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# CONSTRAINING HOT SOURCES IN CENTRAL HEAVY-ION COLLISIONS BELOW 20 MEV/U

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It is well known that pre-equilibrium emissions affect the production of excited systems in nuclear reactions, thus modifying their properties which enter as input parameters in the comparison with statistical models. In this contribution we will discuss this subject referring to recent results from experiments performed at Legnaro National Laboratories (Italy) with the GARFIELD apparatus complemented with other detectors. In particular, we will consider three experiments in which the investigation of non-statistical emission was relevant for the fusion-evaporation and fusion-fission reaction channels. First we will consider a study on the GDR evolution in the fusion reactions  $^{48}\text{Ti} + ^{40}\text{Ca}$  at three bombarding energies (6.3, 9.4 and 12.5 MeV/u) [1]. Here it is very important to ascertain whether the pre-equilibrium contribution remains negligible at the three beam energies. If so, the complete fusion hypothesis can be safely used to estimate thermodynamical properties of the hot source and then follow its radiative decay to extract the GDR width and strength. Indeed, the composite experimental information collected in these campaigns allowed us to check that the pre-equilibrium emission is low even at 12.5 MeV/u, as stated in [2]. Another example will be shown at higher energy where signals of pre-equilibrium emission become more evident. The analysis of  $^{32}\text{S} + ^{40,48}\text{Ca}$  and  $^{32}\text{S} + ^{48}\text{Ti}$  reactions at 17.7 MeV/u will be presented and the experimental data will be compared to statistical model simulations. As shown in [3], the pre-equilibrium emission appears in these reactions and can significantly affect the measured observables, in particular the energy distributions. Finally, how the pre-equilibrium emission could be used to put into evidence  $\alpha$ -cluster structure in nuclei will be shown, as discussed in [4]. In particular, some preliminary results from the analysis of  $^{16}\text{O} + ^{65}\text{Cu}$  and  $^{19}\text{F} + ^{62}\text{Ni}$  reactions at 16 MeV/u will be presented.

## REFERENCES

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