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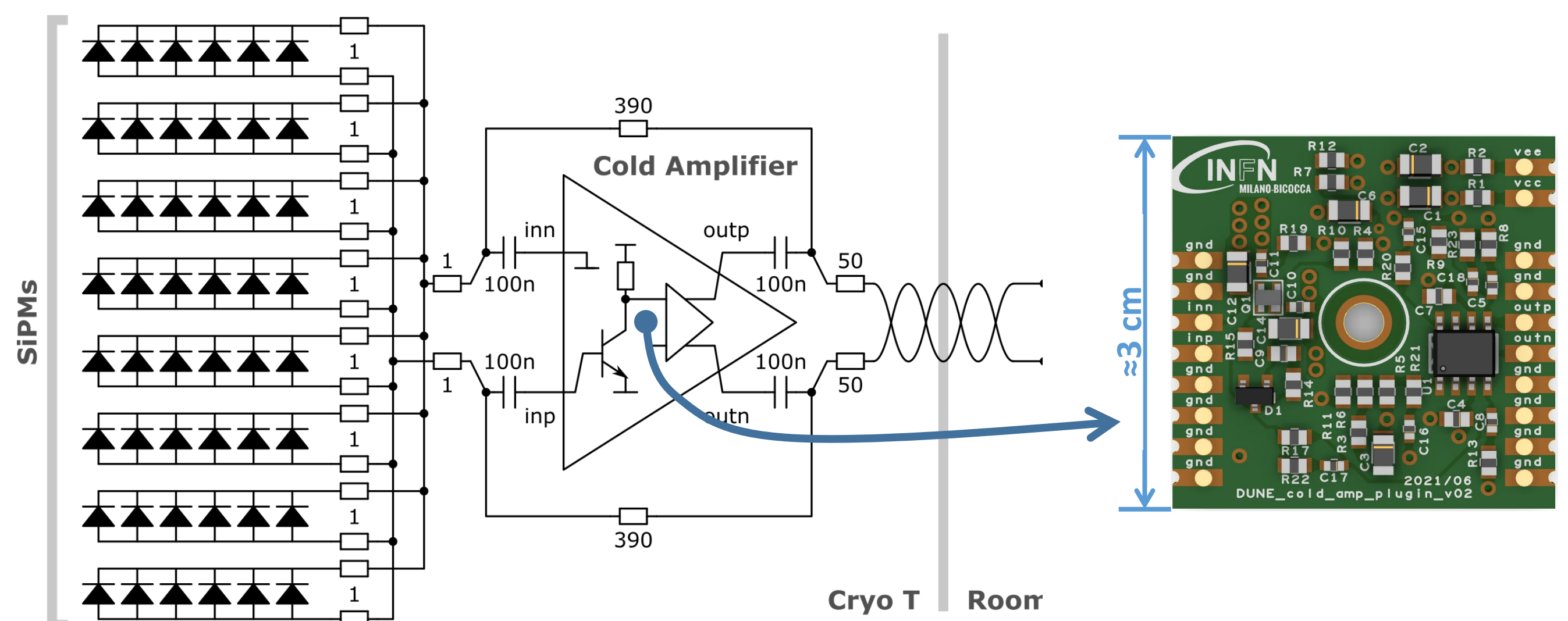
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Several detectors for the next generation of particle physics experiments will make use of silicon photomultipliers (SiPMs) to detect scintillation photons in liquid Argon. Cryogenic operation reduces dark counts by orders of magnitude, and allows 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/ $\sqrt{\text{Hz}}$, while dissipating only 2 mW. Design variants have been also tested, which allow to reduce noise to 0.22 nV/ $\sqrt{\text{Hz}}$, 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 $6 \times 6 \text{ mm}^2$ SiPMs, for a total photosensitive area of 35 cm^2 , demonstrating good single photon sensitivity even at low overvoltage values.

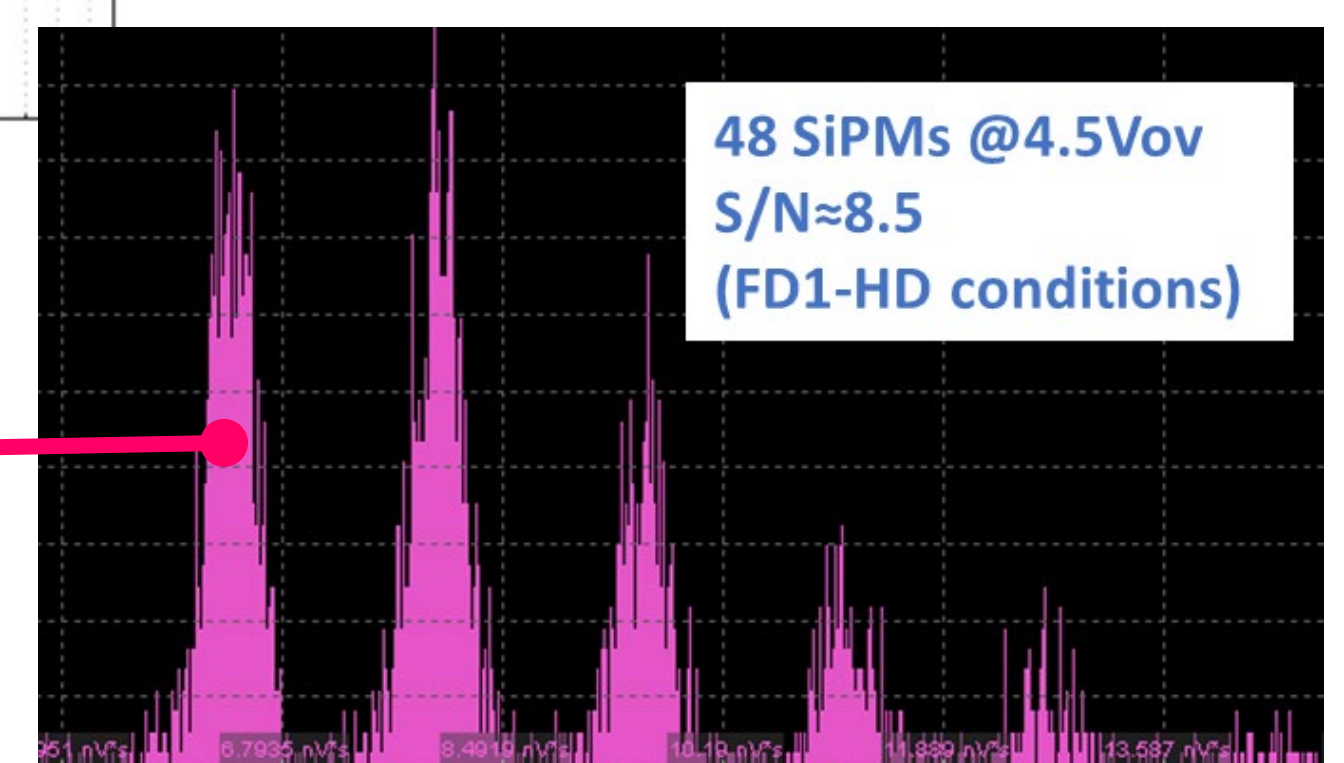
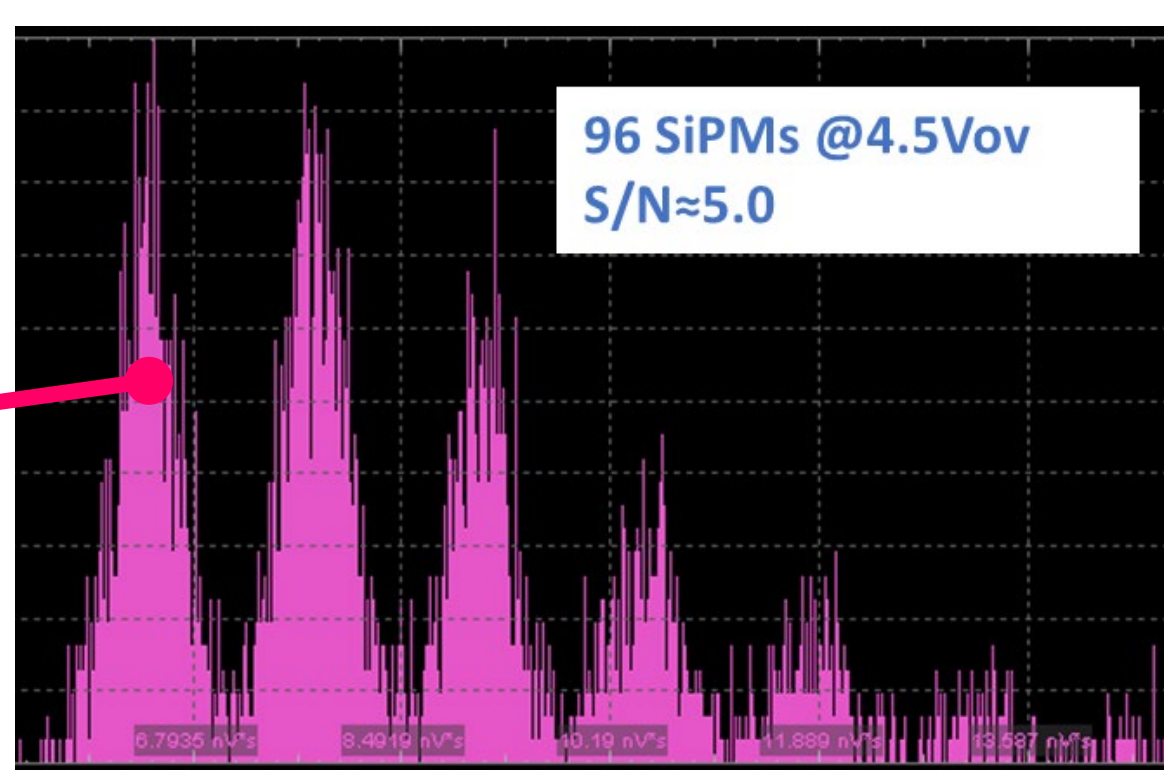
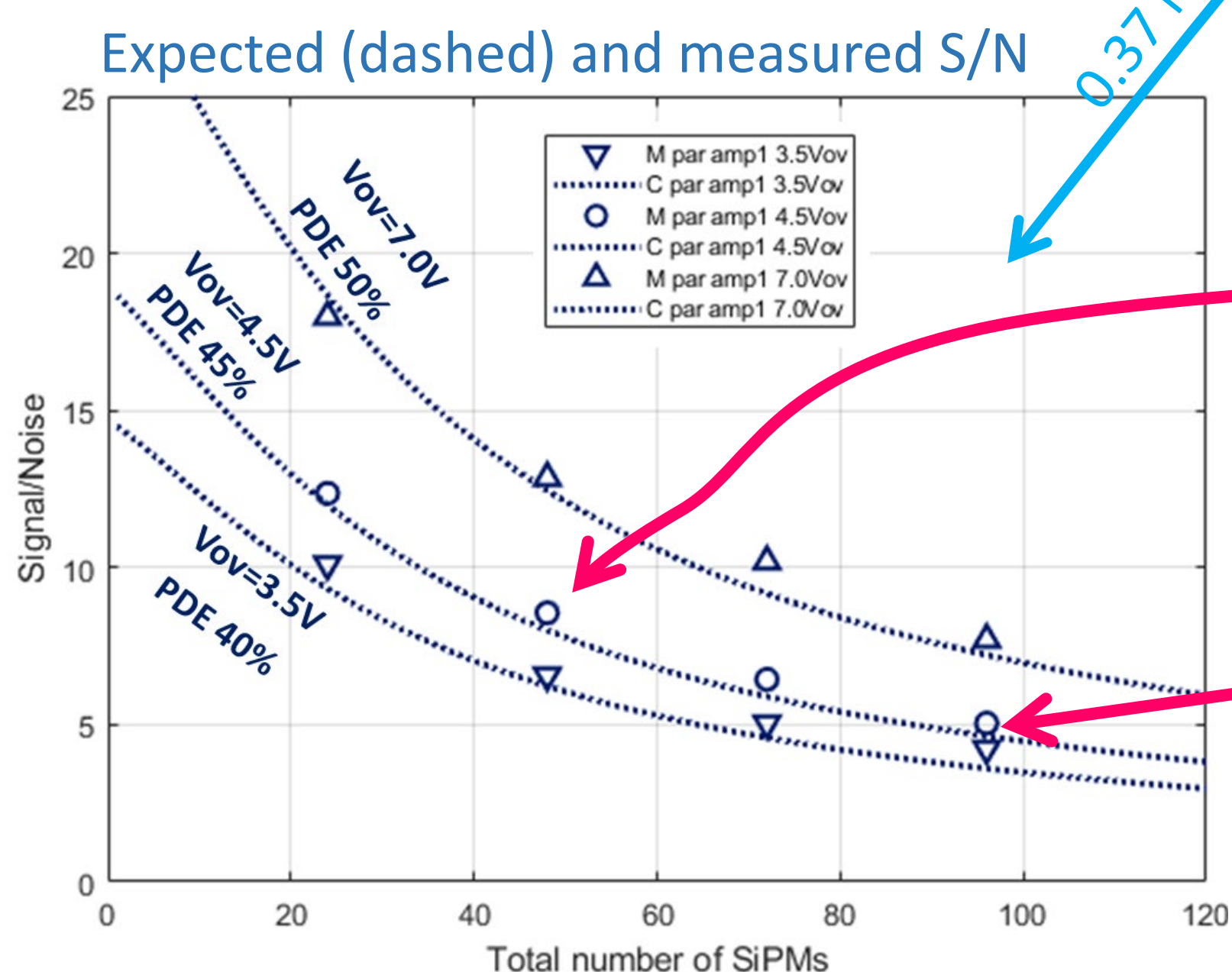
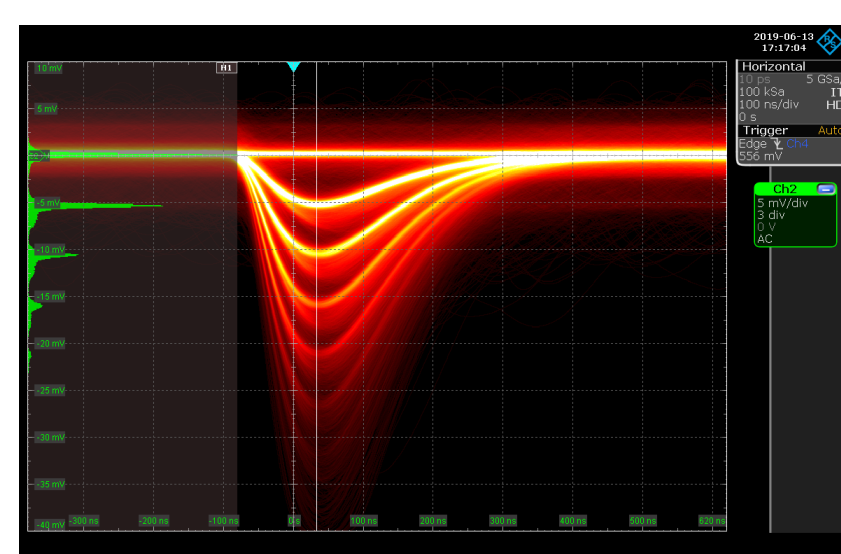
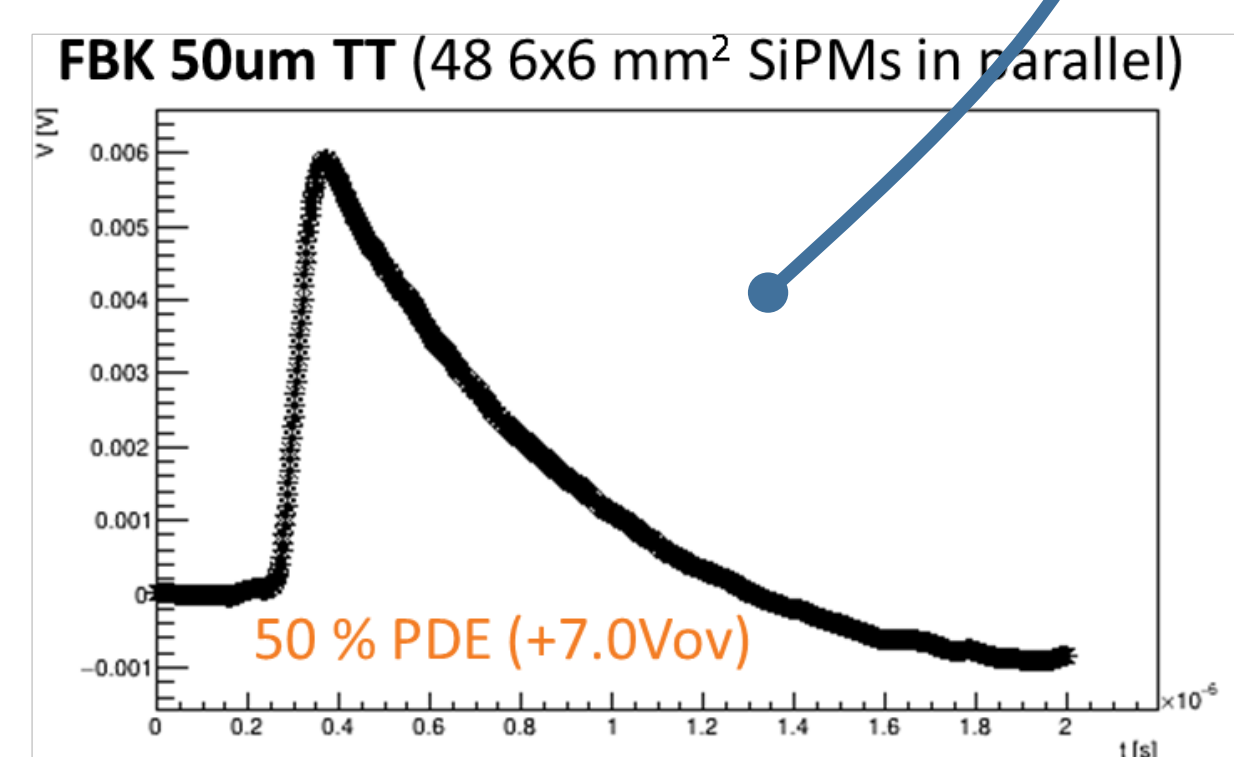
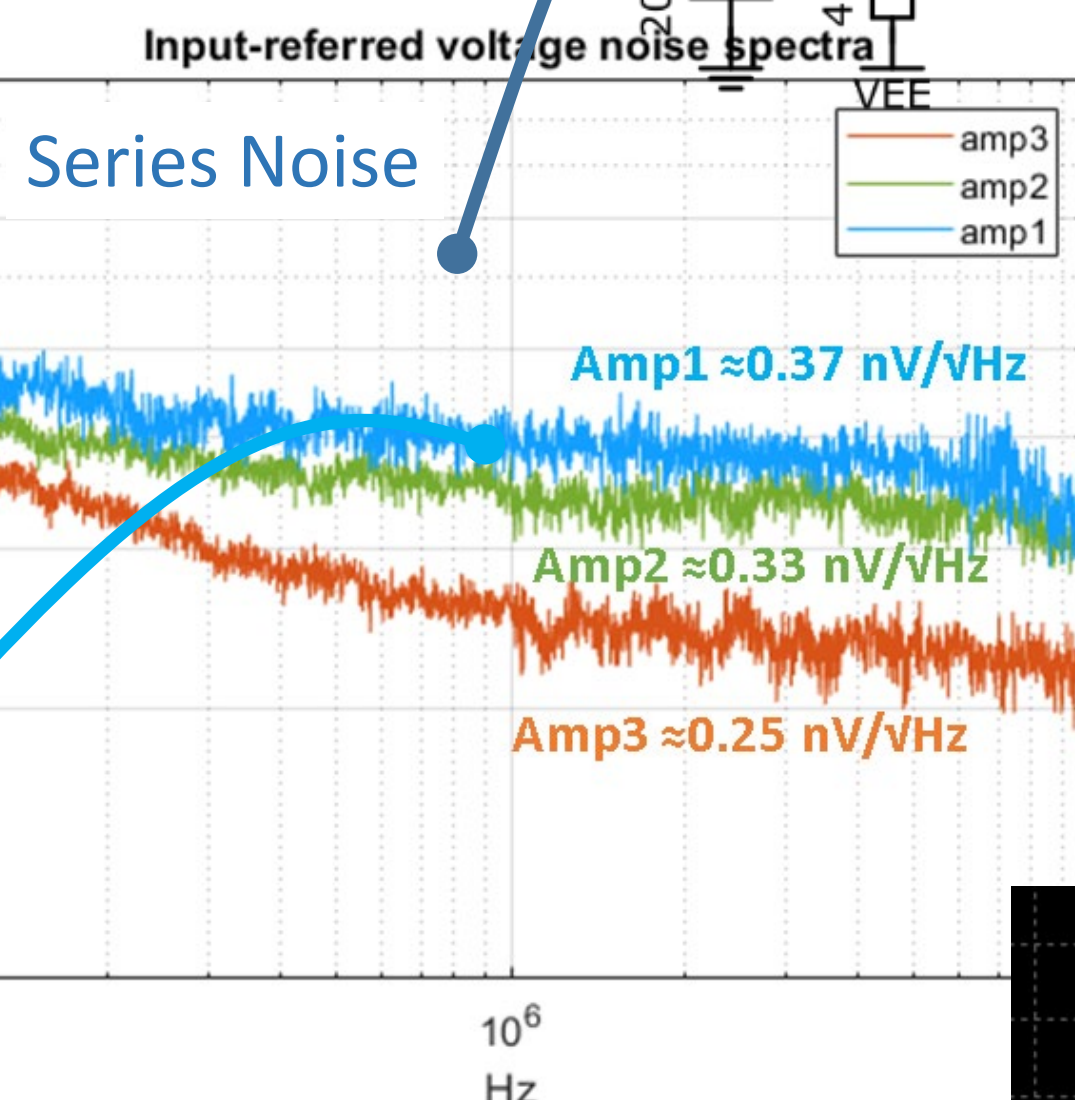
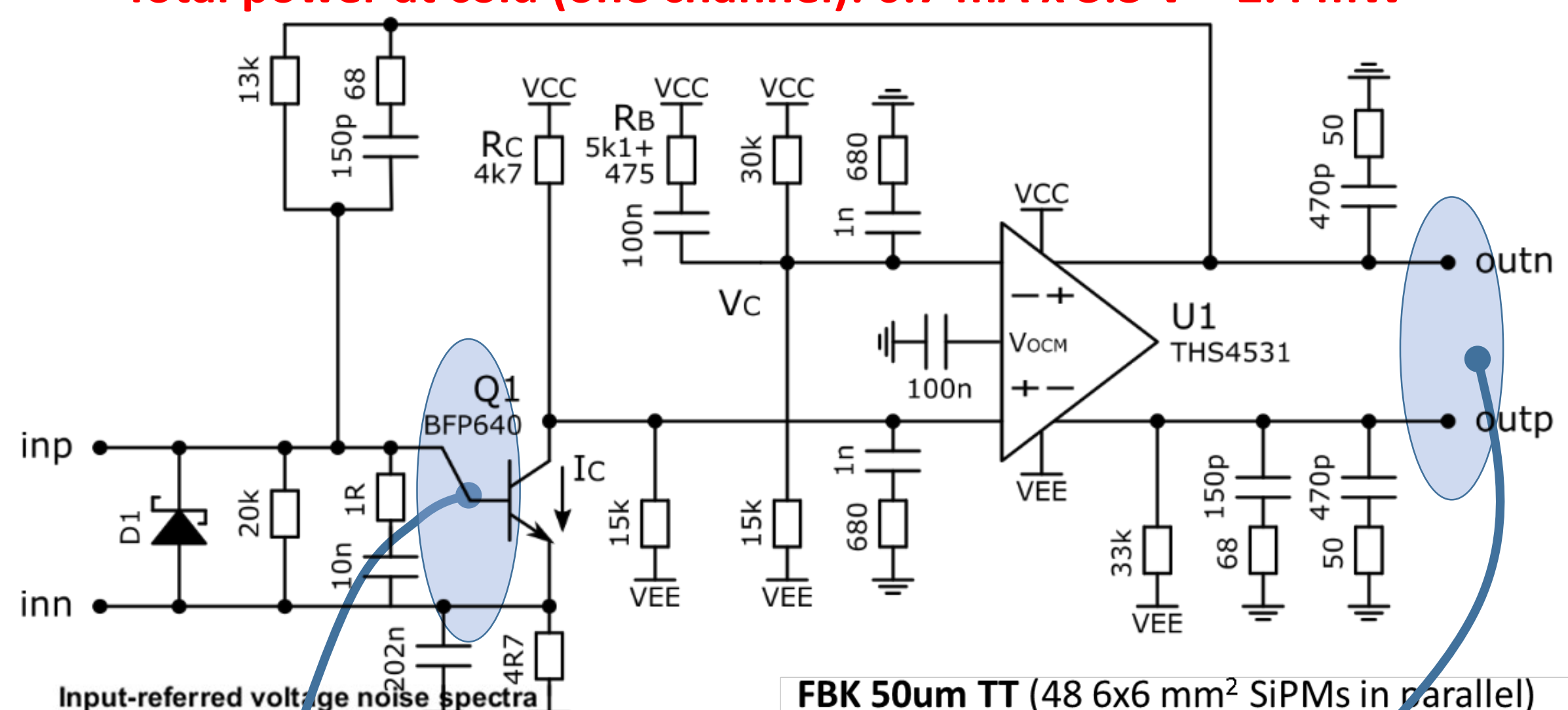
The objective is the readout of very large area SiPM arrays (hundreds of nF) operating in cold, LN or LAr. The cryogenic readout is located close to the detector. Possible experiments that could benefit from our amplifier are *Darkside* and *DUNE*.



Our choice was a hybrid amplifier with a commercial SiGe HBT as input and a fully differential Bi-CMOS amplifier as second stage.

- Due to the **engineering of the base**, SiGe HBTs have a very small value of base spreading resistance, while the channel shot noise is reduced at cryogenic temperatures. This allows the input device to be operated at a very low current, with high gain and BW.
- The dissipation of our chosen **second stage** is small and its contribution to input noise is negligible when cold.

Total power at cold (one channel): 0.7 mA x 3.3 V \approx 2.4 mW



Here some results under working condition with a parallel of 48 x SiPM, or about 95 nF, and a parallel of 96 x SiPM, or about 190 nF.