First application of the Trojan Horse Method with a radioactive ion beam: study of the $^{18}$F($p, \alpha$)$^{15}$O reaction at astrophysical energies

S. Cherubini et al.: In this report.

The results of a pioneering experiment where the Trojan Horse Method$^{1,2}$ was applied for the first time for measuring the cross section of an astrophysically important reaction, namely $^{18}$F($p, \alpha$)$^{15}$O at Nova energies$^{3,4}$, using a radioactive beam were published in Phys. Rev. C 92, 015805 (2015).

![Graph](image-url)

**Fig. 1.** The nuclear cross section spectrum as a function of the p-$^{18}$F cm energy. The blue vertical line shows the position of the threshold for the $^{18}$F+p reaction ($E_{th} = 6.41$ MeV). The red dashed lines represent Gaussians used for fitting the data. The numbers above the arrows represent the peak positions in $^{18}$Ne excitation energy obtained from the fitting procedure.

The experiment was performed at the RIKEN Nishina Center using the CRIB apparatus from the University of Tokyo. The primary beam of $^{18}$O delivered by the AVF cyclotron was used to produce a $^{18}$F radioactive beam with intensity in the range of $10^5$-$10^6$ pps.

The nuclear cross section and the astrophysical factor $S(E)$ were extracted from the data for the reaction $^{18}$F($p, \alpha$)$^{15}$O. These are shown in Figs. 1 and 2 respectively. In order to improve the results obtained in this work, a new measurement of the same reaction was performed again in Fall 2015. The new experiment is also reported in this Accelerator Progress Report$^5$.

![Graph](image-url)

**Fig. 2.** The $^{18}$F($p, \alpha$)$^{15}$O astrophysical S-factor from this work. The full dots are THM experimental data with the assumption of $J^* = 3/2^+$ for the resonance at $E = 6460$ keV, the open ones corresponds to the assumption of $J^* = 5/2^-$ (the difference from this last assumption to the other possible value 1/2$^-$ and 3/2$^-$ being negligible within the errors). The solid and dashed lines shown in the figure are calculations presented and discussed in Ref.$^6$ smeared to the present experimental resolution.

References
5) S. Cherubini et al.: In this report.