ECLIPSE, the cryogenic readout circuit of the polarimetric camera B-BOP for the SPICA spatial observatory project

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SPICA is a spatial infrared observatory project proposed by the Japanese spatial agency (JAXA) and selected in May 2018, with two other projects, as M5 medium mission candidate of the ESA Cosmic Vision Program. B-BOP is one the three instruments of this project: a three-band polarimetric imager made of five 16 x 16 pixels matrices and one 8 x 8 pixels matrix.

The B-BOP detector has the particularity of being directly built on its readout circuit, which is used as a mechanical substrate during its manufacturing process. By this mean, the distance between the detector and the readout electronics is minimized, and so the parasitic capacitance of the interconnections. It results that the working temperature of the detector and the readout circuit is the same: 50 mK. This imposes extremely severe constraints on the power consumption of the circuit, with a thermal budget of only 0.1 μW by matrix of 16 x 16 pixels, each pixel requiring 5 readout channels.

The readout circuit that we have designed, ECLIPSE, takes in charge the first "amplification"stage (buffering), and the 16 to 1 multiplexing, of a 16 x 16 pixels matrix. To reduce the power consumption, the input stage of a channel is powered only when it is read, i.e. 1/16th of the time. The impedance of the detector being very high (1 Gohm), a complex sequencing of the clocks has been implemented to avoid charges injection in the detector when switching. The performances of the used technology, CMOS 0.35 μm by AMS, had been previously validated at 100 mK on a technology test circuit. The test of ECLIPSE circuit will start in the coming months, after reception from the foundry.

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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