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Taking the CCDs to the ultimate performance for low threshold experiments (12' + 3')

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Scientific grade CCDs show atractive capabilities for the detection of particles with small energy deposition in matter. Their very low threshold of approximately 40 eV (5 sigma) and their good spatial reconstruction of the event are key properties for currently running experiments using this technology: CONNIE experiment aiming the detection of the neutrino-nucleus coherent interaction using nuclear reactor antineutrinos, and DAMIC experiment focused on direct detection of dark matter by the observation of WIMP-nucleus recoils. Both experiments can benefit from any increase of the detection efficiency of nuclear recoils at low energy. In this work we present two different approaches to increase this efficiency by increasing the SNR of events. The first one is based on the reduction of the readout noise of device, which is the main contribution of uncertanty to the signal measurement. New studies on the electronic noise from the integrated output amplifier and the readout electronics will be presented together with result a new configuration showing a lower limit on the readout noise(currently of 2e-) which can be implemented on the current setup of the CCD based experiments. Also, the measured performance parameters of the first science size Skipper CCD will be presented, which is the new technology for the detector upgrade of the experiments due to their very low readout noise below 1e-. A second approch to increase the SNR of events at low energy that will be presented is the studies of the spatial conformation of nuclear recoil events at different depth in the active volume by studies of new effects that differ from expected models based on not interacting diffusion model of electrons in the semiconductor.

Primary authors: Mr FERNANDEZ MORONI, Guillermo (Universidad Nacional de Bahia Blanca-IIIE-CONICET); TIFFENBERG, Javier (Fermilab); SOFO HARO, Miguel (Instituto Balseiro-CAB-CONICET); CANCELO, gustavo (Fermilab); ESTRADA, juan (fermilab)

Co-authors: PAOLINI, Eduardo Emilio (Universidad Nacional de Bahia Blanca-IIIE); BERTOU, Xavier (Centro Atomico Bariloche)

Presenter: SOFO HARO, Miguel (Instituto Balseiro-CAB-CONICET)

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