Probing the nuclear symmetry energy at supra-saturation densities

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In this talk we will try to address the following three questions if at all possible:

- Why is the nuclear symmetry energy so uncertain at supra-saturation densities?
- Why do we care about it?
- How can we constrain it?

Using the Hugenholtz-Van Hove theorem and the interacting Fermi gas model of isospin asymmetric nuclear matter, the nuclear symmetry energy can be expressed in terms of isoscalar and isovector single-nucleon potentials. This analytical relation allows us to study in a transparent way effects of the in-medium three-body interaction and the two-body short-range tensor force due to the ρ meson exchange as well as the short-range nucleon correlation on the high-density behavior of the nuclear symmetry energy can be demonstrated respectively. Possible physics origins of the extremely uncertain nuclear symmetry energy at supra-saturation densities will be discussed. Some ramifications of the different high density behaviors of the symmetry energy will be briefly discussed. Finally we examine a few promising experimental probes of the nuclear symmetry energy at supra-saturation densities.