Indirect methods constraining nuclear capture - the Trojan Horse Method

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Understanding energy production and nucleosynthesis in stars requires a precise knowledge of the nuclear reaction rates at the energies of interest. To overcome the experimental difficulties arising from the small cross sections at those energies and from the presence of the electron screening, the Trojan Horse Method has been introduced [1]. The method represents one of the most powerful tools for experimental nuclear astrophysics because of its advantage to measure unscreened low-energy cross sections of reactions between charged particles, and to retrieve information on the electron screening potential when ultra-low energy direct measurements are available. This is done by selecting the quasi-free (QF) contribution of an appropriate three-body reaction $A + a \rightarrow c + C + s$, where a is described in terms of clusters $x \oplus s$. The QF reaction is performed at energies well above the Coulomb barrier, such that cluster x is brought already in the nuclear field of A, leaving s as spectator to the $A+x$ interaction. The THM has been successfully applied to several reactions connected with fundamental astrophysical problems as well as with industrial energy production. I will recall the basic ideas of the THM and show some recent results. Particular emphasis will be given to those related to the ^{12}C+^{12}C fusion channel, whose reaction rate was found to be strongly enhanced at the relevant astrophysical temperatures [2].

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[1] R.E. Tribble et al., Rep. Prog. Phys. **76**, 106901 (2014).

[2] A. Tumino, Nature **557**, 687 (2018).