From Nuclei to Neutron Stars with a Microscopic Approach

F. Sammarruca

Physics Department, University of Idaho, Moscow, Idaho 83844-0903, U.S.A.

Neutron-rich systems are associated with a variety of important and still open questions such as: the location of neutron drip lines, the thickness of neutron skins, and the structure of neutron stars. Common to these diverse situations is the equation of state (EoS) of neutron-rich matter. Our predictions of the EoS are based on microscopic high-precision nuclear interactions derived from chiral Effective Field Theory (EFT) [1]. In recent years, chiral EFT has evolved into the authoritative approach to construct nuclear two- and many-body forces in a systematic manner [1, 2]. We apply the microscopic EoS of symmetric nuclear matter and the ones of pure neutron matter as derived in Ref. [3].

Although future experiments are anticipated which should provide reliable information on the weak charge density in ^{208}Pb and ^{48}Ca, the identification of other "observables" whose knowledge may give complementary information on neutron skins would be most welcome. An issue of current interest is whether information on the neutron skin can be obtained through the knowledge of proton radii alone, specifically those of mirror nuclei [4]. I will explore, from the microscopic point of view in contrast to the phenomenological one, the relation between the neutron skin of a nucleus, on the one hand, and the difference between the proton radii of the mirror pair with the same mass, on the other.

Most recent predictions of my group concerning neutron stars will also be presented.

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References

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