Feasibility studies of EXL setup at FAIR using GSI storage ring

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The investigation of light-ion induced direct reactions in inverse kinematics, using stored and cooled radioactive beams, interacting with internal H, He, etc. gas-jet targets, bears a large potential for nuclear structure and astrophysics studies on exotic nuclei. In particular, this technique enables, as compared to investigations at external targets, high resolution measurements down to very low momentum transfer. It also provides in many cases a gain in luminosity from accumulation and recirculation of the radioactive beams [1]. Consequently an extended research project EXL (EXotic nuclei studied in Light-ion induced reactions at the NESR storage ring) [2] has been accepted by the FAIR-PAC. In order to explore the experimental conditions for measurements planned at FAIR, a first attempt exploring experimentally the feasibility of EXL concept has been recently made. A detector setup was installed at the ESR storage ring at GSI, Darmstadt. A ^{136}Xe beam of 350 MeV/u energy was interacting to an internal hydrogen gas-jet target with a density $\sim 10^{12}$ atoms/cm^2). The beam lifetime was $\sim$ 30 min, on the average more than 10^8 ions were circulating in the ring with a frequency of 2 MHz resulting in a luminosity $\sim 10^{27}$ s^{-1}cm^{-2}. The detector setup had all the basic ingredients as foreseen by EXL collaboration: a Si-strip detector for the target recoil protons, a liquid scintillator for (p,n) reactions, an array of scintillator bars plus iron converters for fast neutron and charged particle ejectiles, and heavy ion counters (multi-wire chamber, position-sensitive large-area Si diode and fast scintillator) placed behind the first ESR bending arc after the internal target. A luminosity has been monitored by 4 different detectors.

Despite a fact that the detectors covered a small fraction of the solid angle, a reasonable coincidence rate of up to 10 per second as expected to occur between different detectors was observed. The data analysis is still in progress but few first results will be presented: a comparison between different luminosity monitors; an absolute differential cross section of ^{136}Xe(p,p) elastic scattering; estimation of the cross sections of 1- and 2-neutron removal reaction, ^{136}Xe(p,2p)^{136}I knockout reaction and ^{136}Xe(p,n)^{136}Cs charge-exchange reaction. Some experimental results will be compared with the theoretical predictions. The overall performance of the setup demonstrates the feasibility of the EXL experimental approach.

[1] P. Egelhof, O. Kiselev, G. Münzenberg, S. R. Neumaier and H. Weick, Physica Scripta, **T104**, (2003) 151.
[2] EXL technical proposal; http://www-linux.gsi.de/∼wwwnusta/tech_report/05-exl.pdf