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†

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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).

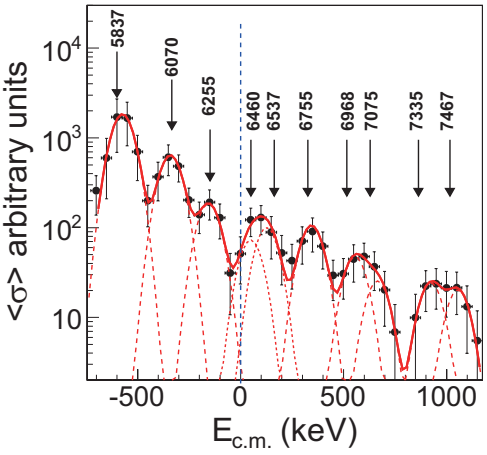

Fig. 1. The nuclear cross section spectrum as a function of the p-^{18}F cm energy. The blue vertical line shows the position of the threshold for the ^{18}F+p reaction (E_{th} = 6.41 MeV). The red dashed lines represent Gaussians used for fitting the data. The numbers above the arrows represents the peak positions in ^{19}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].

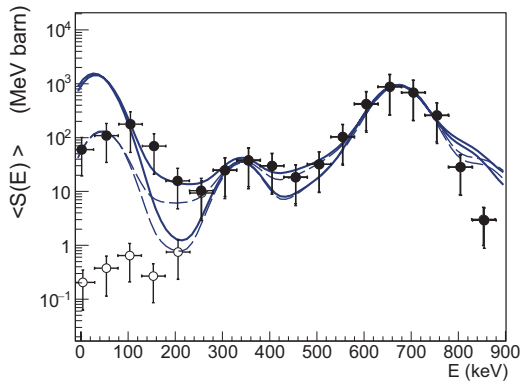

Fig. 2. The ^{18}F(p, α)^{15}O astrophysical S-factor from this work. The full dots are THM experimental data with the assumption of $J^\pi = 3/2^+$ for the resonance at E = 6460 keV, the open ones corresponds to the assumption of $J^\pi = 5/2^-$ (the difference from this last assumption to the other possible value $1/2^-$ and $3/2^-$ being negligeable 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.

† Condensed from the article in Phys. Rev. C **92**, 015805 (2015)

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