PRODUCTION OF NEUTRON-RICH ISOTOPES FOLLOWING ^{82}Se FRAGMENTATION

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Experimental studies of very neutron-rich nuclei provide us information on the evolution of magic numbers, shell gaps and the nucleon-nucleon interaction when one moves away from stability. These results can be used for testing and developing theoretical nuclear models, which predict nuclear properties in extreme conditions. Also, experimental information from level structure and decay properties can be used as input data to perform more reliable r-process calculations [1].

One region, which has only recently been accessible because the technical progress in radioactive beams and detection techniques, lies between magic numbers of Z = 28 and N = 50. There have been successful experiments to identifying ^{78}Ni [2] and also measuring the half-life of ^{76}Ni [3]. But there are still only limited data for excited states and decay properties of neutron-rich Ni and Cu isotopes.

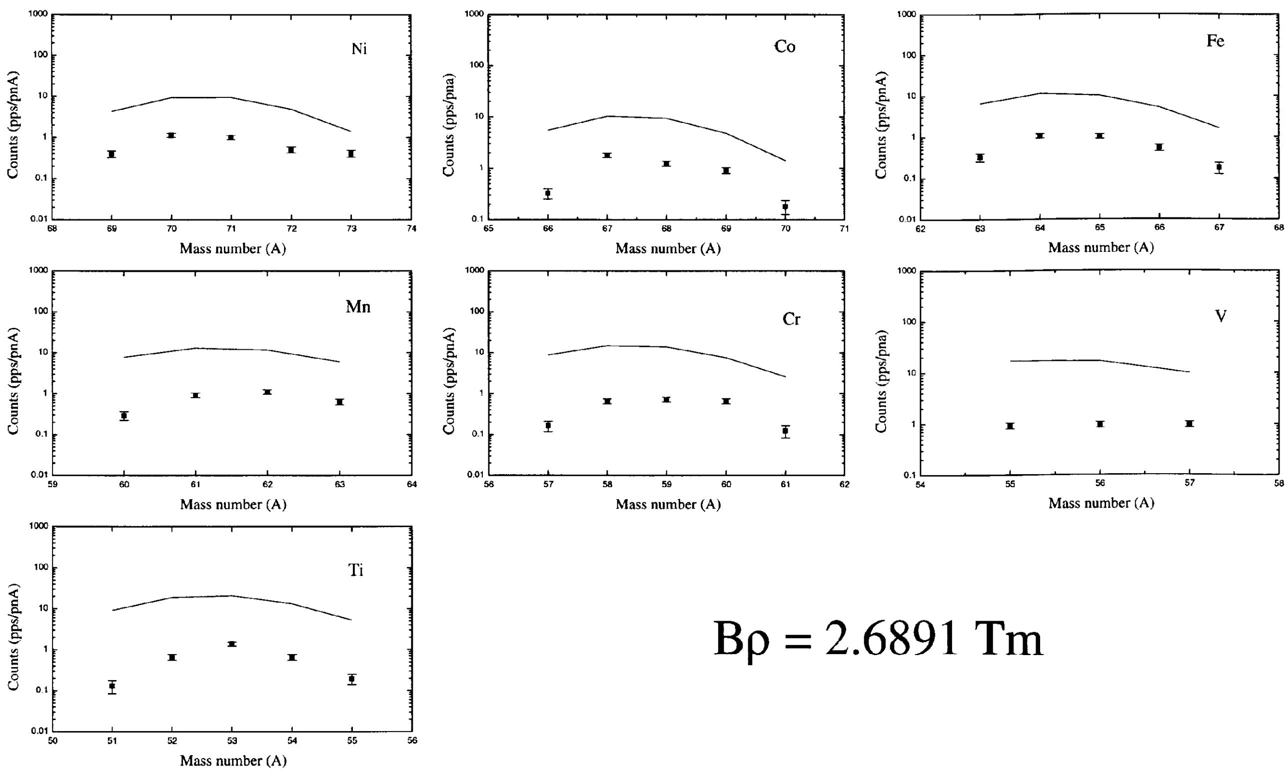

Figure 1: Isotopic distributions of Ni to Ti isotopes at Bρ = 2.689 Tm produced by fragmentation of ^{82}Se projectiles at 70 MeV/nucleon in a ^{9}Be target.

We have completed a measurement of the production rates of the neutron-rich Ni to Ti isotopes produced following the fragmentation of 70 MeV/nucleon ^{82}Se beam on a ^{9}Be target. We studied production cross sections of these nuclides to determine the feasibility of performing decay spectroscopy experiments. The ^{82}Se beam was injected as $^{nat}SeF_6$ inside the superconducting ECR and accelerated to 80 MeV/nucleon using the K1200 cyclotron. The beam was made incident on a 188 mg/cm^2 Be target at the entrance of A1200 fragment separator. The momentum acceptance of A1200 was set to 0.5% using a slit at the first dispersive image. Fragments were identified using their energy loss in a 300 μm Si PIN detector at the A1200 focal plane and the fragment time-of-flight measured between the K1200 cyclotron radiofrequency and Si PIN detector. The typical beam intensity of ^{82}Se measured before the A1200 production target was 0.02-0.05 pnA. The low intensity of the ^{82}Se beam was due to (i) use of natural material and (ii) the interaction between SeF_6 and plasma region of the ion source. Too large amounts of SeF_6 weakened the plasma and made the ion source unstable. The isotopic distributions of Ni to Ti isotopes for a set value of Bρ are shown in Figure 1. Points with error bars are experimental results normalized to intensity of 1 pnA. Solid lines are the predicted production rates based on INTENSITY [4] calculations.

References

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