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ORIGINAL ARTICLE

# Effects of electromagnetic field on shearfree spherical collapse

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**Abstract** This paper is devoted to study spherically symmetric shearfree charged gravitational collapse with radial heat flux and isotropic pressure. For the matching of the interior spacetime, we take Vaidya-Reissner-Nordström metric outside the spherical system. We solve the field equations numerically by taking ansatz on the metric functions and using Darmois junction conditions. The behavior of density, pressure, radial heat flux, luminosity and the mass function is analyzed. Finally, we check validity of the energy conditions through plots.

**Keywords** Junction conditions · Shearfree fluid · Electromagnetic field · Gravitational collapse

## 1 Introduction

A comprehensive study of collapsing process and structure formation of compact objects is one of the interesting problems in general relativity. During the evolution of stars, a large amount of energy radiates at various stages in the form of photons and neutrinos. It is believed that net amount of radiated energy gradually increases during the collapsing process. Thus, a radiating spherical collapse leads to energy dissipation which is described by two approximations. The first one is the diffusion approximation in which the dissipation is designed by the heat flow type vector, while the second is the free streaming approximation characterized by an outflow of null fluid.

Oppenheimer and Snyder (1939) did the pioneering work in the scenario of gravitational collapse by considering spherically symmetric model filled with pressureless fluid. Vaidya (1951, 1966) and Bayin (1979) found exact spherically symmetric solutions with perfect fluid and heat radiation. Misner and Sharp (1964) studied collapsing matter with non-vanishing pressure and found black hole as the end state of gravitational collapse. Lake (2000) investigated dust collapse for spherical matter distribution with negative and positive cosmological constant. Ghosh and Deshkar (2007) discussed the inhomogeneous spherically symmetric dust collapse in higher dimensions with cosmological constant and concluded that its end fate would be a black hole.

Chan (2001) explored gravitational collapse of radiating star filled with viscous fluid suffering with shearing motion. Nolan (2002) considered evolution of the hollow cylindrical dust cloud undergoing gravitational collapse. Govinder et al. (2003) investigated gravitational collapse of the radiating star and found that its final fate will be a super dense star. Sharif and his collaborators (Sharif and Fatima 2011; Sharif and Yousaf 2012a, 2012b, 2013) discussed dynamics and some models for cylindrically and plane symmetric spacetimes with and without heat flux. Tewari (2012) has investigated the shearfree spherical solutions of isotropic radiating stars.

Ghezzi (2005) studied the temporal evolution of stellar structure of compact charged spheres and found that the charged stars have larger mass and radius than the uncharged stars. Di Prisco et al. (2007) formulated dynamical equations for charged spherically symmetric anisotropic matter distribution. Recently, Pinheiro and Chan (2013) have obtained numerical solution of the field equations of anisotropic radiating shearfree spherical object in the presence of elec-

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