ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

INFN -High density and low-power CMOS front-end electronics with on-board intelligence for radiation detectors used in fundamental physics and applications

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Context of the research activity	In applications using charged particle and photon detectors, the available link bandwidth often limits the amount of data that can be preserved for off-line post-processing. The aim of this research is to investigate novel integrated front-end electronics with smart intelligence on-board allowing for an optimal use of the bandwidth through software reconfigurable selection algorithms that can be tailored to the particular application. Emphasis will be put on the reliability in harsh environments
Objectives	The National Institute for Nuclear Physics (INFN), operating under the ministry of university and research (MUR), is the Italian research agency in charge of studying the fundamental constituents of matter and the physical laws defining their behaviour. To fulfil its mission, INFN develops novel radiation detectors, based on customised sensors and dedicated front-end electronics. It is not uncommon that such detectors find use also in applications beyond fundamental research, such as medical imaging, material analysis and others. All the detectors of interest in this domain are segmented, with the degree of segmentation ranging from a few to many thousands independent channels on each individual sensor unit. In many cases, it is of interest to preserve as much information as possible, in order to be able to post-process the data with sophisticated algorithms running on powerful computer farms. The data are transmitted off-detector with serial links and their bandwidth is often the main limitation to the amount of information that be preserved and further studied. It is therefore of primary interest to have front-end electronics running on-board signal processing algorithms capable of reducing the data by the minimum necessary to fit in the link bandwidth. In order to cope with different experimental situations and running scenarios, such electronics should be highly configurable. In practice, this will entail both the development of specific IPs (high bandwidth A/D and D/A converters, digital signal processing units, etc...) and their organisation in a multi-channel system within a power a budget of at most few mWs/channel. Furthermore, the electronics should work in harsh conditions, tolerating moderate to severe radiation load and operating also in cryogenic

	environments.

Skills and competencies for the development of the activity	The successful candidate will have completed a 3+2 path in engineering or physics, with at least a basic knowledge of electronics. It is preferable to have a solid background in digital electronics, with good skills in hardware description languages such a Verilog and/or VHDL and high level programming.