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P1.22: Design and preliminary test results of the charge sensitive amplifier for Gain-less Charge Readout in High-pressure TPC

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A new No neutrino Double-beta-decay Experiment (N ν DEx) at China Jinping Underground Laboratory (CJPL) of the deepest natural rock shield in the world is being developed to search for the $0\nu\nu\beta\beta$ of ^{82}Se using a high-pressure gas time projection chamber (TPC) with $^{82}\text{SeF}_6$ as the working medium and read out directly by Topmetal sensor chip. The Topmetal sensor, named Topmetal-S, is composed of an exposure top-most hexagon metal with a diameter of 1 mm as a charge collection electrode, a Charge Sensitive Amplifier (CSA), an analog-to-digital converter and a digital readout network. The TPC detector of the N ν DEx experiment requires a meter-sized charge readout plane with $\sim 10^5$ Topmetal-S sensors on the plane without gas-electron avalanche. This scheme eliminates the conventional avalanche fluctuations but demands exceedingly low internal noise on the front-end amplifier to achieve sufficient energy resolution. This paper presents the design and preliminary test results of the low-noise CSA fabricated in a 130 nm CMOS process. The input linear dynamic range of the CSA is about 6.25 fC and the charge-conversion gain is about 223 mV/fC. The ENC is about 112 e^- after a digital trapezoidal pulse shaper.

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