Measurement of the ^{16}O(n, α)^{13}C reaction cross-section at the CERN n_TOF facility.

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The fundamental role played by the ^{13}C(α, n)^{16}O reaction rate in the understanding of stellar nucleosynthesis processes is widely recognized. Heavy elements (90 $< A <$ 204) are produced in light Asymptotic Giant Branch (AGB) stars, with masses $\frac{M}{M_{\odot}} < 3$, by the slow neutron capture process (s-process), which main source of neutrons is precisely the ^{13}C(α, n)^{16}O reaction. Therefore, an accurate and precise knowledge of this reaction rate is crucial to correctly model the nucleosynthesis process and to predict the abundances of elements along the s-process chain [1]. A direct measurement is experimentally extremely challenging to perform. In this context, an indirect method to obtain this cross section is chosen to measure the inverse ^{16}O(n, α)^{13}C reaction and apply the time-reversal invariance theorem.
To this purpose, a Double Frisch Grid Ionization Chamber (DFGIC) containing the oxygen atoms as a component in the counting gas has been developed and a prototype was constructed at Helmholtz-Zentrum Dresden-Rossendorf, in Germany. The first in-beam test of the detector has been performed at the first experimental area (EAR1) of the neutron time-of-flight facility (n_TOF) at CERN. The neutron beam is produced by spallation of 20 GeV/c protons from the CERN Proton Synchrotron accelerator on a water-cooled lead target coupled with a moderation system. This, together with the 185 m flight path allow to reach a very good energy resolution and an instantaneous high neutron flux, which are key features to successfully measure the ^{16}O(n, α)^{13}C reaction cross-section.
The outcome of the detector test will be presented, with a particular focus on the performance of the detector and electronics in the high-energy region of the neutron spectrum, which is of main interest because of the reaction threshold of 2.35 MeV. In addition, the future developments will be illustrated, which will lead to the final measurement by the end of 2018.

References

[1] F. Käppeler *et al.*. Rev. Mod. Phys. **83** (2011)157