STUDY OF MANY FRAGMENT PRODUCTION IN THE REACTIONS $^{32}S + ^{58,64}Ni$ AT 14.5 AMeV

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1. INTRODUCTION

Measurements on the reactions $^{32}S+ ^{58,64}Ni$ at 14.5 MeV/n have been performed at LNL with the GARFIELD apparatus, coupled with the HECTOR BaF_2 and a newly designed RING counter.
The aim of the experiment is to explore the multi - fragment emission at relatively low excitation energy and to characterize their production mechanisms in the framework of a study of the thermodynamics and dynamics of nuclear matter at low and intermediate energy.

2. EXPERIMENTAL SET-UP

The experiment was performed in the GARFIELD large scattering chamber located in the III experimental hall of the ALPI-TANDEM complex.

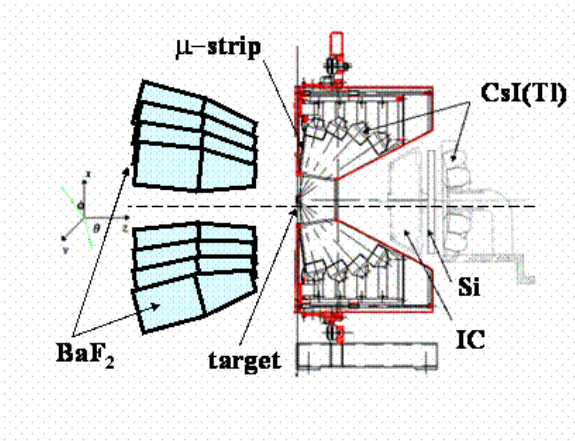

Fig. 1. Schematic view of the experimental set-up.

The energy of the ALPI beam was 464 MeV of ^{32}S. The timing of the pulsed beam has been quite stable during the measurements, around 900ps – 1ns.
Light charged particles and fragments have been detected by one of the GARFIELD drift chambers, which covered the angular range θ=30°-90° in the laboratory system. In the backward direction 8 BaF_2 of the HECTOR apparatus were positioned (see Fig. 1).
Heavy fragments in the forward direction have been detected by an annular detector, shown in fig. 2, which is divided in 8 three elem ent telescopes, each of them consisting of a gas ionization chamber, 8 -strip silicon detectors and 2 CsI(Tl) crystals.

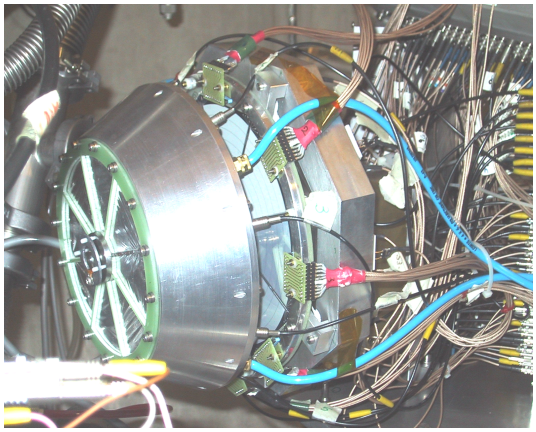

Fig. 2 – Picture of the newly designed RING Counter.

3. STATUS OF ANALYSIS

The experiment was performed at the end of the year and analysis is in progress. The calibration of the GARFIELD apparatus and of the RING Counter will require few months, but from the data collected and the very good performances of the detectors interesting results are expected. In the forward angles the first two stage of the Ring telescope, ionization chamber and silicon detector, are very powerful to identify reaction products and evaporation residues, as shown in Fig.3.

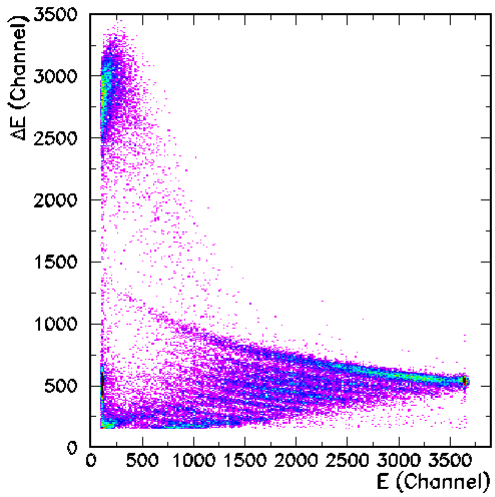

Fig.3 – ΔE-E (IC -Si) spectrum of the new RING counter.

A very good isotopic resolution has been obtained up to oxygen, with highly amplified silicon signals. In Fig. 4 an example is shown up to Berillium isotopes.

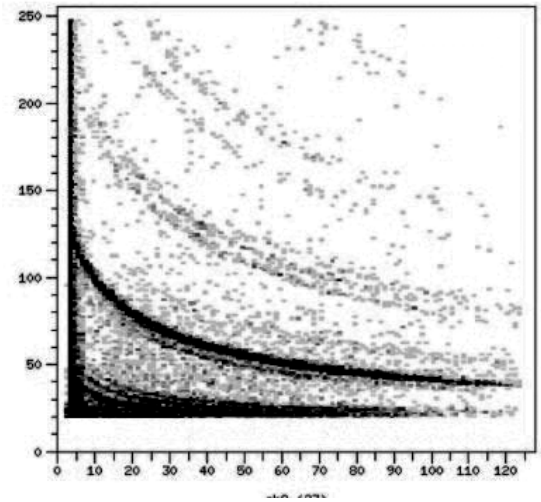

Fig.4 – ΔE-E (Si -CsI) spectrum of the new RING counter.

For many years, the nature of th e mechanisms responsible for the production of many fragments have been discussed. The fragments could be produced a) in a sequential statistical decay, which is a fission chain process, characterized by a long emission time between one step and the following; b) in a fast prompt way, the so-called multi -fragmentation; c) due to dynamical driven forces.

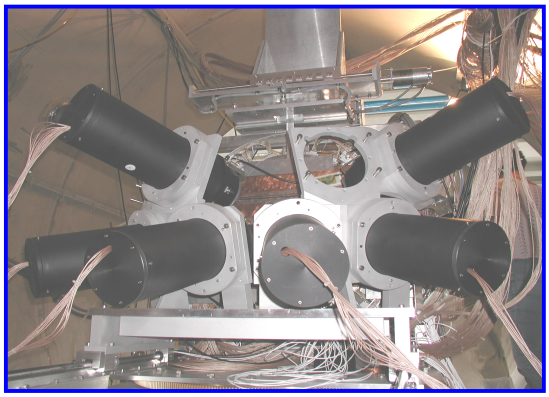

Fig. 5 – The BaF_2 of the HECTOR array in the GARFIELD scattering chamber.

To characterize the production mechanism of many fragment at low energy an event by event analysis will be performed, studying the charge correlations between the fragments and the high moments of the charge distributions connected to the partitions in each event. Many other different physical quantitie s, which can be of key importance to better characterize the emission sources of these fragments, will be studied, cross checking different experimental signals and using all possible correlations.
The coupling between the GARFIELD and HECTOR detectors (see Fig. 5), for instance, have demonstrated to be a powerful tool to perform very clean measurements, in which coincidences between charged products and γ-rays can be easily collected. This will help in better understanding the phenomena which happen in the relatively high excitation energy region, both from the side of reaction mechanisms studies and from the side of nuclear structure.