The SOFT Nucleus

By James E. Beichler

One of the greatest unrecognized failures of twentieth century physics has been the inability to develop a single unique theoretical model for the atomic nucleus. There are presently two dominant theories, the shell model and the fluid model, each of which successfully explains different aspects of the nucleus from their own exclusive perspectives, but still remain mutually incompatible. The scientific community seems satisfied with a status quo that depends upon the experimental measurement of half-lives and a corresponding but incomplete understanding of the process of nuclear decay, so the development of a complete nuclear theory has been pushed back from the forefront of scientific efforts. This situation would seem intolerable in a scientific age when theorists are attempting to develop a 'theory of everything' (TOE), even though the basic problem posed by the lack of a complete nuclear theory is largely ignored. Part of the reason for this dilemma can be found in the brilliant successes of the quantum theory over the past several decades, mesmerizing the scientific community into a belief that quantum theory will eventually explain everything, even the nucleus. But can this conclusion be considered the only valid option for the progress of science?

Quantum theory claims 'completeness' and with that claims the high road to developing a TOE, but still regards gravitational attraction within both the nucleus and outer atom as negligible and thus irrelevant and ignorable. Quantum theory is therefore incomplete and can never render a complete model of the nucleus. It can only approximate nuclear events, never totally explaining them without including gravitational interactions within the atom and especially inside the nucleus. In its probabilistic interpretation, quantum mechanics only describes the reactions of matter by mathematical methods, but the mathematics of probability cannot be substituted nor account for the substantial reality of physical matter itself. Nor can quantum theory account for the space-time curvature within nuclei and individual particles that does represent the physical reality of matter and seems for all intents and purposes (relativistically speaking) mathematical singularities.

Theoretical physics is presently split between these two paradigms, the quantum and relativity, even as some scientists are trying to unify them without direct reference to the nucleus, the very point at which the two paradigms would logically merge into one. On the other hand, even the simplest differences between these two fundamental theories reflects a deeper concern inherent in our common scientific view of physical reality that has also been largely overlooked by the scientific and scholarly communities. The primary question is not whether physical reality is deterministic or indeterministic as has been debated for the past eight decades, but whether it is discrete or continuous as represented by the shell and fluid models of the nucleus, respectively. The argument for the deterministic and indeterministic nature of reality is only an auxiliary concern, and should have no immediate bearing upon a nuclear theory.

In this respect, the quantum theory fails again. The most advanced quantum theory is 'quantum field theory' (QFT), but a 'quantum field' is impossible since the quantum is discrete and the field is continuous [1], a fact that the quantum theorists would have the scientific community as a whole overlook, if not completely forget. The best that any QFT could ever hope to accomplish is an accurate, but not absolute, mathematical approximation of the continuous field. The quantum cannot act as a substitute for the field in any complete theory, because gravity would always fall between the cracks made by the inherent differences between the discrete and continuous viewpoints, the nether world of physical effects so small as to be considered negligible, as has been the case in previous attempts to derive a unifying TOE. In a true TOE, no physical effect would be negligible and thus left unaccounted for.

Under these circumstances, it is natural to turn to the concept of a pure field, represented by relativity theory, as a more effective and truer basis for new theory of the nucleus. In particular, an extension of the relativity theory called the single field theory (SOFT) offers the most comprehensive model of the nucleus. SOFT is based upon the reality of a fifth physical dimension. This concept is not new and has a very distinguished history, as will be demonstrated. In SOFT, our four-dimensional space-time continuum is curved into the fifth dimension, or rather, it is embedded within the five-dimensional space occupied by a single continuous field. In fact, our four-dimensional space-time continuum is the densest part of this five-dimensional field. SOFT completely incorporates both general and special relativity as true representations of our physical reality. The physical reality underlying quantum theory is continuous, not discrete, and the discrete nature of our common four-dimensional existence is a product of the five-dimensional continuum. SOFT also accepts the Kaluza five-dimensional model of a combined gravitational/electromagnetic field as its mathematical basis, with a small exception.

Kaluza placed specific restrictions upon his five-dimensional electromagnetic model. For mathematical purposes, individual points in continuous four-dimensional space-time were viewed as extended five-dimensional lines called 'A-lines.' The 'A-lines' formed parallel closed loops of equal length in five-space. However, Kaluza further stated that the 'A-lines' must be of very short length compared to distances in normal space-time since we do not experience and cannot experimentally detect the fifth dimension [2]. Oskar Klein used this 'periodicity' along the 'A-lines' at the quantum level to develop a quantum theory of five-dimensional space-time [3], but later abandoned his work after making other futile attempts to correct his model [4]. More recently, Superstring theories have adopted the original Kaluza-Klein model (ignoring Klein's later models) as the basis of their own attempt to unify all of physics [5].

More realistically, there is no need to limit the five-dimensional extension of 'A-lines' after the manner prescribed by Kaluza and adopted by Klein. In 1938, Albert Einstein and Peter Bergmann [6], and again in 1941, Einstein, Bergmann and Valentin Bargmann [7] demonstrated that the original Kaluza model yielded Maxwell's equations when the restriction limiting 'A-lines' to a very short extension in the fifth direction was abandoned. So there is no longer any need to limit the extension of 'A-lines' into the fifth dimension to quantum lengths. Einstein published no further work in this direction of his search for a unified field theory. He gave up his search for a unified field theory based upon the Kaluza five-dimensional model stating that such a model could not be used unless it could be explained why we do not experience the fifth dimension [8]. This notion could be called the Einstein condition, while the stipulation that the 'A-lines' are closed and of equal length could be called the Kaluza condition. Any serious attempt to develop a five-dimensional theory must meet both the Einstein and Kaluza conditions.

Einstein missed the fact that a five-dimensional model could be easily based upon his theoretical research in the late 1930s if the approach taken by William K. Clifford in the 1870s [9] was taken into account. Clifford attempted to develop a four-dimensional model of electromagnetism without unifying space and time as Einstein did in 1905. He, and his followers, thought that our normal three-dimensional space formed an extended sheet within a higher four-dimensional space. Clifford sought to develop a geometry based mathematical model to describe his physical model of space [10], but his life was cut short by consumption before he could completely develop his ideas and publish his theory. Charles H. Hinton did develop a philosophical model of this four-dimensional physical space in the 1880s and thereafter [11], but he did not develop the mathematical model of the theory any further. When the model that Clifford and Hinton proposed is combined with the work of Kaluza, Einstein, Bergmann and Bargmann, the single field described by SOFT emerges as a completely unified field out of which the quantum and quantum theory naturally emerge. In this manner, the SOFT mathematical model fulfills the Kaluza condition as well as the Einstein condition by limiting our world of matter and relative space-time to an existence within the four-dimensional 'sheet.'

Five-dimensional space is strictly governed by the continuity of the single field that is further characterized by a varying density. The four-dimensional 'sheet,' which serves as our commonly sensed space-time, is actually the densest portion of the five-dimensional field. However, the 'sheet' can be represented mathematically by an 'effective width' of quantum proportions in the fifth direction. The 'effective width' serves to define the quantum as well as our common material and discrete existence. The 'sheet' curves spherically in the macroscopic domain to render the Riemannian curvature of the universe as a whole as prescribed by general relativity, while there are three basic forms of curvature in the smallest possible local portions of the 'sheet' at the quantum level.

The first form occurs when the 'sheet' just begins to curve locally, forming burble, which corresponds to a neutrino. The second occurs just before the local curvature becomes great enough to actually fold upon itself, and is called an electron, while the third case occurs when the 'sheet' actually folds upon itself locally and forms a proton. These three forms represent the true elementary particles as defined by SOFT. Each of these particles can be represented by a 'field density center' which lies along the 'A-line' corresponding to the geometrical center of the particles in three-space, or rather, the five-dimensional extension of a particle's classical center of mass. While this central 'A-line' is important for mathematical reasons, particles are not points in four-dimensional space but extended portions of curvature in the 'sheet.'

According to the mathematics of a single polar Riemannian space, as developed by Simon Newcomb in 1877 [12], a physical object passing along an extension into the fourth spatial dimension and back into three-dimensional space would twist by 180 degrees and exchange right for left. This concept was even used by H.G. Wells as the basis of a science fiction story in 1897 [13], demonstrating that the concept was well known prior to the early twentieth century. Since an 'A-line' must be closed in its circuit around the fifth dimension, the central 'A-line' representing an elementary particle would twist, like a Moebius strip, as it returns back into itself in normal space-time if five-space exhibits a single polar Riemannian geometry. This 'twist,' as Clifford called it [14], corresponds to our modern concept of half spin and serves to explain many previously mysterious physical phenomena.

Particle paths and the development of an equation of motion in quantum theory are normally defined by the Schrödinger wave function that is commonly interpreted as representing probability densities. However, the concept of the Schrödinger wave function is completely compatible with this five-dimensional model without reference to probabilities. In 1926, William Wilson derived the Klein-Gordon equation by assuming that the wave function was actually a five-dimensional volume [15]. Wilson conducted further work on this model of the wave function, but H.T. Flint, deriving more advanced models using the five-dimensional wave function, including the Dirac equation, conducted far more mathematical research in this area [16]. In the SOFT model, the Wilson five-dimensional volume corresponds to the volume delineated by the 'effective width' of the four-dimensional space-time continuum, which corresponds to an elementary particle. Therefore, the SOFT model is mathematically compatible with the Schrödinger wave function for elementary particles and thus all of wave mechanics without the need to adopt or refer to a probabilistic interpretation of the wave function.

A neutron forms from the combination of an electron and proton whose 'field density centers' fall along the same central 'A-line.' The central 'A-line' of the proton and electron 'twist' parallel to each other and thus overlap without coupling end-to-end forming a single continuous 'A-line.' So any coupling of 'A-lines' must come from a new unspecified 'A-line' of opposite twist or spin, in order to conserve the parity of the combination. From the four-dimensional perspective, the electron and proton are stacked one upon the other in the fifth direction and thus occupy the same space in the normally experienced space-time continuum, appearing as a single neutron. A free neutron is unstable due to the overlapping or coincidence of the two independent 'A-lines,' or rather; the four-dimensional space-time curvature at the quantum level tends toward or favors the three natural extremes of local curvature that define the neutrino, electron and proton. Yet it is the 'stacking' structure of the electron and proton in the fifth dimension to form the neutron that implies the basic structure of the atomic nucleus.

Take for example the simplest combined nucleus, that of deuterium, consisting of a single proton and a single neutron. The proton and neutron are 'stacked' one upon the other in the fifth direction. Their individual 'field density centers' fall along a single central 'A-line' that corresponds to the four-dimensional center of mass of the nucleus. This 'stacking' gives the nucleus its internal structural characteristics as described by the 'shell' model of the nucleus. But from the four-dimensional perspective, the nucleus would remain approximately spherical with a 'mixing' of proton and neutron that would seem 'fluid' in nature. The SOFT model thus unifies the shell and fluid models within a single simple geometrical framework, so the adoption of a real fifth dimension has led directly to a method of unifying all of physics at the nuclear level where the quantum and relativity would logically be expected to merge.

A free neutron rapidly decays according to the formula n --> p + e + anti-neutrino, and parity is only conserved by the creation of the anti-neutrino. In order to substantialize that 'A-line' that was necessary for the original coupling from its purely mathematical existence, the smallest form of curvature possible was created, in this case an anti-neutrino. Within the neutron, the spins of the bound proton and electron are parallel along their 'A-lines,' but the 'A-lines' are not coupled end to end. In other words, the individual central 'A-lines' lay side by side in the fifth direction and are not continuous with one another, so the neutron decays. Under these circumstances, parity cannot be conserved when the neutron decays by the spontaneous separation of the overlapping central 'A-lines' of the individual particles. When that neutron combines with a proton to form a deuterium nucleus, the central 'A-line' of the proton couples with the component central 'A-lines' of the neutron forming a single continuous central 'A-line' representing the deuterium nucleus. The continuity of the combined central 'A-line' gives the deuterium nucleus the stability that the individual neutron lacks.

Two neutrons and two protons can combine together in much the same manner to form a helium nucleus that is the most stable nuclear configuration possible. In the helium nucleus, the ends of each and every individual central 'A-line' is coupled, leaving no ends free, forming a single continuous central 'A-line' representing the complete nucleus. The overriding stability of the helium configuration is demonstrated by the fact that the helium nucleus, as an alpha particle, is a primary and common decay product in the radioactive decay of much larger nuclei. On the other hand, when two neutrons combine with a single proton, as in the tritium nucleus, they cannot couple together completely to form a single continuous 'A-line' representing all the constituent particles in the nucleus, much in the same manner as the individual neutron. So the tritium nucleus is unstable and undergoes nuclear decay to stabilize.

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