Decay spectroscopy around ^{78}Ni with the EURICA setup

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Exotic nuclei play an important role in nuclear shell structure studies since they allow to search for possible modifications of magic numbers with increasing N/Z ratio. The tensor force, one of the non-central components of the effective nucleon-nucleon interaction, is expected to modify the relative single particle energies owing to an increased attraction for orbitals with anti-parallel spin configuration and a repulsion for orbitals with parallel spin configuration. In such contest, nuclei at Z=28, N=50 shell gaps are particularly interesting since they are good candidates to reveal changes into the shell structure. Astrophysical implications also involve the discussion on neutron-rich nuclei, since they are expected to dominate the nuclear composition throughout the collapse of massive stars.

In this view an experiment aiming at studying decay spectroscopy in the region close to ^{78}Ni, i.e. in the isotopic chains of Cu, Ni, Co and Fe, was performed at RIKEN in May 2013 as part of the EURICA campaign at the Radioactive-Isotope Beam Factory (RIBF) facility.

The wanted species were produced by means of inflight fission of a ^{238}U beam at a bombarding energy of 345 MeV/u. The resulting fragments were separated in the BigRIPS separator, by the use of degraders at the intermediate dispersive foci[1)]. The cocktail beam was transported in the ZeroDegree spectrometer down to the final focal plane F11. The beam was then slowed down in an Al degrader to ensure the implantation of the wanted species in the 5 silicon detectors of the WAS3ABi array[2)]. This silicon array was surrounded by the EURICA spectrometer consisting of 12 EUROBALL cluster detectors[3)]. $LaBr_3$ scintillator detectors were also mounted in clusters to allow fast-timing measurements. The experiment collected data for an equivalent time of 3 days with an average primary beam intensity of 10pnA. The total count rate at the final focal plane F11 was limited to 100pps to ensure ion-β correlations. In Figure 1 a particle identification (PID) plot is shown. The plot does not include the full statistics of the experiment. The Bρ setting of the separator was set in order to transport ^{71}Fe in its central trajectory.

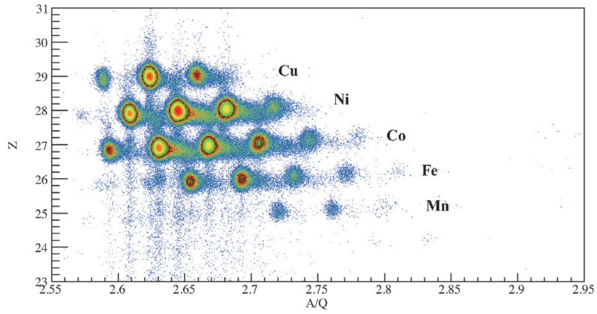

Fig. 1. PID plot of the cocktail beam implanted in the WAS3ABi array.

The study of isomeric γ transitions and β-delayed transitions in the populated nuclei is ongoing. The same reaction was also exploited to perform Coulomb excitation reaction to study the first excited states in $^{73-75}$Ni isotopes[4)].

References
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