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The multi-channel experimental and theoretical approach to study the $^{12}C(^{18}O,^{18}F)^{12}B$ single charge exchange reaction mechanism

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A full understanding of the reaction mechanisms involved in double and single charge exchange nuclear reactions is mandatory for the purposes of the NUMEN project. The main goal is to extract data driven information on nuclear matrix elements of neutrino-less double-beta decay from measured cross section of heavy-ion induced double charge exchange reactions.
An interesting benchmark to test the capability of state-of-the-art nuclear reaction and nuclear structure theories is the network of nuclear reactions involved in the ^{18}O + ^{12}C collision at 15.3 AMeV incident energy.
The experiment has been performed at the INFN-LNS using the K800 Superconducting Cyclotron and the MAGNEX magnetic spectrometer. The experimental results and the theoretical analysis for the single charge exchange, elastic and inelastic scattering, one-neutron addition and one-proton removal nuclear reactions will be discussed during the conference.
The main purpose of this work is to describe the newly extracted experimental cross-sections in a full comprehensive theoretical framework in which the reaction channels are treated all together. The many aspects that play a relevant role in the description of the single charge exchange reaction mechanism are the choice and tuning of the optical potential, the role of the couplings with the low-lying excited states of the involved nuclei, the single-particle and many-body properties of the nuclear wave functions and the competition between the direct and the sequential reaction mechanisms.

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