OAK RIDGE National Laboratory

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Irradiation Studies with 3D-PDCs

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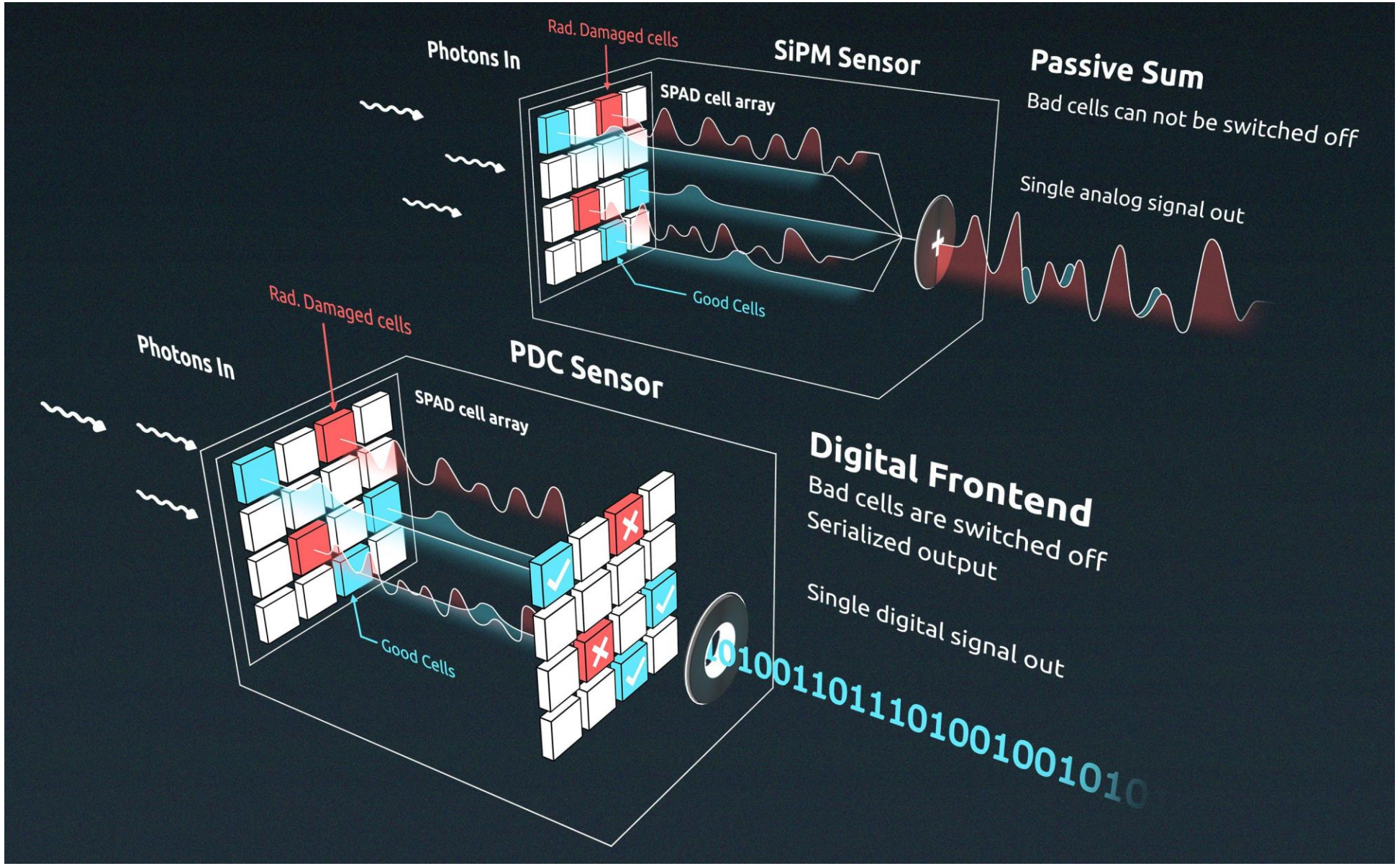
ORNL

U.S. DEPARTMENT OF ENERGY

ORNL IS MANAGED BY UT-BATTELLE LLC
FOR THE US DEPARTMENT OF ENERGY

Photon-Digital Converters: Fully Digital SiPMs



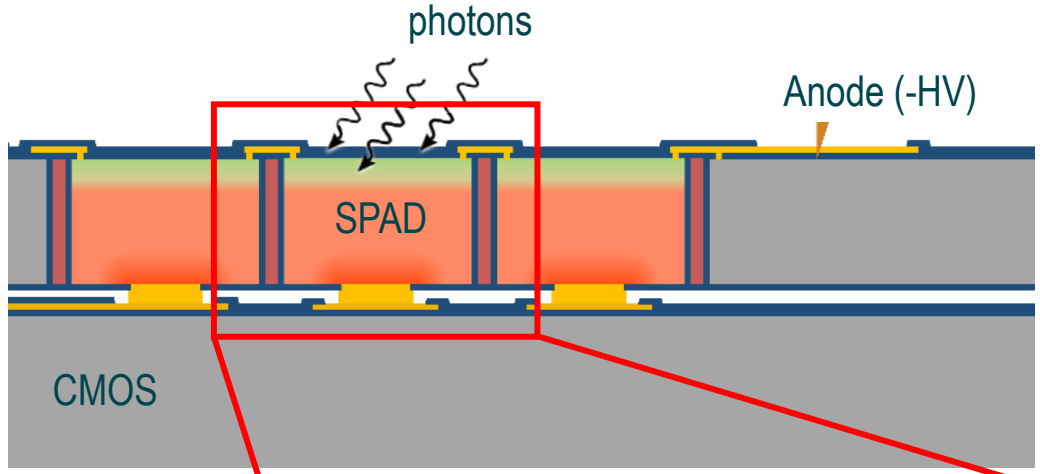
ORNL + Uni Sherbrooke: 3D-integrated PDCs

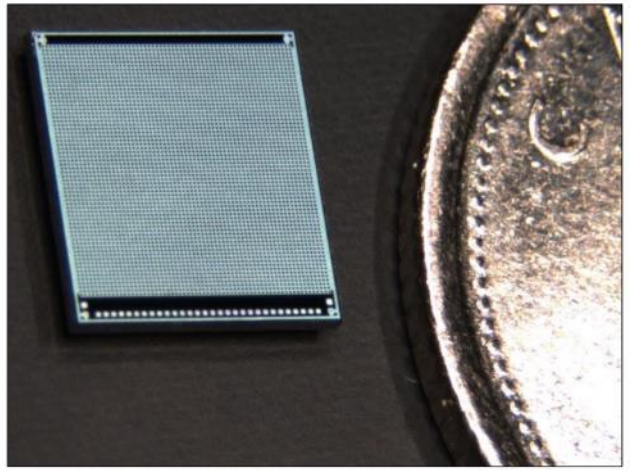
1st fabrication run completed

(October 2024)

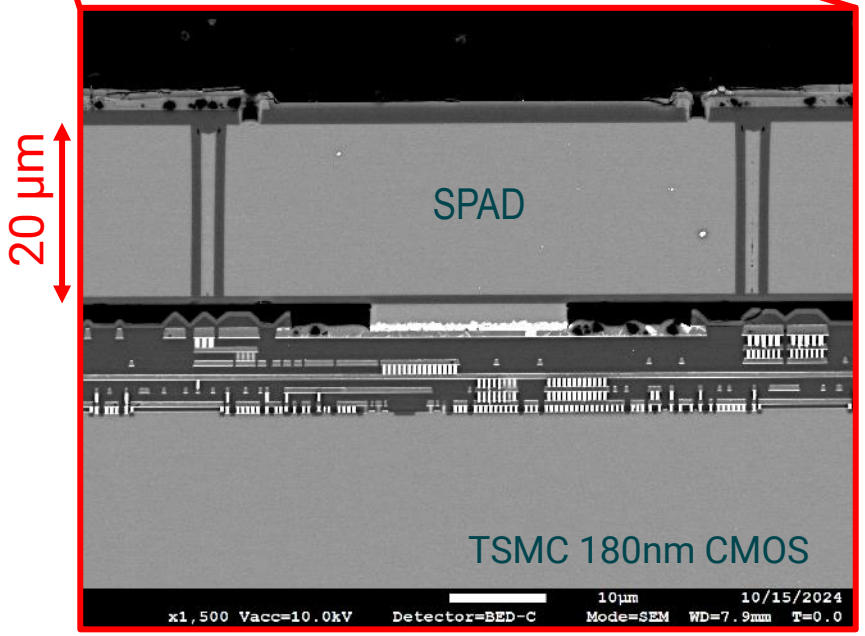
Thin SPAD layer + CMOS readout

- p⁺n SPAD
- 64 × 64 SPAD Array
- 78 µm pitch
- Al-Ge eutectic bonding
- 5.85 × 5.25 mm² die



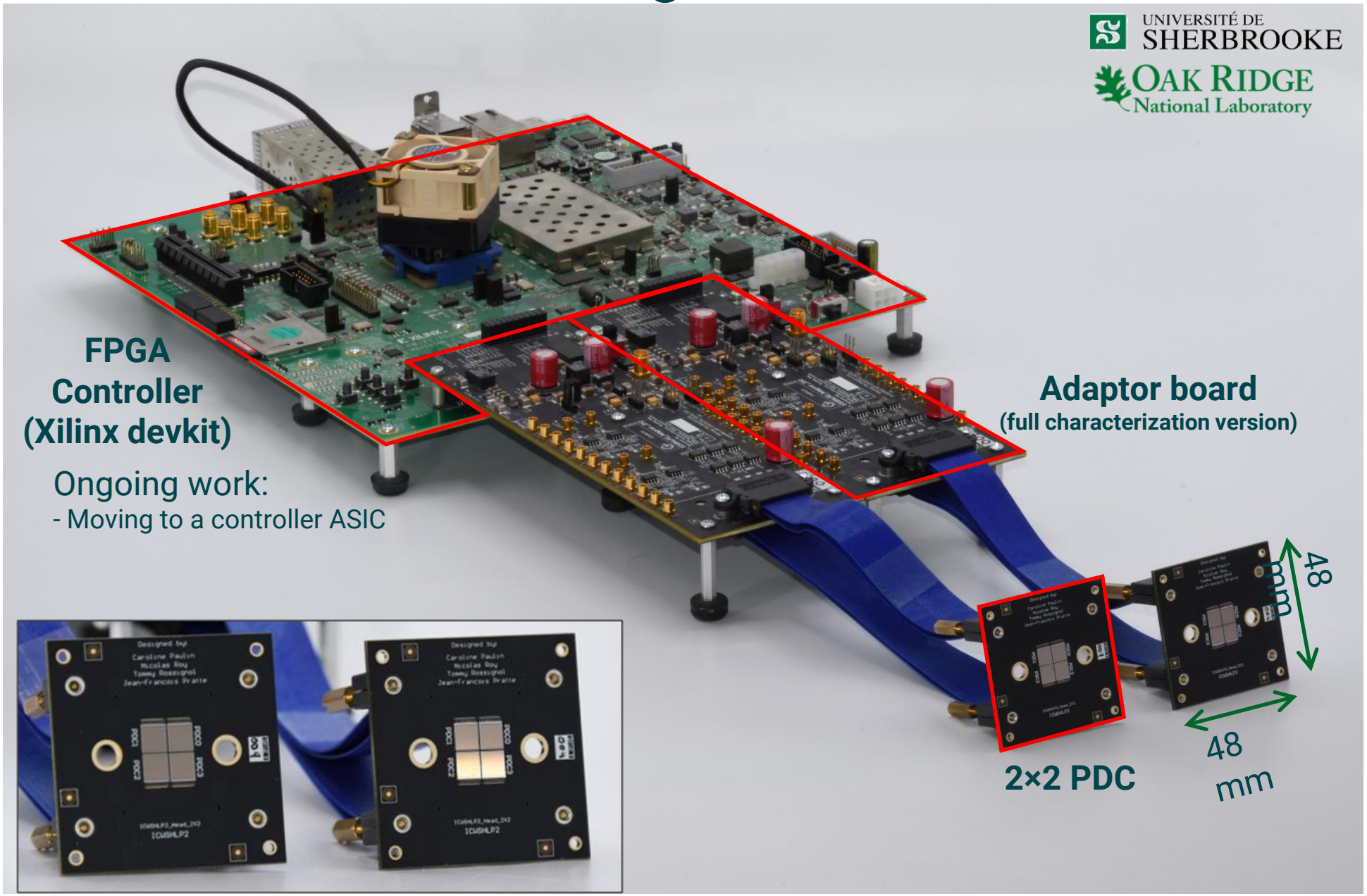


3D SPAD array
(canadian 10¢ for reference)



SEM cross section image

ORNL + Uni Sherbrooke: 3D-integrated PDCs



ORNL + INFN: Irradiation Studies of 3D-PDCs

- 3D-PDCs not tested for radiation hardness
  - Can individual SPAD access effectively reduce dark noise after irradiation?
  - Individual SPAD access also yields completely new insight into radiation damage of SPADs
- Submitted EIC generic R&D proposal: Irradiation + annealing studies of 3D-PDCs
  - ORNL: M. Benoit, A. Steinhebel, L. Fabris, OH
  - INFN Trieste: S. Dalla Torre
  - INFN Bologna: R. Preghenella, P. Antonioli, L. Rignanese
  - Irradiation with protons (INFN) + neutrons (ORNL)
- Option for future RICH detectors at EIC? Upgrade/mitigation option for dRICH?
- Far future: bond 3D-PDC CMOS readout with commercial SPAD arrays