



Scaling Up the Readout for Ultraviolet, Optical, and Near-IR Microwave Kinetic Inductance Detectors to 10 Kilopixels

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We report on our progress toward building the next generation of digital readout capable of reading arrays of 10,000+ UV through near-IR MKIDs. The system is composed of readout units that contain three electronics boards, where each unit will be used to read out 1024 pixels in 2 GHz of bandwidth. The unit contains a ROACH2 (Reconfigurable Open Architecture Computing Hardware) board, developed by the CASPER collaboration, connected to an ADC/DAC (analog-to-digital/digital-to-analog converter) board designed at Fermilab. The third board in the unit is used to mix up the readout signals from the DAC to the range of 4 to 8.5 GHz as well as to mix down again before digitizing the signals with the ADC. The ADC/DAC board will have two 12 bit, 2.0 Gsps ADCs and a dual 16 bit, 2.8 Gsps DAC. Each ROACH2 houses a Virtex-6 FPGA, which will run a scaled up version of the firmware used to read out the ARCONS instrument. This firmware processes the frequency multiplexed readout signal, performing a "channelization" process to separate each pixel's contribution as well as finding and collecting the signature of individual photons. The ADC/DAC board has its own FPGA to feed the DAC with precomputed tones stored in memory. The Virtex-6 will time tag detected photons, apply preliminary wavelength calibration, and send the list of photons to the data acquisition computer every 0.5 ms. With the possible assistance of a GPU, data cubes with two spatial dimensions and one wavelength dimension can be generated in real time, for use in adaptive optics corrections. The cost of the system is estimated to be \$10 per pixel.