1S-10

A 15 x 15 SPAD Array Sensor with Breakdown-Pixel-Extraction Architecture for Efficient Data Readout

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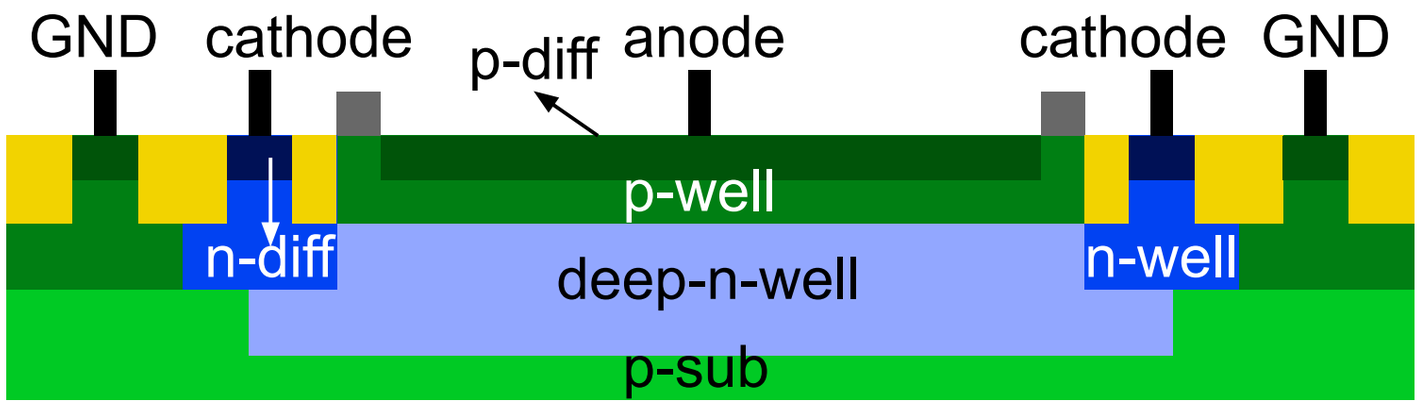
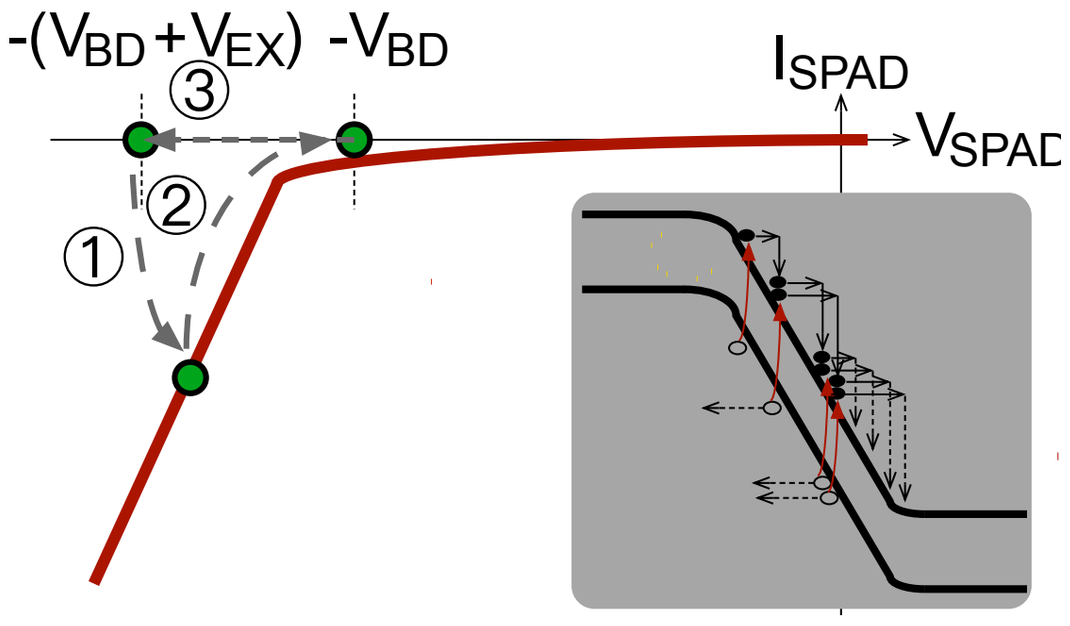
Single photon avalanche diode (SPAD)

- P-N diode reversely biased above breakdown voltage
- High sensitivity, fine time resolution
- Binary output (stable or breakdown)

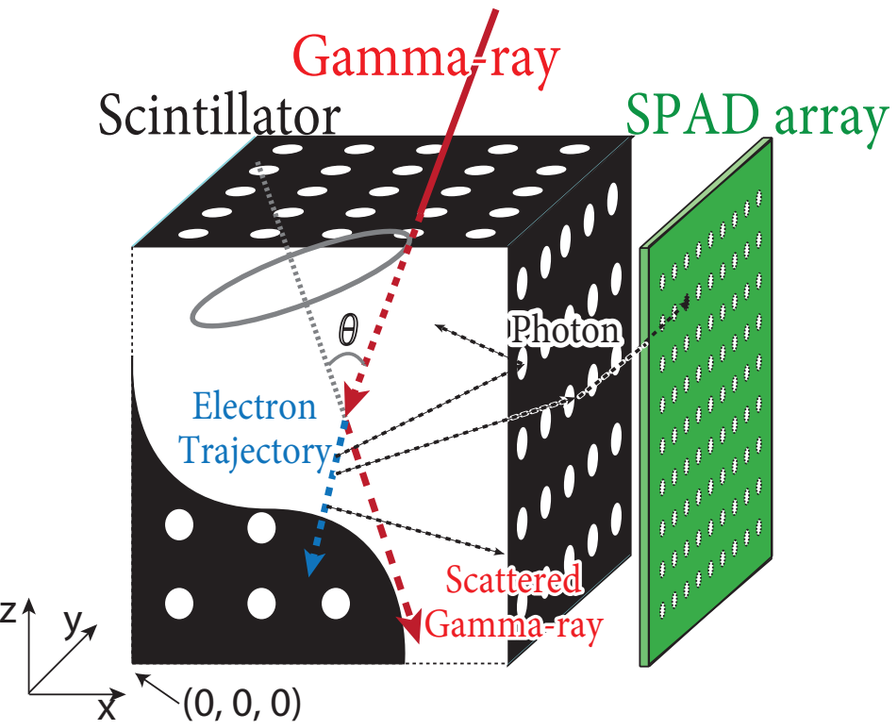


CMOS SPAD in our design



Motivation:

SPAD array sensor for scintillation detector



Proposed scintillation detector structure

Proposed scintillation detector

- Scintillator coated with pinholes array
- Surrounded by SPAD array sensors

Scintillation event

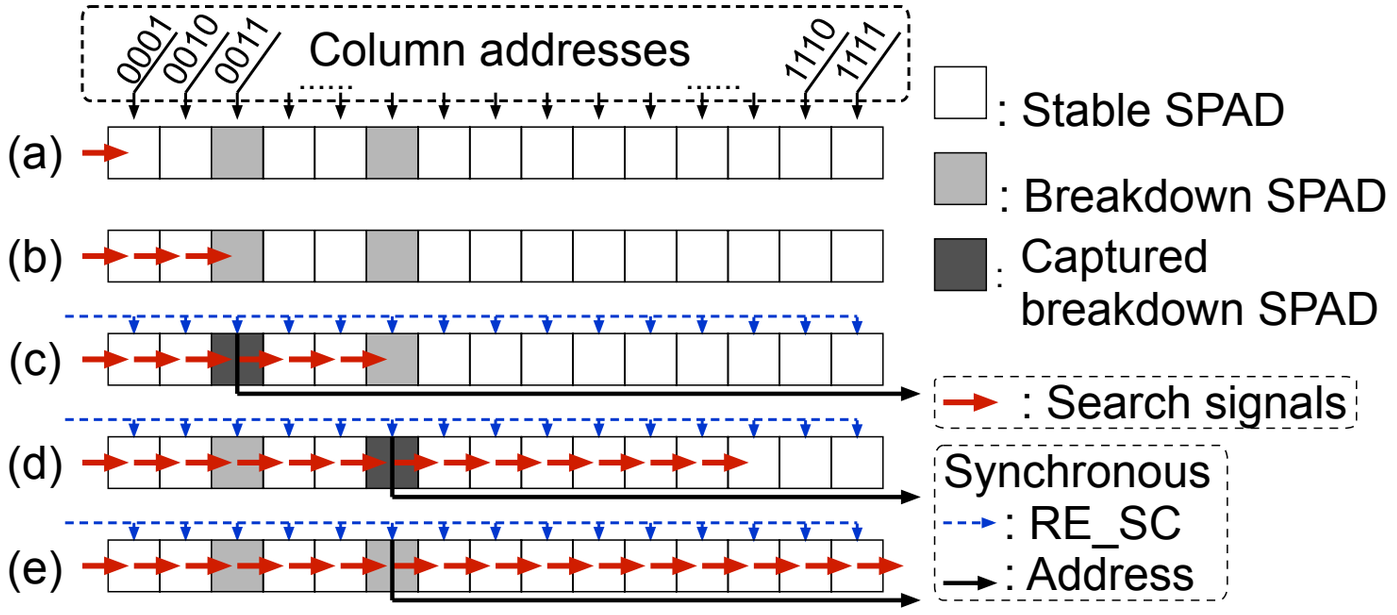
- Compton scattering caused by gamma-ray
- Emitting scintillation photons
- SPAD array sensors capture the photons
- Finer spatial resolution

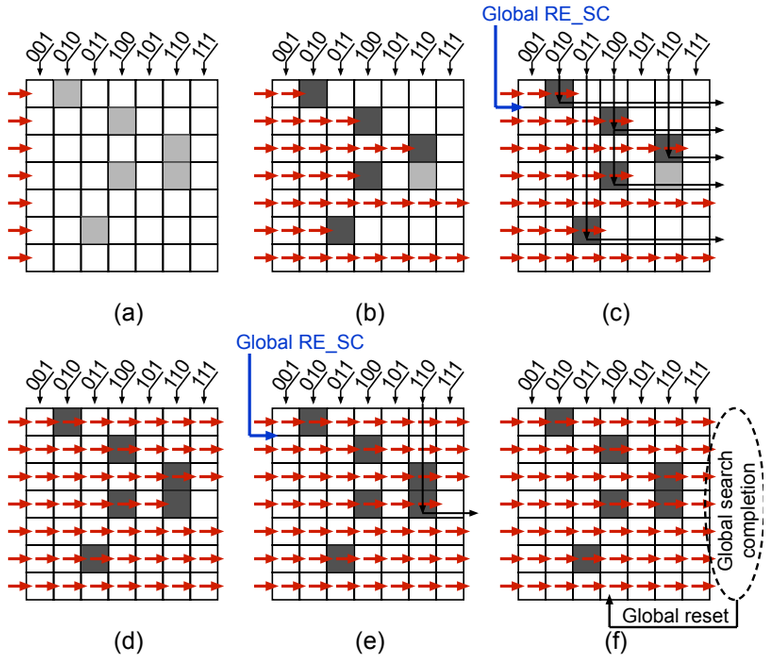
The ratio between window time and dead time is important

Key techniques:

Breakdown-pixels-extraction (BPE) architecture

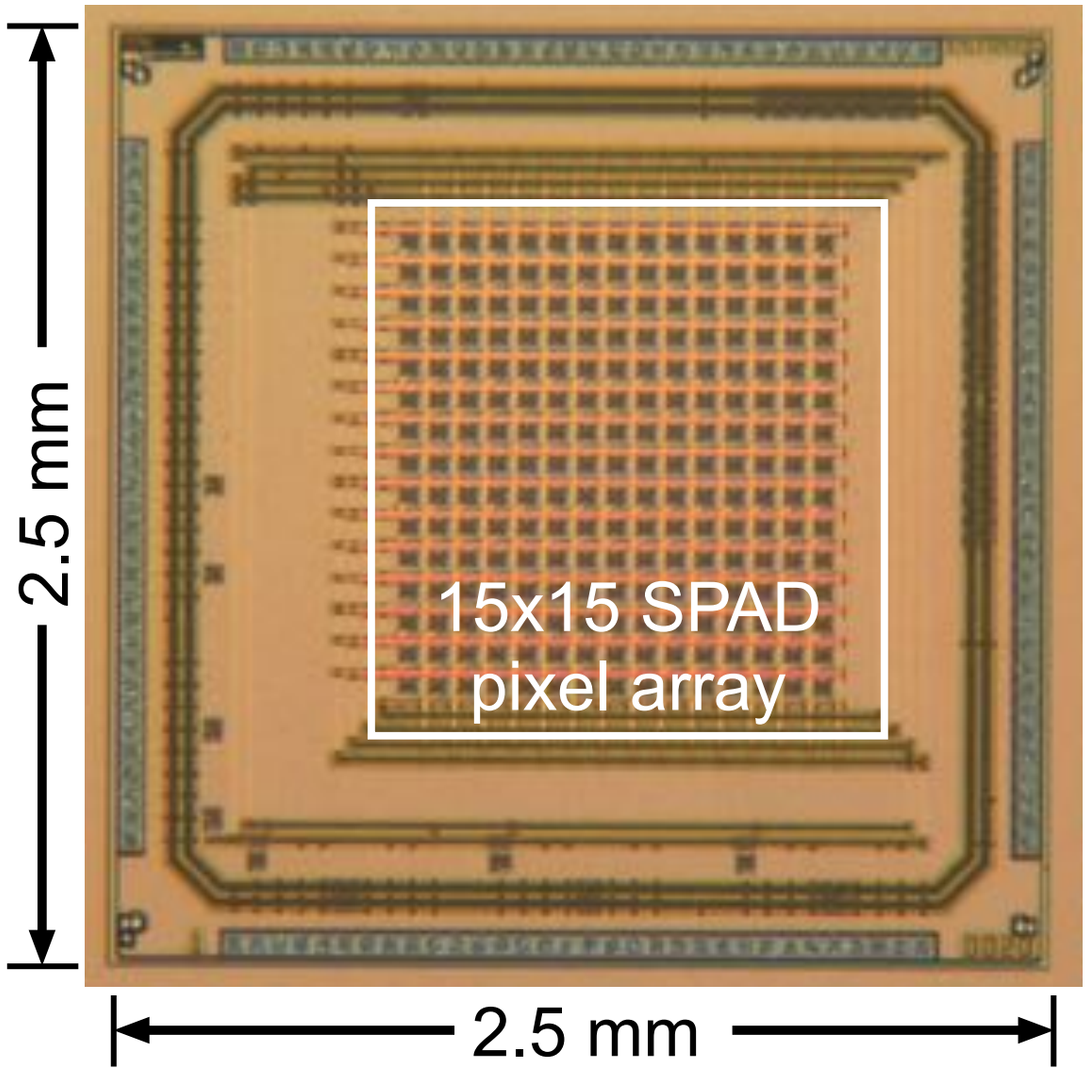
- Extraction the addresses of breakdown pixels in row parallel
- Readout cycles: 1+Max($N_{BD,i}$) X (5+1) (31 x 31 SPAD array)
- Dark condition: Max($N_{BD,i}$) is small → shorter dead time

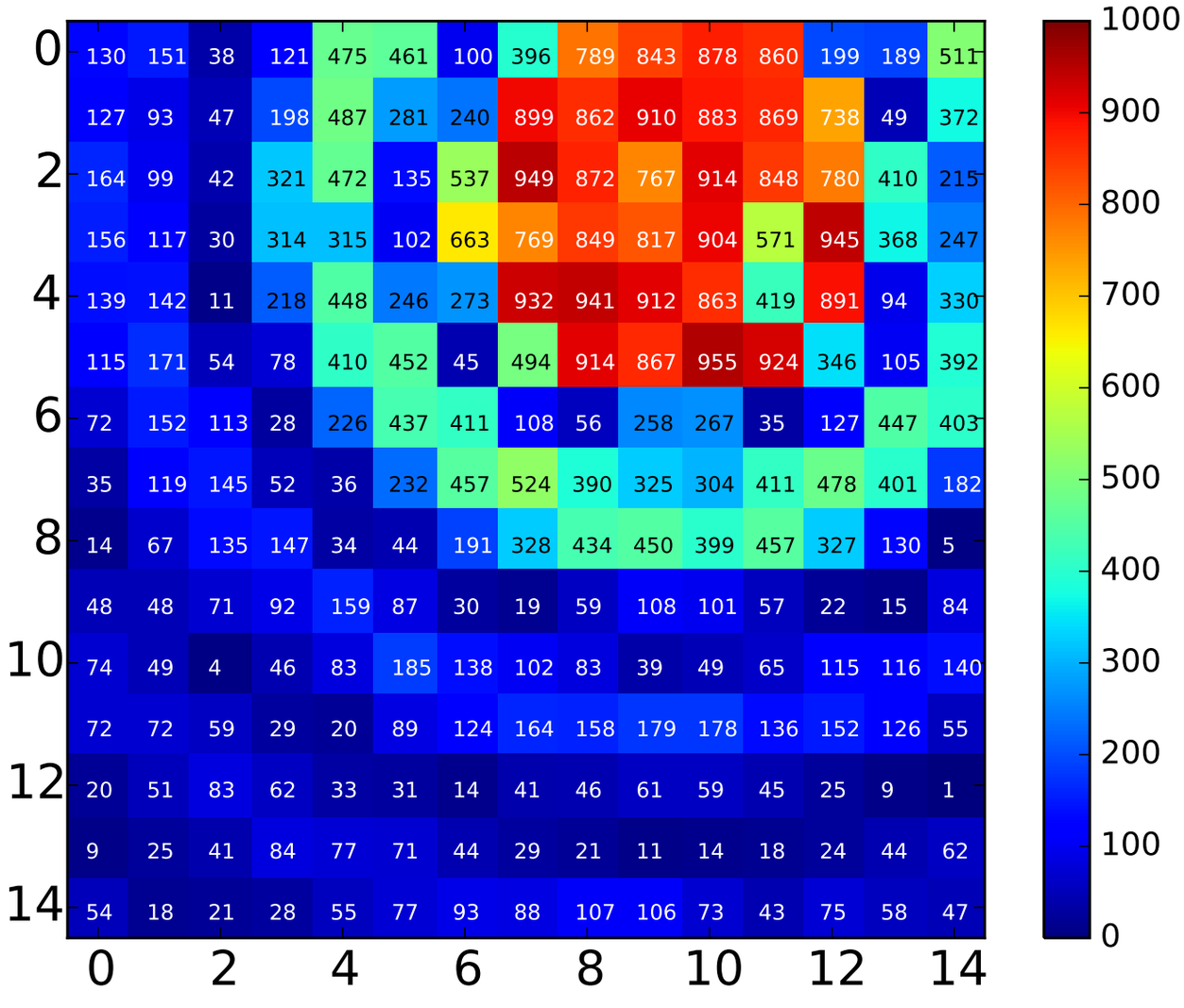




Scintillation light

N_{BD}: the # of breakdown pixels in the whole chip
$N_{BD,i}$: the # of breakdown pixels in the i-th row





Our design in presented at poster session 1S-10.

I look forward to a fruitful discussion.

Thank you.