

# THE INNER CORE OF A NEUTRON STAR

## Part 1

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**Abstract:** Neutron stars are formed by super compaction that result from the gravitational collapse of a massive star after a supernova. Neutron star composition makes it so heavy that its density is at least twice the mass of Earth's Sun. Current thinking subscribes to the possibility that a neutron star is primarily made up of almost entirely sub-atomic particles without net electrical charge. Neutron stars are very hot and are supported against further collapse by super compression gravitational forces, such as quantum degeneracy pressure, due to the phenomenon described by the Pauli exclusion principle. This states that: "No two neutrons (or any other fermionic particles) can occupy the same place and quantum state simultaneously". Although this is true, little is known about the possible inner functioning mechanisms of the gravitational forces, and what the inner core of a neutron star in theory may or may not be composed of. This article was accomplished by utilizing the imaging capabilities of the Infinite Microscopic-Macroscopic Imaging (IMMI) technology to help ascertain in theoretical terms that the composition of the inner core of a neutron star must be composed of a super concentration of densely packed neutrons.

**Key words:** Neutron Stars, Neutron Star Properties, Super Novas

## 1 Introduction

### 1.1 Mass and Proportional Weight

Mathematically the surface temperature of a neutron star may be as much as  $\approx 6 \times 10^5$  K [14] [3] . However, some authors discuss in much greater depth

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and detail that the inner mechanisms and functions of a neutron star may have densities as high as  $3.7 \times 10^{17}$  to  $5.9 \times 10^{17}$  kg/m<sup>3</sup> ( $2.6 \times 10^{14}$  to  $4.1 \times 10^{14}$  times the density of Earth's Sun) [9] [6] [12] [7]. As a matter of fact, NASA clearly presents and demonstrates that a comparable atomic nucleus relating to a neutron star could also be equal to  $3 \times 10^{17}$  kg/m<sup>3</sup> [13]. Although [10] further explains and describes in simpler terms that a portion of the inner core of a neutron star (about 2.0 inches long x 0.5 inches thick, and with a density of up to  $3 \times 10^{17}$  kg/m<sup>3</sup>, with a diameter of about 1.5 inches containing neutron star material, would have a mass of approximately 5 trillion tons of Earth rock. Picture a sugar cube with a density of  $1 \times 10$  g/cm<sup>3</sup>, which would weigh 1 t.

## 2 Current Understanding of The Composition of a Neutron Star

Current understanding of the structure of neutron stars is defined by existing mathematical models, but it might be possible to infer through studies of neutron star oscillations. Similar to astro-seismology for ordinary stars, the inner structure might be derived by analyzing observed frequency spectra of stellar oscillations [7].

Where do the neutrons come from? The neutrons are formed due to the stellar core collapse, when the electrons in the iron-nickel are compressed into the protons in the iron-nickel nuclei. This cancels out their charges and leaves neutrons, releasing neutrinos in the process [11].

Current models indicate that matter at the surface of a neutron star is composed of ordinary atomic nuclei crushed into a solid lattice with a sea of electrons flowing through the gaps between them. Since neutrons have fewer quantum states than electrons, neutron degeneracy pressure is stronger than electron degeneracy pressure. The tremendous nuclear forces between the densely packed neutrons cause quantum waves, forcing the neutrons to flow along lines of minimized repulsive nuclear forces [8]. The tremendous nuclear forces between the densely packed neutrons cause quantum waves, forcing the neutrons to flow along lines of minimized repulsive nuclear forces. The neutrons are behaving as a superfluid, the state of matter where all particles flow without resistance and with zero viscosity, and where quantum properties prevail. It is possible that the nuclei at the surface are iron, due to iron's high binding energy per nucleon. This is likely, as most nuclear

processes have already culminated. It is also possible that heavy elements, such as iron, simply sink beneath the surface, leaving only light nuclei like helium and hydrogen. If the surface temperature exceeds  $10^6$  K (as in the case of a young pulsar), the surface should be fluid instead of the solid phase observed in cooler neutron stars (temperature  $<10^6$  K) [17] [2].

### **3 Accretion of a Neutron Star in a Binary Star System**

During the last ten years, the launch of X-Ray telescopes, such as the Chandra X-Ray Observatory, have also opened up new windows of opportunity, helping astronomers and astrophysicists to acquire a much better understanding of the properties of star accretion. This assists in the analysis and assessment of such conditions including the rapid variability phenomena that occur at time scales just outside neutron star surfaces. This is also discussed in greater detail in black hole horizons by Psaltis [15].

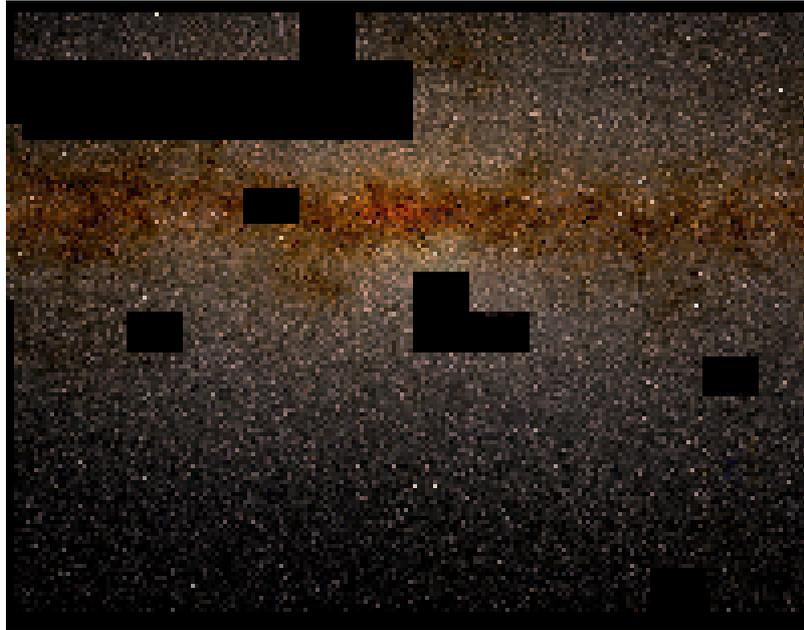
This paper further discusses that accreting neutrons stars and black holes have been monitored in broad spectral bands, from the radio telescopes and by some minimal direct imaging; also encouraging additional discussion that the possible identification of neutron stars with masses close to the maximum value allowed by general relativity. Therefore, in theory, and in theoretical modeling of accretion flows also experienced significant advances, such as the identification of a whole suit of stable solutions for accretion flows beyond the standard mode of geometrically thin accretion disks. This also offers an explanation of the very efficient transport of angular momentum in accretion flows.

### **4 Preliminary Views of a Neutron Star and Its Blue to Bluish Green Center**

2010 saw the culmination and described a massive undertaking that literally involved the work of hundreds of astronomers and scientists from all over the world, who gathered in the United Kingdom in order to finish the world's largest image. However, why was such an effort made to create the world's largest image? What was the reason that involved constant work in essentially stitching together approximately over thirty-thousand images of the center of the Milky way Galaxy, which started in 2000, and was not fin-

ished in 2010? When the image was finished, it measured over one hundred fifty billion pixels in diameter. The purpose behind this massive undertaking was to shrink this down to a size of only 6.0 inches in diameter<sup>1</sup>.

Figure 1: A piece of VISTA gigapixel mosaic of the central parts of the Milky Way (Source: [5])



However, Stewart [16] presents and demonstrates using the macroscopic expansion capability of the IMMI technology will be used to expand the above image which shows in extreme imaging close ups what a singular neutron star may look like within a probability factor within 96-97%.

Figure 2 is an astrograph of a possible neutron star within a (96-97%) probability. ESO [5] and Stewart [16] attest that the center of a neutron star is bluish to a bluish green color as seen in Figure 2, as previously noted by Baade & Zwicky [1].

## 5 Acknowledgements

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<sup>1</sup>The reader of this paper may be able to get some: "Hands On Experience" for themselves, by paying more than the usual attention to, and may be attained, by referring to the URL in [5].

Figure 2: Astrograph of a possible neutron star (Source: [5])



IMMI technology, for their help and granting permission to use the Infinite Microscopic-Macroscopic Technology (IMMI) applicable to telescopic instrumentation in helping to attain astrographs of the possible inner working mechanisms of a neutron star [16].

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