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A 0.22 nV/√Hz, 4.5 mW/channel cryogenic amplifier for large arrays of SiPMs in liquid Argon

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Several detectors for the next generation of particle physics experiments will make use of silicon photomultipliers (SiPMs) to detect scintillation photons in liquid Argon. Cryogenic operation reduces dark counts by orders of magnitude, and allows to retain single photon sensitivity even if large arrays of SiPMs are readout by a single amplifier. The total capacitance of a SiPM array with a total area of tens of cm^2 can range up to 100 nF. The series noise of the amplifier is the dominant factor that determines the signal to noise ratio of the readout chain.
In this contribution, we present a cryogenic amplifier, designed to operate in liquid Argon. The base version has a series white noise of 0.37 nV/√Hz, while dissipating only 2 mW. Design variants have been also tested, which allow to reduce noise to 0.22 nV/√Hz, with a power consumption close to 4.5 mW, still low enough to not cause bubbling.
The amplifier base design and variants have been tested reading out SiPM arrays consisting of up to 96 6x6 mm^2 SiPMs, for a total photosensitive area of 35 cm^2, demonstrating good single photon sensitivity even at low overvoltage values.

Collaboration

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