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The NUMEN project: Heavy-Ion Double Charge Exchange reactions towards the $0\nu\beta\beta$ NME determination

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NUMEN proposes cross sections measurements of Heavy-Ion double charge exchange reactions as an innovative tool to access the nuclear matrix elements, entering the expression of the life time of Neutrinoless double beta decay ($0\nu\beta\beta$). If detected, such a process would give direct evidence to the Majorana-nature of neutrinos, opening a window to physics beyond the standard model.

A key aspect of the project is the use at INFN-Laboratori Nazionali del Sud (LNS) of the Superconducting Cyclotron (CS) for the acceleration of the required high resolution and low emittance heavy-ion beams and of MAGNEX large acceptance magnetic spectrometer for the detection of the ejectiles.

However, a main limitation on the beam current delivered by the accelerator and the maximum rate accepted by the MAGNEX focal plane detector must be sensibly overcome in order to systematically provide accurate numbers to the neutrino physics community in all the studied cases. The upgrade of the LNS facilities, in this view, is part of this project.

First experimental results, obtained at the INFN-Laboratori Nazionali del Sud in Catania using MAGNEX magnetic spectrometer, for the $^{40}\text{Ca}(^{18}\text{O},^{18}\text{Ne})^{40}\text{Ar}$ reaction at 270 MeV are shown. The data give encouraging indication on the capability to access quantitative information towards the determination of the Nuclear Matrix Elements for $0\nu\beta\beta$ decay. Preliminary results, in particular of the reaction $^{116}\text{Cd}(^{20}\text{Ne},^{20}\text{O})^{116}\text{Sn}$ at 15 MeV/u, performed at INFN LNS, are reported.

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