



CLASSICAL FIELD THEORY METHODS FOR GETTING TOV LIMIT AND GRAVITATIONAL RED SHIFT

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Abstract: A deterministic and unified theory of fields was developed in the previous publication. This theory includes a modified general theory of relativity and deterministic quantum mechanical theory too. In this article, by applying the Chandrasekhar's limit and the classical field theory Tolman -Oppenheimer-Volkoff (TOV) limit is very easily derived. By applying classical field theories, gravitational red shift of white dwarf and neutron stars are also derived.

Key words: Gravitational red shift and TOV limit.

Introduction: The author's D.Sc. degree thesis [1] mainly deals with developing a deterministic unified field theory [2][3] and a modified big bang theory of cosmology [4][5]. A modified general theory of relativity [3] is a part of developing the above mentioned theories. In this article, by applying classical field theory in the field of astrophysics, Tolman – Oppenheimer -- Volkoff limits [6] is derived and gravitational red shift of white dwarf and neutron stars are derived.

In the electrostatic and magneto static theories, electric and magnetic fields due to different charged bodies are found by applying Coulomb and Bio-Savart laws [7]. If certain conditions are satisfied, field of the charged bodies could be easily found by applying Gauss's law. The difference between Coulomb's law and Gauss's law of electrostatics is that the field of a charged particle acts at a point as per the Coulomb's law and the field of the same charged particle acts over a closed spherical surface as per the Gauss's law. So, the field due a charged particle could be considered as a spherical field or straight line fields. Since Newton's and Coulomb's laws are comparable, the gravitational field could be considered as spherical or straight line forms. Newton's law considers that the fields are acting in a straight line at a distance, but Einstein general theory of relativity considers gravitational fields in the curved forms. By assuming that the fields and space are one and the same, Einstein proved that the space is curved. But such an assumption was proved to be not required in [8].

In the modified general theory of relativity, the gravitational field inside a material body of mass M at a distance R is $M.G/R$ where G is gravitational constant [3]. This formula is valid if the material body is made up of atoms and molecules like in the sun like stars. Because atoms of the material body could be modeled as electric dipoles. The body of mass M could be considered as an array of electric dipoles. By such modeling and considerations, gravitational fields were proved to be electromagnetic fields [3]. So, inside the material body, the field is due to the electric dipoles is inversely proportional to R. But when two material bodies are interacting, the atomic dipoles of the bodies are oriented to attract each other material body. That is why gravitational forces are always attractive/ The attractive gravitational field is inversely proportional to R^2 .

In this article, by applying the Chandrasekhar's limit[] and classical field theory, Tolman – Oppenheimer – Volkoff limit for Neutron stars is very easily derived. Then by applying classical field theory, gravitational red shift formulas for white dwarf and neutron stars were derived.

Gravitational red shift of Sun's radiation:[3] Atomic radiation from the Sun's surface are affected by the gravitational pull of Sun. The electrons of the atoms at the surface are pulled down by the Sun's gravitational force. Electrons of the atoms are energized and they jump up to the higher levels and radiate electromagnetic energy, lose the energy and come back to the original level. The electrons in the orbits

of the atoms oscillates from the current state to the higher state and so, this oscillation between states and the radiation could be modeled as a Hertzian dipole radiator [9].

If the gravitational pull acts on the electrons, the period of the radiation T is reduced to $T - \Delta T$ where ΔT is the change in T due to gravitational pull. As per the Newton's second law of forces,

$$\text{Force} = M.a \text{ where } a \text{ is the acceleration due to gravity} \dots\dots\dots(1)$$

$$\text{Therefore, the gravitational field of the Sun} = \text{Force}/M = a = C/\Delta T, \text{ where } C \text{ is the speed of light} \dots(2)$$

$$\text{As discussed in the introduction, the Sun's gravitational field at the surface} = M.G/R \dots\dots\dots(3)$$

So, by equating equations (2) & (3), we get,

$$C/\Delta T = M.G/R \dots\dots\dots(4)$$

$$\Delta T = C.R/M.G \dots\dots\dots(5)$$

$$\Delta\lambda/\Delta T = C \text{ and so, } \Delta\lambda = C.\Delta T, \text{ where } \Delta\lambda \text{ is the change in wavelength of the radiation} \dots\dots\dots(6)$$

$$C = \Delta\lambda.\Delta f \text{ where } \Delta f \text{ is change in the frequency of radiation} \dots\dots\dots(7)$$

By combining the equations (6) and (7), we get,

$$\Delta f = 1/\Delta T \dots\dots\dots(8)$$

From the equation (5) and (8), we can calculate the red shift in the Sun's radiation due to gravitational pull. The calculated value agree with the calculated value of Albert Einstein based on the general theory of relativity and the observed values [10][11].

Tolman -Oppenheimer-Volkoff (TOV) limit: In a white dwarf, degenerate electrons repel each other due to negative charge of the electrons. This cumulative force develops into electron degenerate pressure..This pressure is balanced by the gravitational pressure of the mass of the electrons. This balancing process could be easily understood if we consider that the electrons are arranged in the radial lines of the spherical coordinate system. Based on this theory, Chandrasekhar's limit (1.4M) could be derived. In a neutron star, neutrons replace the electrons of the white dwarf. But a neutron is made up of equal amount of positive and negative charges (A neutron is made by merging a proton and an electron). In other words, a neutron could be considered as a spherical electric dipole. So, maximum neutron degeneracy pressure is developed when the dipoles are arranged to develop repulsive forces. But this repulsive force is two times the repulsive force of the electrons of the white dwarf since neutrons have charges two times the charges of electrons. So, the TOV limit is two times that of Chandrasekhar's limit. This means TOV limit is 2.8M. The spin of the neutrons may change the force between the neutrons. Approximately 1/3rd of the force between the neutrons may be reduced when the dipoles are aligned on the same straight line. Charges facing in the direction normal to the straight line can't interact. So, the TOV limit may vary between 2.1M to 2.8M. This simple calculation agrees well with other complicated calculations [12].

Gravitational red shift of White Dwarfs and Neutron Stars: TOV limit, gravitational red shift of the Sun, White dwarfs and Neutron stars are calculated by using complicated theories. In this article, TOV limit, gravitational red shift of the Sun, White Dwarfs and Neutron stars are calculated very easily by using very simple theories. Gravitational red shift of the Sun and TOV limit were derived in the above paragraphs. Gravitational red shift of white dwarfs and the neutron stars are derived in this section.

In white dwarfs and neutron stars radiations are due to residual thermal energy and not due to any atom and so, mechanism of gravitational red shift is different. Thermal radiations from the white dwarfs and neutron stars are pulled down by the gravitational field of the degenerate particles of the atoms. This is very similar to moving source of radiation in the opposite direction to the direction of radiation. So,

$$C/\Delta T = M.G/R^2 \dots\dots\dots(9)$$

By substituting the equation (8) into the equation (9), we get,

$$\Delta f = (M.G)/CR^2 \dots\dots\dots(10)$$

By substituting the equation (7) into equation (10), we get

$$\Delta\lambda = C/\Delta f = C^2.R^2/(M.G) \dots\dots\dots(11)$$

From the equations (10) and (11), red shift of white dwarfs and neutron stars were calculated and they agree with the other calculated values.[13] [14] [15]

Conclusion: Gravitational red shift of sun's radiation was calculated using the modified gravitational field theory and the classical field theory. The calculated red shift agrees well with the observed values. TOV limit and gravitational red shift of white dwarf and neutron stars were derived using classical field theories. The calculated values of red shifts agrees well with the published values of red shifts.

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