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A 960-pixel X-ray-TES readout platform for Athena X-IFU development

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The X-ray Integral Field Unit (X-IFU) is an imaging spectrometer of 3,168 X-ray transition-edge sensors (TESs) under development for ESA's Athena satellite mission. Our time-division SQUID multiplexing (TDM) architecture is a backup readout option for X-IFU. In TDM, each dc-biased TES is coupled to its own first-stage SQUID (SQ1). The SQ1s are turned on and off sequentially such that one TES at a time is read out per column. Recent work on the 3-column by 40-row scale has shown that TDM can meet all of X-IFU's requirements, so the next challenge is to demonstrate TDM readout on a scale closer to the final array size. In this vein, we are developing a new 960-pixel readout platform (24 readout columns of 40 multiplexed rows) that is designed to screen X-IFU TES arrays and to develop and test 40-row TDM readout. When the system comes online in 2019, it will contain the largest multiplexed array of X-ray TESs built to date.

Also under consideration for X-IFU is a hybrid scheme of TDM and flux-summing code-division multiplexing (CDM) that we call "hybrid CDM."In flux-summing CDM, each dc-biased TES is coupled to all SQ1s in the column with coupling polarities that form a row of a Hadamard matrix. CDM's aliased system noise is a factor of $\sqrt{N_{\rm rows}}$ lower than TDM's because in CDM all TESs are read out during all row periods. Our proposed hybrid-CDM scheme will allow a multiplexing factor of 64 with slightly lower readout noise than in 40-row TDM. A new row-addressing scheme, in which each SQ1 has a pair of flux-actuated switches, will allow operation of the 64 SQ1s per column with the 40 row-address lines available in the 24x40 platform.

In this presentation we discuss the design of the 960-pixel platform, with a focus on improvements over NIST' s previous-generation 8-column X 32-row TDM architecture.

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

N

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

N

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