Constraints on the Symmetry Energy

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Using the systematic of excitation energies to isobaric analog states (IAS), we extract symmetry coefficients on a nucleus-by-nucleus basis. Consistently with charge invariance, the coefficients vary weakly across an isobaric change. However, they change strongly with nuclear mass and range from $\sim$10 MeV at A$\sim$10 to $\sim$23 MeV at A$\sim$240. The variation of the symmetry coefficients with mass is tied to details in the variation of symmetry energy with density in the region between 0.04 to 0.13 per cubic fm. By confronting results from Skyrme Hartree-Fock (SHF) calculations with symmetry coefficients extracted from IAS, we are able to place narrow (1-2 MeV) constraints on the symmetry energy of uniform matter in the above subnormal density region. By using auxiliary experimental information on nuclear asymmetry skins, we narrow the constraints in the subnormal density region and additionally arrive at useful ($\sim$2 MeV) constraints in the normal region. The value and slope of the symmetry energy at normal density come out highly correlated.