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# Star's age, origin and the end

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*Abstract*— **The stars were formed during the formation of the Galaxies. It was explained in the Paper "Formation of Galaxies" about how stars and planets were formed from huge molten mass rotating at high velocities at the centre of the Galaxy. The masses for stars come from the core matter of galaxy. Stars formation from its beginning to its end may be predicted. Stars are energy providers for all of its planets in their respective solar system. Stars have enormous amount of energy from its nuclear fusion. We have known that nuclear fusion is made possible on the stars due to its high pressure which in turn has high temperatures. Since in my another Paper titled "Acceleration due to the motion of planets inferred as Gravity" it was shown that acceleration due to Gravity is indeed only due to the two velocities of the planets (rotation and revolution).Hence it became necessary to find alternate explanation for the death of a star, which was till now believed to be due to the balance between the pull force of Gravity and outward burst force of energy produced. Here we derived mathematical formula showing the condition for death of a star based on the idea that when mass per unit area of a star in turn force per unit area increases beyond its threshold value making the star to explode unconditionally which we witness as a death of a star also known as supernova. Not all stars will explode as a supernova. It is only when star meets certain specific condition it will explode otherwise it will turn as a white dwarf followed by further cooling with thermal radiation. Also in this paper we derived the mathematical formula to find the age of a star. The age of a star indicates the active period it engages in energy production and radiation. After exhaust or depletion of its fuel star begins to stop producing energy marking the death of a star.**

*Index Terms*— **Stars, age of a star, supernova and white Dwarf.**

## I. INTRODUCTION

The Galaxies are formed from central high rotational velocities of huge molten mass which throws some masses at regular intervals due to high momentum which in turn produces various arms of Galaxies. This again in turn throws some masses due to high momentum to produce further stars and planets of their respective solar system. This was explained in the Paper "Formation of Galaxies". Hence it can be said that the shape of the galaxies and its corresponding velocities were due to its own momentum which caused its creation. The stars were said to be formed from the ejected mass from the central core of Galaxy due to high rotational velocities of its central core. The high momentum of rotating and revolving stars in turn ejects masses from it to form its rotating and revolving Planets. But the dynamic processes in star starts only based upon its escape velocity, acceleration due to Gravity, gas constituents and surface area of the star. The above three factors leads to nuclear fusion on the surface of the stars due to conditions like high pressure and temperature.

## II. History

We all know that there is high pressure and temperature in the stars. The high pressure arises due to high column of hydrogen and helium gases which in turn because of high acceleration due to Gravity, escape velocity of star which make it possible to retain high volume of gases on its surface. The high pressure and volume of gases rises the temperature of the gases, as per ideal gas law PV=RT since pressure and volume are increased naturally its temperature also increased. By having both high pressure and temperature star makes nuclear fusion possible by fusing hydrogen into helium liberating huge amounts of energy. The process of converting hydrogen into helium makes the column height of hydrogen getting lesser with corresponding column height of helium getting higher gradually. This results in increase in mass per unit area on the surface of a star which in turn increases force per unit area because Pressure is given as P=force/area=F/A
Force F = mg (mass * acceleration due to gravity)

Pressure P = F/A= (m/A) g
This process of conversion goes on for thousands of years till all its fuels gets depleted and becomes either as a white dwarfs or explodes as a supernova. We need to find the mathematical conditions for a star to become a white dwarf or to get exploded as a supernova. This we can show by forming some mathematical equations with some assumptions and help of some physical constants that by reaching certain physical conditions the supernova event occurs.

## III. Proposed Method for calculating the condition for a star to collapse and explode into supernova

We assume that Star's core consists of very high density followed by the helium which is less dense than the core, followed by Hydrogen which is still much less dense than Helium. There may be the border where both hydrogen and helium co-exist where actual conversion of Hydrogen into Helium takes place. For practical consideration we neglect these border areas. We assume that the pressure exerted by the column of hydrogen and helium is balanced by the reaction of the star's high density core. Hence we can equate the pressure of Hydrogen and Helium of a star to the reaction pressure of the star's inner high density core as balance of all these keeps equilibrium of a star.
Pressure also given by P= ρgh
Where ρ= density
g= acceleration due to Gravity
h=Height of the gas column
Here,
$P_h$=pressure of hydrogen column in a star
$P_{he}$=pressure of helium column in a star
$P_{star}$=reaction pressure exerted by star's core to the pressure of hydrogen and helium column in a star
By equating the pressure and reaction pressures of a star we get
$P_h+P_{he}=P_{star}$

$\rho_h g h_h + \rho_{he} g h_{he} = F_{star}/A_{star}$ where $A_{star}$ =surface area of star which is usually a sphere

$\rho_h g h_h + \rho_{he} g h_{he} = M_{star} g / A_{star}$

$\rho_h h_h + \rho_{he} h_{he} = M_{star}/A_{star}$

Since $M_{star} = \rho_{star} V_{star}$

$\rho_h h_h + \rho_{he} h_{he} = \rho_{star} V_{star} / A_{star}$

$V_{star}$=Volume of a star = $4/3 \prod r^3_{star}$

Where $r_{star}$=core radius of a star

$\rho_h h_h + \rho_{he} h_{he} = \rho_{star}\ 4/3 \prod r^3_{star} / A_{star}$

We have a surface area of sphere $A_{star} = 4 \prod r^2_{star}$

$\rho_h h_h + \rho_{he} h_{he} = \rho_{star}\ 4/3 \prod r^3_{star} / 4 \prod r^2_{star}$

By simplifying we get

$\rho_h h_h + \rho_{he} h_{he} = \rho_{star}\ r_{star} /3$.....(1)

By substituting all the parameters in the equation (1) we can know the status of the respective star.

Here, as an example substitute the density of hydrogen and helium gases as 0.089kg/m$^3$ and 0.18 kg/m$^3$ respectively.

We get

$0.089h_h + 0.18h_{he} = \rho_{star}\ r_{star} /3$

$\rho_{star}\ r_{star} = 0.267h_h + 0.54h_{he}$.....(2)

From the equation (2) we can deduce that the star will continuously produce energy and emit light till both the LHS and RHS of equation (2) are equal and balanced by converting Hydrogen to helium. But, we can say if LHS exceeds RHS the star may explode into supernova due to its own force per unit area exceeds its threshold limit.

## IV. To find the age of a star

We know that escape velocity of a star given by $=V_e = \sqrt{2gx}$ ..... (3)

Where g= acceleration due to gravity of a star

And $x = ut + 1/2gt^2$..... (4)

Where u=revolution velocity of a star around its parent heavenly body

g= acceleration due to gravity of a star

t=time

Substituting the equation (4) in (3) we get

$V_e = \sqrt{2g(ut + 1/2gt^2)}$.....(5)

We also have root mean square velocity of gases is given by the equation $V_{rms} = \sqrt{3RT/M}$..... (6)

We also know that from Ideal gas law that PV=RT

Where P=pressure, V=Volume and T=Temperature

Hence the equation (6) can be shown as $V_{rms} = \sqrt{3PV/M}$

Above equation can also be written as $V_{rms} = \sqrt{3PV/M} = \sqrt{3\rho ghV/M} = \sqrt{3\rho gh/\rho} = \sqrt{3gh}$..... (7)

Since Pressure = $\rho gh$ and $M/V = \rho$

We know that gases can be retained in the Atmosphere of any star only when its root mean square velocity is equal to the surface escape velocity of a star. But if it exceeds it will escape into outer space.

Hence we can equate the root mean square velocity of gases on the star to its surface escape velocity of the star

i.e., equating the equations (5) and (7), we get

$V_e = \sqrt{2g(ut + 1/2gt^2)} = \sqrt{3gh}$

By simplifying we get $h = 2/3(ut + 1/2gt^2)$

Where h= height of the respective gas column

Substitute h in the equation (2) we get

$\rho_{star}\ r_{star} = 0.267h_h + 0.54h_{he} = 0.267(2/3(ut + 1/2gt^2) + 0.54(2/3(ut + 1/2gt^2)$

By simplifying we get

$\rho_{star}\ r_{star} = 0.09612(ut + 1/2gt^2) + 0.36(ut + 1/2gt^2)$

$\rho_{star}\ r_{star} = 0.45612(ut + 1/2gt^2)$.....(8)

By substituting the core density, core radius, revolution velocity and acceleration due to Gravity of a star in equation (8) and solving for t, which is time, we will get the life of a star.

## V. Conclusion

Any star continuous to produce energy using nuclear fusion due to its own enormous pressure and temperature till both the sides of the equation (1) remains balanced. But once the LHS exceeds RHS the star may explode into supernova expelling huge amounts of star remnants into the space with high brightness and luminosity. But if opposite happens, that is RHS exceeds LHS or becomes equal, when all of its hydrogen fuel gets depleted and becomes helium, it may get converted into white dwarf instead of exploding as a supernova. The whole life of a star starting from initial hydrogen to fully converted helium may be found by the equation (8).

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