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Gauge angle dependency in fusion and transfer reactions, restoration of broken symmetries in dynamical calculation

Heavy ion transfer reactions are an ideal tool to study the pair correlations. New experimental data show that the probability to transfer a pair of neutrons is enhanced compared to the expected value in the uncorrelated limit or pure sequential transfer.

In order to understand this enhancement, the Time-dependent Hartree-Fock (TDHF) with BCS pairing has been studied but this approach cannot reproduce the experimental data. To go beyond this approach, we use the Time-dependent Hartree-Fock-Bogoliubov (TDHFB) theory. The calculation is done with a Gogny interaction in a hybrid basis of two-dimensional harmonic oscillator eigenfunctions and a one-dimensional Lagrange mesh. With that model, the Josephson effect is quantitatively described in the reaction 20O+20O as well as the dependency of the Nucleus-Nucleus potential with respect to the Gauge angle.

The restoration of the gauge angle symmetry is then studied with a projection method. The accuracy of this method is discussed in a simple model.

As a complementary method, the coupled-channels formalism is used. A phenomenological approach is used consisting in fitting the transfer coupling to reproduce the experimental data for the 40Ca+96Zr and 60Ni+116Sn systems. We investigate two different mechanisms for the pair transfer: a pure sequential transfer hypothesis and a sequential plus direct pair transfer hypothesis. We discuss the validity of the perturbative approach and highlight the effect of high-order terms. In this simple model, it is find that the direct pair transfer give a better reproduction of the experimental data at energies close to the coulomb barrier. Finally, we use the coupled-channels approach to achieve a simultaneous description of the fusion cross sections and the transfer probabilities for the 40Ca+96Zr reaction.

Jeudi 16 mars 2017, *11h30*

IPN, Bât. 100, Salle A015