

Is there quark matter in (low-mass) pulsars?

J. Schaffner-Bielich^a, M. Hempel^a, G. Pagliara^a, I. Sagert^a, M. Wietoska^a, and C. Sturm^b

^aInstitute for Theoretical Physics, Goethe University, Max von Laue Str. 1,
D-60438 Frankfurt, Germany

^b Institute for Nuclear Physics, Goethe University, Max von Laue Str. 1,
D-60438 Frankfurt, Germany

There has been a tremendous activity in the area of pulsar physics in particular triggered by the recent pulsar radio scans and several new pulsar mass measurements ranging from very massive pulsars to pulsars with quite low masses. Based on symmetry properties of QCD several new phases have been predicted to be present at high densities. The phenomenon of colour superconductivity implies the existence of several first order phase transitions which could be right in the range of densities as encountered in the core of neutron stars. The equation of state will be substantially modified giving rise to new observable signals from neutron star measurements. I outline the mass-radius relation for compact stars with quark matter in both regimes, for the high-density high mass and the moderate density low-mass regions. I argue that the simultaneous measurement of the mass and the radius for low-mass pulsars could already constrain the onset of the QCD phase transition or signal that there is exotic matter in the core of compact stars. New astrophysical observations will be discussed with regard to the possible existence of quark matter in compact stars.

References

- [1] M. Alford, D. Blaschke, A. Drago, T. Klahn, G. Pagliara and J. Schaffner-Bielich, “Quark matter in compact stars?,” *Nature* **445**, E7 (2007) [arXiv:astro-ph/0606524].
- [2] J. Schaffner-Bielich, “Signals of the QCD Phase Transition in the Heavens,” arXiv:0709.1043 [astro-ph].
- [3] I. Sagert, M. Wietoska, J. Schaffner-Bielich and C. Sturm, “Is a soft nuclear equation of state extracted from heavy-ion data incompatible with pulsar data?,” arXiv:0708.2810 [astro-ph].
- [4] G. Pagliara, J. Schaffner-Bielich: “Stability of CFL cores in hybrid stars,” in preparation