EMDEN-CHANDRASEKHAR EQUATION

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BACKGROUND

- Used in Astrophysics
- Introduced in 1907
- Dimensionless form of the Poisson Equation

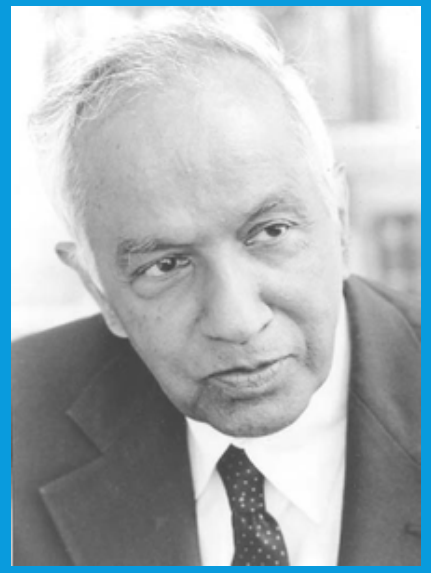
$$\Delta\varphi = f$$

- Used to create a density distribution (graph) of a spherically symmetric isothermal gas sphere subjected to its own gravitational force. (think stars)
- An Isothermal gas has no net/noticeable temperature change

CREATORS

- Robert Emden (1862 – 1940)

- Subranmanyan Chandrasekhar (1910-1995)



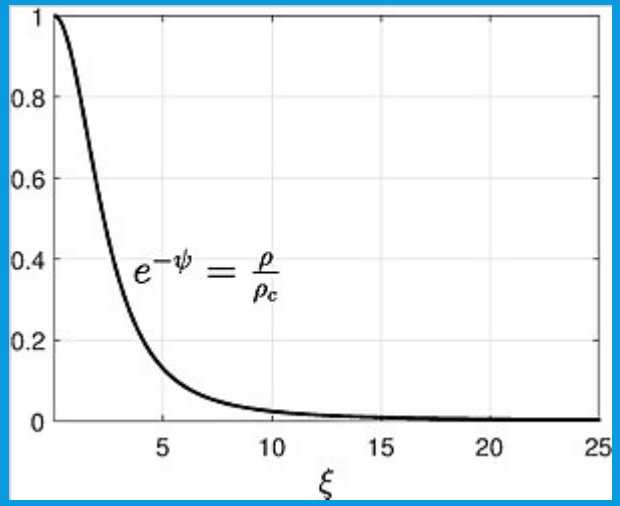
THE EQUATION

$$\frac{1}{\xi^2}\frac{d}{d\xi}\left(\xi^2\frac{d\psi}{d\xi}\right) = e^{-\psi}$$

$$\rho = \rho_c e^{-\psi}$$

- Variables here are Xi and Psi, and their derivatives
- Xi = dimensionless radius of spherical gas
- Psi = Value involved in equation for density of gas sphere. (rho is the density and rho sub c is the density at the center of the sphere)
- Isothermal condition is used to simulate core of star

THE DISTRIBUTION



- Shows that the independent variable here is the xi, or the dimensionless radius.
- Shows that the dependent variable here is the e^-phi, or the ratio of the density of the gas sphere over the density of the center of that sphere. (in the equation the dep. variable is just phi)

DERIVATION

$$p = \rho \frac{k_B}{WH} T + \frac{4\sigma}{3c} T^4$$

- Solves for the pressure of an isothermal gas star
- Uses variables such as temperature, speed of light, weight and mass of the star to calculate the pressure.
- This equation is able to be rewritten as the equation for the equilibrium of a star which can then be rewritten to be the Emden-Chandrasekhar equation

QUESTIONS?

THANK YOU!