HELMHOLTZ

RESEARCH FOR
GRAND CHALLENGES

M. Weber, S. Masciocchi

Detector Technologies and Systems DTS

Preparations for PoF IV

Subtopics and workpackage structure

DTS has compiled an ambitious, high-tech portfolio

Detector Technology and Systems (DTS)
Speaker: M. Weber (KIT), S. Masciocchi (GSI)

ST1: Detection and Measurement
M. Caselle (KIT)
D. Eckstein (DESY)

Sensing
Alexander Dierlamm (KIT)
Andreas Wilms (GSI)

ASICs
Ulrich Trunck (DESY)
N.N. (GSI)

ST2: System Technologies
A. Kopmann (KIT)
A. Mussgiller (DESY)

Advanced Data Transmission
Karsten Hansen (DESY)
Marc Schneider (KIT)

Digital Real-time Data Acquisition and Processing Systems
David Emschermann (GSI)
Oliver Sander (KIT)

Novel Engineering Techniques, Advanced Materials and Interconnects
Thomas Blank (KIT)
Andreas Mussgiller (DESY)

ST3: Science Systems
C. Schmidt (GSI)
C. Wunderer (DESY)

Particle Physics, Hadrons & Nuclei
Christoph Caesar (GSI)
Ingrid Gregor (DESY)

Photon Science
Michael Fiederle (KIT)
David Pennicard (DESY)

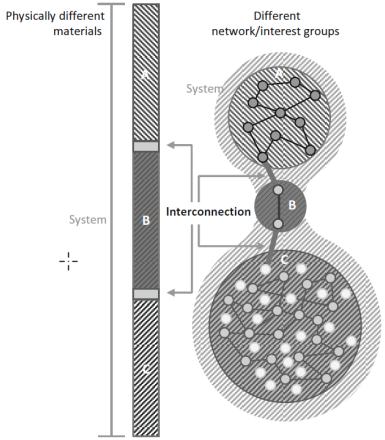
Astroparticle Physics
Timo Karg (DESY Zeuthen)
Matthias Kleifges (KIT)

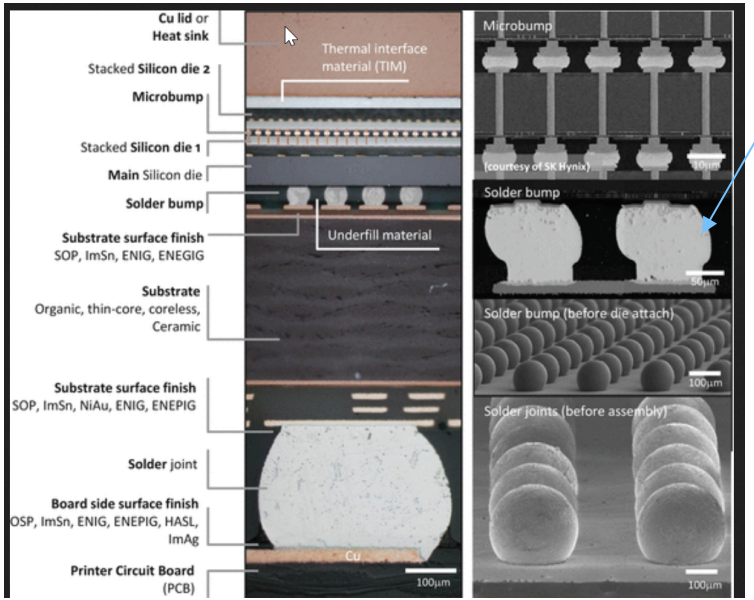
Beam Physics
Matthias Balzer (KIT)
Markus Schwickert (GSI)

Advanced Materials and Interconnects

Interconnections Solutions in PoF_IV

Interconnection





- UBM
- Warpage/Planarity
- Accuracy
- Inspetion
- Metallurgy/Phases
- Electrical tests

Advanced Materials and Interconnects

Interconnections Solutions in PoF_IV

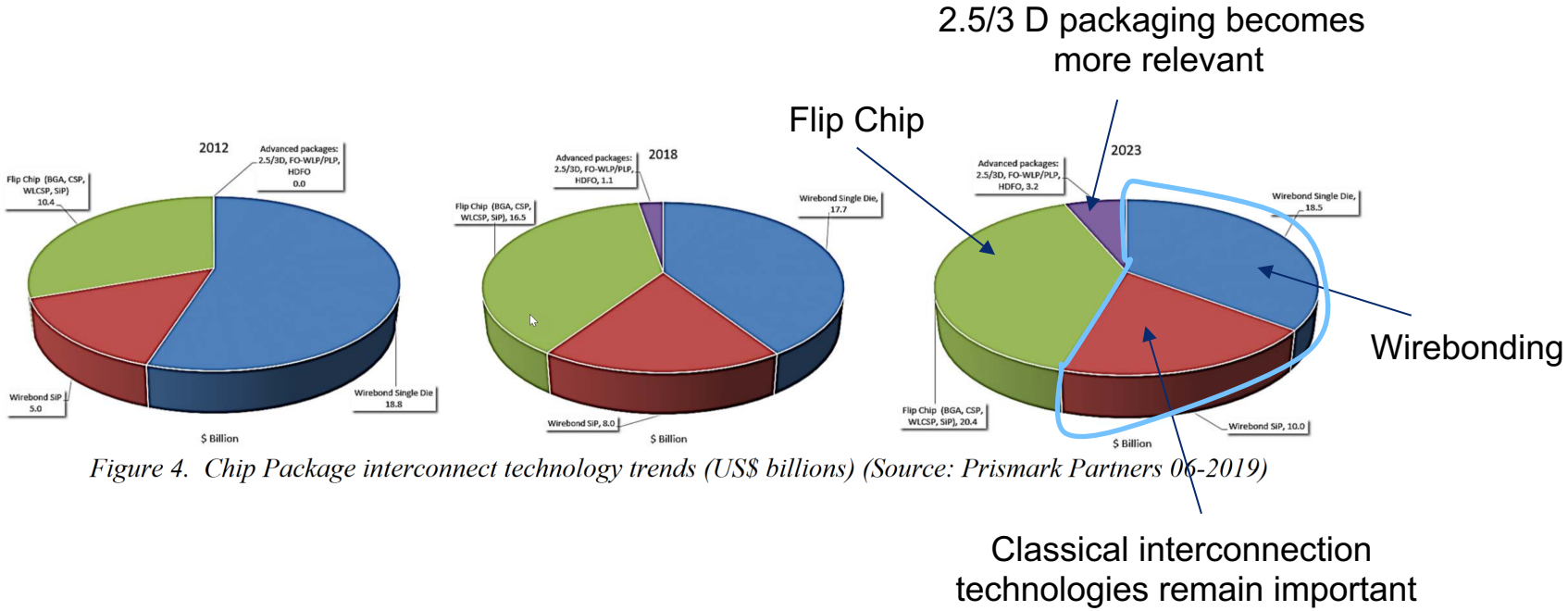


Figure 4. Chip Package interconnect technology trends (US$ billions) (Source: Prismark Partners 06-2019)

Advanced Materials and Interconnects

Applications in POF_IV and Interconnection Challenges

Emerging Applications

- Quantum Sensing HSS
- Silicon Detector Systems (CERN/FAIR/…)
- Quantum Computing

Requirements

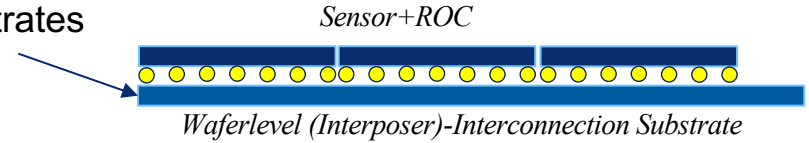
- massless
- No blind sensor zones
- tight pixel pitch < 50µm
- Hybrid sensor- and packaging materials
- billion-channels
- Small series (only some devices) to large scale detector production

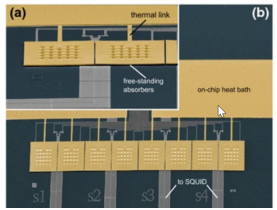
Advanced Materials and Interconnects

Applications in POF_IV and Interconnection Challenges

Issues to be addressed in POF-IV

- Hybrid Materials: CTE, Warpage, Reliability, Radiation
- Interconnection-Processes: Welding (Tab/Wire-Bonds), Glued, Soldered, Sintered, Pressed, TSV
- Mechanical Challenges: Small Pixels, Small wires, massless and fragile components, thin and large semiconducting devices (e.g. 60x120 mm Si. Sensors)
- Custom Assembly and Test-Stations
- Interposer- and Interconnection substrates





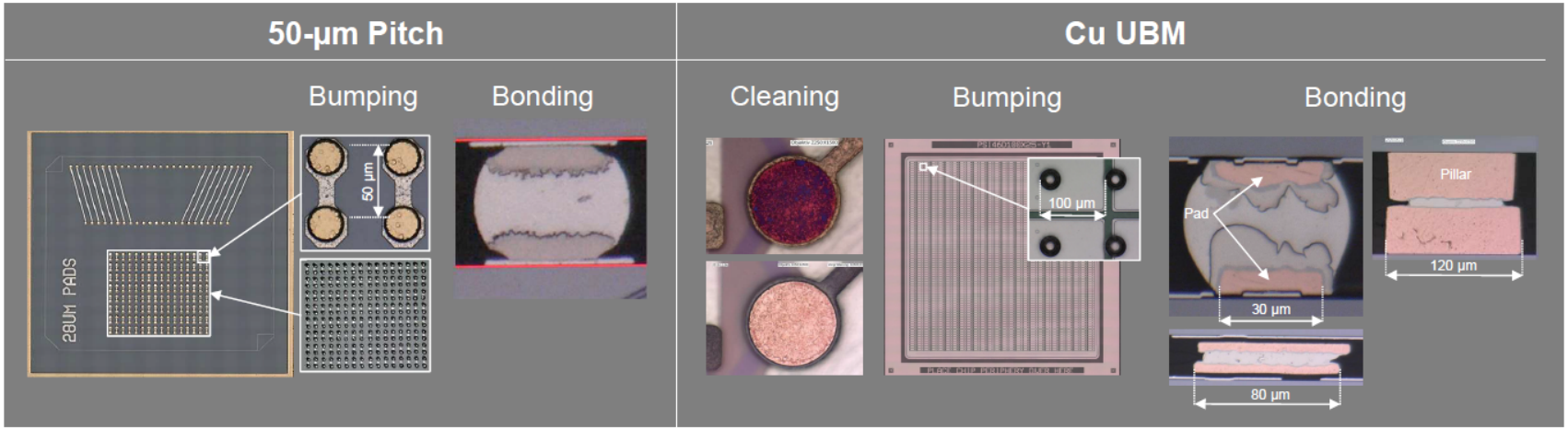
Overhanging galvanic structures in superconducting sensor

⇒ **Approach:**

- HSS-Lab (KCOP) allows us to set up new processes (galvanic, sputtering, …)
- Renewal of outdated machines by new ones (state of the art printing, bonding, …)
- Validate interconection processes in large scale production (sensor systems for experiments)
- Dedicated, PHD-based research (fulltime).

Inhouse Bump Bonding at DESY

Towards Smaller Pitches and Copper Metallization



- all Processes now in-house available
- Ball Placement, Bonding & Reflow tested for 50-µm Pitch & Cu UBM
- 1st Cu UBM Application for the upcoming CMS-Pixel Luminosity Telescope

DESY. AvT | FEC