High Density QCD Phase Transitions in Compact Stars

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A "phase diagram" for rotating compact stars (angular velocity-baryon mass plane) is suggested as a heuristic tool for obtaining constraints on the equation of state of QCD at high densities [1]. It has a critical line dividing hadronic from quark core stars which is correlated with a local maximum of the moment of inertia [2] and can thus be subject to experimental verification by observation of the rotational behavior of accreting compact stars. Another characteristic line is that of the maximum mass configurations. The positions and shapes of these lines are correlated to the properties of the QCD equation of state at high densities [3]. We present investigations of different scenarios for the spin evolution of compact stars and show that the so called Z sources of quasiperiodic oscillations in low-mass X-ray binaries (LMXBs) should predominantly populate the region of the suspected phase border between hadronic and quark core stars in the phase diagram [4]. The existence of a population gap between the critical line and the black hole limit on the frequency-mass plane of LMXBs would signal the occurrence of deconfinement phase transition in accreting compact stars [2,3,4]. The absence of a such gap does not exclude the existence of deconfined quark matter in LMXBs as we show in a study of accreting strange stars [5]. The influence of color superconducting phases of quark matter on the compact star configurations, their gravitational mass and their cooling evolution is presented for generic scenarios [6] and recent observations are discussed.

References

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