The Density Gradient in White Dwarf Stars

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In connection with assembling the material for a new edition of the 1959 book in which I introduced the theory of a universe composed entirely of motion, I am reviewing the progress that has been made in the intervening 22 years, both in the development of the details of the theory itself and in the fields of observation and experiment, to make certain that the new work has the benefit of these advances. One item that came to my attention during this review is particularly important because it supplies a positive verification of the theoretical findings as to the structure and density of the white dwarf stars, a result that has far-reaching implications.

In order to appreciate the significance of the observed facts in relation to the theory, it is necessary to understand the general nature of the motion of which the theoretical universe of motion is composed. The most important direct consequence of the postulates that define this universe is the existence of a general reciprocal relation of a scalar nature between space and time. By reason of this reciprocal relationship, motion in such a universe can take place either on the basis of a space-time ratio of 1/n, a speed less than unity (which we can identify as the speed of light), in which case the change of position takes place in space, or on the basis of a space-time ratio of n/1, a speed greater than unity, in which case the change of position takes place in time. The first of these alternatives is the prevailing motion in our immediate environment. What I have shown in my previous publications is that the extremely compact astronomical objects discovered in recent years—white dwarf stars, pulsars, quasars, etc.—are aggregates whose components are moving at greater-than-unit speeds.

Of course, the idea of speeds in excess of the speed of light conflicts with Einstein's dictum that such speeds are impossible, but to err is human, and Einstein is no exception. As usually happens in such cases, the error stems from the use of an invalid assumption. In his book, *The Character of Physical Law*, Richard Feynman points out that when we put all of our presumed knowledge together, "we get inconsistency, because we get infinity for various things when we calculate them, and if we get infinity how can we ever say that this agrees with nature?" Feynman attributes this inconsistency to the use of "a number of tacit assumptions… about which we are too prejudiced to understand the real significance." What Einstein apparently did not realize is that one of the assumptions on which he based his conclusions violates a universal law: the Law of Diminishing Returns.

Strangely enough, this law, generally recognized in most other fields of thought, is practically ignored in science. But we cannot repeal a law of nature by ignoring it. This is the law that prohibits the infinities that Feynman deplores. It tells us that the ratio of the *output* of any physical process (such as the acceleration of a mass) to the *input* (in this case, the applied force) does not remain constant indefinitely, but eventually decreases, and ultimately reaches zero.

So the relation expressed in Newton's Second Law of Motion, F=ma, *cannot* remain constant. Recognition of this fact leads to an interpretation of the experimental results that is quite different from Einstein's. Instead of his conclusion that it is impossible to exceed the speed of light (which follows if, as he assumed, the relation F=ma remains constant), the correct interpretation is that it is impossible to accelerate a mass to a speed greater than that of light *by means of an electrical force*. In other words, the limitation is not on the speed, but on the capabilities of the process. The significance of this is that it does not preclude acceleration to higher speeds by other means, such as the sudden release of large quantities of energy in violent explosions.

One of the reasons why Einstein's interpretation of the observed facts has been so widely accepted in spite of its unsound foundation, involves another of the "tacit assumptions" mentioned by Feynman. It has been *assumed* that a speed in excess of that of light would result in a corresponding increase in the rate of change of spatial position. The absence of any observed changes of position at higher rates (except for some observations of quasar components, whose true significance is still in doubt) has therefore been regarded as a confirmation of Einstein's conclusion. But here again, the conclusion that has been drawn goes beyond the evidence, which applies only to the rate of change of position in space, and has relevance to the speed only insofar as the change of position due to the motion takes place in space. In the universe of motion, the change of position is in space if the space-time ratio (speed) is 1/n. It is thus impossible for a change of position *in space* to take place at a rate (speed) in excess of unity (the speed of light), because the limiting value of the quantity 1/n is 1/1. But this does not mean that higher speeds are impossible; it merely means that motion at higher speeds, with space-time ratio n/1, is motion in time rather than motion in space.

According to the theory of a universe of motion, the neutral condition is motion at unit speed, and the motions of the universe as a whole are symmetrical around this level, the true speed magnitude in each case being the deviation from unity. As a result of the space-time symmetry, the effect of any motion in time is the inverse of the effect of the corresponding motion in space. The particular motion with which we are concerned at the moment is the motion imparted to the products of the explosion of a star: a supernova. Some of the products of such an explosion are ejected at speeds less than that of light, and they take the form of a cloud of particles moving outward in space from the site of the explosion, but remaining in the original location (the moving location indicated by a clock) in time. Another portion of the explosion products is accelerated to speeds greater than that of light. These products take the form of a cloud of particles expanding into three-dimensional time, but remaining in the original location in space. This cloud of particles is the white dwarf star.

As I have shown in my publications, a development of the details of the properties and the evolutionary course of the white dwarfs on this theoretical basis leads to results that are in full accord with the observations. For present purposes, however, we are concerned only with the density relations. The expansion of the (relatively) slow-moving explosion products into space results in a large *decrease* in the density of the expanding aggregate. Because of the reciprocal relation between space and time, the expansion of the fast-moving product into time results in a large *increase* in the density of this aggregate. The white dwarf star is therefore an object of abnormally high density, compared to a normal star. Furthermore, the density gradient is the inverse of that which prevails in the normal stars; that is, the center of the white dwarf is the region of greatest compression in time (equivalent to expansion in space), and it is therefore the region of minimum density.

This picture of the white dwarf derived from the theory of a universe of motion is, of course, quite different from the currently popular view, and it is possible that many individuals will find it little short of outrageous. But the reason for writing this article is that in the course of my review of the progress in the white dwarf field that has taken place in recent years, it became evident that some of the information about these objects that is now available supplies a *positive confirmation* of the upside down nature of the white dwarf structure.

As pointed out by James Liebert in a review article in the 1980 *Annual Review of Astronomy and Astrophysics*, it is generally conceded that the apparently normal matter in the outside layers (atmosphere) of the white dwarf stars must have been accreted from the environment. (The development of the theory of a universe of motion arrives at this same conclusion.) This matter, then, is mainly a mixture of hydrogen and helium, with hydrogen as the major constituent. If conventional theory is correct, the heavier element, helium, will preferentially move downward, leaving the outer layers of the star enriched in hydrogen. On the other hand, if the inverse density gradient required by the theory of a universe of motion actually exists, the hydrogen will preferentially move downward, and the outer layers will be enriched in helium. The verdict from observation is unequivocally in favor of the universe of motion. Liebert reports that the "cooler helium-rich stars" are "the most numerous kind of white dwarf," and that some have almost pure helium atmospheres. "The existence of nearly pure helium atmosphere degenerates over a wide range of temperatures has long been a puzzle," he says. But it need not continue to be a puzzle. The helium accumulates in the outer layers because these are the regions of greatest density in the white dwarf.

This theoretical conclusion, strange as it may seem in the light of current thought, is further confirmed by an examination of the behavior of the elements heavier than helium, commonly lumped together as "metals" in discussions of stellar composition. The metals, too, should preferentially accumulate in the regions of greatest density: the center of the star, according to current astronomical theory; the outer layers, according to the theory of a universe of motion. Liebert describes the observed situation in this manner:

> The metals in the accreted material should diffuse downward, while hydrogen should remain in the convection layer. Thus, the predicted metals-to-hydrogen ratio would be *at or below solar* (interstellar) values, yet real DF-DG-DK stars have calcium-to-hydrogen abundance ratios ranging from about solar to well above solar.

Here again, as in the helium distribution, the verdict is unequivocal. The larger concentration of the heavier elements in the outer regions definitely identifies these as the regions of greatest density, a result that is inexplicable on the basis of conventional theory, but is specifically required by the theory of a universe of motion. Liebert admits that no plausible explanation on the basis of current astronomical theory is known. The only suggestion that he mentions is that the accretion of hydrogen must be blocked by some kind of a mechanism, a far-fetched idea without the least support from observation.

When it is viewed in conjunction with the gradual decrease in component speeds that takes place as energy is lost to the environment, the inverse density relation also supplies an explanation of the occurrence of novae. The continued energy losses eventually result in the speeds of some of the constituent particles dropping below the unit level, and into the region of motion in space. These particles then occupy more space because of their spatial speed, and they form "bubbles" that move to the region of least density, the center of the star. Accumulation of this material with high spatial speeds builds up a gas pressure. Eventually the pressure reaches a level at which it breaks through the overlying matter, resulting in a flare-up of the star, as the hot material from the interior is exposed briefly. The outburst relieves the internal pressure, the star resumes its normal condition, and a new pressure build-up begins.

The explanation of the origin, the extreme density, the novae, and other properties of the white dwarfs that I derived originally by deduction from the properties of space and time as they exist in a universe composed entirely of motion requires some significant conceptual reorientation, and most astronomers have been reluctant to entertain the possibility that current ideas may have to be altered to such an extent. However, more and more of those who examine the existing problems carefully are recognizing that *something* will have to undergo a drastic change, and are assessing the situation in a manner similar to the following from Martin Harwit:

> The fundamental nature of astrophysical discoveries being made—or remaining to be made

> —leaves little room for doubt but that a large part of current theory will have to be drastically revised over the next decades. Much of what is known today must be regarded as tentative and all parts of the field have to be viewed with healthy skepticism. (*Astrophysical Concepts*, Wiley, New York, 1973, page 9)

The big problem, of course, is to determine just *what* has to be changed, and what has to be put in its place. The inverse density gradient that we find in the white dwarfs now identifies one of the requirements that must be met by the "drastically revised" theory. It must provide a new explanation of the white dwarf structure that incorporates this upside down density relation. Perhaps there are alternative ways in which this requirement can be met, but it seems rather obvious that the first step in exploring the situation ought to be to take a good look at the theory already in existence that *anticipated* this requirement.