Exclusive Spallation Measurements on ^{56}Fe+p with the SPALADIN Setup

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Understanding spallation mechanism is of great importance in many fields of research from astrophysics to accelerator driven systems (ADS). In this respect, a program centered on residue production measurements started 8 years ago at the FRagment Separator (FRS) at GSI, Darmstadt (Germany). These data led to improvements of spallation models but also raised new questions which appeared impossible to answer with inclusive experiments alone since, in this case, the effects coming from the different phases of the spallation reaction (Intra-Nuclear Cascade + pre-fragment de-excitation) cannot be disentangled. A new type of experiments have been carried out at GSI, performing exclusive measurements of residues in coincidence with particles of low-energy in the Center of Mass (CoM). This is made possible through the use of reverse kinematics where the ion beam is directed onto a liquid Hydrogen target, enabling the detection of low CoM kinetic-energy fragments, which mainly correspond to residues and de-excitation particles. The experimental setup is based on the ALADIN magnet coupled with a multitrack Time Projection Chamber (TPC MUSIC IV) for particle charge identification and tracking. A scintillator wall and a high efficiency neutron detector (LAND) were also used for light-particle Time Of Flight measurements. First data for the ^{56}Fe+p system at 0.5 and 1. A.GeV have been successfully taken in February, 04.

In the on-going analysis, charge identification of all particles from protons to iron has been achieved with a high efficiency in the TPC (ε ~100% for Z > 2). Mass identification of the spallation residues has been performed through high-resolution particle tracking upstream and downstream of the ALADIN magnet (δx~100μm). Heavy-residue velocity (Z >10) is determined with a resolution of $\delta\beta/\beta < 10^{-3}$ by the use of a Ring Imaging CHerenkov.

We will present the charge and mass cross-sections of both heavy and light fragments and compare them to the results of different INC+de-excitation models and to single data taken at the FRS [1]. Coincidence measurements revealed the occurrence of multifragment events which was expected from the data on heavy residues [1]. A study of these events as a function of the reconstructed excitation energies using light particle kinetic energies and neutron multiplicities is undertaken and will be presented. Attempts will be done to disentangle the various models describing the multifragment production, like sequential asymmetric decays or simultaneous multifragmentation .

[1] C.Villagrasa-Canton *et al*., International Conference on Nuclear Data, Santa-Fe, USA (2004), to be published.