Second campaign of the SEASTAR project

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Within the second SEASTAR (Shell Evolution And Search for Two-plus energies At the RIBF) campaign, nuclei "North-East" of the doubly-magic nucleus ^{78}Ni were studied during 9 days of beam time. The experiment was performed in May, 2015 using the DALI2 γ-ray spectrometer[1] and the MINOS liquid hydrogen target system[2]. The set-up was employed at the F8 focus following the BigRIPS[3] fragment separator and reaction products were identified with ZeroDegree[3]. Specifically, in the second campaign 2_1^+ and 4_1^+ energies of ^{82,84}Zn, ^{86,88}Ge, ^{88,90,92,94}Se, ^{96,98,100}Kr, ^{110}Zr, and ^{112}Mo were measured with five different secondary beam settings via knockout reactions.

To produce the secondary beams of interest, a ^{238}U primary beam was accelerated to 345 MeV/nucleon and impinged on a 3-mm thick Be target at the entrance of BigRIPS. The primary beam intensity was about 30 particle-nA. In the five employed settings, BigRIPS was tuned for beam cocktails focusing on ^{85}Ga, ^{89}As, ^{95}Br, ^{101}Rb, and ^{111}Nb ions to enable $(p, 2p)$ and other reactions to populate the 2_1^+ and 4_1^+ states. The particle identification was obtained by the $B\rho$-ΔE-TOF method, employing standard BigRIPS/ZeroDegree detectors. In front of the 100-mm-long MINOS target, beam energies were around 260–270 MeV/nucleon, and total intensities in the order of several kHz. At the end of ZeroDegree, the ions were stopped in the center of the EURICA spectrometer[4] to search for new isomeric decays.

An example for the quality of the Doppler corrected spectra obtained from DALI2 after reconstructing the vertex position with MINOS is given in Fig. 1 for ^{92}Se following $1p1n$-knockout reactions. For this nucleus, an isomeric state was previously observed[5]. However, the $E(2_1^+)$ could not be assigned. Conversely, the 539-keV transition in the in-beam spectrum clearly possesses the highest intensity, and therefore must be the $2_1^+ \rightarrow 0_{gs}^+$ transition. Several other transitions were observed and confirmed in the isomer spectrum of EURICA. In total, data were collected for about 6.5 days, while secondary beam production and user tuning took about 2.5 days for the five applied settings. All 2_1^+ and 4_1^+ energies of interest were observed. Currently, the data and many by-products are under analysis by several groups affiliated to the SEASTAR collaboration.

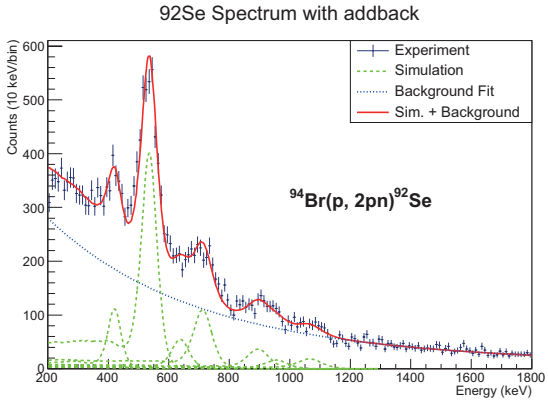

Fig. 1. Doppler-corrected spectrum of ^{92}Se following $1p1n$-knockout reactions from a ^{94}Br secondary beam. The spectrum has been fitted with a double-exponential background (blue dotted) and simulated response functions (green dashed).

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