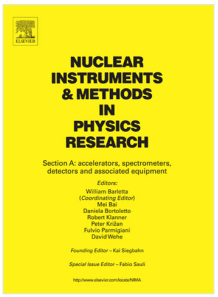
Accepted Manuscript



Silicon photomultipliers as readout for a segmented Time-of-Flight plastic detector

M.L. Cortés, M. Reese, S. Doublet, S. Saha, H. Schaffner, F. Ameil, P. Bednarczyk, J. Gerl, M. Gorska, N. Pietralla, J. Vesic

PII: S0168-9002(18)30636-3
DOI: https://doi.org/10.1016/j.nima.2018.05.031
Reference: NIMA 60815

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date : 19 March 2018
Revised date : 7 May 2018
Accepted date : 14 May 2018

Please cite this article as: M.L. Cortés, M. Reese, S. Doublet, S. Saha, H. Schaffner, F. Ameil, P. Bednarczyk, J. Gerl, M. Gorska, N. Pietralla, J. Vesic, Silicon photomultipliers as readout for a segmented Time-of-Flight plastic detector, *Nuclear Inst. and Methods in Physics Research, A* (2018), https://doi.org/10.1016/j.nima.2018.05.031

Silicon Photomultipliers as readout for a segmented Time-of-Flight plastic detector

M. L. Cortés[a,b,c,*], M. Reese[a,b], S. Doublet[d,a], S. Saha[a,b], H. Schaffner[b], F. Ameil[b], P. Bednarczyk[e], J. Gerl[b], M. Gorska[b], N. Pietralla[a], J. Vesic[b,f]

[a] *Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany*
[b] *GSI Helmoltzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany*
[c] *RIKEN Nishina Center, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan*
[d] *École Centrale de Lyon, 69134 Écully, France*
[e] *IFJ PAN, 31-342 Krakow, Poland*
[f] *Jozef Stefan Institute, 1000 Ljubljana, Slovenia*

Abstract

Particle identification at radioactive ion beam facilities requires Time-of-Flight detectors with an optimal time resolution and high rate capability. Segmented plastic scintillators are a common option for such detectors. A promising approach to cope with the high segmentation of modern devices is the use of silicon photomultipliers (SiPMs) as readout of the Time-of-Flight detectors. A prototype device consisting of strips of plastic scintillator of $4.4 \times 100 \times 1$ mm^3, readout at both ends by SiPMs of two different sizes was tested using a ^{124}Xe beam at 600 MeV/nucleon. Timing and time-over-threshold information were extracted. The time resolution of the prototype was found to vary with the applied voltage and the SiPM size. After optimizing the voltage, resolutions of 14.3(10) ps and 10.4(1) ps were obtained for SiPMs of 1×1 mm^2 and 3×3 mm^2, respectively. These results point to SiPMs being suitable as readout of plastic scintillators at radioactive ion beam facilities.

Keywords: Silicon Photomultiplier, Plastic scintillator, Time resolution, Heavy-ion detection, Time-of-Flight measurement

1. Introduction

The advent of Radioactive Ion Beam (RIB) facilities around the world opened the research on exotic isotopes and the study of the nuclear force for systems with extreme isospin values [1]. For the case of facilities which produce RIBs using the in-flight technique, it is crucial to perform a proper particle identification. Such identification is usually carried out by determining the charge and

*Corresponding author
Email address: liliana@ribf.riken.jp (M. L. Cortés)