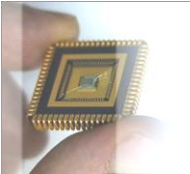


AIDA-WP3

Status and Plans @PM12

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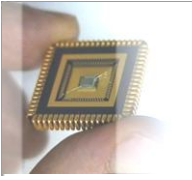


Goal: increase FF with 3D stacking of APD arrays

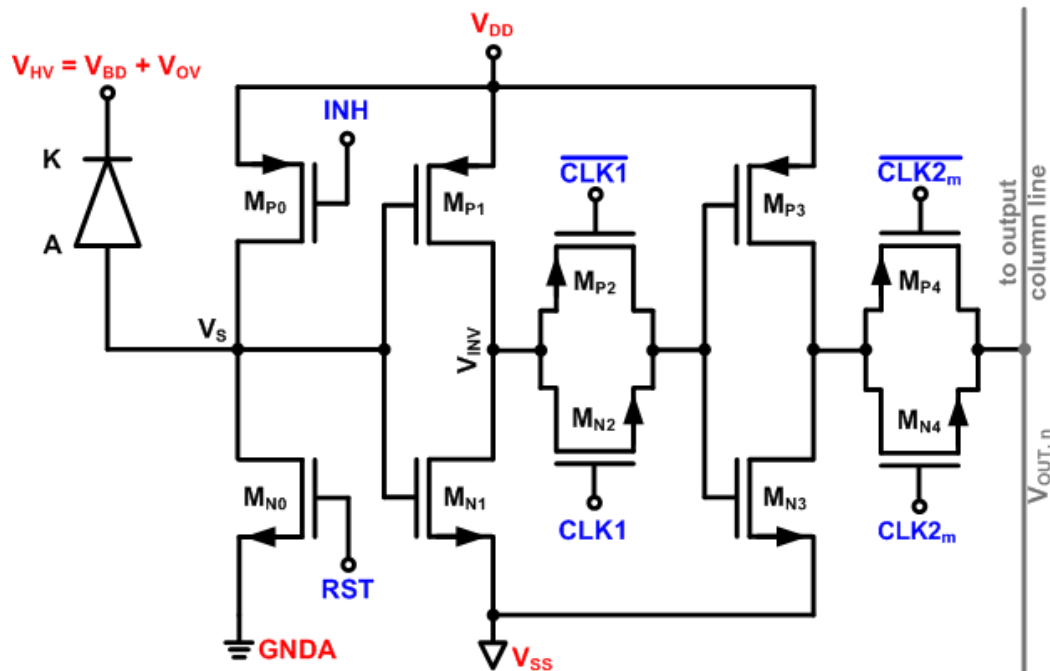
1) Pixel design

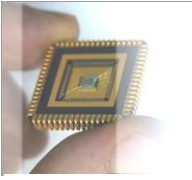
2) Plans for the next Tezzaron run

3) Alternative solutions

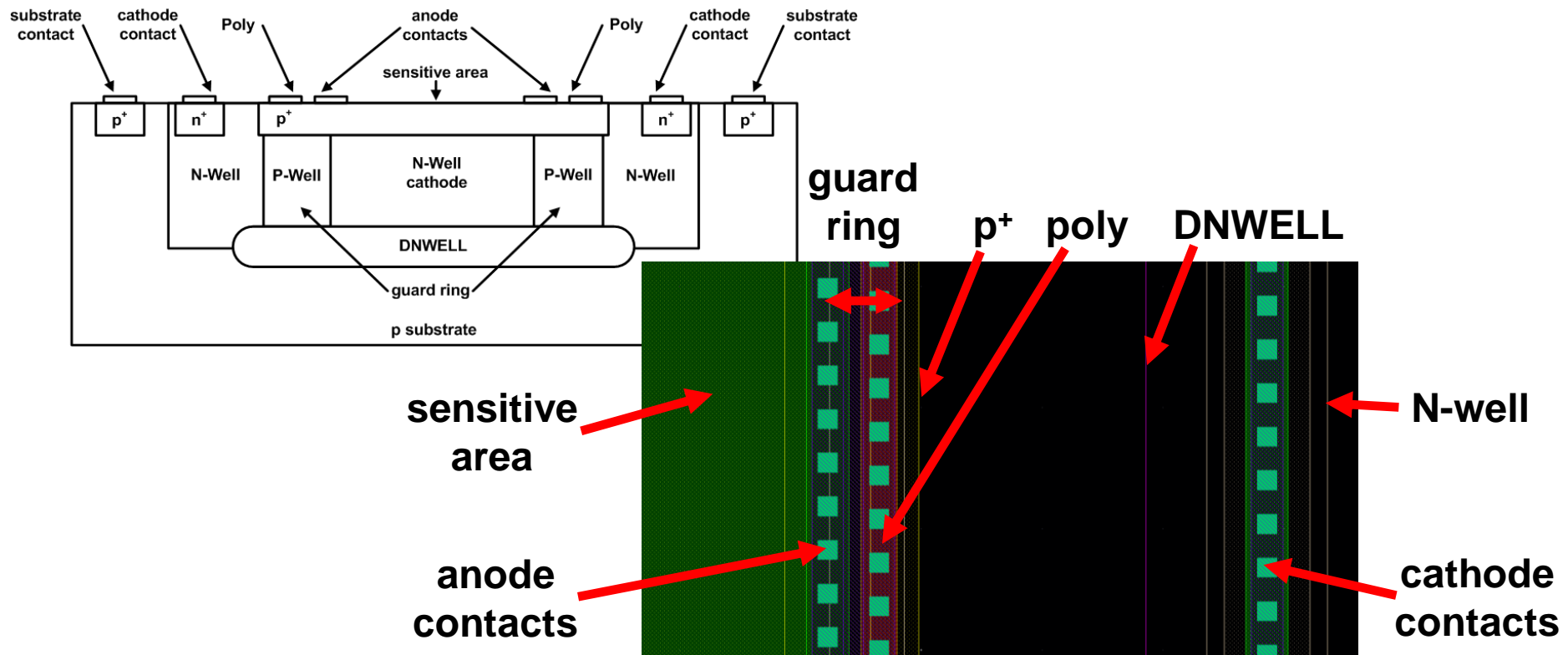


- **Powering** → V_{HV} & GND_A (sensor), V_{DD} & V_{SS} (electronics)
- **Control signals** → INH & RST (sensor), $CLK1$ (transmission gate to enable readout electronics), $CLK2$ (transmission gate to enable output column line)

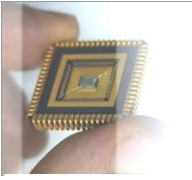




- The deep-submicrometer SPADs are more noisy due to the presence of STI (amongst other factors).
- It is possible to physically separate the STI interface from the SPAD multiplication region using a polysilicon gate that represents a stop mask for n^+ and p^+ implantations.

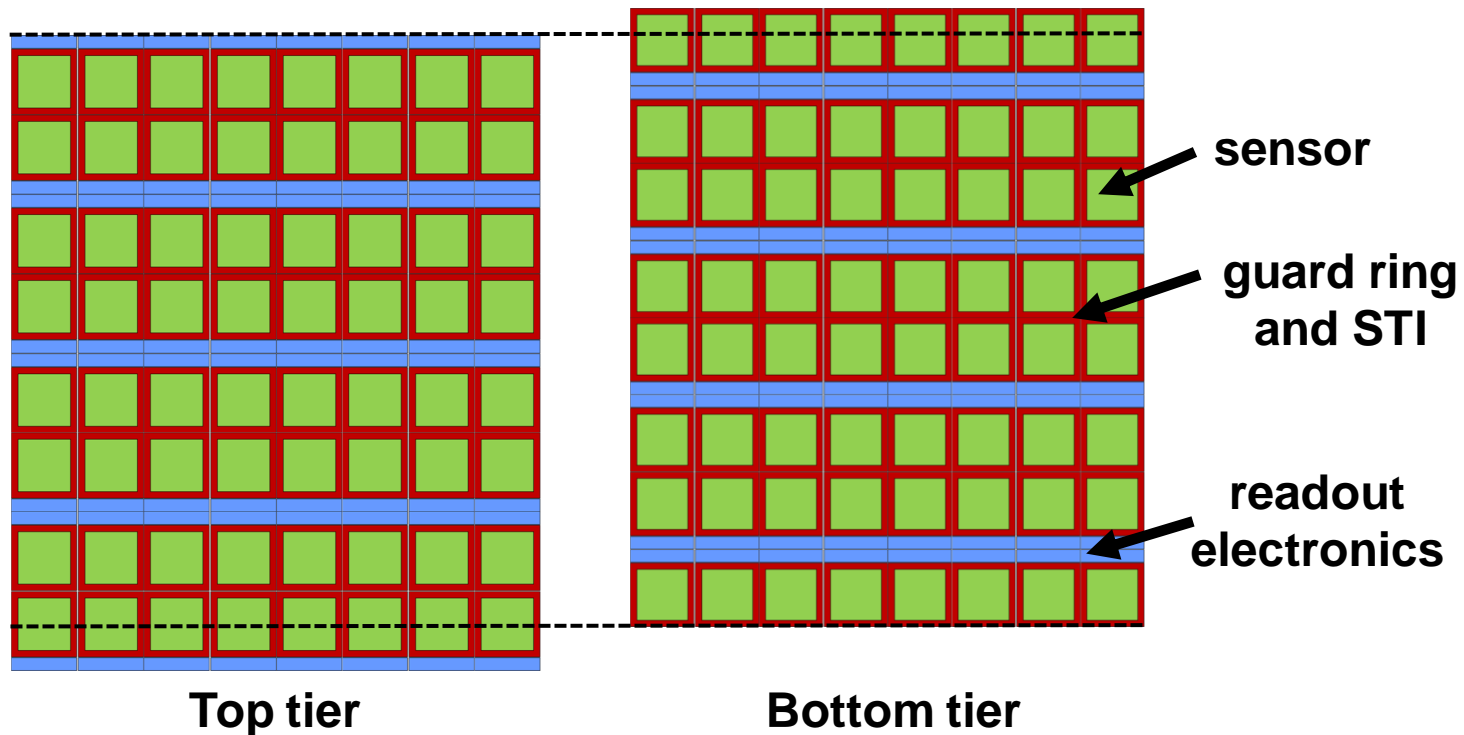


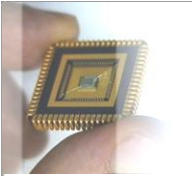
C. Niclass, A Single Photon Avalanche Diode Implemented in 130-nm CMOS Technology, IEEE J. Quantum Electron. (2007).



1) Identic top and bottom tiers. Rows vertically flipped.

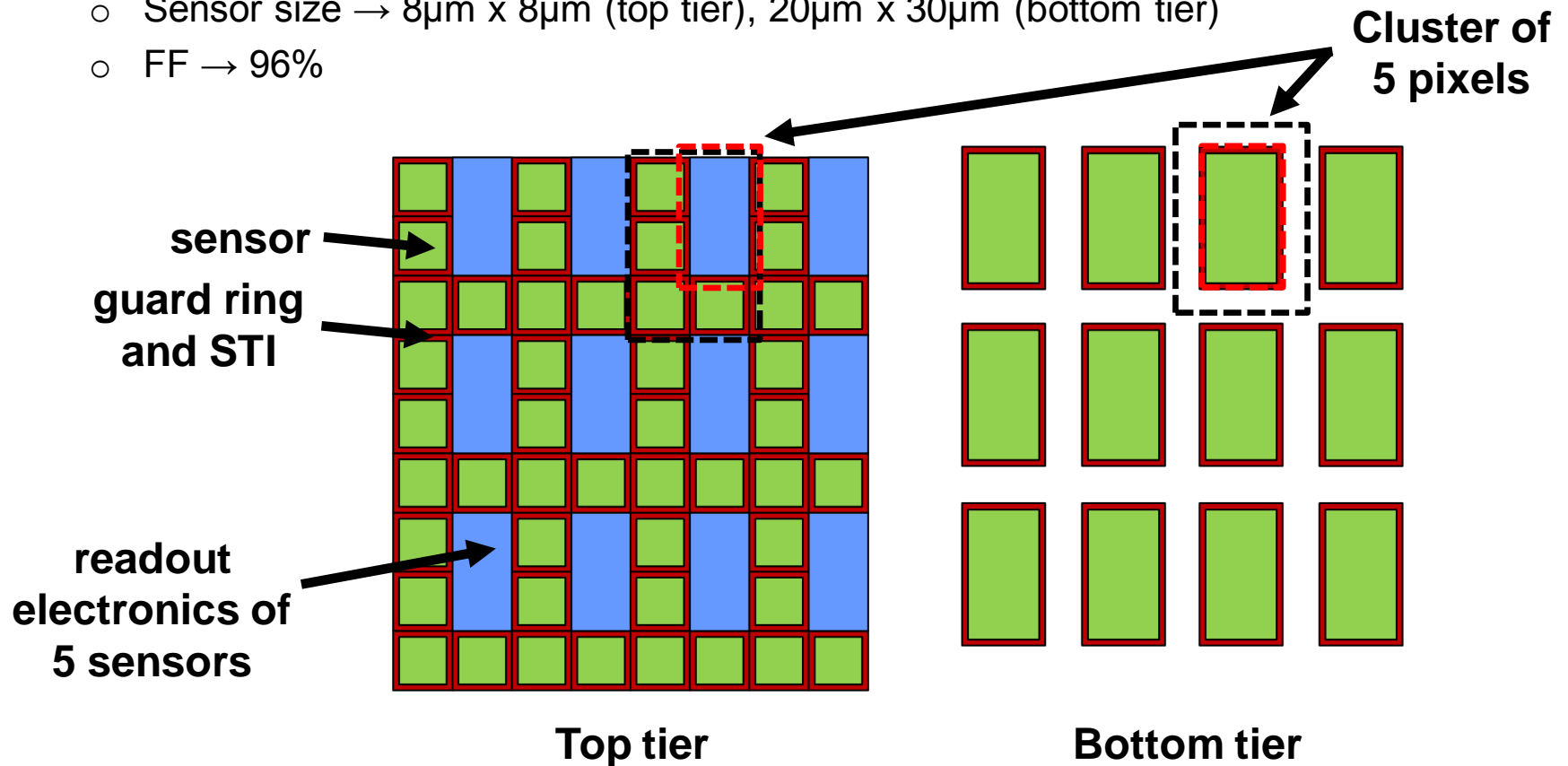
- The top and bottom tiers are displaced to maximize the FF
- Sensor size $\rightarrow 20\mu\text{m} \times 20\mu\text{m}$ in both tiers
- FF $\rightarrow 93\%$

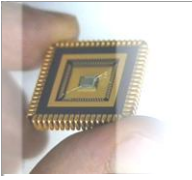




2) Sensor & electronics (top tier), sensor only (bottom tier).

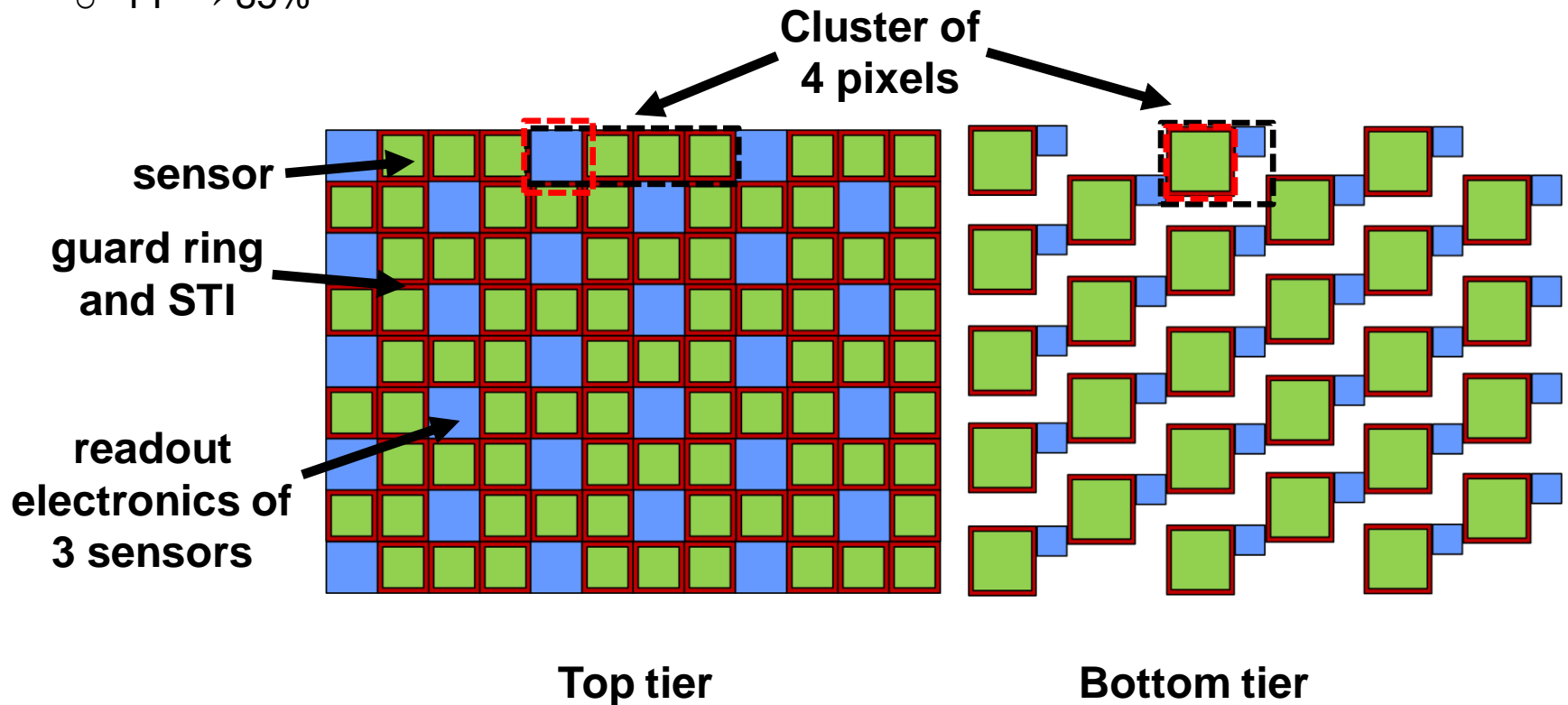
- Bottom tier sensitive areas overlapped with top tier death areas
- Sensor size $\rightarrow 8\mu\text{m} \times 8\mu\text{m}$ (top tier), $20\mu\text{m} \times 30\mu\text{m}$ (bottom tier)
- FF $\rightarrow 96\%$

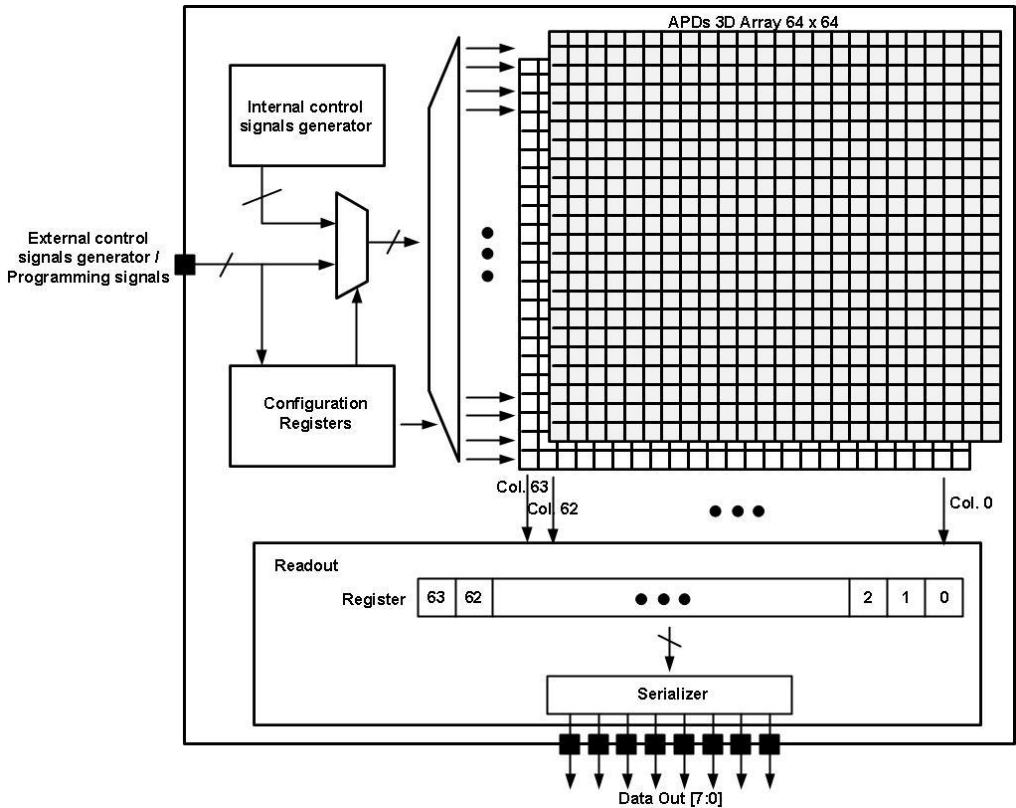
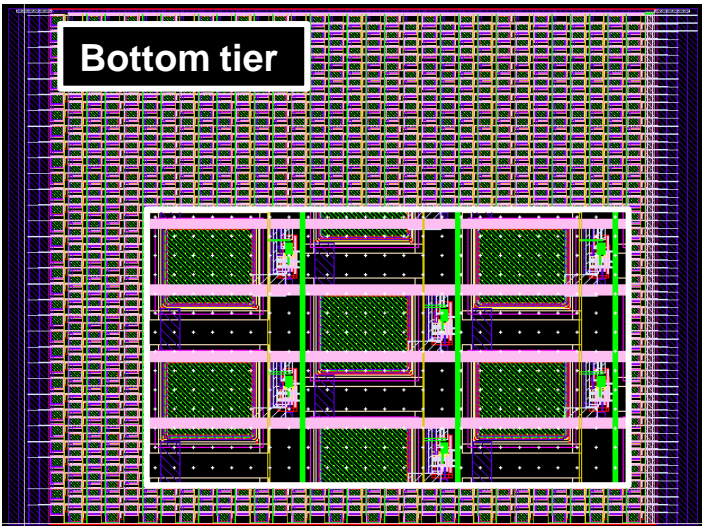
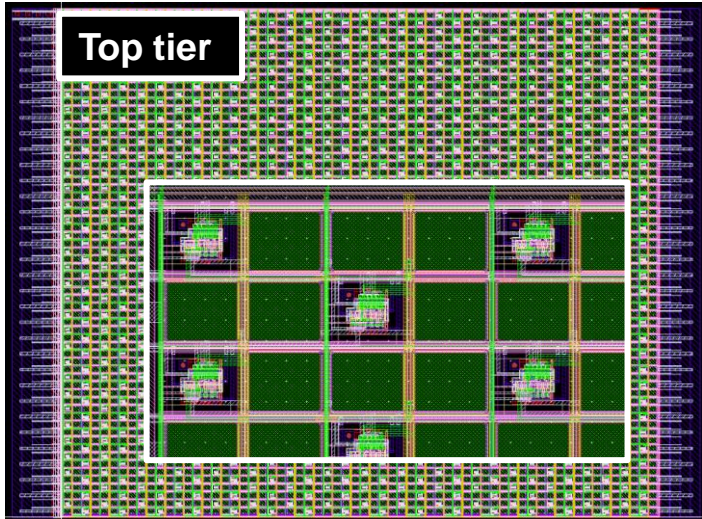




3) Similar idea, with reduced pixel size and sensor & electronics in both tiers.

- Sensor size → $18\mu\text{m} \times 15\mu\text{m}$ (top tier), $23\mu\text{m} \times 20\mu\text{m}$ (bottom tier)
- FF → 85%





The plan is to send the design for the Tezzaron run via CMP 20th September 2012

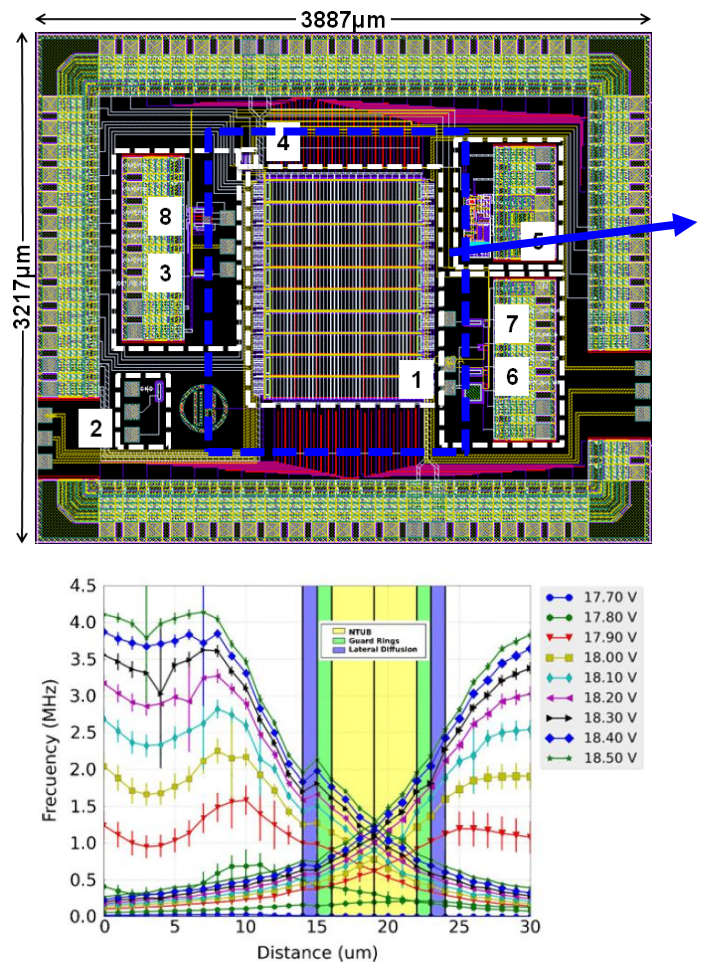
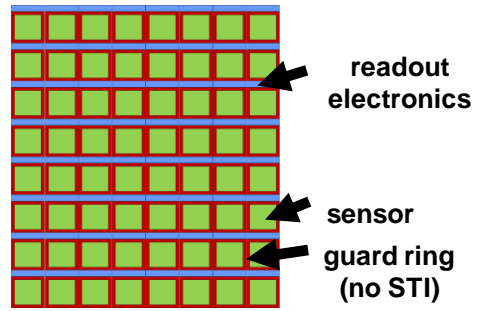


Fig. 16. Detection frequencies measured by scanning a 30 keV electron beam onto two neighbouring pixels in the array.

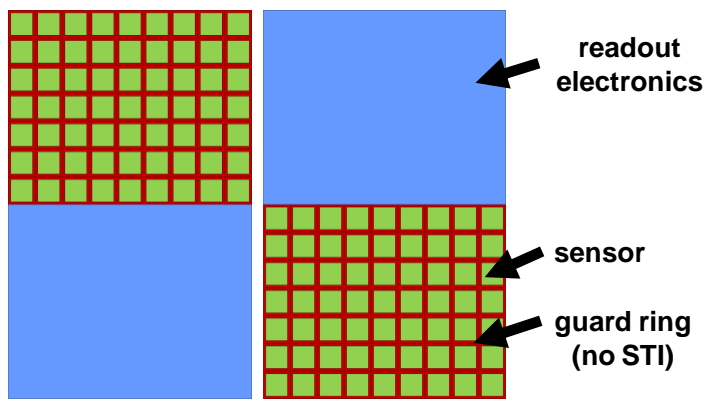
A. Vilà, *Characterization and simulation of Avalanche PhotoDiodes for next-generation colliders*, Sens. Actuators, A (2011).



1 tier only

In 0,35um HV-AMS with our pixel structure the ring is sensitive
 → c.a.100% FF with 2 tiers seems feasible

1) sensor&readout in both tiers:



Top tier Bottom tier

2) Or, sensor on top tier and electronics on bottom tier