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Very low noise transimpedance amplifiers to readout SiPMs at cryogenic temperature

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Several next-generation experiments will use SiPMs cooled to very low temperatures. The DUNE experiment will use large arrays of SiPMs to detect scintillation light produced in liquid argon (90 K) by neutrino interactions. Each channel will require single photon sensitivity with a total photosensitive area of tens of cm^2, read out with a single amplifier. Due to the low source impedance, with a total capacitance of 50-100 nF, an amplifier with very low voltage (series) noise is required, capable of operating reliably in liquid argon for decades of data acquisition, while consuming less than 1 mA per channel. The LHCb Upgrade II RICH detectors will use SiPMs to detect Cherenkov photons for particle identification. Due to the high neutron fluence, up to a few 10^{13} cm^{-2}, cooling to low temperature, most likely to liquid nitrogen (77 K), will be the only way to ensure single photon sensitivity over the lifetime of the experiment. A time resolution of less than 100 ps RMS will be required, which in turn will require SiPMs to be characterised by an amplifier with very low voltage noise, wide bandwidth and low jitter. This talk will describe two transimpedance amplifier designs that meet the above requirements, both based on a SiGe HBT as the input device, followed by different operational amplifiers, both forming closed-loop configurations.

Primary authors: CARNITI, Paolo (Istituto Nazionale di Fisica Nucleare); GOTTI, Claudio (Istituto Nazionale di Fisica Nucleare); PESSINA, Gianluigi Ezio (Istituto Nazionale di Fisica Nucleare); TROTTA, Davide (Istituto Nazionale di Fisica Nucleare)

Presenter: GOTTI, Claudio (Istituto Nazionale di Fisica Nucleare)

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