THE ROLE OF STRANGENESS IN HADRONIC MATTER (IN)STABILITY: FROM HYPERNUCLEI TO COMPACT STARS

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The role played by the strangeness degree of freedom is a very important point in understanding many features of the QCD phase diagram. In order to investigate possible instabilities, we use relativistic mean field models (RMF) and restrict our calculations to neutron-lambda and neutron-proton-lambda matter. As a starting point, we have explored the meson-lambda parameter space constrained to experimental hyper-nuclear potentials.

At sub-saturation densities, the existence of a neutron-lambda "liquid-gas" phase transition is the result of very clear hadronic matter instability. If a neutron-proton-lambda matter is investigated, the instability is still present, strangeness being an order parameter of the phase transition, which means that dilute strange matter is expected to be unstable with respect to hyper-clusters.

When one moves to high densities, the "hyperon puzzle" has to be confronted and one of its facets is the fact that the equation of state becomes softer when strangeness is included, resulting in lower maximum stellar masses as compared with the ones obtained with nucleons only. As very massive neutron stars have been confirmed lately, many models have been reparametrized without any underlying fundamental physics.

In our work, once the meson-hyperon couplings are constrained to satisfy hyper-nuclear experimental potentials, we have checked that no instability at supersaturation densities is found. Hence, one can conclude that a strange phase transition only takes place in neutron star matter if quarks are present. This fact can help us understand the hyperon puzzle. We have then used appropriate parameter sets to obtain stellar macroscopic properties consistent with recent observational data.