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The Paradox of Neutron Decay in Neutron Stars

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Abstract: *Since neutrons cannot become a part of the atomic nucleus without protons, the idea of a long-lived neutron star becomes almost impossible.*
Keywords: *neutron, neutron decay, neutron star, Pauli's Exclusion Principle, proton, atomic nucleus*.

Introduction

It is well known that all celestial objects with a mass of 1.4 times to 3 times that of our sun evolve into another type of celestial object and not the usual white dwarf. The currently accepted theory is that in the last stages of life for celestial objects of this size is that the electrons are forced into the protons forming neutrons, creating a super compressed ball of almost pure neutrons; these celestial objects are called neutron stars. This current theory though does not account for neutron decay. I theorize a simple way, a sort of Occam's razor way, of physics that would explain the neutron content without violating Pauli's exclusion principle.

Discussion

When a celestial object collapses, the electrons are forced into the protons, thereby turning the protons into neutrons. Subsequently you would then have a mass composed entirely of free neutrons, although this could not be the case since all neutrons that are not joined with protons and contained inside the nucleus of an atom become extremely unstable and would decay within 15 minutes. Since neutrons cannot become a part of the atomic nucleus without protons, the idea of a long-lived neutron star becomes almost impossible. This now raises the question of what are these objects are composed of and what are the physics involved in these celestial objects.

I propose that the beginning of such objects is essentially the same, a celestial object between 1.4 and 3 times the mass of our sun collapses and due to the extreme gravity forms into a neutron star. The end result, and the physics involved, I believe are not totally understood yet. The composition of neutrons comes from the electrons and the protons being forced into one another, although all free neutrons decay within 15 minutes. Even with the time dilation (caused by gravity the star) they would eventually dissipate out of existence. The ability of the neutron star to maintain its neutron composition while not decaying out of existence takes the fact that within 15 minutes a free neutron decays into a proton, an electron, and an antineutrino.

My theory is that the neutron composition of a neutron star is maintained by neutron decays and the extreme gravity causing the proton and the electron back into one

another thereby forming a new neutron, which itself will then decay within 15 minutes, thus creating a constant chain reaction which supplies fresh neutrons. Also since the gravity of the neutron star is so strong, the electrons and protons cannot escape gravity's grip and have no other possibility but to recombine into neutrons. Although gravity from the object will cause time to slow considerably, increasing the lifetime of a free neutron exponentially, the 15-minute decay rate is based on Earth gravity scales and will be much longer in an increased gravity environment but the neutron will inevitably decay. This celestial object would have a very long life since most of its mass is essentially being constantly recycled, making it one of the most stable celestial objects in the sky.

Since a neutron star is constantly collapsing, it would continue to emit energy feed by its constant collapse, and so as long as the star has neutrons which are decaying and producing protons and electrons which are re-collapsing into neutrons, the star will continue to emit energy. I also theorize that this complete free neutron content could be considered as another state of matter, caused by strong gravity, much like extreme heat/energy forms another state of matter called plasma. This state of matter would have very unusual behavior and underlying physics, unlike any other. Either way, it is clear that we are not yet capable of understanding the physics of such strong gravity at this time, and the exact nature of the physics of a neutron star are still not known.

Conclusion

This theory easily solves the paradox of neutron decay and in part the physics of neutron stars, mainly the neutron composition of such celestial objects. I conclude that the neutron composition of the neutron star is maintained by the constant decay and rebirth of neutrons. At the very least, the physics and maybe even the formation of neutron stars, is not totally comprehended and understood. Further experimentation will not only yield more understanding of neutron stars, but also a better understanding of black holes and physics in general.

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