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# ZCU111 RFSoC Characterisation, in the Context of a Cost Effective Microwave Readout System for MKIDs

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By lithographically structuring a thin film into arrays of low-loss micro-resonators, each with a unique resonant frequency in the GHz range, microwave kinetic inductance detectors (MKIDs) are inherently suitable for frequency-division multiplexed readout. State-of-the-art MKID arrays for optical/near-infrared detection require frequency spacing of ~ 2 MHz, allowing around 500 pixels to be read per GHz of RF bandwidth. As such, the Xilinx XCZU28DR RF-SoC/FPGA chip with its 8 x 4.0 Giga-samples per second (GSPS) ADCs could potentially digitise quadrature signals in I and Q from 8,000 MKIDs, albeit limited by the logic resources on the chip. A characterisation of the ZCU111 RF-SoC carrier board is presented in this talk, in the context of an RF-SoC MKID readout. One pair of the XCZU28DR's eight on-chip DACS are analysed in I/Q for stability over time, with a waveform constituting a full-bandwidth frequency comb over +/- 2GHz. This frequency comb, representative of the excitation waveform for 2,000 MKIDs is then digitised with one pair of the on-chip ADCs, and fed through an on-chip polyphase filter bank (PFB) digital spectrometer for spectral analysis. Using this compact on-chip readout, I/Q measurements of a small array of prototype MKIDs are presented. The measurement results are compared to a Python-based MKID readout simulator which has been developed for time-efficient investigation of alternative MKID channelisation techniques. Finally, based on the logic resources utilised by the FPGA firmware design described herein, a discussion on the expected processing capacity of the RF-SoC is given, in terms of the maximum number of MKIDs that can be feasibly readout with the ZCU111 board.

## Less than 5 years of experience since completion of Ph.D

Y

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