Readout Electronics for Silicon Micro-Strip Sensors

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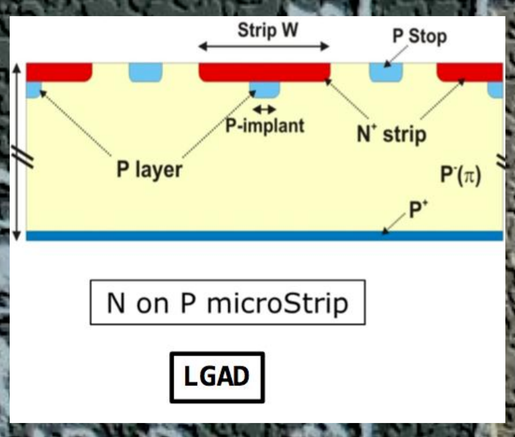
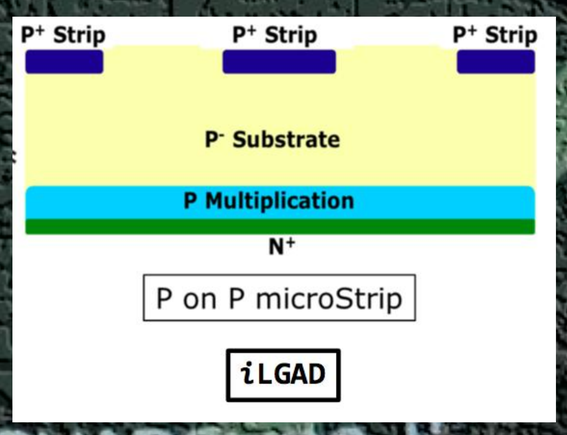
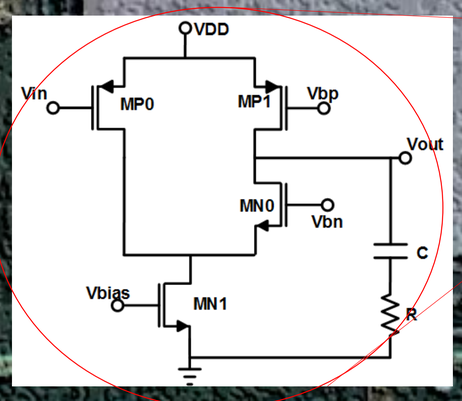
Silicon micro-strips detectors are the baseline for the tracker region of the future International Linear Collider (ILC). Lately, variations of this type of sensors, like resistive micro-strips, Low Gain Avalanche Detectors (LGAD) and inverse LGAD (iLGAD) [1], have been presented to be considered as the technology for the future tracker.

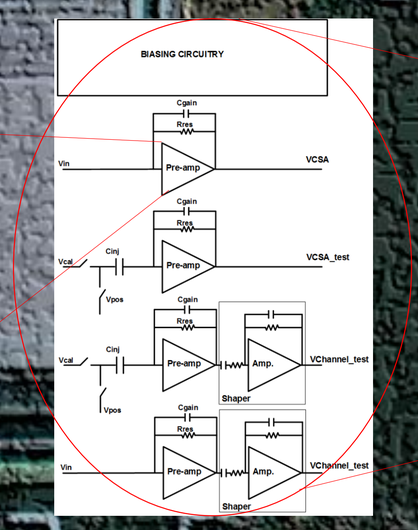


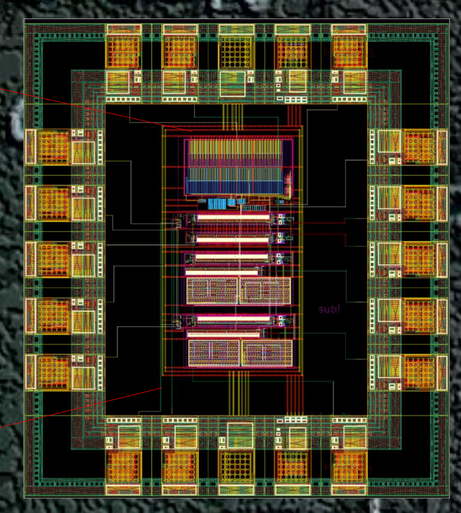


ASIC fabricated in 180 nm CMOS technology from AMS with the very front-end electronics used to readout silicon micro-strips is presented as well as its experimental results. The front-end has the typical architecture for Si-strip readout [2], i.e., preamplification stage with a Charge Sensitive Amplifier (CSA) followed by a CR-RC shaper. Both amplifiers are based on a folded cascade structure with a PMOS input transistor and the shaper only uses passive elements for the feedback stage. The CSA has programmable gain and a configurable input stage in order to adapt to the different strip flavours (resistive micro-strips, LGADs and iLGADs). The fabricated prototype is 0.865 mm x 0.965 mm and includes the biasing circuit for the CSA and the shaper, 4 analog channels (CSA+shaper) and programmable charge injection circuits included for testing purposes.

- Power supply: 1.8 V
- Power consumption x channel < 160 uW
- Pre-amp is the main noise contribution of the circuit.
- Pre-Amplifier:
  - Gain ~ 67,5 dB
  - GBW ~ 19,5 MHz
  - PM ~ 63º
- Optimum L and Ibias to maintain ENC below 400 e- with a C_d of 20 pF
- CSA with two gains (100fC, 500fC)
- CR-RC shaper with a folded cascade structure. C's and R's are passive

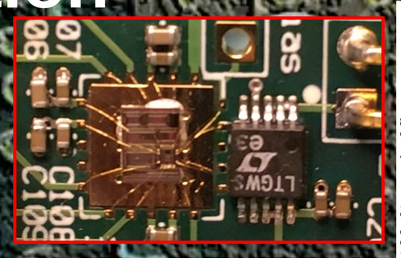


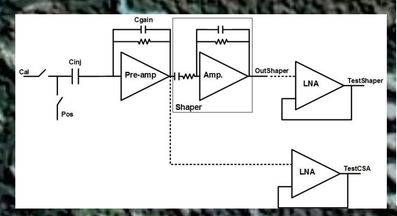


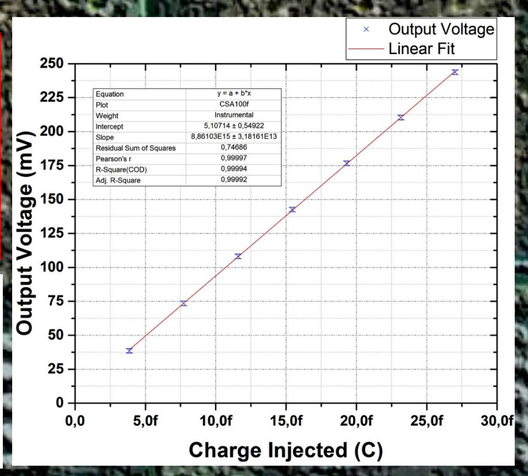


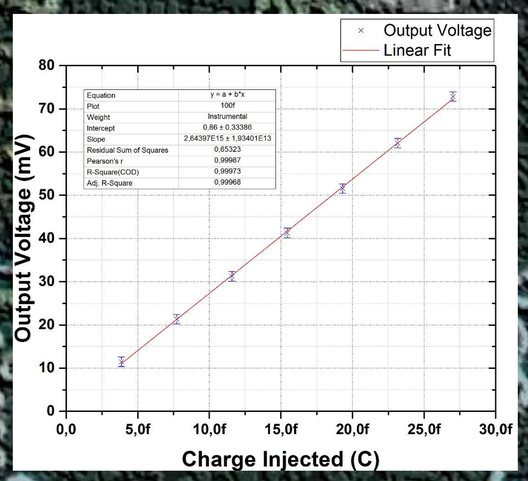
Test and characterization

ASIC:
- CSA gain of 8.86 mV/fC with feedback C = 100f
- Channelgain of 2.64 mV/fC with feedback C = 100f
- Vrms noise = 0.73 mV

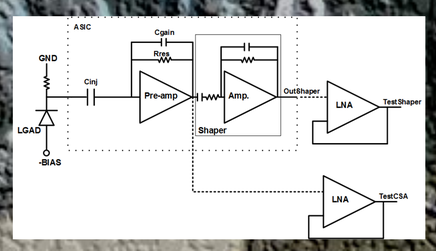


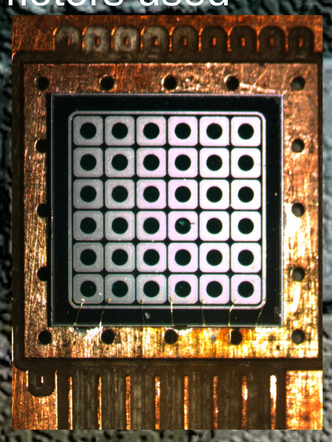


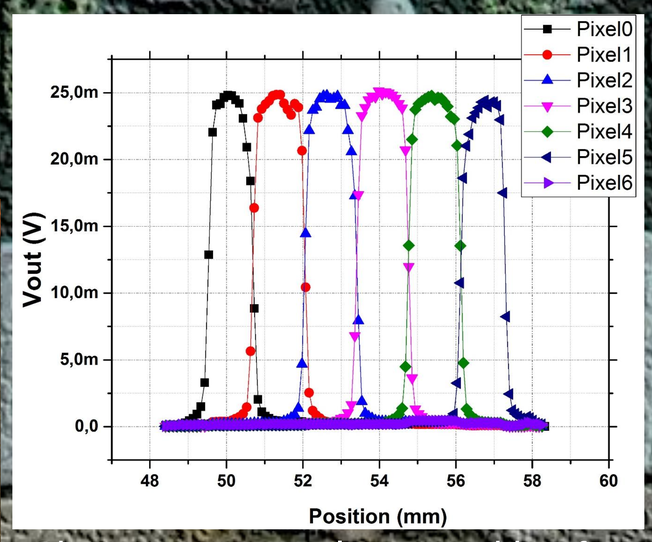




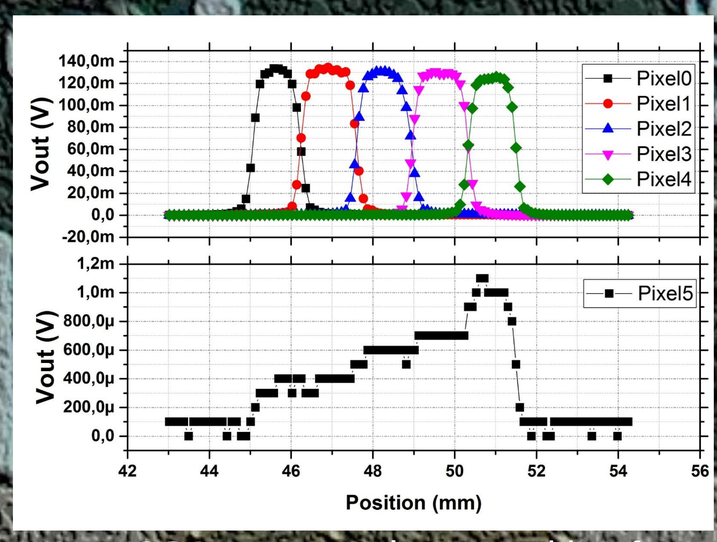
Pixelated LGAD + ASIC:
- LGAD biased @ 420 V
- LGAD back illuminated
- Micro positioners and motors used to move LGAD board
- 100 um pinhole







Shaper output vs laser position for each pixel



CSA output vs laser position for each pixel. Pixel 5 covered.

[1] G. Pellegrini et al., "Recent Technological Developments on LGAD and iLGAD Detectors for Tracking and Timing Applications", Instrumentation and detectors, arXiv:1511.07175.

[2] F. Anghinolfi et al., in: IEEE Transaction on nuclear science, vol. 49, nº 3, pp.1080-1085, 2002

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