Neutron star properties with nuclear BHF equations of state

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We study the properties of static and rotating neutron stars adopting non-relativistic equations of state (EOS) for asymmetric nuclear matter based on the Brueckner-Hartree-Fock (BHF) scheme. The BHF calculation, with the continuous choice for the single particle potential, appears to be very close to the full EOS, which includes the three-hole line contribution calculated by solving the Bethe-Fadeev equations within the gap choice for the single particle potential. Three-body forces are included in order to reproduce the correct saturation point for nuclear matter. A comparison with fully relativistic many-body calculations of nuclear matter EOS is made.

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Signal of Quark Deconfinement in the Timing Structure of Pulsar Spin-Down

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The conversion of nuclear matter to quark matter in the core of a rotating neutron star alters its moment of inertia. Hence the epoch over which conversion takes place will be signaled in the spin-down characteristics of pulsars. We find that an observable called the braking index should be easily measurable during the transition epoch and can have a value far removed (by orders of magnitude) from the canonical value of three expected for magnetic dipole radiation, and may have either sign. The duration of the transition epoch is governed by the slow loss of angular momentum to radiation and is further prolonged by the reduction in the moment of inertia caused by the phase change which can even introduce an era of spin-up. We estimate that about one in a hundred pulsars may be passing through this phase. The phenomenon is analogous to "bach bending" observed in the moment of inertia of rotating nuclei observed in the 1970's, which also signaled a change in internal structure with changing spin.

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Signal for the Quark-Hadron Phase Transition in Rotating Hybrid Stars

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For the past 20 years it had been thought that the coexistence phase of the confined hadronic and quark matter phases, assumed to be a first order transition, was strictly excluded from neutron stars. This, however, was due to a seemingly innocuous idealization which has approximated away important physics. The reason is that neutron stars constitute multi-component bodies rather than single-component ones formerly (and incorrectly) used to describe the deconfinement phase transition in neutron stars. So, contrary to earlier claims, 'neutron' stars may very well contain quark matter in their cores surrounded by a mixed-phase region of quark and hadronic matter. Such objects are called hybrid stars. The structure of such stars as well as an observable signature that could signal the existence of quark matter in their cores are discussed in this paper.

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