Contribution ID: **31** Type: **not specified**

Universal symmetry energy contribution to the neutron star equation of state

Wednesday, September 30, 2015 3:50 PM (40 minutes)

We present systematic investigation of the Universal Symmetry Energy Con- jecture (USEC) starting from the observation made first in [1] that under con- ditions of charge neutrality and β−equilibrium the contribution from the asym- metry energy to the equation of state (EoS) for neutron star matter follows a universal behaviour unless the direct Urca (DU) process becomes allowed. It reveals that indeed the USEC holds provided the density dependence of the sym- metry energy Es(n) follows a behaviour that limits the proton fraction x(n) to values below the DU threshold. The absence of DU cooling processes in typical mass neutron stars appears to be supported by the phenomenology of neutron star cooling data. Two classes of symmetry energy functions are investigated more in detail to elucidate the USEC. Both of them fulfill the constraint from a detailed analysis using isobaric analog states (IAS) [2] which revealed that $E_* = Es(n_*) = 26$ MeV at a reference density $n_* = 0.106$ fm−3.

The first one follows an MDI type ansatz $Es(n) = E_* \cdot (n/n_*)\gamma$ where the IAS constraint limits the admissible values of γ to the range $2/3 \leq \gamma \leq 9/10$ when also the smaller variations at its lower limit for $n = n0/4$ are respected. With this ansatz the USEC is not directly apparent.

The second one uses a recent parametrization of the density-dependent cou- plings in the isovector ρ meson channel within the generalized density functional approach to nuclear matter [3] leading to a moderate increase of the symmetry energy at supersaturation densities; gentle enough to fulfill the DU constraint in the whole range of densities relevant for neutron star interiors and thus in perfect agreement with the USEC.

We discuss that this behaviour is shared with the APR EoS that respects the tensor force of the NN interaction. Note that recent work on short range correlations from the tensor force [4] suggests an MDI type parametrization with $\gamma = 0.8$. While this is apparently in line with the IAS constraint it would fulfill the USEC only for a sufficiently stiff symmetric part of the nuclear EoS.

Primary author: Mr ALVAREZ-CASTILIO, David (JINR Dubna)

Presenter: Mr ALVAREZ-CASTILIO, David (JINR Dubna)