Towards a total cross section measurement of the $^{14}N(p,\gamma)^{15}O$ reaction by activation

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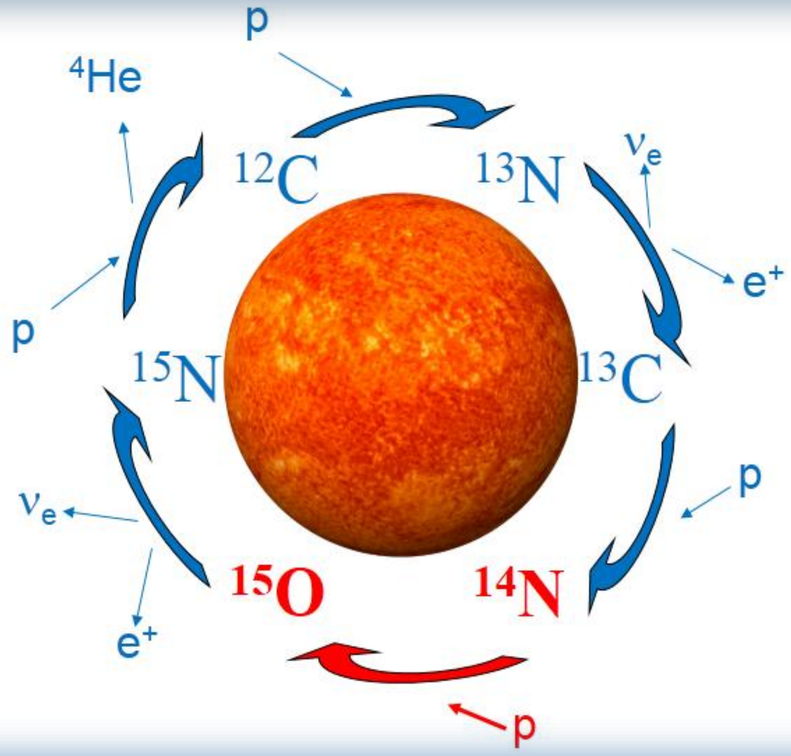
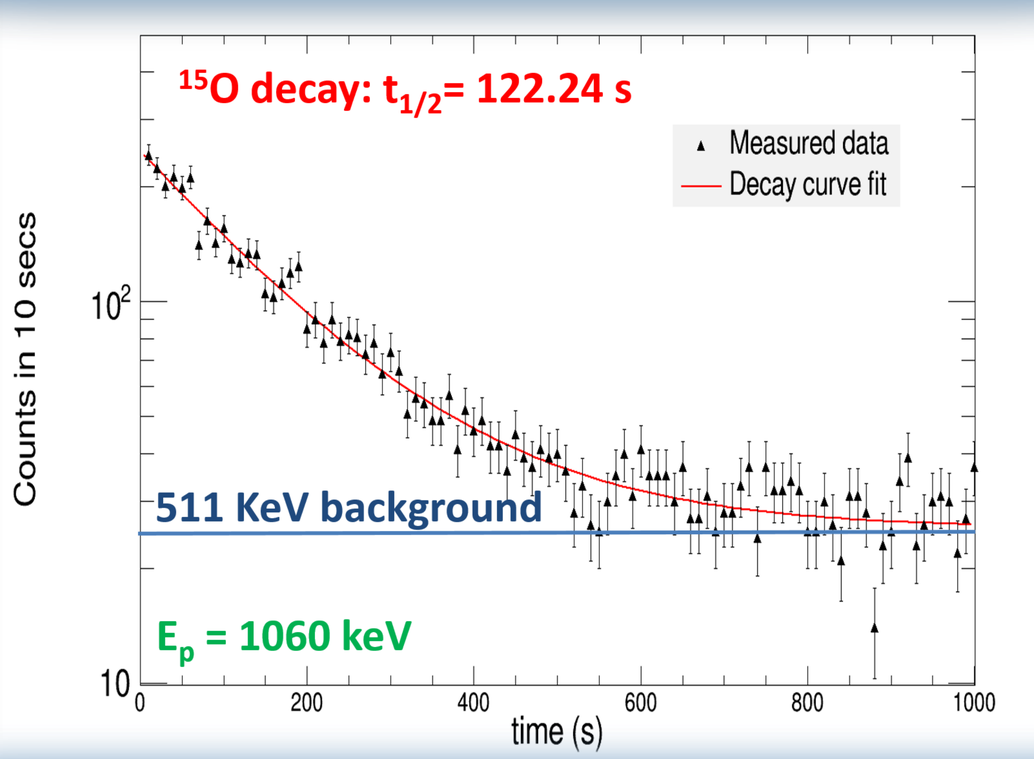
Motivation: the CNO cycle



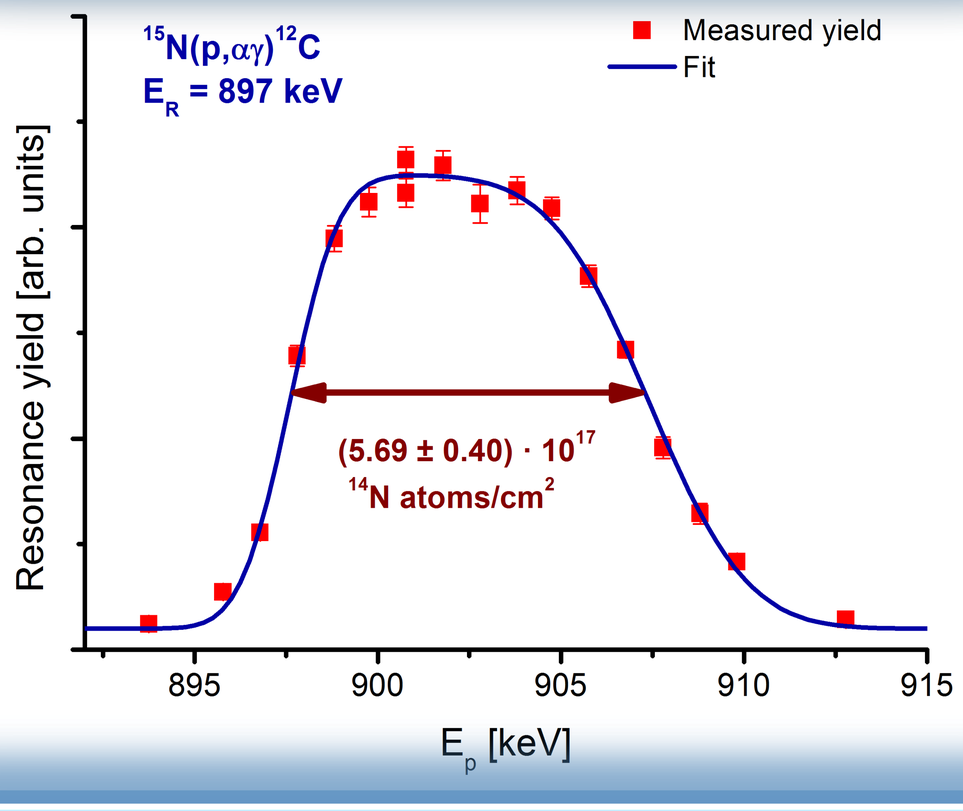
The CNO cycle of hydrogen burning plays a major role e.g. in the energy generation of massive main sequence starts. The key reaction of the cycle is $^{14}N(p,\gamma)^{15}O$ having utmost astrophysical importance.
Only one data set is available in a wide energy region [1] which has some known experimental problems. Therefore, a new measurement of the $^{14}N(p,\gamma)^{15}O$ cross section is needed. (Very recently the results of another wide energy range experiment became available [2], showing some differences compared to [1])

Method: activation



The reaction product ^{15}O is radioactive, decays by positron emission with 2 minutes half-life. The detection of positron annihilations allows the cross section measurements by activation. The above figure shows the decay curve of a test run on the 1058 keV resonance.
The activation method provides the total cross section and is independent from angular distribution effects and from the problems related to weak transitions.

Target characterizations



Target properties will be determined with different methods. This figure shows the resonance profile of the 897 keV resonance in $^{15}N(p,\alpha\gamma)^{12}C$ which was used to determine the target thickness in our test measurement.

Experiments and plans

Test experiments are in progress at the new 2MV tandetron accelerator of Atomki, where solid state TiN targets are bombarded with proton beams and the annihilation radiation following the ^{15}O decay is detected by a 100% relative efficiency HPGe detector. The cross section is planned to be measured in a wide energy range between about 500 keV and 3 MeV.

[1] *U. Schröder et al., Nucl. Phys. A 467, 240 (1987)*
[2] *Q. Li et al., Phys. Rev. C 93, 055806 (2016)*