A variety of explanations and answers to all these questions are explored at length by numerous articles, books and scientific papers. While some authorities say that the time dilation effect is symmetrical others bring in the Doppler Effect; and still others use reasoning

*Mr. Jeffrey Lee's address is P.O. Box 52, Whittier, California 90608.