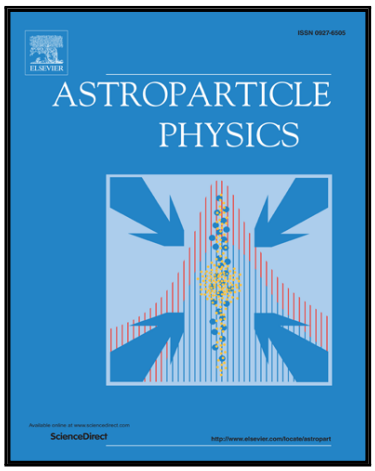

About the influence of the density profile on neutron star cooling by neutrino emission

C.E. Alvarez-Salazar, C.J. Quimbay

PII: S0927-6505(18)30069-0
DOI: 10.1016/j.astropartphys.2018.07.007
Reference: ASTPHY 2312

To appear in: *Astroparticle Physics*

Received date: 21 February 2018
Revised date: 14 June 2018
Accepted date: 23 July 2018

Please cite this article as: C.E. Alvarez-Salazar, C.J. Quimbay, About the influence of the density profile on neutron star cooling by neutrino emission, *Astroparticle Physics* (2018), doi: 10.1016/j.astropartphys.2018.07.007

About the influence of the density profile on neutron star cooling by neutrino emission

C.E. Alvarez-Salazar[a,*], C.J. Quimbay[b]

[a] *Instituto de Física Gleb Wataghin, UNICAMP, 13083-859, Campinas, SP, Brazil*
[b] *Departamento de Física, Universidad Nacional de Colombia, Carrera 45 N. 26-85, Bogotá, Colombia*

Abstract

We analyzed the influence of the density profile on neutron star cooling by neutrino emission, considering four different equations of state. After interpolated density profiles are obtained from discrete data, we calculate numerically, as a function of the radial distance to the center of the star, the following quantities: the neutron and proton number densities, their Fermi momenta, the proton fractions and the neutrino emissivities for two models of neutron stars with masses $1.33M_{\odot}$ and $1.4M_{\odot}$. For a specific equation of state and considering the effects of the density profile, we calculate the neutrino and photon luminosities and the cooling curve for these two models, taking into account two different possibilities for their particle composition. The photon luminosities obtained are consistent with the measurements of the bolometric luminosities for isolated neutron stars with thermal emission presented in the literature. The cooling curves are in good agreement with empirical data for the surface temperatures observed in several neutron stars.

Keywords: Neutron star; equation of state; density profile; neutrino cooling.

1. Introduction

Neutron stars (NSs) are considered one of the densest manifestations of matter in the universe, as they concentrate a mass of the order of the solar mass, $M_{\odot}$, in spheres with a radius of the order 10km. NS physics started with the "superficial anticipation"

*Corresponding author
Email addresses: calvarez@ifi.unicamp.br (C.E. Alvarez-Salazar), cjquimbayh@unal.edu.co (C.J. Quimbay)