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W. Fields

H. Miller

J. Whitmore

D. Davis

G. Detwiler

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Authors

W. Fields, H. Miller, J. Whitmore, D. Davis, G. Detwiler, J. Ditmars, R. Whitelaw, and G. Novaez

A CRITIQUE OF THE FUNDAMENTAL ASSUMPTIONS OF QUANTUM MECHANICS

PHILIP B. GASKILL

ABSTRACT

The quantum is attributed to resonance in the atom or molecule. The point particle is contrary to scattering and spin experiments. A finite-size particle model provides a physical explanation for particle characteristics. It is concluded that these assumptions of quantum mechanics are not based on a solid experimental foundation.

INTRODUCTION

Quantum mechanics is a theory which demands consideration by scientists working toward a complete Creationism model of the physical world. Quantum mechanics attempts to construct a description of physical reality wherein random chance and objective probability underlie all events. It is apparent that the idea of an objectively random universe is in agreement with the theory of Evolution, thus quantum mechanics provides the foundation for the Evolutionary world-view, the antithesis of Creationism.

Because the Evolutionary world-view is scientifically and philosophically inconsistent, one would expect the same to be true for quantum mechanics. This paper is an attempt to examine the scientific validity of quantum mechanics.

Fundamental Assumptions

Quantum mechanics contains many assumptions and principles which guide its formulation. Two of these could be considered the most fundamental, 1. The quantum; 2. The point particle.

The theory of quantum mechanics utilizes these assumptions to construct a description of the physical universe wherein matter is composed of point particles possessing intrinsic, quantal attributes and interacting through the transfer of energy and momentum by discrete particles of varying rest mass.(1)

THE QUANTUM

The concept of quanta caused a revolution in physics which resulted in the demise of classical mechanics and promoted quantum mechanics as a more complete description of physical processes. But from an examination of the supposed evidence for quanta it becomes obvious that the concept is wholly unnecessary.

The concept of quanta was invented by Max Planck to explain experimental data on blackbody radiation. The behavior of heated blackbodies differs greatly from the classical prediction of the Raleigh-Jeans formula, making it obvious that a different mechanism is needed. Planck's empirical packaging scheme, embodied in the formula, $E=h\nu$, provides an accurate mathematical description of blackbody radiation where the Raleigh-Jeans formula fails, and also reduces to the classical case where it is applicable.

The data from blackbody radiation, along with the photoelectric effect, Compton effect, and line spectra of atoms, was eventually interpreted as evidence that light was both emitted and absorbed in discrete units named quanta. This concept was hard to reconcile with the vast amount of experimental data indicating the wave nature of light. That, however, is a separate problem not discussed here. Instead it will be shown that the evidence for quanta can also be interpreted as evidence for an internal resonance in the atom or molecule, and held that this is the correct view.

Blackbody Radiation and Atomic Line Spectra

The blackbody radiation phenomenon exhibits a discrete nature in the emission of radiation from a heated object. The intermittent emission of radiation was interpreted as evidence that the radiation was emitted in discrete packets instead of continuously. However, as noted by Planck(2), the intermittent nature of emission tells nothing about the nature of the radiation itself. To insist that intermittent radiation requires intermittent (discrete) carriers of that radiation is logically inconsistent. The primary reason that the blackbody radiation phenomenon was later included in the supposed body of evidence for the quantum was that it meshed with the quantum-mechanical explanations of the photoelectric and Compton effects. The phenomenon of blackbody radiation, in itself, therefore indicates nothing about the nature of light or energy. It is then legitimate to search for an alternative plausible mechanism whereby the blackbody phenomenon can be explained. A resonance in the atom or molecule involved, restricted to specific frequencies by internal structure, is a logical choice. This possibility is further supported by the striking similarity between data curves for the blackbody phenomenon, and general resonance curves. (Figures 1 & 2)

When an electrical current is passed through a gas such as hydrogen, the energetic atoms emit radiation at certain dominant frequencies (line spectra). According to the quantum-mechanical theory of the atom, these line spectra are produced by electrons jumping from one discrete orbit to another in the atomic structure, and emitting a quantum of radiation associated with the difference. The quantum-mechanical model seems to explain this phenomenon quite well, at least in principle. This is taken as evidence for quanta and the quantal characteristics of the atom. However, this interpretation employs circular reasoning. Atomic line spectra can be interpreted as evidence for quanta only in the framework of the quantum-mechanical model whose validity is assumed from the same experimental data. It is clear that, based solely on experimental results, the phenomenon of atomic line spectra indicates nothing about the nature of the light emitted. Atomic line spectra can easily be explained by resonance in the atom or molecule, which is restricted to specific dominant frequencies by internal structure.

A resonance model which is applicable to both the blackbody radiation phenomenon and atomic line spectra would involve vibrational modes of the electric charge structure within the atom. As noted by Thomas Barnes(3), a resonance system with extremely high Q (little internal resistance) would produce very sharp resonances and vibrate for an extremely large number of cycles. This would result in sharply defined dominant frequencies and radiation that is coherent through millions of wavelengths. It appears that a resonance model of blackbody radiation and atomic line spectra is very much in agreement with the experimental data.

The Photoelectric Effect

The photoelectric effect occurs when light strikes the surface of a metal. Photoelectrons are ejected out from the metal almost immediately, and leave the surface with kinetic energy less than or equal to a maximum. These aspects of the phenomenon present no problem for classical physics. It is also found that the effect is dependent upon the frequency of the incident light instead of its intensity, and that there is a threshold frequency, for the incident light, below which no photoelectrons are emitted. This frequency-dependence is held to be contrary to classical physics. Let us examine this claim.

The photoelectric equation may be written so that the quantum, $h\nu$, is equal to the maximum kinetic energy of the photoelectron plus the work function, or energy required to remove the electron from the surface of the metal. Einstein attributed the quantum to a discrete particle of light, the photon. However, others such as Poincare(4) and Ives(5) thought it belonged in the molecule. Respected quantum experimentalist Alain Aspect(6) admits that though the photoelectric effect has a well-known particulate or quantal quality, the light that triggers it need not be particulate or quantal. It is possible to construct a perfectly feasible model of the photoelectric effect based on a resonance in the atom or molecule. This explanation seems plausible since the phenomenon is frequency dependent and also exhibits a threshold frequency, both characteristics of resonance phenomena.

Herbert Ives' experimental work on photoemission, involving standing waves of polarized light, yields the same photoelectric equation as Einstein's but attributes the effect to an internal resonance in the atom, not to a quantum in the incident light. In his 1951 Rumford Lecture, Ives explained the results of his experiments with two planes of incident polarized light:

> You will see that the crucial point - the enormous ratio of the photo-electron emission for the two planes of polarization at high angles of incidence - is completely accounted for by this theory that the emission is proportional to the energy density in the standing wave system...(7)

Ives also states that:

> Viewing the phenomena presented by standing waves, it is... extremely difficult, if not impossible to retain the idea of light as consisting of discrete photons.(8)

In further support of the resonance model, Thomas Barnes(9) has developed a classical model of the hydrogen atom wherein a resonant phenomenon in the atom is responsible for the photoelectric effect.

The Compton Effect

The Compton effect involves an X-ray impinging on an atom with the subsequent emission of an electron and the change in wavelength of the scattered X-ray. The equations of Compton, which utilize a particle model of light, are able to accurately describe the effect. This is taken as evidence for the particle nature of light.

However, one of the indications that Compton scattering is not the simple scattering of a photon from an electron is that the effect appears to be dependent upon the state of the atom involved.(10) The effect is greater for free atoms than for atoms in a crystal lattice, as shown by Figure 3. This can easily be explained by assuming that the presence of neighboring atoms in the crystal lattice restricts the energetic resonance of the atom involved. In such a resonance model, Compton scattering is considered to be a special case of the photoelectric effect. Ralph Sansbury(11) suggests this model for the photoelectric and Compton effects: the incident radiation produces oscillations of charge "in the scattering material which in turn produces resonant ejection of a photoelectron and/or the secondary X-ray radiation and recoil of a free electron."(12)

G. Burniston Brown(13) gives this explanation of the shifted wavelength of the X-ray radiation:

> The wave account holds that the electrons are set into oscillation by the X-rays reradiation, and the change in wavelength of some of them is a Doppler effect.(14)

This appears tenable since it is believed that the Doppler effect is a possible explanation for certain characteristics of Compton scattering.(15)

Summary

From the above consideration it can be seen that blackbody radiation and atomic line spectra data lend no support to the concept of quanta. They can both be easily explained by resonance in the atom or molecule. It has also been shown that the photoelectric effect can be explained, in principle, by a resonance in the atom or molecule and that the Compton effect is simply a special case of the photoelectric effect and can be explained in like manner. However, as noted by Ives(16), these explanations are complex and not yet complete:

> I do not minimize the difficulty of arriving at an explanation of all optical phenomena, such for instance as the Compton effect, in terms of wave transmission and quantum "vestibules"; nevertheless, on the basis of a long preoccupation with standing waves, I venture to predict that this will be done and the photon will go the way of the "caloric" that Rumford demolished.(17)

THE POINT PARTICLE

The second fundamental assumption of quantum mechanics, the point particle, was placed on questionable grounds soon after the development of sophisticated scattering techniques, employed to determine the structure of nucleons. It has been well established by several experimenters that the behavior of at least the proton and neutron deviates from point particle scattering laws.

The Proton

In electron scattering experiments involving liquid hydrogen and deuterium under high pressure and electron energies from 100 Mev to 550 Mev, it has been clearly shown that the proton has a finite size and internal charge distribution, by Hofstadter(18) and others.(19) (Figures 4 & 5)

The Neutron

Based on experimental data from neutron-electron interactions, Foldy(20) has determined that the interaction stems from an internal electromagnetic structure of the neutron. The work of Hofstadter(21) and others(22), based on electron scattering, also yields data in support of a finite-size neutron. (Figure 6)

The Electron

The electron's size is somewhat of a puzzle. It has been indicated by Yennie, Levy, and Ravenhall(23) as well as by Foldy(24) and also Hofstadter(25), that a finite electron size could very well enter into the data on scattering. A finite electron size could also offer an explanation for the larger-than-expected core distribution of the proton(26) in terms of an additional factor (the electron's size) in the interaction. The concept of a finite-size electron will be developed later.

Pionic and Kaonic Atoms

Lucas(27) has found that while the point particle idealization works well for electronic atoms, it fails with pionic and kaonic atoms where the nucleus and meson both have finite size and overlap each other in the lowest energy levels.

Finite-Size Particles and Quantum Mechanics

It is clear from the above discussion that the proton and neutron are not point particles. An incorporation of this new data into quantum mechanics has been attempted, but strictly on the assumption that the finite size of the particles is due to their internal charge structure being composed of point particles called quarks.(28) This treatment is highly speculative at best since individual quarks have never been observed, only asymmetrical charge densities.

Spin

The necessity of point particles in quantum mechanics follows from its inclusion of Hamiltonian mechanics, which conceives of forces acting on geometrical points. Thus quantum mechanics must assume inherent attributes of spin and magnetic moment with no physical explanation, since the normal explanation for such phenomena assumes a finite-size particle.(29) An attempt to incorporate finite-size data into quantum mechanics by employing the quark model does not eliminate the non-physical explanations for spin and magnetic moment since the quarks are thought to be point particles.(30) Based on the quark model, one would expect the spin of a particle such as the proton to be constant since it is the result of the additions of the quarks' spins which are inherently fixed and non-physical.

Testing Spin

In accordance with the above explanation of the proton's spin, one should be able to test the point particle model of the quark by experiments involving the proton's spin.

The effect of the proton's spin in high-energy proton-proton collisions should be negligible. Alan Kirsch explains in his 1979 article, "The Spin of the Proton":

> The reasoning behind this assumption is simple: the energy associated with a proton's spin is constant, and so it becomes an ever smaller fraction of the total energy as the collision becomes more violent...(31)

This assumption does not agree with experiment:

> 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 the collision increases; on the contrary, spin becomes more important as the collision becomes more violent.(32)

At this point, writing in 1979, Kirsch concludes:

> The large and unexpected influence of spin on large-angle scattering strongly constrains any theory that would explain violent scattering experiments in terms of the fundamental constituents of the proton.(33)

Recent experiments(34,35,36) confirm the results of Kirsch and also show that they are applicable to a wide energy range.(Figure 7) It is therefore concluded that the quark model is inconsistent, though its symmetric nature appears to have some validity.

Finite-Size Proton, Electron, and Neutron Model

Since it is apparent that the quantum-mechanical, and in particular the point-particle, model is inconsistent with experiment, a finite-size particle model is the most logical choice.

A finite-size model would provide a physical explanation for spin and magnetic moment by assuming that one or more of the "charges" inside a particle such as the proton or electron is in orbit about a central "charge." This produces a current loop which in turn produces the magnetic moment fields. From this consideration we see it is likely that the electron has a finite size since it has a magnetic moment.

The neutron is considered to be a compound particle composed of the electron and proton. It could be thought of as a collapsed hydrogen atom. Thus one would expect that the neutron should have an anomalous moment distribution greater than that of the proton. This is in agreement with one of the possible alternative explanations of Schiff's(37) conclusions, which seem to indicate a vanishing neutron charge density in the deuteron. Schiff also assumes(38) that the free nucleon densities are not deformed in the deuteron binding. If, however, it is assumed that finite-size particles are elastically deformable, then Schiff's conclusions are in agreement with a non-vanishing neutron charge density. Thus the finite size particle model is in excellent agreement with scattering and magnetic moment data.

(Note: See the appendix for a further development of the finite-size particle model.)

CONCLUSION

Blackbody radiation, atomic line spectra, the photoelectric effect, and the Compton effect are all explainable, at least in principle, by a resonance in the atom or molecule. Thus the concept of the quantum as a fundamental characteristic of light is seen to be untenable.

The point particle of quantum mechanics is contradicted by high-energy electron scattering and proton-proton spin experiments. It is also evident that a finite-size particle model can be constructed which, at least in principle, is in excellent agreement with experimental data. Therefore, the point particle is untenable.

Though it is not possible to thoroughly examine the foundation of the broad-reaching quantum mechanics in a paper of this length, it is possible to show that quantum mechanics is based on questionable assumptions, a possibility which I believe has been realized in this paper. It is my hope that this paper will stimulate further research into the nature of the resonance in the atom or molecule, and also into the addition of finite size particle effects to classical descriptions so that the long-neglected field of classical physics may be revived. It is, I believe, our hope for the future.

ACKNOWLEDGEMENTS

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APPENDIX

It has been shown that a finite-size model of the proton and neutron is in agreement with experimental data. It has also been shown that a finite size structure composed of point particles does not agree with experimental data. It is therefore reasonable to develop a model which considers the proton, at least, to be elementary and of inherent finite size. It will be shown later that an elementary electron and composite neutron of inherent finite size are also plausible.

In a proton of extended charge distribution, it is conceivable that one or more of the "charges" takes up an orbital position about a "charge" which acts as the center of the proton. An orbiting "charge" will naturally create a current loop which gives rise to the magnetic moment of the particle. An orbital "charge" or "charges" would also produce the angular momentum or spin of the particle. Thus, the magnetic moment and spin of the proton should be closely related. Since the spin of the proton arises from orbital motion within the proton's structure, an increase in the proton's total energy should cause an increase in the magnitude of the proton's spin. This assertion is in agreement with data from proton-proton spin experiments.(39,40)

It can also be seen that the proton's shape is not inherent, but is dependent on the orbital motion of its internal "charges." Thus, an alteration of the orbital structure of the particle should manifest itself as a deformation of the proton's shape. Orbital alteration could conceivably be caused by the influence of "charges" outside the proton's structure (i.e. another finite-size particle). The case of the deuteron charge densities(41) seems to be in agreement with the above model.

A finite-size particle model also gives an explanation for the possibility, raised by Schiff(42), that the anomalous moment distribution of the neutron is considerably larger than that of the proton. In the finite-size model, the electron exhibits characteristics similar to those of the proton (i.e. magnetic moment, deformation, etc.) because it has a finite size also. If the neutron is composed of an electron and a proton, an inference drawn from its decay (the neutrino will be discussed later), then it is reasonable to assume that the electron adds an additional component to the proton's magnetic moment and this creates a large neutron moment. But, a reasonable mechanism must be found to explain the separation of the oppositely-charged electron and proton in close proximity. This mechanism is the magnetic moments of the two particles. If the poles of the two particles' "magnets" are oppositely oriented, then a large repulsive force would be generated at small distances of separation. This would serve to counter the electrical attraction between them.

In accordance with the orbital "charges" model of the proton and electron, the spin and magnetic moment characteristics of the free particles should be different than the characteristics of the same particles in the confines of the neutron configuration. This is a result of the deformation of the orbital structures of the two particles. Since it is also known, from the finite-size model, that a portion of a particle's total energy is attributed to its spin, the deformation of the particles in the neutron should cause a suppression of the spin energy and a tendency toward the free-particle state. This tendency is presumably stabilized by the influence of other nucleons when the neutron is located in the nucleus, but when the neutron is free it decays into its electron and proton components.

In a conventional model, utilizing point particles and their necessary inherent characteristics, the decay of the neutron would appear to violate conservation laws. In the finite-size particle model, however, the components have alterable characteristics and they return to their normal values and orientations of spin, magnetic moment, etc. in their free state. Since, in principle, no discrepancies arise in a finite-size model of neutron decay, there is no need for the neutrino in this process.

The above model of finite-size particles is by no means complete and much investigation into the advantages of such a model is still needed. It is encouraging to note that Lucas(43) and Barnes(44) have developed similar models. Therefore, it seems reasonable that the finite-size particle model is indeed a viable approach to a complete physical theory of particles.

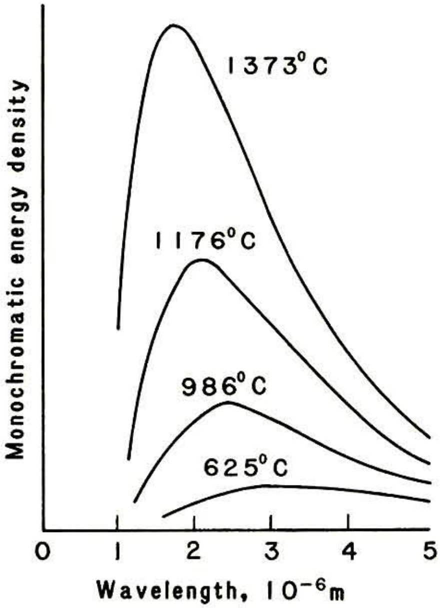

Figure 1. The monochromatic energy density of blackbody radiation as a function of temperature. (taken from Beiser, MODERN PHYSICS: AN INTRODUCTORY SURVEY, p.18)

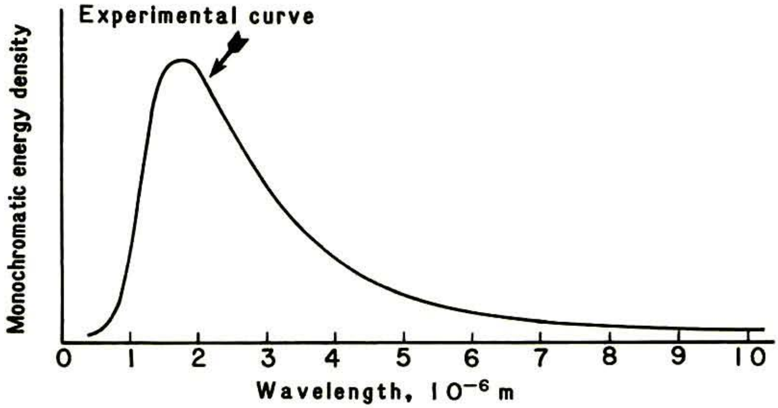

Figure 2. The experimental data for blackbody radiation at a temperature of 1600° K. (from Figure 1-12 Beiser, MODERN PHYSICS: AN INTRODUCTORY SURVEY, p.20)

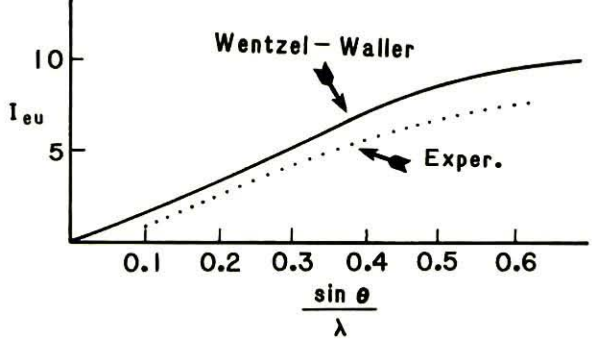

Figure 3. Comparison of the Wentzel-Waller theoretical curve for Compton scattering with the experimental curve. (from Curien, REVIEWS OF MODERN PHYSICS, vol.30, No.1, p.233)

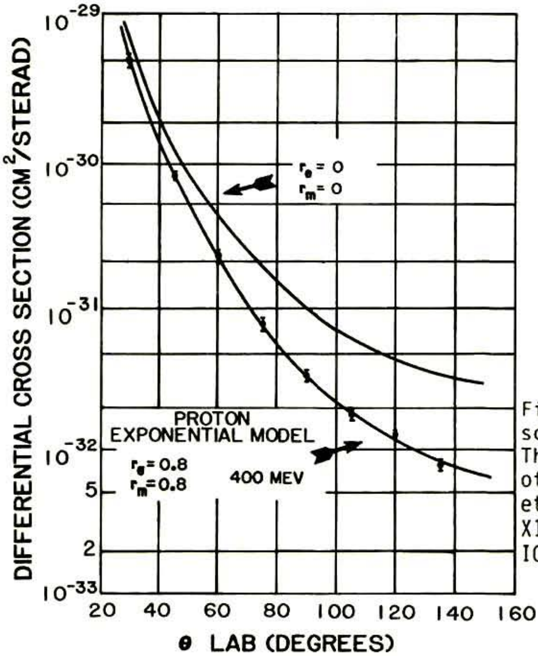

Figure 4. Typical angular distribution for elastic scattering of 400 Mev electrons against protons. The solid line is a theoretical curve for a proton of finite extent. The model providing the theoretical curve is an expotential with rms radii=0.80 X10^{-13} cm. (from Hofstadter, REVIEWS OF MODERN PHYSICS, vol.28, No.3, p.235)

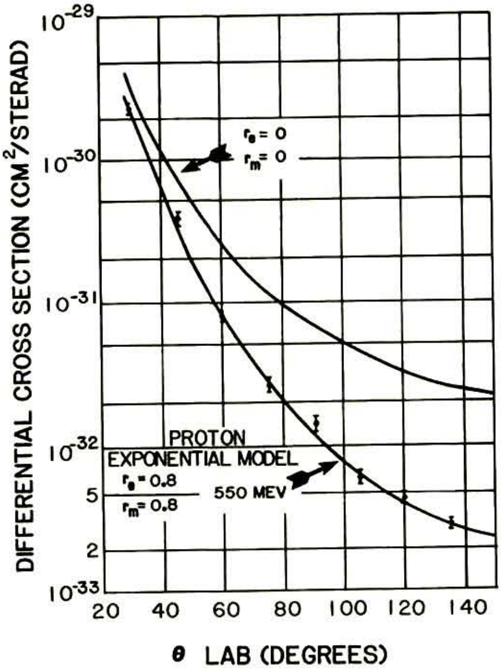

Figure 5. The experimental electron-proton scattering data of Chambers and Hofstadter observed at an incident energy of 550 Mev. The Rosenbluth point-charge curve is shown above. Drawn through the experimental points is a theoretical curve with $F_1 = F_2$ and a choice of an expotential model of the proton with appropriate choices of rms radii. The best fit is obtained with $r_e = r_m = 0.80 \times 10^{-13}$ cm. (from Hofstadter, Bumiller, and Yearian, REVIEWS OF MODERN PHYSICS, vol.30, No.2, p.484)

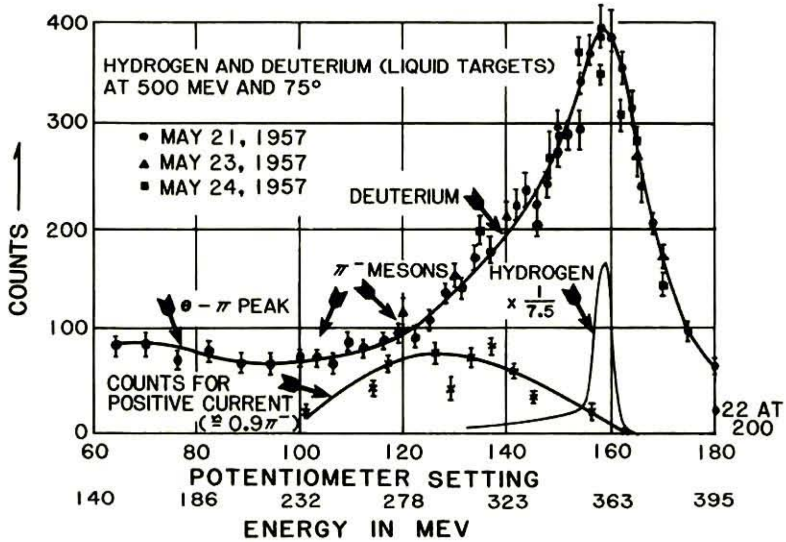

Figure 6. The inelastic peak corresponding to scattering of 500 Mev electrons from deuterons at an angle of 75° in the laboratory system. The experimental data are those of Yearian and Hofstadter. The data are immediately seen to be incompatible with a neutron whose magnetic moment is a point. (from Hofstadter, Bumiller, and Yearian, REVIEWS OF MODERN PHYSICS, vol.30, No.2, p.490)

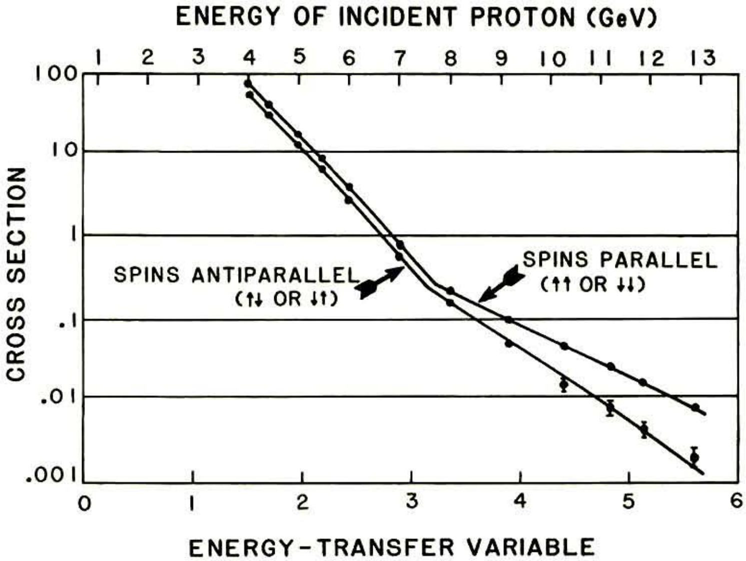

Figure 7. The cross section at 90 degrees - the probability of scattering at that angle - is plotted against the energy-transfer variable for the collisions. Two sets of data have been plotted, one in which the spins of the incoming proton and the target proton were parallel and one in which the spins were antiparallel. For low values of energy the parallel and antiparallel cross sections are identical, as predicted by the prevailing theory of the proton's structure and properties, quantum chromodynamics (QCD). At higher energies, however, the cross sections diverge noticeably. (from Kirsch, SCIENTIFIC AMERICAN, vol.257, No.3, p.45)