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Cold readout technology development for the LCLS - II soft x-ray spectrometer

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The combination of good energy resolution, high dynamic range, and large solid angle coverage has made arrays of transition-edge sensors (TES) an attractive option for x-ray spectral analysis. Because of these unique properties, we are developing a soft x-ray spectrometer that will become one of the first instruments available to scientists at the upgraded Linac Coherent Light Source (LCLS-II), an x-ray free electron laser at SLAC. The requirements for this ambitious instrument include maintaining an energy resolution of 0.5 eV across 1,000 pixels in a compact and expandable geometry that enables future upgrades. In this presentation, we will discuss the cold readout technology we are developing to meet these stringent. A key challenge is to increase the packing efficiency relative to our existing 250-pixel detector packages without degrading the performance of the detector and its associated microwave SQUID multiplexing readout. To this end, we have developed the concept of the “micro-snout” detector package. Each micro-snout will hold a 250-pixel TES array on the top of a box shaped structure, with the microwave readout chips placed on the 4 adjacent sides. To minimize the footprint, the sensors and microwave readout chips are connected via around-the-corner wire bonds, and 4 micro-snouts are tiled to produce a 1,000-pixel focal plane assembly. We will present the design of this compact 1,000-pixel detector assembly, and discuss challenges associated with maintaining undegraded high-frequency signals in this tight geometry. We will show electrical measurements from multiplexer chips installed on our prototype micro-snout, including successfully routing the microwave transmission line to all 4 sides of the micro-snout without major unwanted reflections. Finally, we will discuss progress in developing a suitable TES array that is compatible with this geometry and meets the resolution requirement of the instrument.

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

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Student (Ph.D., M.Sc. or B.Sc.)

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