2 - 19 Introduction to the SEASTAR Data Analysis

Ding Bing, Liu Zhong, Huang Tianheng, Sun Mingdao, Xu Zhengyu[1,2], Lee Jenny[1,2], Pieter Doornenbal[2], Obertelli Alexandre[2,3] and the SEASTAR collaboration

([1]Department of Physics, The University of Hong Kong Pokfulam Road, Hong Kong;
[2] RIKEN Nishina Center, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan;
[3] CEA Saclay, Service de Physique Nucl'eaire, F-91191 Gif-sur-Yvette, France)

The first SEASTAR (Shell Evolution and Search for Two-plus energies At RIBF) campaign was carried out in May 2014. We are analyzing the data for $^{58-63}$V and $^{63-66}$Mn.

The experiment was performed at the Radioactive Isotope Beam Factory in RIKEN. A high-intensity ^{238}U beam was accelerated to bombard beryllium target to produce secondary beams. The $B\rho$−ΔE−Bρ method was applied to select and purify secondary beams. An ionization chamber located at the focal point F7 (F11) measured the energy loss ΔE, yielding the fragments' element number Z in BigRIPS (ZDS)[1]. The time-of-flight (TOF) was measured with two plastic scintillators placed at the focal points F3 (F9) and F7 (F11), enabling the deduction of the mass-to-charge ratio A/q in BigRIPS (ZDS)[1]. The resultant PID plots are presented in Figs. 1(a) and (b). However, the resolution of A/q for ZDS is not good enough, it is corrected with the position and angle measurements at F9 and F11; the corrected plot is shown in Fig. 1(c). In order to analyze one certain reaction channel, the radioactive projectile and the neutron-rich product can be selected in the PID plots as shown in Fig. 1.

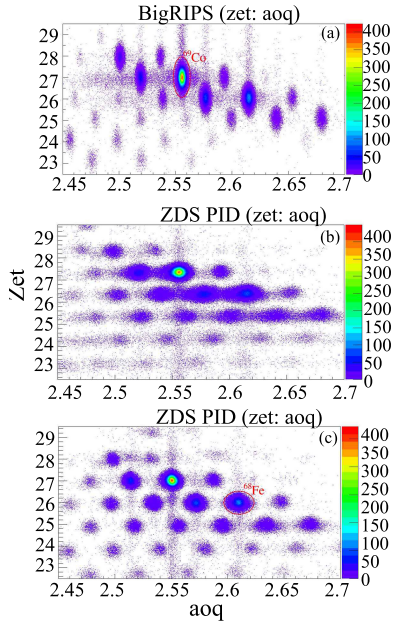

Fig. 1 (color online) (a) BigRIPS PID; (b) ZDS PID; (c) Improved ZDS PID. The ^{69}Co projectile and the ^{68}Fe product have been chosen in the Figure respectively, corresponding to the ^{69}Co (p, 2p) ^{68}Fe reaction channel.

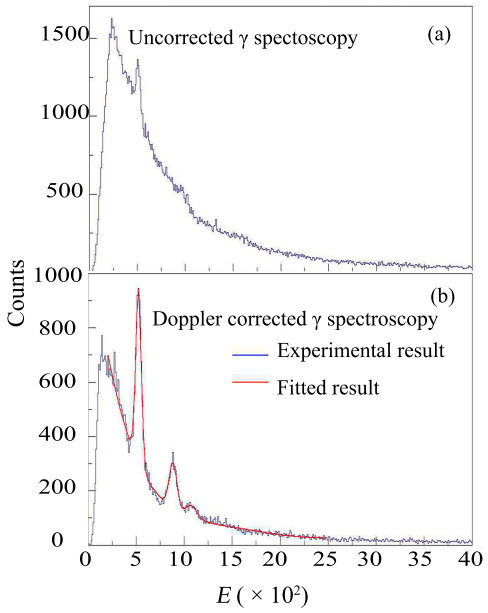

Fig. 2 (color online) (a) Preliminary γ spectroscopy of ^{68}Fe; (b) Doppler corrected γ spectroscopy of ^{68}Fe.

Given the reaction channel, γ rays belonging to the interested nucleus can be deduced (Fig. 2(a)), however, no obvious γ peak can be seen in the preliminary spectroscopy due to the Doppler shift effect. So, Doppler correction has to be made according to the formula $E_{\rm true} = E_{\rm detected} \times (1\text{-}\beta\cos\theta)/\mathrm{sqrt}(1\text{-}\beta^2)$. A special tracking system MINOS, *i.e.*, a thick liquid hydrogen target coupled to a compact time projection chamber serving as a vertex tracker[2], was used in the experiment aiming at improving the luminosity by a significant factor compared to standard solid-target material. The γ ray emission angle θ and the velocity β of the secondary reaction product can be extracted from the reaction point in the liquid hydrogen target. The Doppler corrected γ spectroscopy was shown in Fig. 2(b).

References

[1] N. Fukuda, T. Kubo, T. Ohnishi, et al., Nucl. Instr. Meth. B, 317(2013)323.

[2] A. Obertelli, A. Delbart, S. Anvar, et al., Eur. Phys. J. A, 50(2014)8.