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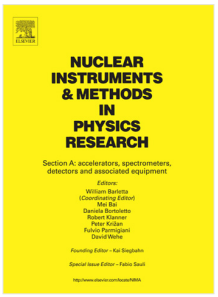

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A gas detection system for fragment identification in low-energy heavy-ion collisions

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Abstract

A gas detection system has been developed for the identification in atomic number Z and the measurement of energy E, timing and scattering angles of the fragments produced in low-energy heavy-ion induced reactions. In particular, it has been designed to be used in kinematic coincidence measurements in conjunction with the large solid angle magnetic spectrometer PRISMA. The detection system is composed of a multiwire parallel plate avalanche counter (MWPPAC) followed by an axial field ionization chamber. Both detectors have been fully characterized with analog electronics by means of heavy-ion beams delivered by the Tandem-ALPI accelerator complex of LNL. Digital electronics has also been tested for the processing of anode signal of the ionization chamber.

Keywords: Multiwire parallel plate avalanche counter; Timing and position-sensitive detector; Axial field ionization chamber; Digitizer

1. Introduction

The identification of fragments produced in low-energy heavy-ion collisions is crucial in exclusive measurements addressed to the understanding of the reaction dynamics and to the study of the structure of exotic nuclei performed via particle-γ ray coincidences. The forthcoming operation of radioactive ion beam facilities will allow to carry out experiments in which more exotic nuclei will be populated requiring their identification in nuclear charge Z, and the measurement of their energy E and emission angles. Time-of-flight (TOF) measurements will also be required for their mass identification.

The use of gas detectors for ion identification offers several and well known advantages. In particular, they can satisfy a wide range of geometrical requirements and cover large detection areas (and thus large solid angles) with low costs, they have a relatively small pulse-height defect and suffer negligible radiation damage. Moreover, their low sensitivity to background radiations such as photons and neutrons allows to install them close to the target area.

Transverse and axial field ionization chambers were widely used for the detection of fragments produced in heavy-ion reactions providing a good atomic number identification up to $Z \sim 50$, energy resolutions $\Delta E/E$ of the order of 1% and broad dynamic ranges. The main disadvantage of this kind of detectors is the lack of a fast timing signal to be used as trigger for data acquisition systems or for coincidence and time-of flight measurements.

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