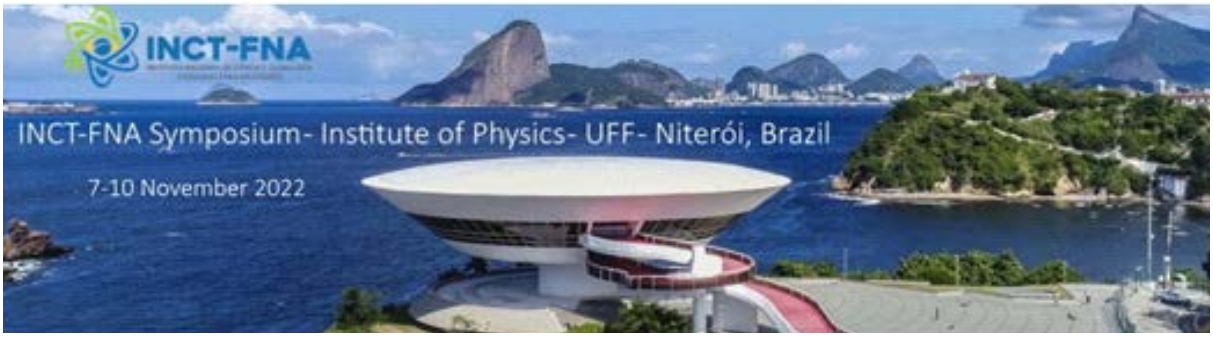

Neutron-star physics: basics and current developments

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Neutron stars (NS) represent one of the possible ends of stellar evolution of massive ordinary stars which after millions of years exhaust their hydrogen fuel producing the thermal pressure which avoids an imminent gravitational collapse to form a black hole. On the other hand, NS owe their mechanical equilibrium to the Fermi degeneracy pressure coming from the microscopic degrees of freedom depending on the accumulated baryon density, i.e. hadrons and quarks, thus defining pure hadronic and quark stars, respectively. Nevertheless, it is still an open question how hadrons become deconfined when densities reach a critical value which might affect non trivially the behavior of the so-called equation of state (EoS) which serves as input to determine the masses and radii of the associated stars which are currently know as hybrid NS. In this talk we review the fundamental mathematical and physical ingredients to study systematically the structure of NS. Besides, we summarize recent advancements towards constraining the NS equation of state from the fundamental theory of strong interactions, quantum chromodynamics (QCD), using perturbative methods at low densities through chiral effective field theory and perturbative QCD at ultra-high densities. Interestingly, this kind of EoS also uses recent astrophysical data from X-ray measurements of the radii of canonical NS and limiting values of the tidal deformabilities of NS in gravitational waves coming from NS mergers. Finally, we briefly comment on other related issues such as the behavior of the speed of sound in NS interiors, the EoS for hot and dense matter appropriate for supernova explosions, twin stars and the dynamical stability of all the aforementioned stars.

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