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Gravastar model in Cylindrically Symmetric Space-time and its possible mass limit

A class of new Gravastar solution is presented here following the Mazur and Mottola model in gravitational Bose-Einstein condensate (GBEC) star in the cylindrically symmetric space-time. A stable gravastar with three distinct regions namely, (i) interior de-Sitter space, (ii) intermediate thin shell with a slice of finite length and (iii) exterior vacuum region. The interior region is characterised by positive energy density and negative pressure ($p = -\rho$), which exerts a repulsive outward force on the thin shell. The thin shell separating the interior and exterior is supposed to be consisting of ultra-relativistic stiff fluid having equation of state $p = \rho$, which satisfies the Zel'dovich's criteria (Y. B. Zel'dovich, Sov. Phys. JETP 14, 1143 (1962) & Y. B. Zel'dovich, Mon. Not. R. Astron. Soc. 160, 1P (1972)). This thin shell, which is considered as the critical surface for the quantum phase transition, replaces both the classical de-Sitter and Schwarzschild event horizons. Flat exterior space-time is achieved though the computation of Kretschmann scalar. The new solution is free from any singularities. The energy density, total energy, proper length, mass and entropy of the shell region are explored in this model. From the consideration of gravitational surface redshift, we have obtained a constraint on the possible numerical value of mass limit (2.714 $M_\odot$ - 3.316 $M_\odot$) for gravastars with different characteristic radii (9.009 Km-11.009 Km). Thus, we have noted singularity free physically viable gravastar solution.

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