Chiral Effective Field Theory and Nucleonic Matter

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The main features and strengths of chiral Effective Field Theory (EFT) can be summarized as follows: 1) the framework of chiral EFT has a firm connection with quantum chromodynamics; 2) it represents a method to generate two- and few-nucleon forces on an equal footing; 3) it allows for systematic improvement of the predictions.

High-quality two- and three-nucleon forces have been developed up to fifth and sixth order of chiral EFT [1, 2]. Naturally, the next step is the application of these forces in the many-body system–the goal of *ab initio* nuclear physics and a task of formidable complexity.

In spite of recent progress, we are still faced with serious problems. One of them concerns the proper quantification of the uncertainty in predictions of structure and reaction observables. A related issue is whether the order-by-order convergence of the chiral expansion in the many-body system is satisfactory [3]. I will illustrate the above problems by way of representative examples of nucleonic matter and nuclear structure issues.

Specifically, I will also discuss recent EFT-based predictions of the symmetry energy and the pressure in neutron-rich matter in relation to recent constraints from heavy-ion collision measurements at GSI [4] and demonstrate the importance of proper consideration of the theoretical uncertainty in order to guide phenomenological analyses.

References

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