

Detectors for Photon Science

Developments at DESY



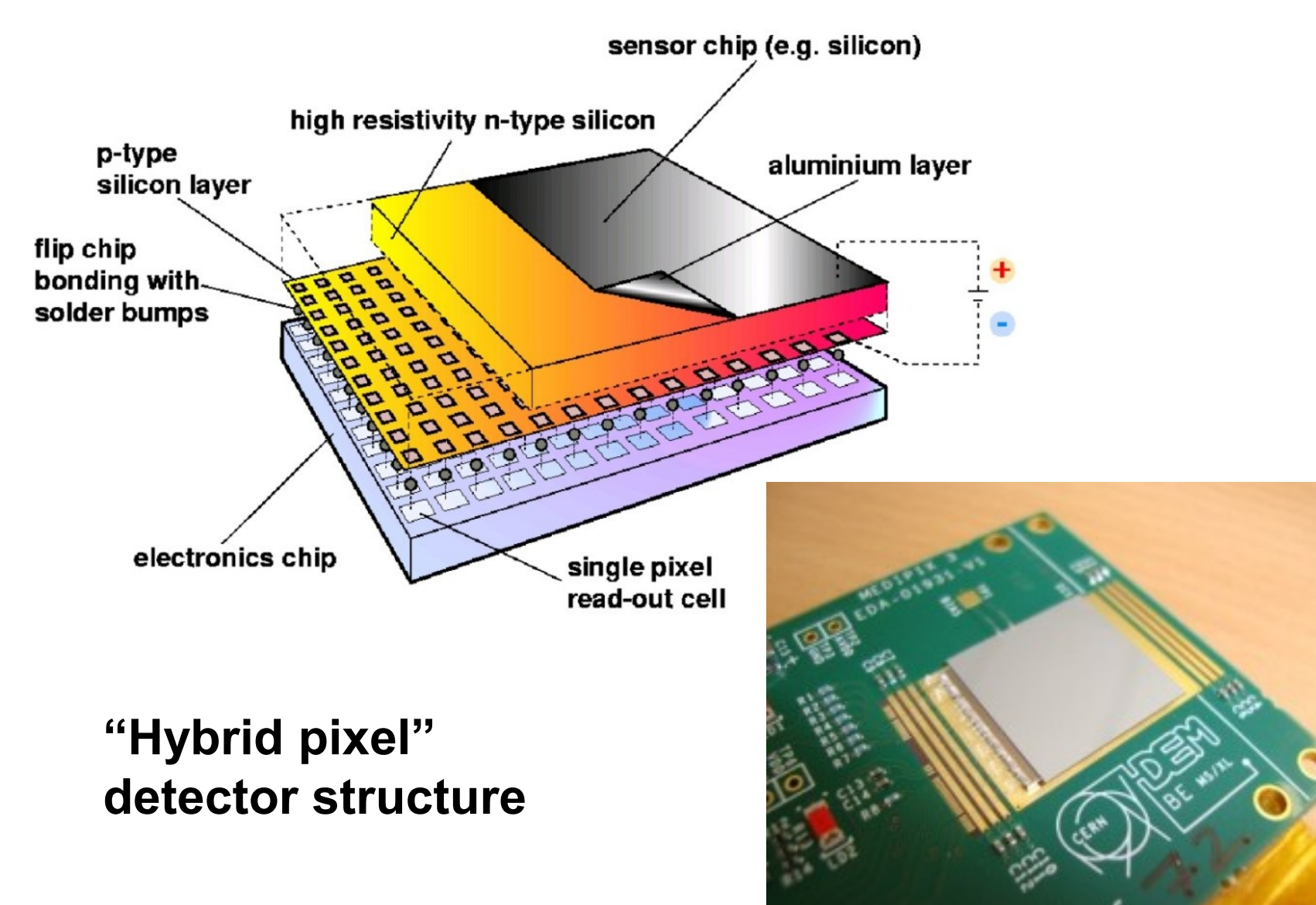
David Pennicard, Heinz Graafsma, Matthias Bayer, Julian Becker, Laura Bianco, Helmut Hirsemann, Stefanie Jack, Alexander Kluyev, Sabine Lange, Michael Lohmann, Alessandro Marras, Björn Nilsson, Sergej Smoljanin, Ulrich Trunk, Cornelia Wunderer – DESY FS-DS

Large Area Medipix3-Based Detector Array (LAMBDA)

A new generation of photon-counting pixel detector with fast readout and improved image quality

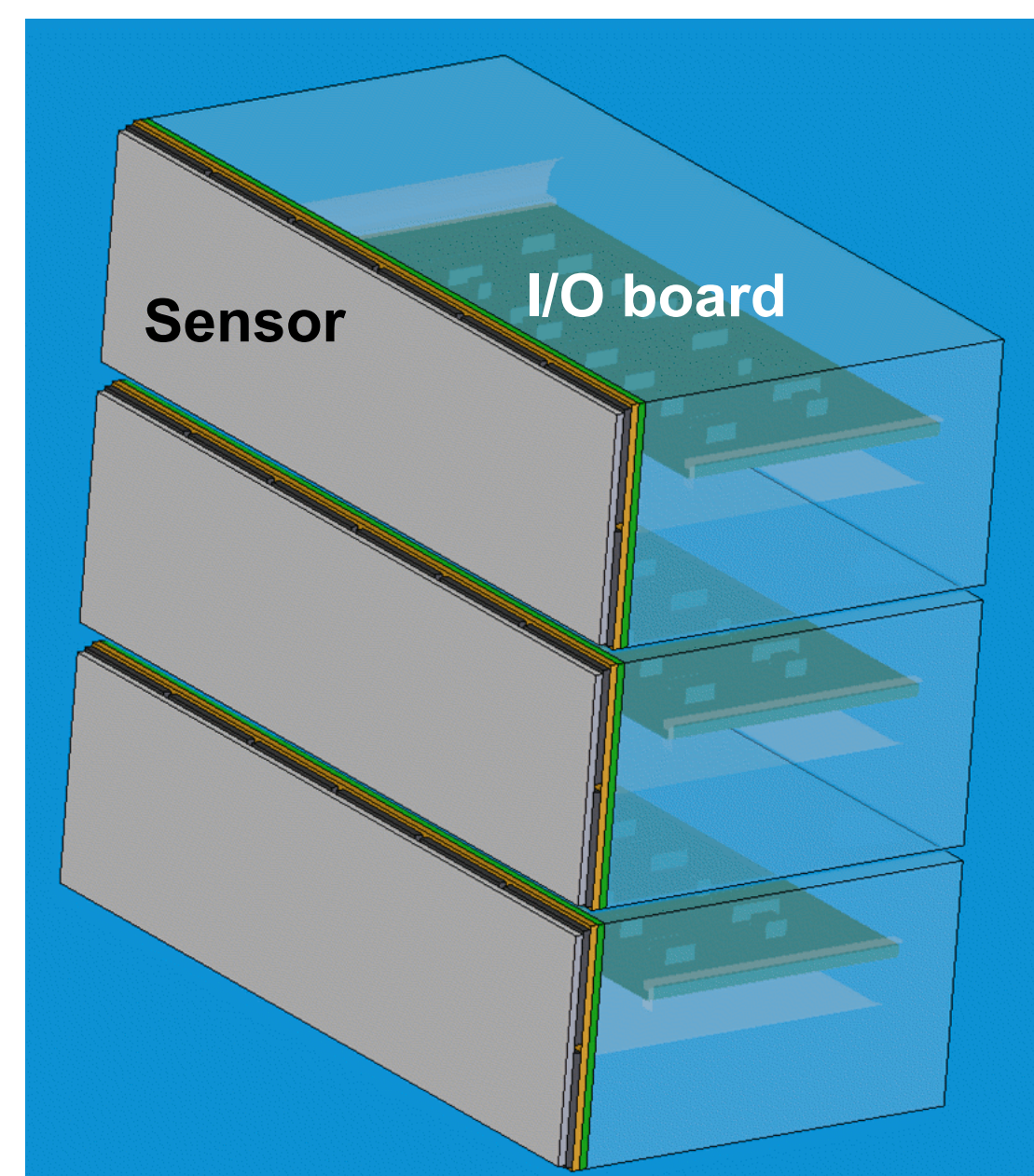
Based on Medipix3 readout chip

- CERN-led collaboration
- Photon counting – “noise free”, background rejection
- Small pixels - 55µm
- Deadtime free readout up to 2000 frames / second
- “Charge summing” feature improves image quality



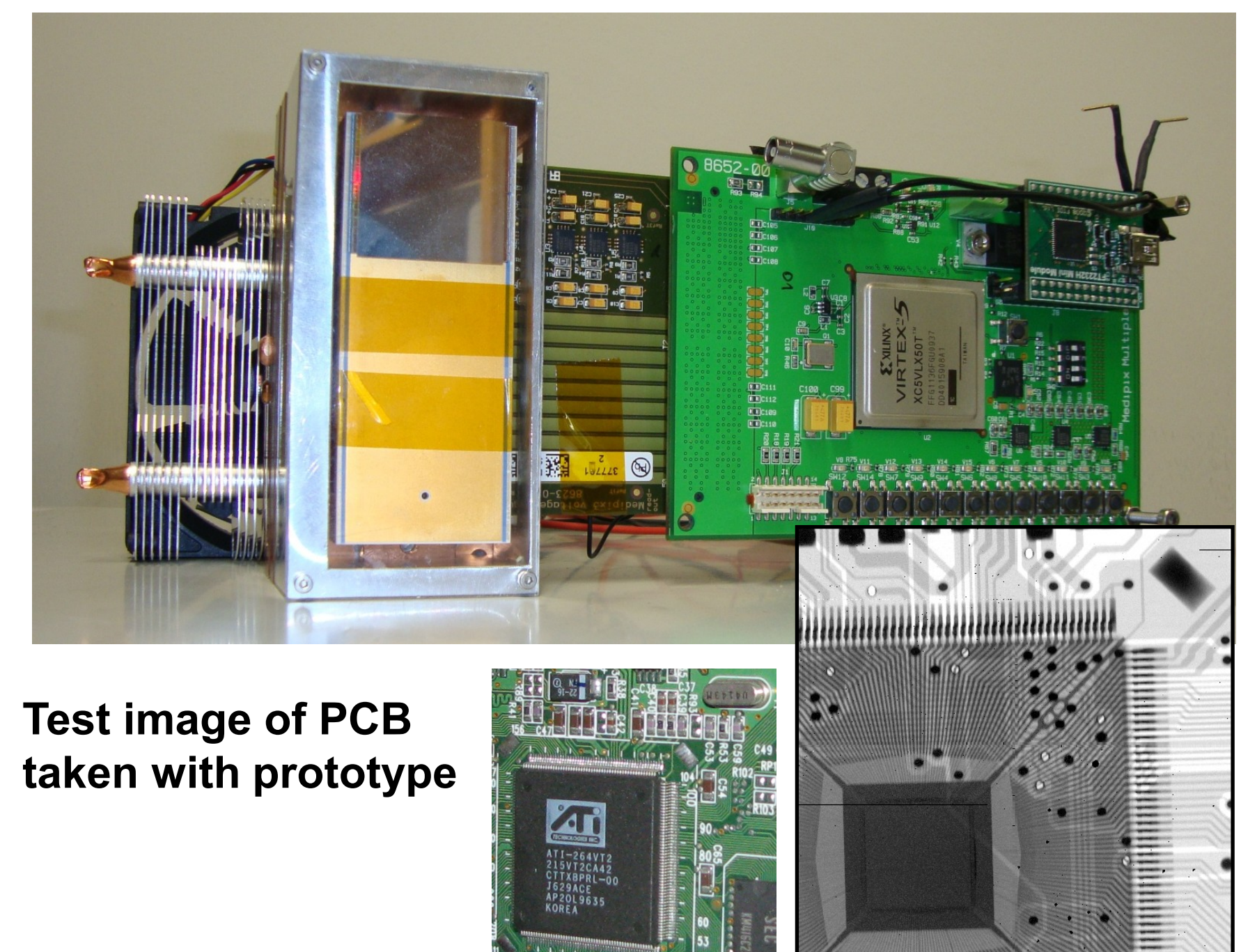
Multi-module design

- 1536 * 512 pixel module
- 85 mm * 28 mm sensor on module
- Titable layout
- Compatible with different sensors



Current status

- Prototype modules working (smaller sensor, USB readout)
- High-speed readout board in development in DESY FEA
- Large sensor modules in production



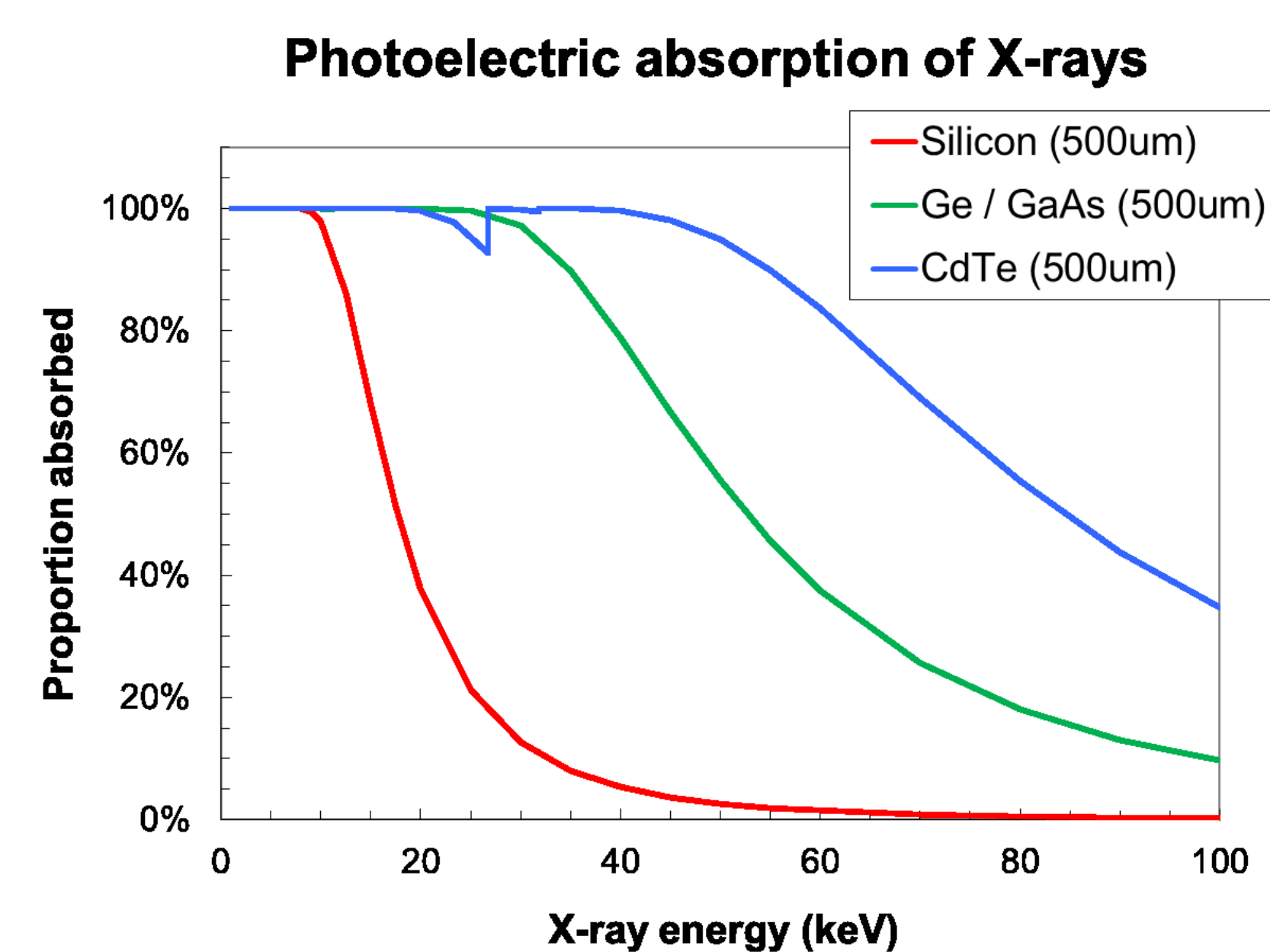
Test image of PCB taken with prototype

“High-Z” semiconductor pixel detectors

Photon-counting pixel detectors with high efficiency at high energies

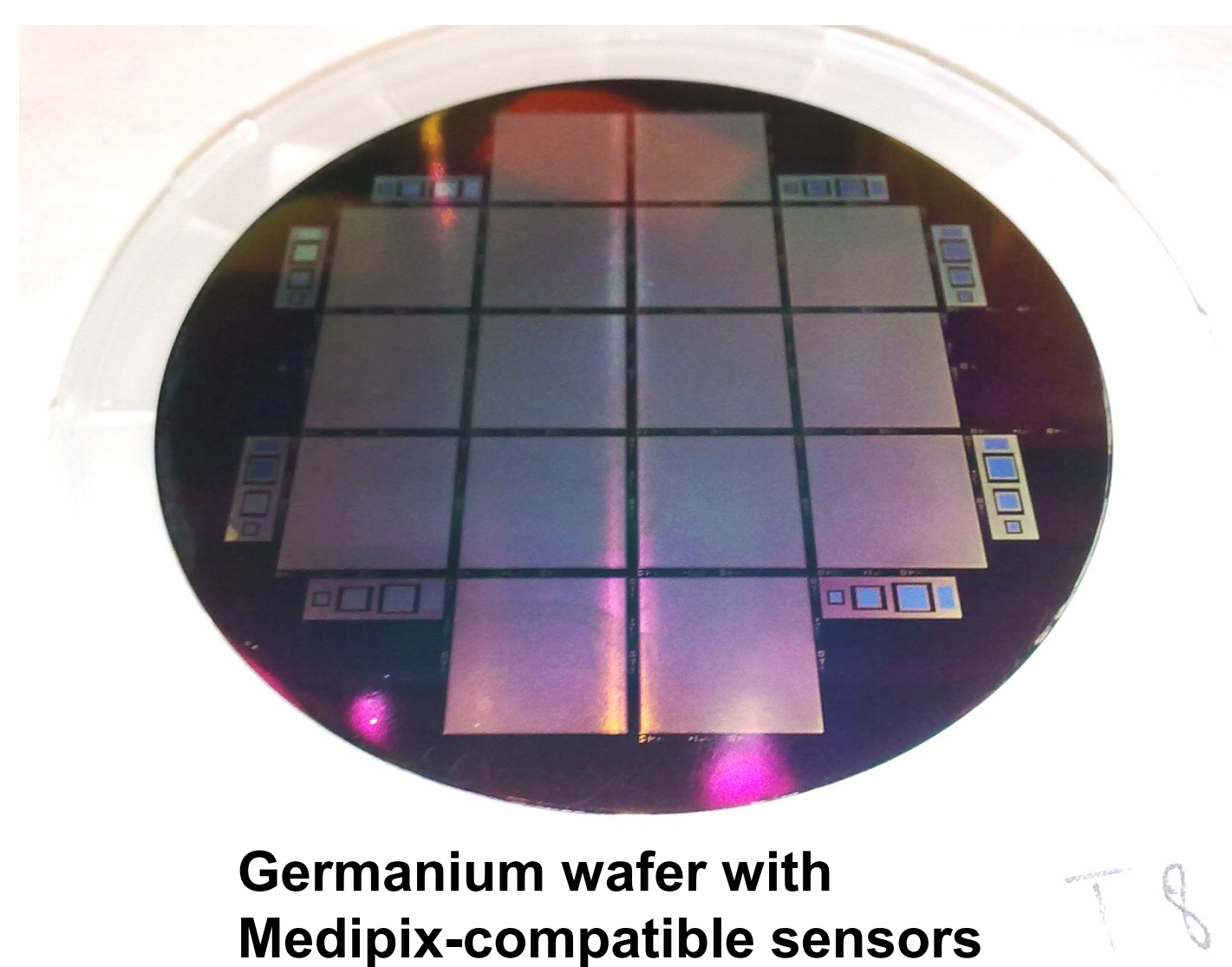
Aims of project

- Replace Si sensor with heavier semiconductor
- Sensor has high QE across wide energy range
- Readout chip still allows photon counting, high speed etc.
- *But each high-Z material has pros and cons*
- Working on different materials in collaboration with others



Germanium pixel sensor

- Ge already available in high-quality wafers
- However, not yet used in hybrid pixel system
- Canberra Lingolsheim producing sensor
- Fraunhofer IZM (Berlin) developing In bonding
- Cooling and mechanics developed at DESY
- Prototype sensors expected in Spring



Cadmium telluride

- Room temperature semiconductor, already used in some detectors
- However, material has nonuniformities
- Evaluated CdTe pixel sensors from XIE at BW5



GALAPAD project (GaAs)

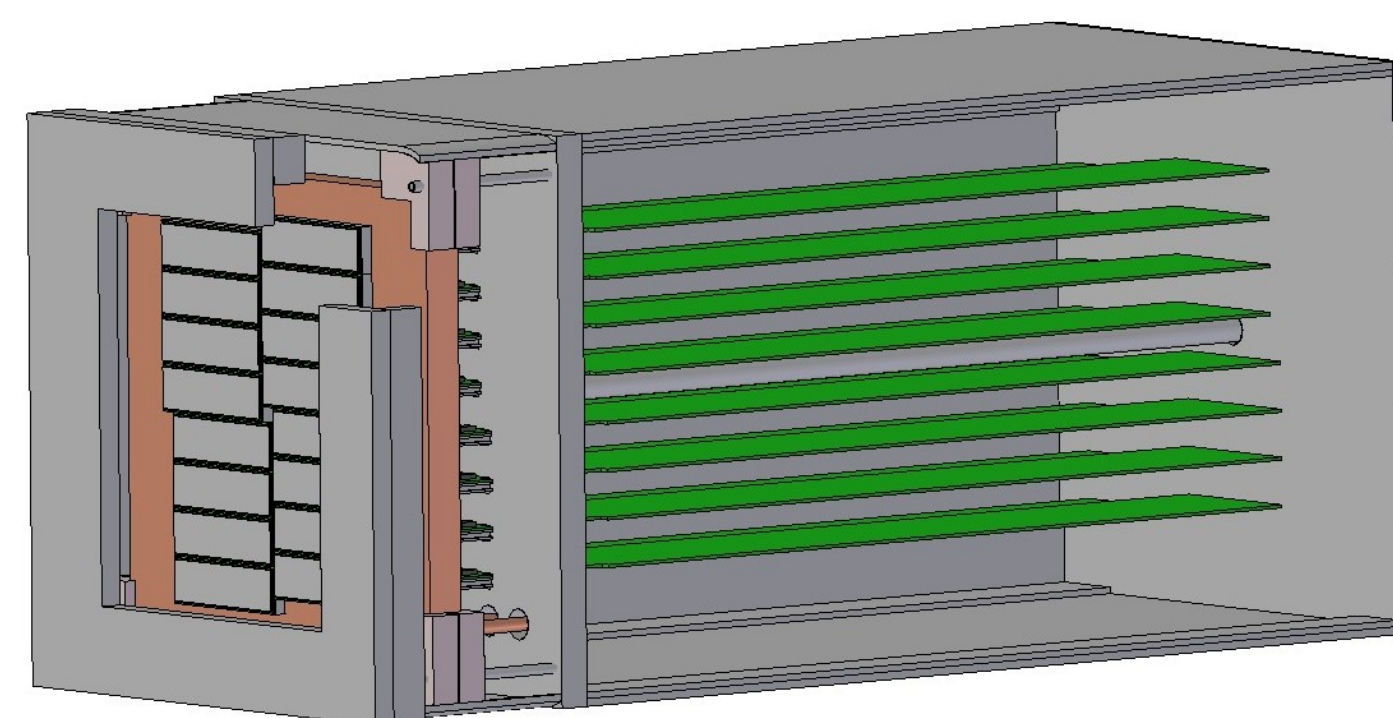
- New German-Russian partnership to produce Gallium Arsenide sensors
- Members: RID Ltd (Tomsk), JINR (Dubna), FMF (Freiburg), KIT, DESY

Pixel detectors for the European XFEL

Adaptive Gain Integrating Pixel Detector (AGIPD)

See poster 114, J. Sztuk-Dambietz

- 4.5 MHz frame rate
- Single-photon sensitive
- $\geq 10^4 * 12$ keV photon range
- Scheduled for XFEL startup



DESY, PSI, Universities of Hamburg and Bonn

Depmos Sensor with Signal Compression (DSSC)

See poster 118, M. Porro et al.

- 4.5 MHz frame rate
- Single-photon sensitive at low energies
- Large dynamic range (signal compression)

DSSC Consortium – MPI-Semiconductor Lab Munich (coordinator), Politecnico di Milano, DESY, Universities of Heidelberg, Siegen and Bergamo

Other work in DESY FS-DS

Please look at our web pages:

http://hasylab.desy.de/instrumentation/detectors/index_eng.html

Support for beamlines

- Support for beamline-specific detectors
- Loan pool detectors available
 - Detector list and booking system online
- See Michael Lohmann



Diamond beam position monitors

- 4-quadrant diamond detector
- Better than 50 nm position resolution
- RF readout electronics
- Collaboration with ESRF

XNAP (X-ray Nanosecond resolution APD Pixel detector)

- 2D counting detector based on avalanche photodiode
- Nanosecond timing resolution
- High count rate possible
- **Project partners:** ESRF, PerkinElmer Inc., Spring8, University of Heidelberg