

Abstract

Some features of cold compact stars have been studied by considering a class of compact stars described by Vaidya-Tikekar(VT) model. The model permits a simple analytic method of systematically fixing bounds on the maximum possible mass of cold compact stars within this class with a given value of radius or central density or surface density. The relevant equations of state are also determined. Although simple, the model is capable of describing general features of some of the recently observed very compact stars. For the calculation, no prior knowledge of the equation of state(EOS) is required. This is in contrast to the earlier calculations for maximum mass which were done by choosing first the relevant EOS and using it to solve the Tolman-Oppenheimer-Volkoff(TOV) equation with appropriate boundary conditions. The bounds obtained by us are comparable and, in some cases, more restrictive than earlier results. The VT model gives a class of EOS of the fluid as an output of the calculation, if the mass and radius are given. The effect of rotation has not been considered.

The physical features of cold compact anisotropic stars have also been studied. The effect of pressure anisotropy on the maximum mass and surface redshift has been analysed by a generalisation of the VT model. It is shown that maximum compactness, redshift and mass increase in the presence of anisotropic pressures; numerical results have been obtained which are in agreement with other results. We have also studied the case of a charged anisotropic fluid sphere to show that the inclusion of pressure anisotropy softens the charged EOS and increases the maximum mass.

VT model can describe a strange star with a density dependent bag parameter in the strange matter EOS. We have shown that the EOS of strange quark matter(SQM)

in the color-flavor-locked(CFL) phase with density dependent bag parameter can be described by VT model. The contribution of color superconductivity term in the EOS has been studied in the case of very dense strange stars. The physics of the CFL strange matter in the stars have been discussed by considering a few possible candidates, noting that some of these may be described by VT model.

The effect of extra dimensions on the physical features, e.g., mass, radius, surface redshift etc. of a very compact fluid sphere is analysed in the context of VT model. We obtain that for a given configuration compactness decreases if the number of dimensions increase. It is noted that the maximum mass initially increases, attains a maximum value at dimension $D = 5$, thereafter it decreases as the number of dimensions is increased.

The conclusion of the study is that VT model provides a simple analytical method of studying a class of cold and very compact systems, in particular neutron stars and strange stars, even if the EOS is not known initially. Although the class of solutions is restricted, fortunately it is useful in the case of very compact stars.