White Dwarfs, Nova and Stellar Youth in the General Theory

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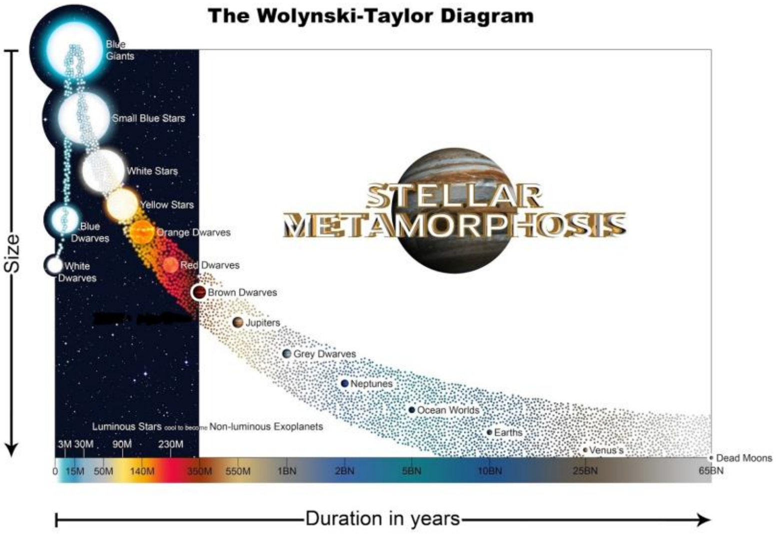
Abstract: A few thoughts as compared to early scientists on white dwarfs, (super)novas and stellar youth in the general theory.

White dwarfs are the youthful stars in the General Theory. Therefore some corrections can be made concerning the establishment's acceptance of them being old stars. White dwarfs are in the tens of thousands of degrees Kelvin, some even hundreds of thousands. No dead star is that hot on their surfaces, dead stars have temperatures in the tens of Kelvins. It was theorized that white dwarfs can cool down to the tens of degrees Kelvin, but since none have been observed in any part of the galaxy, and the universe is eternal according to the eternal universe principle, then the concept of a super-dense Earth sized black dwarf the density of a white dwarf can be laid to rest.[1] Below is a diagram that shows where white dwarfs are located on an evolution diagram. They are on the left hand side and are very hot, young, dense stars that expand outwards becoming blue giants.



It is mentioned in the book, Voyage Through The Universe: Stars, by Timelife (1989), that, "*astronomers were even beginning to understand how stars evolve---except for one nagging question. If stars shine by burning up their nuclear fuel, then what occurs at the end of a star's life when its fuel is exhausted?*" This brings up an extremely important point, one that I have just realized while writing this. The processes behind fusion can only occur inside of electron degenerate matter and where the matter has a high enough velocity to overcome the Coulomb barrier.

White dwarfs can be a location for fusion type reactions, as an additional source of heavy material, other than AGN's and radio galaxy jets, though they are not dead stars as well they cannot experience any large scale fusion type reaction after large portions of the electron degenerate matter have gained electrons. As well cannot fuse matter without an event triggering a reaction, young white dwarfs and stars in general cannot fuse matter strictly by themselves. There has to be a stable nuclear potential formed, and then triggering reactions take place after the fact. What this means is that as a white dwarf expands outwards the likelihood of events to trigger fusion reactions from the electron degenerate matter being compressed is lowered, because there is less degenerate matter to work with. The electron degenerate matter undergoes plasma recombination near the surface where it can interact with interstellar dust and the electron shells that expand outwards cause the whole body of the star to expand from the outside in. The central regions are the last place for electron degenerate matter to take up residence. So essentially establishment dogma has it backwards. The white dwarfs are where the action is, and once they get really big and all the degenerate matter is gone, the fusion potential party is over. From then on dull but still highly energetic thermochemical and electrochemical events take hold, causing the star to exhibit elemental interactions that we are familiar with on Earth.

1a. Establishment dogma has white dwarfs being the ending stages of a star's evolution, yet none have been found that are near the low temperatures of the most evolved stars like Neptune or Earth.

1b. They also have them not being powered by fusion at all, but the leftover heat from fusion reactions, long in their theorized past. Yet, clearly they are the beginning stages of star evolution, so forcing them to have long histories is misguided.

1c. As well, actual dead stars are composed of material that is full of electrons, such as rocks/minerals, which prevent their nuclei from interacting.

1d. Lastly, they have degenerate matter as lacking electrons, thus forced a concept called "electron tunneling" to overcome a barrier that was never needed to begin with, inside of stars that are no longer fusing matter, such as the Sun. White dwarfs have no electron barrier between the nuclei of their atoms. If a large iron rich asteroid were to smack into a white dwarf when it is young, it would trigger a fusion reaction, thus an actual physical explanation of (super)nova is provided. It also explains why you can see supernova or nova remnants, the entire star did not explode, just a large part of the electron degenerate matter gained electrons, causing enough pressure to push the already close nuclei of the degenerate matter together, because of the newly expanding electron shells. Basically the degenerate matter is not perfectly stable when you have a body in outer space, especially when you have iron/nickel asteroids roaming about.

The next few pages are notes and copies out of the book.

However, there was still a problem. The proton-proton reaction explained the energy output of the Sun, but it fell far short of the energy radiated by hotter, more massive stars. "So I said to myself, 'Well, maybe there is something else for these bigger stars,' " recalled Bethe.

Bethe mulled over the problem on his way back to Cornell. Another kind of reaction chain was clearly needed. Upon his return he began a systematic search through laboratory data on nuclear reactions, starting from the lightest and simplest nuclei and working his way through the heavier species, checking every one that could possibly react with protons. "Nothing seemed to work," he recalled, "and I was almost ready to give up. But when I tried carbon, it worked. So, you see, this was a discovery by persistence, and not by brains."

Bethe realized that each carbon nucleus in the center of the Sun acts rather like a soft ball of clay: Each time a proton hits it, the proton sticks. The nucleus collects four extra protons in this way before the particles split off as a single helium nucleus. The result once again is four protons gone, one helium nucleus created, and a lot of energy generated.

According to Bethe's figures, the carbon cycle would contribute very little energy in a star the size of the Sun, which is why the proton-proton reaction explains the Sun so well. But with more and more mass, the carbon cycle would soon become a star's dominant energy source. Sirius, for example, with a mass more than twice that of the Sun, derives its power almost entirely from the carbon cycle.

Working out the details took Bethe six weeks. In the summer of 1938, he sent the finished paper to the *Physical Review*. But then a graduate student, Robert Marshak, pointed out to Bethe that the New York Academy of Sciences was offering a $500 prize for the best unpublished paper about energy production in stars. "So I asked the *Physical Review* to return the paper to me, and I promised Marshak a finder's fee of ten per cent," recalled Bethe. "I got the prize and he got the fifty dollars. I used part of the prize to help my mother emigrate. The Nazis were quite willing to let her out, but they wanted $250, in dollars, to release her furniture. Part of the prize money went to liberate my mother's furniture." It was not the last prize Bethe was to win for his summer's labor. In 1967 he was awarded the Nobel prize in physics for elucidating the energy source of the stars.

January 13, 2018
JJW

STARS IN OLD AGE

Thus, by the eve of World War II the energy source of stars on the main sequence of the H-R diagram was well understood, thanks to the work of Atkinson, Houtermans, Bethe, and their colleagues. Astronomers were even beginning to understand how stars evolve—except for one nagging question. If stars shine by burning up their nuclear fuel, then what occurs at the end of a star's life when its fuel is exhausted?

False. Evolved/dead stars are composed of rocks/minerals.

As it happens, the question had been answered in the late 1930s. Few had recognized it, because the solution was opposed and ridiculed by a figure of

The nagging question should have been, "do we have observations of the oldest stars?"

enormous stature and influence, a man who had so often championed unpopular ideas himself: Arthur Stanley Eddington.

The question of stellar death turned on white dwarf stars, one of the more remarkable specimens in the astrophysical zoo. Their existence was foreshadowed in 1844, when the German astronomer Friedrich Bessel noticed a slight irregularity in the motion of Sirius. In the next three decades, astronomers learned the irregularity was caused by the gravitational attraction of a barely visible companion star, Sirius B, which is almost as massive as the Sun. However, Sirius B (and a handful of other such stars discovered by Eddington's day) is much smaller than the Sun. In fact, it is roughly the size of the Earth, which means that it has a fabulously high density. As Eddington wrote later, "The message of the Companion of Sirius when it was decoded ran: 'I am composed of material 3,000 times denser than anything you have come across; a ton of my material would be a little nugget that you could put in a matchbox.' What reply can one make to such a message? The reply that most of us made in 1914 was—'Shut up. Don't talk nonsense.' "

A white dwarf seemed to be an impossibility. On the one hand, said Eddington, a star of such incredible density would have to consist of atoms that had been completely stripped of their protective cloud of electrons and then crammed together, nucleus to nucleus. This was conceivable only if the star was extremely hot—hot enough to ionize the atoms completely. White dwarfs were in fact known to have surface temperatures of 10,000 degrees Kelvin or more. This was twice as hot as the Sun, implying interior heat on the order of 50 to 100 million degrees.

On the other hand, Eddington continued, as hot things radiate energy, they are supposed to cool off. So when a white dwarf's sea of ionized atoms cool off enough, the electrons should return to their orbits, forcing the nuclei apart as atoms fill out to normal size. If the atoms moved apart, then the white dwarf as a whole would have to expand. Paradoxically, however, to do so, it would have to press out against its own ferocious gravity, and with no more fuel to burn, it simply would not have enough energy. "I do not see how a star that had once got into this compressed condition is ever going to get out of it," wrote Eddington. "Imagine a body continually losing heat but with insufficient energy to grow cold."

White dwarfs expand into blue giants

The white dwarf is the ~~begin~~ beginning stages of stellar evolution, not the end!

The solution to the paradox came from quantum mechanics, which was first applied to the white dwarf problem in 1926 by Eddington's Cambridge colleague Ralph Howard Fowler. According to Fowler, atoms in a white dwarf are ionized, all right; the mistake lay in assuming that electrons would recombine with nuclei as the star cooled. The very fact that the material was so tightly packed meant that the electrons were sharply constrained in position, unable to travel very far. But according to the Heisenberg uncertainty principle, this would just force the electrons to be highly unconstrained in momentum—so unconstrained, in fact, that they would usually be moving much too fast to reunite with their nuclei. So the star would never swell up after all.

January 13,
2018
—JJW

There was never a paradox. The white dwarf's material undergoes plasma recombination and expands greatly, losing heat.

It isn't a mistake, plasma recombines into gas, it is a basic thermodynamic phase transition.

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False, this conjecture neglects the influence by outside electrons being injected into the star, triggering (super)novas.

Further support for white dwarfs, said Fowler, came from the exclusion principle, a statement formulated several years earlier by the German physicist Wolfgang Pauli. The principle says that two identical particles cannot occupy the same quantum state in an atom; in a sense, they cannot be in the same place at the same time. In the context of white dwarfs, Pauli's principle meant that electrons would strongly resist being jammed on top of one another. The result would be a new kind of pressure, known as degeneracy pressure. This finally resolved Eddington's paradox. Not only would degeneracy pressure be strong enough to withstand the crushing gravity of a white dwarf, but it would be independent of temperature. It would persist even when the star cooled to absolute zero.

Degeneracy pressure is interrupted by objects, such as iron meteorites entering the star. This is what causes different types of nova. So a "nova" is a new star, but only as a part of external ~~intro~~ interruptions. No stars (young stars) nova by themselves.

Eddington found Fowler's solution profoundly satisfying. His colleague had solved the mystery of white dwarfs while explaining what happens to ordinary stars when they exhaust their hydrogen fuel. They simply shrink into white dwarfdom, slowly radiating away their remaining heat until they become dark cinders held up by degeneracy pressure. But Fowler's theory had neglected something that Eddington of all people should have recognized—relativity. And in 1930, the year Eddington was knighted by the King, that oversight was brought forcibly to his attention with the arrival in Cambridge of a shy, intense, and dogged twenty-year-old from India.

There was no "hydrogen" fuel to exhaust. White dwarfs are hot/young/dense stars.

A SELF-TAUGHT QUANTUM PHYSICIST

Subrahmanyan Chandrasekhar was born in 1910 in Lahore, in what is now Pakistan, and grew up in the southern Indian city of Madras. His uncle was the great Indian physicist Chandrasekhara Venkata Raman, who was to win the Nobel prize for his work in atomic physics in 1930. "The atmosphere of science was always at home," Chandrasekhar recalled many years later.

As a student at the Presidency College in Madras, the teenage Chandrasekhar excelled in mathematics and physics. From thousands of miles away, he caught a few glimpses of the new world of quantum mechanics. Chandrasekhar taught himself what he could, working from texts and papers that were often out of date. Soon he was publishing original research papers of his own. He also won a college contest for the best essay on the quantum theory. Since the prize was a book, he asked for one that he had seen at the college library, Eddington's *The Internal Constitution of the Stars.*

Clearly, this was no ordinary student. When he graduated in 1930, the young man won a Government of India scholarship to do graduate work at Cambridge University. In those days, a trip from India to England involved weeks of living on a boat. Chandrasekhar, wanting to pass the time as productively as possible, set himself a little problem: Use the equations from Eddington's book to find the internal structure of white dwarf stars. This he did, incorporating Fowler's insights on degeneracy pressure. However, his results led him to a new problem. At the densities that would prevail at the center of such a star, electrons would be moving so fast that their velocities would approach the speed of light. And that meant that the laws of relativity

[1] http://vixra.org/pdf/1610.0143v2.pdf