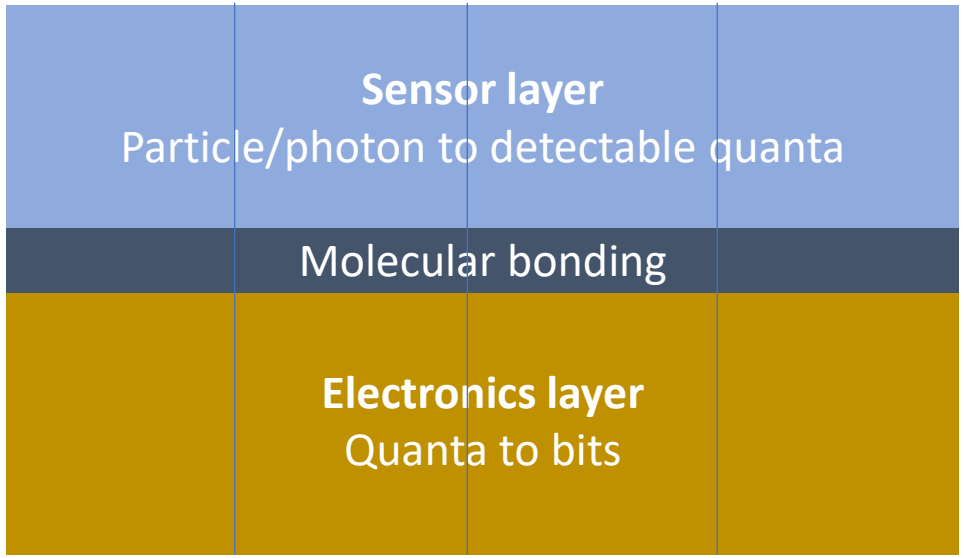
Aim of the workshop

1) Learn about each other's work
2) Identify synergies:
    1) design/simulation (e.g. TCAD, Silvaco, ANSYS, …)
    2) Fabrication (TSMC, DALSA, FBK, Hamamatsu,…)
    3) Characterization
3) Discuss implementation strategies
    1) How to avoid being sub-critical? Aka great idea but fail to implement
    2) How to start and get funding at low "technology readiness level"?
    3) How to foster emergence of "Canadian technology"?
4) Working together?

Switching to my personal interest

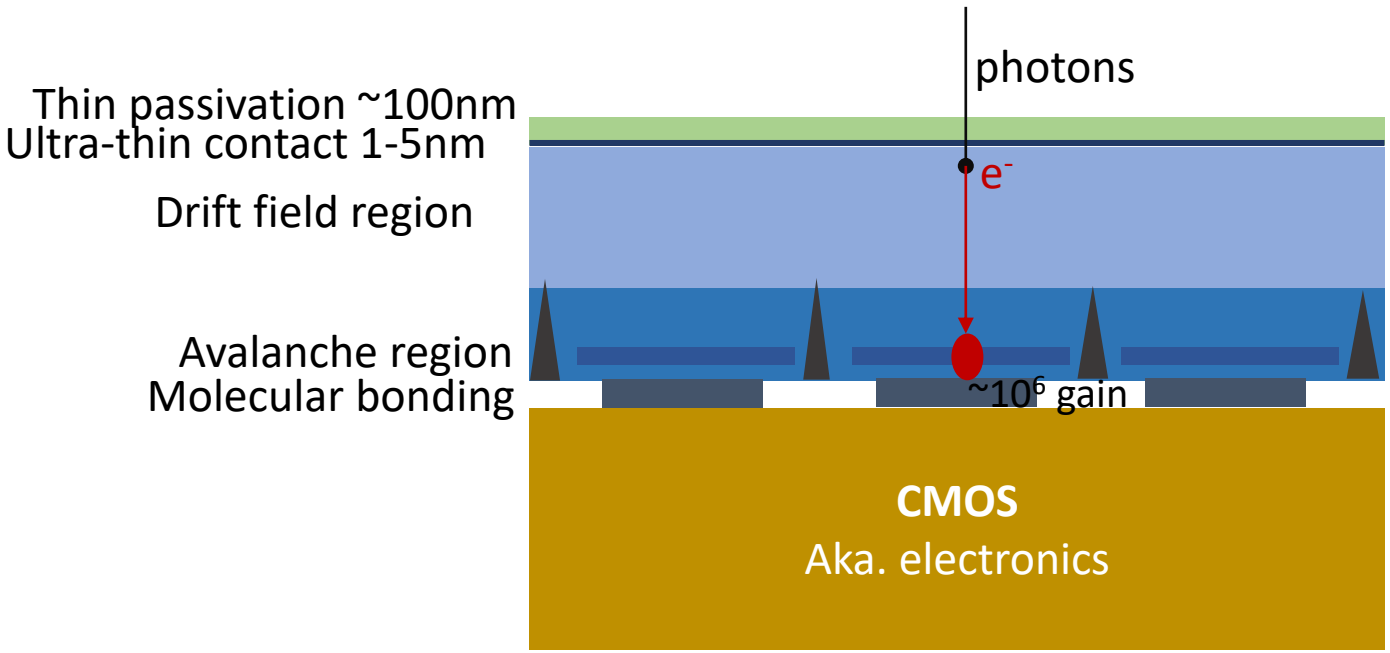
3D integrated digital technology

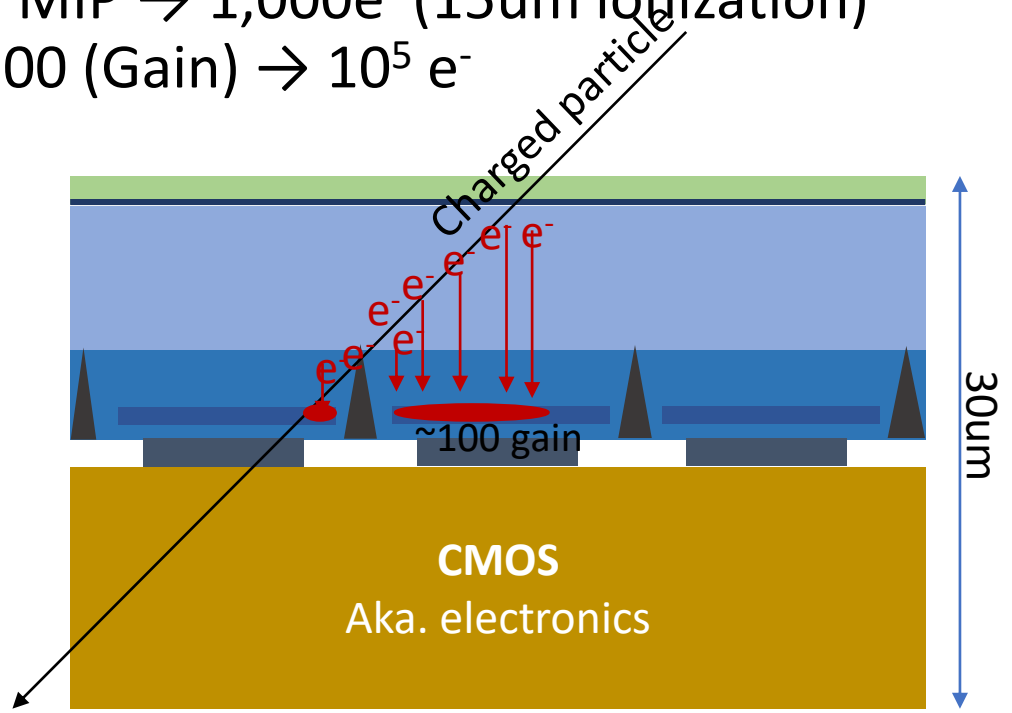
- Aim: measure charged particle and photon position & time within a single package
- Solution: 3D integration
- Technology available at Teledyne-DALSA + Sherbrooke



4Dimension Digital Detector, $4D^3$ concept

- Single Photon Avalanche Diode
  - 1 photon → $1e^-$ * 10^6 (Gain) → 10^6 e^-
- Low Gain Avalanche Diode
  - 1 MIP → 1,000e^- (15um ionization) * 100 (Gain) → 10^5 e^-





Signal close enough to be handled by similar electronics

Made in Canada technology: Sensor layer and 3D integration could be done at Teledyne-DALSA (Bromont, QC)

Other configurations

- ~5keV electron detection for hybrid photo-detector (JP Yanez, Alberta)
- Thick (300-500um) for direct dark matter detection with Geiger-mode and linear gain (with P. Agnes and J. Monroe, from RHUL, UK)
- ?Heavy ionizing particle for nuclear physics?

Electronics + information management

- “Analog” side
  - 1 comparator per diode (pixel)
  - Possibly 2 for time over threshold
- Digital. Tailor to needs. Possible configurations:
  - Blue single photon sensor + high speed TDC (10ps) + coarse position (1-5mm) [PET, plastic scintillator,..]
  - VUV/blue single photon sensor + low speed TDC (1ns) + coarse position (1-5mm) [ARGO, nEXO]
  - Charged partice sensor + high speed TDC (10ps) + fine position (<100um) + rad hard [collider]

Making this happen… challenges

- Sensor development
  - Currently only front side configuration exists. Need to move to Back side
  - <350nm wavelength detection require very shallow doping
  - Radiation hardness
- Molecular bonding development
  - Available at DALSA but not used yet
- CMOS
  - Sherbrooke has produced 2 flavors both with coarse position information: high speed/high power, and low speed/low power
  - Radiation hardness

Need $$$ and possibly/probably a collaboration structure