

Fall 2022 Colloquium

Department of Physics & Astronomy, A&M-Commerce

Nov 17, Thursday, 4-5 PM in Science Building 127

(coffee and cookies will be served at 3:50 PM)

Astro-Physics

An Analysis of the Deformation of Highly Magnetized Neutron Stars

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Dr. Omair Zubairi earned his BS (2007) and MS (2009) degrees in Physics at San Diego State University, and his Ph.D. in Computational Science (2015) from the joint doctoral program at Clairmont Graduate University and San Diego State University. From 2015-2019 Dr. Zubairi served as a tenured Assistant Professor of Physics at Wentworth Institute of Technology in Boston, MA. He is currently a Senior Training Engineer at MathWorks, where he conducts customer trainings in the realm of Data Science, Parallel Computing, and MATLAB Code Generation. He is also a Research Associate at the Computational Science Research Center at San Diego State University. His research lies in the areas of general relativity and numerical astrophysics, in particular the physics of compact stars. His other interests include mathematical modeling, computational methods/techniques, and high performance/parallel computing. He currently sits as a steering committee member for the International Association of Relativistic Dynamics. Dr. Zubairi authored an undergraduate textbook on Computational Physics and contributed a book chapter to the Centennial of General Relativity; A Celebration, commemorating the publication of Einstein's General Relativity.

Abstract

Neutron stars are compact objects formed in cataclysmic astrophysical events known as supernovae. They have masses about twice that of the Sun and radii of approximately 10 to 15 kilometers resulting in densities on the nuclear scale. They have high temperatures and large magnetic fields up to 15-20 orders of magnitude greater than our Sun. With such extreme conditions, neutron stars make excellent laboratories for nuclear, particle and astrophysics. For over 80 years, since the publication of the well known papers from R. C. Tolman (Tolman 1939) and J. R. Oppenheimer and G. M. Volkoff (Oppenheimer and Volkoff 1939), traditional models of nonrotating neutron stars are assumed to be perfect spheres; however, this may not be true if high magnetic fields are present. Certain classes of neutron stars such as Magnetars and/or neutron stars that contain color-superconducting quark matter cores can exhibit such anisotropies and break from perfect spherical symmetry making them oblate or prolate spheroids. In this talk, I will discuss the stellar structure of highly magnetized neutron stars in the framework of general relativity and the implications this has on the stellar properties such as masses and radii, along with pressure and energy-density profiles. Due to the deformation of these compact stars, the gravitational redshift and gravitational mass quadrupole moment are also affected and are calculated.