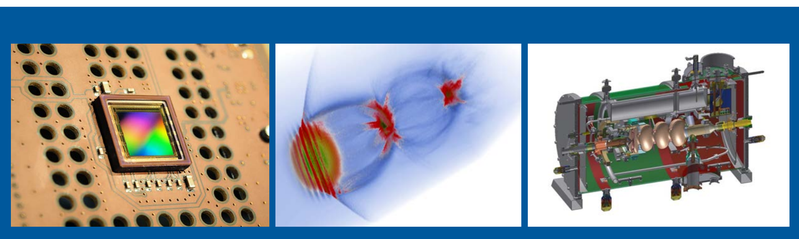
Programme Matter and Technologies

KALPSO Systems – Update



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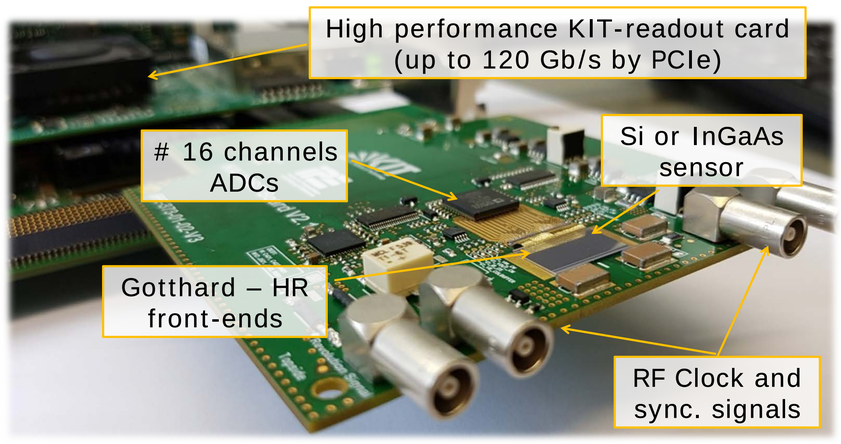
KALYPSO III: toward real-time beam diagnostic at 10 Mfps

***Novel front-end electronics ASIC*: "Gotthard- High Rate":**

- low-noise front-end for Si and InGaAs sensors
- Up to 10 Mfps @ full occupancy

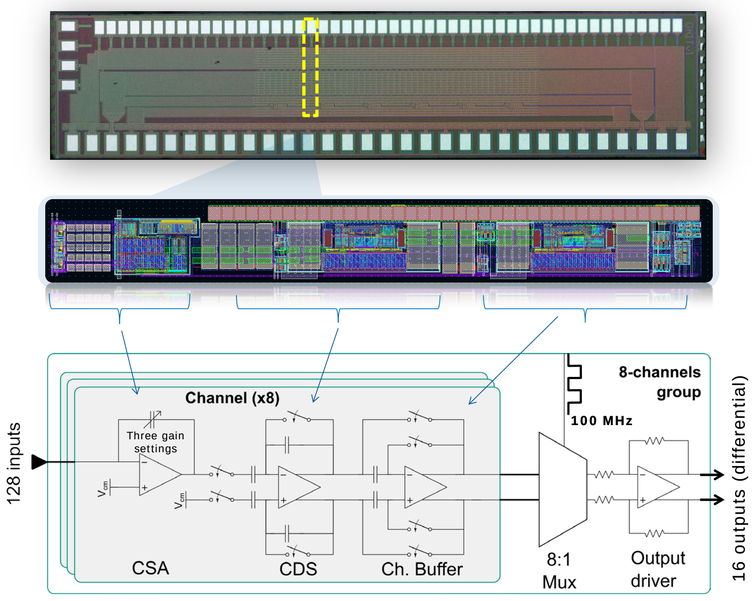
Novel linear array sensors:

- 512/1024 and 2048 pixels with pitch of 25 µm and Anti-reflective Coating layers for Near-IR, Near-UV and standard
- 512, 1024 LGAD (Low Gain Avalanche Detector) with pitch 50 µm



KALYPSO Version 2.1

New Gotthard – High Rate



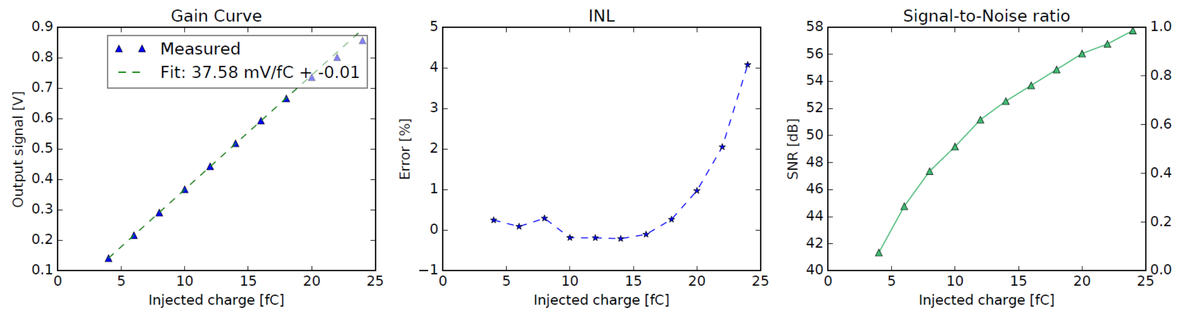
Charge Sensitive Amplifier (CSA): differential folded-cascode with high open-loop gain > 60 dB to improve the charge collection efficiency and the cross-talk between channels

Correlated Double Sampling (CDS): fully-differential switched capacitor time-variant filter to reduce the noise from front-end

Output buffer: fully-differential which can be directly connected to a differential Analog to Digital Converter (ADC)

First prototype received Dec, 2016 (UMC CMOS 110 nm):

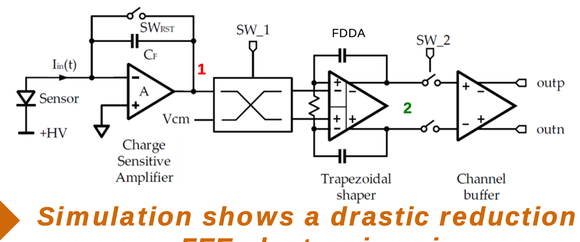
- ❑ **Frame-rate up to 12 Mfps** (continuous readout by interleaved integration and readout time)
- ❑ Compatible with different sensors **Si** (*p-in-n* or *n-in-p*) and **InGaAs**
- ❑ Fully-differential architecture → high PSRR & CMRR



Measured linearity, integral non linearity (INL) and signal-to-noise ratio of the readout chip, not connected to the external sensor (tested with high-gain setting and a line-rate of 10 MHz.)

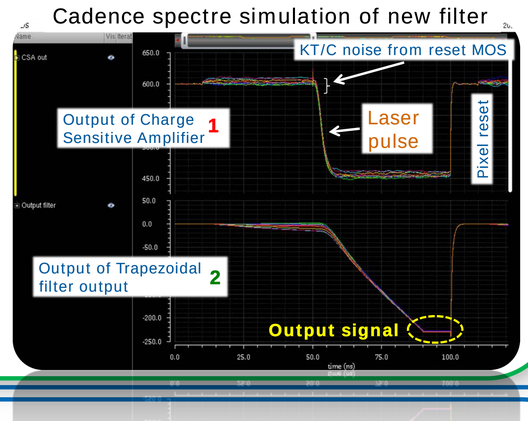
Second prototype to be submitted Oct, 2017

Improvement: Fully-differential trapezoidal filter to reduce the electronic noise from sensor and front-end



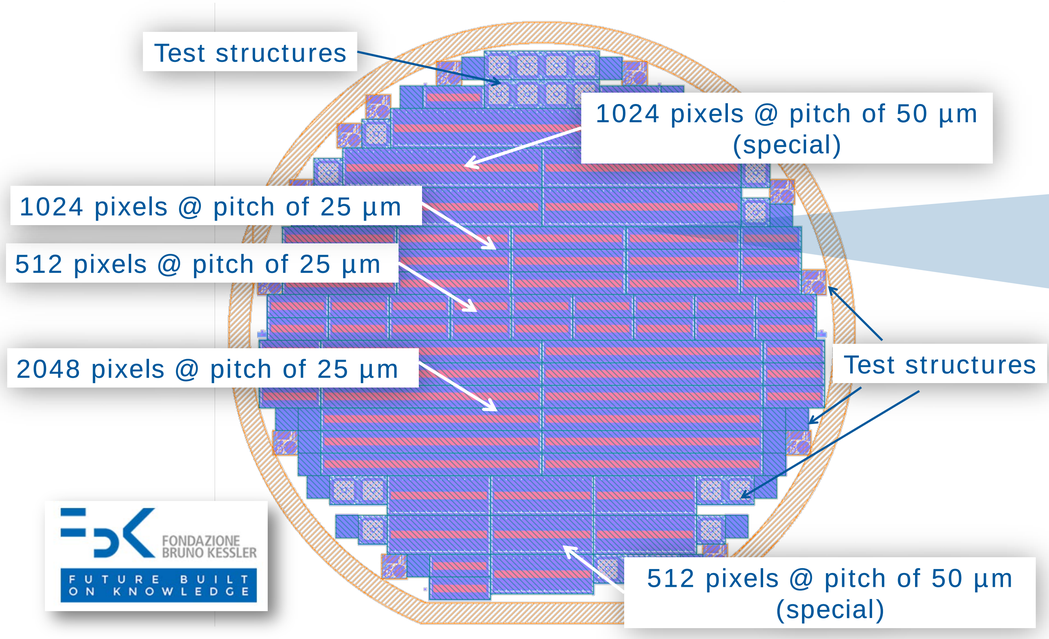
Simulation shows a drastic reduction of FEE electronic noise

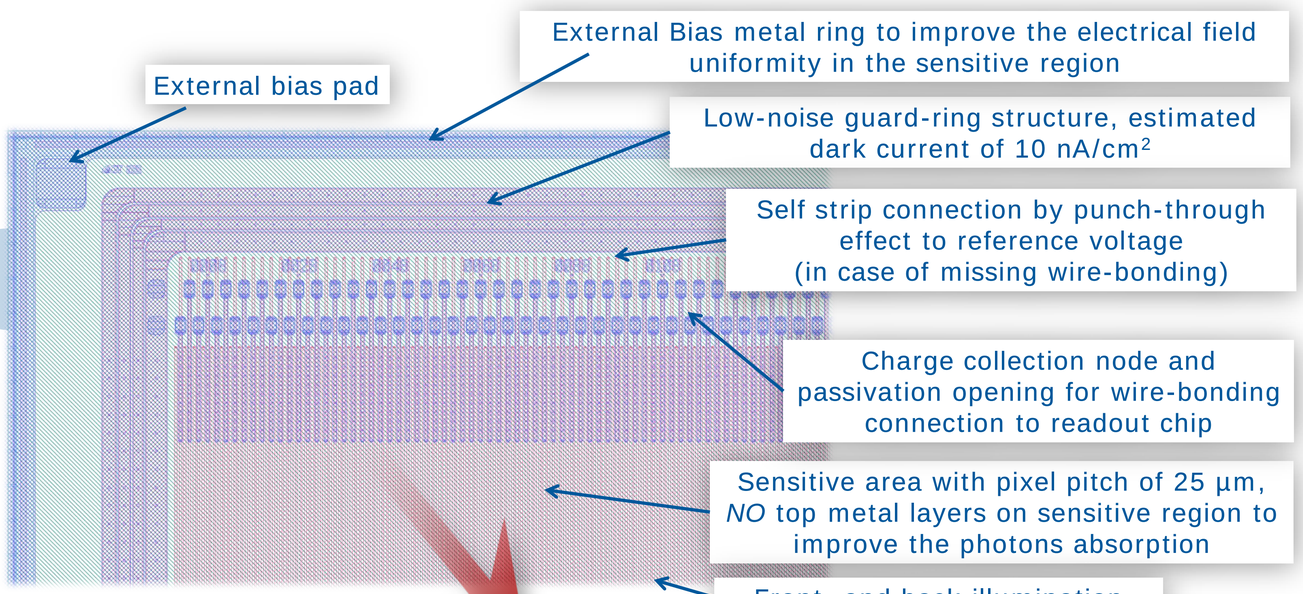
Cadence spectre simulation of new filter



New linear array sensors technology for KALYPSO

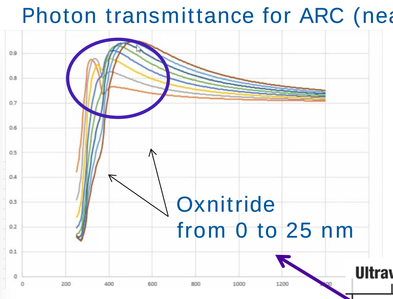
5 wafers submitted to FBK Trento for NUV, NIR and visible



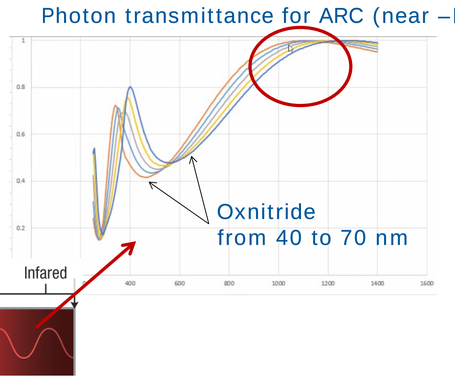


Sensors with Anti-Reflective Coating (ARC) layers → all photons transmitted into semiconductor (no reflected wave)

Photon transmittance for ARC (near –UV)



Photon transmittance for ARC (near –IR)

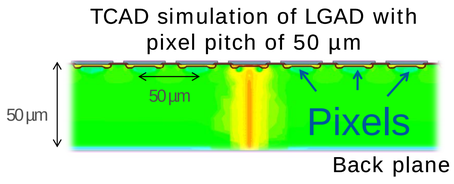


Low-Gain Avalanche Detector for "fast" transverse bunch profile

Improvement:

- ➢ Reduced substrate thickness from 300 µm to 50 µm → reduced collection time for multi-bunch operation
- ➢ Integrate a small-gain (10 – 30) in a sensor while maintaining similar noise levels
- ➢ No quenching circuit is necessary

TCAD simulation of LGAD with pixel pitch of 50 µm



Total charge collection time < 3 ns