Bragg Detector for Isobar-Separation at Rex-Isolde

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Isobaric purity of radioactive ion beams is very important for the analysis of secondary reactions, such as Coulomb excitation, with such beams. At Rex-Isolde a ΔE-E detector consisting of an ionization chamber coupled to a Si-detector was used for the determination of beam content in experiments at energies of 2.2-2.8 MeV/u. While a seperation was possible in the A∼80 mass region, e.g. between ^{78}Ga and ^{78}Zn, the resolution was not sufficient to seperate isobars in the A∼130 region, e.g. ^{122}In and ^{122}Cd. Therefore a new detector was developed for the purpose of achieving higher mass resolution (Fig.1). The detector is based on the concept of a Bragg-Ionization-Chamber (BIC) consisting of 20 electrodes and a Frisch grid (FG) geometrically isolated by 3mm spacers and connected through a resistive chain to the HV. The FG consists of parallel 50μm copper wires equally spaced at 0.5mm. The anode is located 1mm behind the FG and is connted to a seperate HV to avoid current noise. In a Bragg Ionization Chamber (BIC) the time evolution of the anode pulse corresponds excellently with the dE/dx curve of the intruding particle. Separation can be achieved by the long-short method using two spectroscopic amplifiers or by sampling the full information after preamplification.

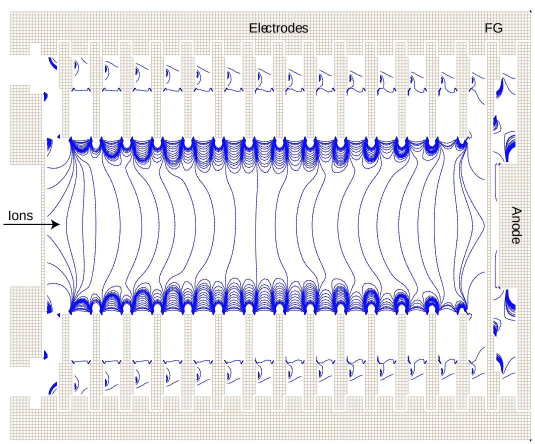

Fig. 1: Schematic view of the BIC and Field Gradients calculated by SIMION

The resistive chain guarantees constant drift velocities of ∼5cm/μs for the charges in the P10 detector gas at a field of E=11V/cm. Sampling of the time evolution is a direct measure for the ionization density in space. Data were taken with a SIS 3300 sampling ADC at a frequency of 100MHz. The expected depth or time profile Fig.2 of the anode signal depends on the ion properties therefore imposing different shapes. The BIC gives back three features of a trespassing ion: Range, total energy and differential energy loss. Digital shaping with long integration times (2.2μs) and a charge protection interval of 0.8μs yielded E_{tot} while shaping with short integration times (50μs) and a charge protection interval of 0.05μs gave the maximum of energy loss. A test experiment was done at the MLL using ^{58}Ni at an energy of 3.1MeV/u and ^{57,56}Fe targets. The detector was placed in beam for calibration as well as at 30° in the lab system. For the test case scattered ^{58}Ni and ^{57}Fe have nearly the same energy of 135.0MeV and 135.7MeV respectively. Already online the pulse shapes were clearly separated. (see Fig.2)

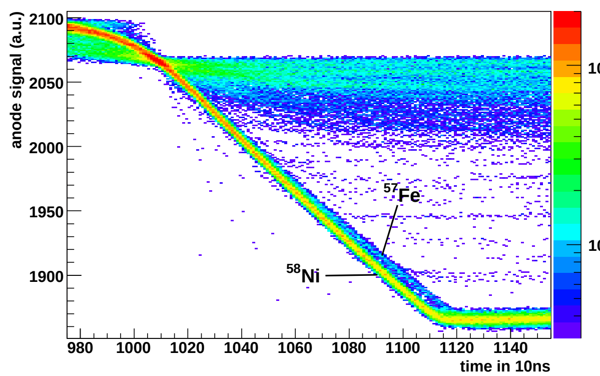

Fig. 2: Sampled Anode Signal for ^{58}Ni on ^{57}Fe under 30°

Due to the very similiar E_{tot} separation is mainly achieved by the different signal slopes at the detector entrance and particle range. Fig.3 shows the preserving of the pulse amplitudes in a.u. using the short shaper described before. Preliminary results show a separation of 6σ between ^{58}Ni and ^{57}Fe. The detector will be used in the upcoming Cern Rex-Isolde beam campaign 2006.

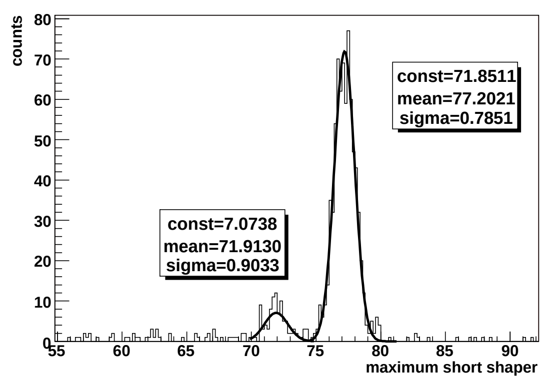

Fig. 3: Short shaping signal for ^{58}Ni on ^{57}Fe under 30°

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