The (^{18}O,^{16}O) reaction: a bridge from direct to dissipative dynamics

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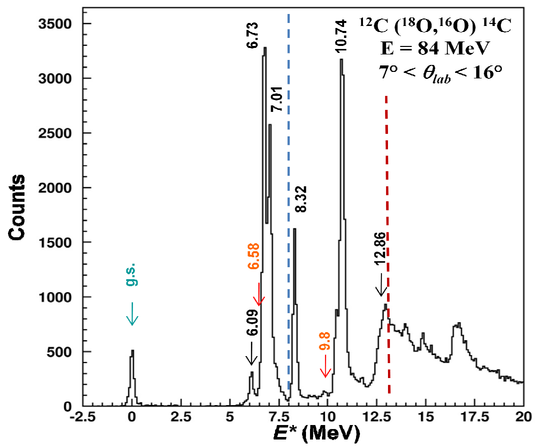
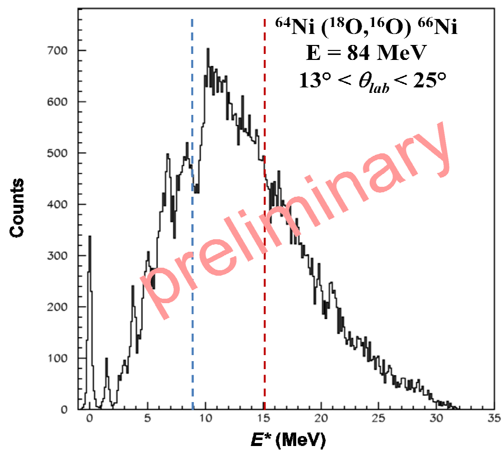
A study of the (^{18}O,^{16}O) two-neutron removal reaction at 84 MeV and 270 MeV incident energy was pursued at the Catania INFN-LNS laboratory. The experiments were performed on several solid targets from light (^{9}Be, ^{11}B, ^{12,13}C, ^{16}O, ^{28}Si) to heavier ones (^{58,64}Ni, ^{120}Sn, ^{208}Pb). The ^{16}O ejectiles were detected at forward angles by the MAGNEX magnetic spectrometer [1]. Exploiting the large momentum acceptance (20%) and solid angle (50 msr) of the spectrometer, energy spectra were obtained with a relevant yield up to about 20 MeV excitation energy [2]. The application of the powerful trajectory reconstruction technique did allow to get energy spectra with energy resolution of about 150 keV and angular distributions with angular resolution better than 0.3°.

In the energy spectra obtained from the light targets at 84 MeV, several known low lying and resonant states of the product nuclei are observed. Instead, the spectra from the heavier targets are dominated by the appearance of a broad bump, indicating that more dissipative processes are contributing. This is confirmed by the measured angular distributions which are peaked at the grazing angle. In the data at 270 MeV a clear trend to dissipative dynamics is observed, even for light targets. However, a simple picture such as the deep inelastic reaction mechanism can be hardly associated to our data, due to the relatively low excitation energy of the observed bumps. In this case, calculations based on semi-classical transport theories seem to indicate the possible occurrence of other dissipative reaction mechanisms.

The measured absolute cross-section angular distributions for transitions to bound and resonance states of the residual nucleus are compared to Exact Finite Range Coupled Reaction Channel calculations based on a parameter free double-folding optical potential [3]. The form factors for the (^{18}O,^{16}O) reaction are extracted within an extreme cluster and independent particle scheme with shell model derived coupling strengths. The results show that the measured cross-sections are accurately described for the first time without the need of any arbitrary scaling factor. This opens the door to the use of the (^{18}O,^{16}O) reactions, under certain conditions, as powerful tools for quantitative spectroscopic studies of single-particle and pair configurations in nuclear states.





[1] F. Cappuzzello et al., *MAGNEX: an innovative large acceptance spectrometer for nuclear reaction studies* in: Magnets: Types, Uses and Safety, Nova Publisher Inc., New York, 2011, 1-63.
[2] M. Cavallaro, et al., Eur. Phys. J. A (2012) 48: 59.
[3] L.C. Chamon, et al., Phys. Rev. Lett. 79 (1997) 5218.