Special Guest Lectures

Numerical Approaches to Neutron Star Pulsations

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Abstract:
Pulsating relativistic stars are considered a prime astrophysical source of gravitational waves. Through gravitational-wave asteroseismology, the high-density equation of state of compact objects could be revealed. In highly magnetized sources (magnetars) pulsations have already been observed in X-rays and efforts are underway to interpret the data. In the talk, several numerical approaches to the study of pulsations in relativistic stars will be reviewed, with emphasis on recent 2D and 3D nonlinear simulations, 2nd-order perturbative studies and linear perturbations of magnetized stars. Specifically, we will discuss pulsations excited in differentially rotating proto-neutron stars during supernova core collapse, which we studied by nonlinear methods in the spatially conformally flat approximation. Next, we present a new study of nonlinear harmonic frequencies, via a gauge-invariant, second-order perturbative approach and discuss their detectability by next-generation, planned gravitational wave detectors. Finally, we present a new computation of torsional Alfv\'en oscillations in magnetars, studied with a perturbative approach to the ideal magnetohydrodynamic equations and compare our numerical results to observed quasi-periodic oscillations in soft gamma-ray repeaters.

Speaker's Bio:
Dr. Stergioulas obtained his PhD from the University of Wisconsin-Milwaukee in 1996 and was a postdoc at the Albert-Einstein-Institute in Golm (Germany) for one year, before joining the Physics Department of the Aristotle University of Thessaloniki (Greece) in 1999. He is currently an Assist. Professor. Dr. Stergioulas' research interests are in relativistic astrophysics, numerical relativity and rotating compact stars as gravitational-wave sources.

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