SÉMINAIRE du GROUPE THÉORIE

INSTITUT DE PHYSIQUE NUCLÉAIRE
Groupe de Physique Théorique
Bât. 100, F-91406 ORSAY CEDEX
Tél (33)-(0)1-6915-7330 - Fax (33)-(0)1-6915-7748

Guillaume Hupin
CEA/DAM/DIF, IPNO, and LLNL Livermore

Unified Ab Initio Approaches to Nuclear Structure and Reactions of Light Nuclei

Advances in the fundamental description of the interaction among nucleons, in many-body techniques and in scientific computing have opened new avenues for the modeling of low-energy light-ion structure and reactions on an equal footing. Starting from chiral effective interactions, which provide a systematic and improvable scheme based on the underlying theory of QCD and, applied with an *ab initio* method, we are now able to arrive at accurate evaluations of crucial reaction data for nuclear astrophysics, fusion-energy research, and other applications. I will present in this talk the No-Core Shell Model with Continuum formalism, which combines square-integrable A-nucleon eigenstates and cluster states that constitute the reacting system. This method can accurately describe reaction systems of more than four nucleons starting from two- and three-nucleon interactions. I will briefly review the physics cases recently unraveled by the method such as impact of three-nucleon forces. I will elaborate further on how combined together *ab initio* theory and experiments with exotic nuclei to discriminate between different flavors of chiral interaction. Encouraged by these recent applications that validate our approach, we aim at modeling t(d,n)^{4}He fusion from an *ab initio* point of view. It was suggested more than 40 years ago that polarized fusion should be consider to achieve earth-based fusion. I will present our first results towards accurate predictions for polarized fusion reaction observables.

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Mercredi 25 janv. 2017, 11h30
IPN, Bât. 100, Salle A015