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Analog Front-End for the Readout of LGAD Based Particle Detectors

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Charge resolution in cosmic-ray based experiments for the identification of individual elemental species with high energies (above hundreds of GeV) suffers from the presence of backscattered radiation originating from the calorimeter. A means to efficiently reject backscattered radiation consists in developing particle detectors with sub-ns time resolution capabilities to perform Time-of-Flight (ToF) measurements.
In this regard, this work will present the design of an analog front-end channel, developed in the framework of the ADA-5D project (funded by the National Institute for Nuclear Physics, INFN) to be used for the readout of an innovative particle detector based on arrays of Low Gain Avalanche Diodes (LGADs) for the next generation of space-borne experiments. Accounting for a typical flight time between the detector and the calorimeter of around 700 ps, the proposed front-end circuit has been designed to work over a range of input charge larger than three decades (from tens of fC to few pC), achieving a time resolution better than 100 – 150 ps (which is required to efficiently reject backscattered radiation to better than five sigma). The front-end circuit consists of a Charge Sensitive Amplifier (CSA) implementing a dynamic signal compression feature to achieve improved noise performance, along with enhanced time resolution capabilities over the wide range of input charge to be detected. The CSA is then followed by an RC-CR shaper, a fast comparator and a Time-to-Amplitude Converter (TAC). In the conference paper, the analog front-end designed for the ADA-5D project will be discussed, along with post-layout simulation results. Specific design choices, described in the final paper, have been adopted to comply with the timing specification set by the foreseen application. Eventually, measurement results relevant to the main blocks of the front-end circuit will be provided.

Collaboration

ADA-5D

Role of Submitter

I am the presenter

Autore principale: GIROLETTI, Simone (Università di Pavia / INFN)

Coautore: BROGI, Paolo (Università di Siena and INFN Pisa); COLLAZUOL, Gianmaria (Università di Padova and INFN Padova); DALLA BETTA, Gian-Franco (Università di Trento and TIFPA); MANGHISONI, Massimo (Università di Bergamo and INFN Pavia); MAROCCHESI, Pier Simone (Università di Siena and INFN Pisa); MORSANI, Fabio (INFN Pisa); PANCHERI, Lucio (Università di Trento and TIFPA); RATTI, Lodovico (Università di Pavia and INFN Pavia); VACCHI, Carla (Università di Pavia and INFN Pavia)

Relatore: GIROLETTI, Simone (Università di Pavia / INFN)

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