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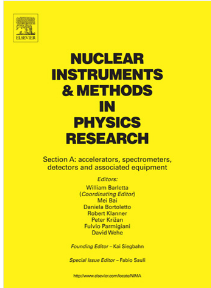

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R. Smith, J. Bishop, Tz. Kokalova, C. Wheldon, M. Freer, N. Curtis, Z. Haider, D.J. Parker

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Optimizing resistive charge-division strip detectors for low energy charged-particle spectroscopy

R. Smith⋆[1], J. Bishop[1], Tz. Kokalova[1], C. Wheldon[1], M. Freer[1], N. Curtis[1], Z. Haider[1], D. J. Parker[1]

[1] *School of Physics and Astronomy, University of Birmingham, Edgbaston, B15 2TT*

Abstract

Two novel approaches to improving the signal-to-background ratio (SBR) for silicon resistive charge-division strip detectors (RSDs), when performing low energy charged-particle spectroscopy, are presented. Firstly, the normally-unutilized rear contact of the detector was used to veto events where the charge collected by this rear face did not match the sum of the charges collected by the strips on the front. Secondly, leading edge discriminator time walk was used to determine complementary information about the hit position along a strip. Using this alongside the position extracted from the charge division allowed clearer identification of true events over background, leading to an improved SBR. These methods were tested by measuring radiation from a triple-α source and then the ^{12}C(^{4}He,α)$\alpha\alpha\alpha$ breakup reaction at 40 MeV beam energy. The first method was found to improve the SBR by a factor of 4.0(2). The second method gave a SBR improvement of factor of 3.7(4). When both methods are applied together, a total improvement by a factor of 5.7(3) was measured.

Keywords: Charged-particle spectroscopy, semiconductor strip detectors
PACS: 29.40.Gx, 25.55.-e, 29.30.Ep

1. Introduction

Position-sensitive silicon strip detectors (PSDs) are essential for modern nuclear physics experiments involving the measurement of charged particles [1, 2]. In many cases, it is crucial to know both the position (direction) of incidence and the energy of a particle in order to determine the full kinematics of the reaction being measured. Such detectors typically come in two forms, double-sided silicon strip detectors (DSSDs) and resistive charge-division strip detectors (RSDs), which are shown schematically in Figs. 1 and 2, respectively.

Intrinsically, DSSDs and RSDs work in a similar way [3]. The front and rear faces consist of *p*-type and *n*-type semiconductor layers respectively, with a reverse bias applied across an electrode layer on each side. The resulting depletion region provides the detection medium and electron-hole pairs, excited by an incident charged particle, are collected by the electrodes on each detector face. The collected charge is proportional to the energy deposited by the particle.

☆Current address: Sheffield Hallam University
Email address: `Robin.Smith@shu.ac.uk` (R. Smith⋆)