The Trojan Horse Method and its applications in nuclear astrophysics and in nuclear physics: recent results.

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In the last two decades the Trojan Horse Method (THM) has been applied to several nuclear reaction involved in different astrophysical scenarios. The method allows to extract information on the astrophysical S(E) – factor in the energy regions where the direct measurements are strongly restricted [1-3].

The THM is based on the quasi-free break-up mechanism. A suitable three-body reaction is selected as a mean to investigate the two-body reaction of astrophysical interest. In the process it is assumed that the interaction between a projectile and the Trojan Horse particle, which may be described as made up by two clusters, involves only one cluster (participant) leaving the other one as a spectator. If the break-up of the target occurs in the nuclear interaction field, the hindering Coulomb Barrier is overcome. Appropriate kinematic conditions allow one to select the interacting energies as close as possible to the relevant Gamow energy. Finally, because of the three-body nature of the process, a continuous two body energy range can be explored in a single measurement.

Thus the THM can be applied to determine the energy dependence of the bare nucleus astrophysical $S_b(E)$-factor, without the Coulomb suppression as well as the electron screening effect.

Today, the method is recognized as the only technique to investigate nuclear effects at ultra low energies.

Recently, the same technique has been applied to reactions in which the participant to the process is a neutron. In these cases, of course, there are not coulomb effects. Thus the main advantage is the possible investigation of neutron induced reaction and its application both in nuclear and astrophysical scenarios.

The application of the method will be presented together with recent results. In particular a new result concerning the first experimental study of the 10 keV resonance in the $^{10}B + p$ interaction will be discussed. The $^{10}B(p,\alpha)^{7}Be$ represents one of the most important reactions for the boron destruction in stellar atmospheres, and the bare nucleus S(E)-factor measurement can give useful hints for non-standard transport processes discrimination in stars [4].

[1] C. Spitaleri et al., Phys. Rev., **C60**, 055802 (1999);
[2] A. Tumino et al., Phys. Rev. **C67**(2003)065803;
[3] C. Spitaleri et al. Phys. Rev. **C69** (2004)055806;
[4] A.M. Boesgaard , *"The Light Elements: Lithium, Beryllium and Boron", Carnegie Observatories Astrophysics Series*, **Vol.4**: 2004.