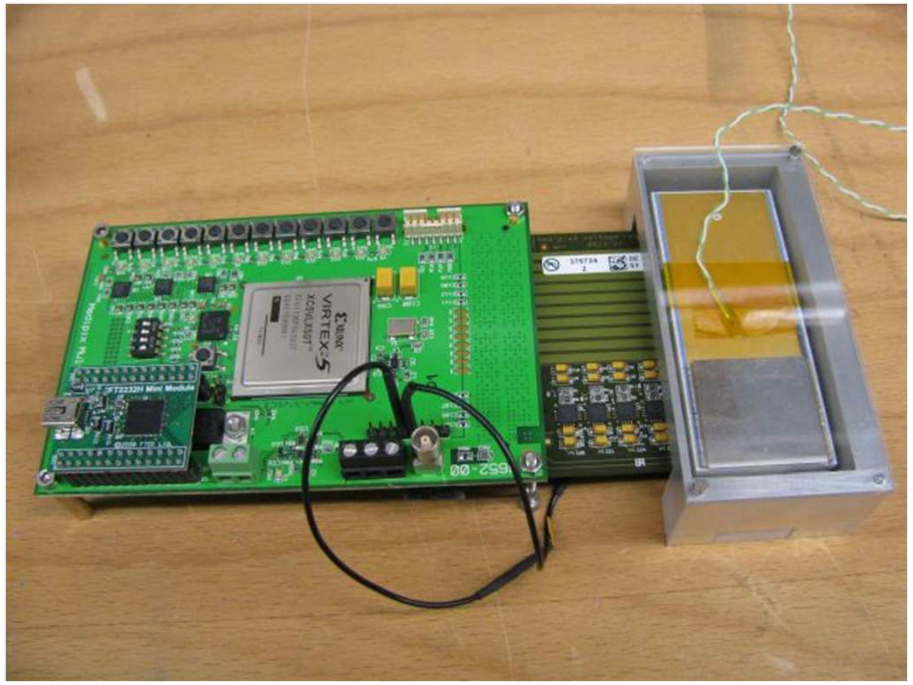
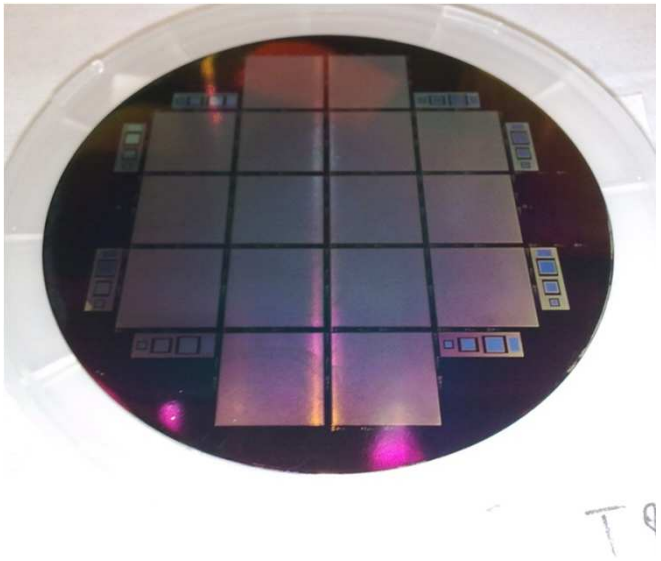
Update: Lambda project





Sabine Lange
Detector Group DESY

Medipix meeting, May 29-31, 2012

HELMHOLTZ ASSOCIATION

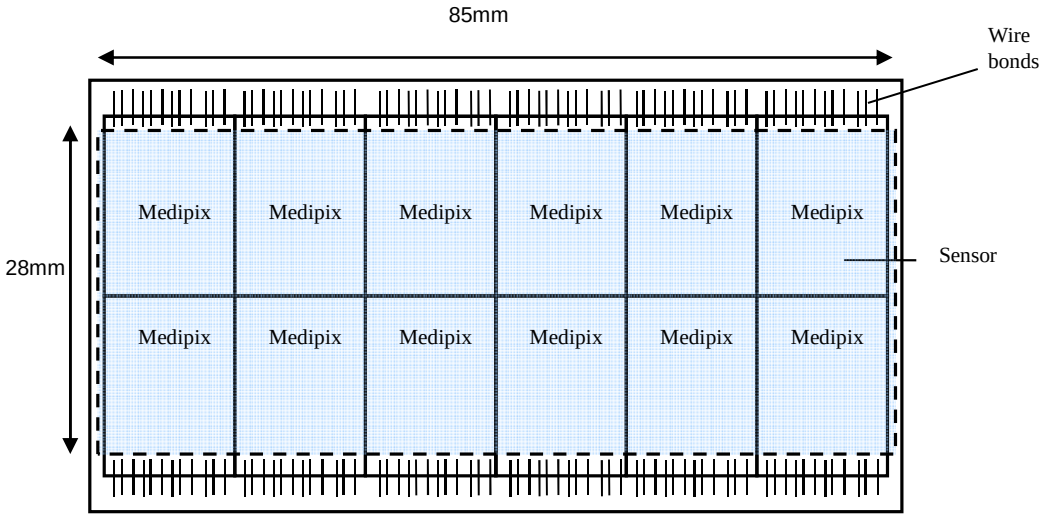
DESY

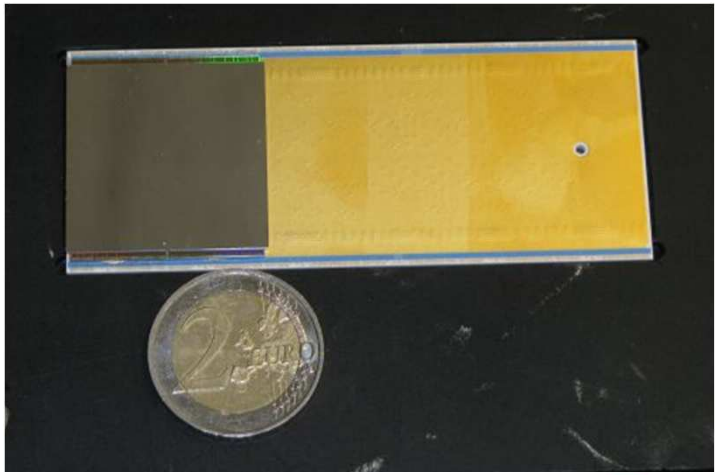
s1

Lambda project

About Lambda:

- 2 x 6 Medipix3 chips (~28 x 85mm)
- high frame rate (8 read out lines, 2kHz readout)
- 10 gigabit Ethernet high-speed readout
- experiments up to 100 keV (high-Z sensors)





Folie 2

s1 For experiments at the Petra-III light source, we'd like to have a Medipix3 module with a reasonably large area, small dead area at each edge, and high-speed readout. The module we're working on will carry 2*6 Medipix3 chips, which could either read out a single large silicon sensor or two smaller sensors made from high-Z material.

senges; 21.09.2010

Update: Lambda project

New sensor production

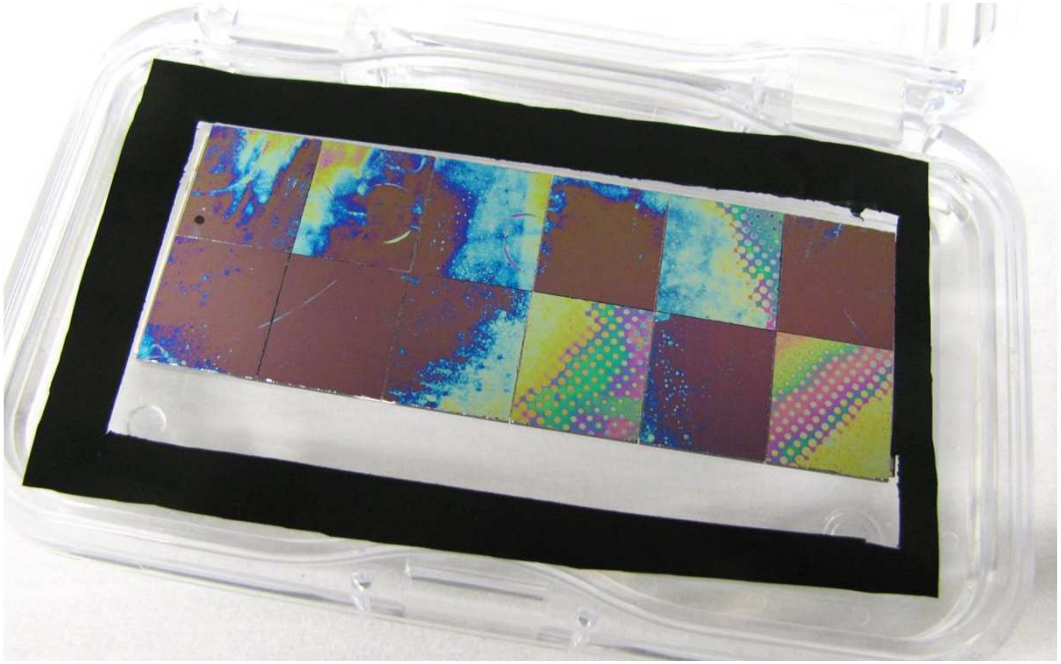
Development of readout system and mechanics

Ideas for TSV-compatible board development

Large-area silicon sensors

2 x 6 – chip layout Si, 55µm pitch, 300µm thick (2/6 received)

- Ordered from Canberra – delayed, opted for 5” wafer instead of 6”
- Bonded at IZM – no problems reported with planarity, etc.
- X-ray tests at IZM show a small number of joined bumps on 2 chips of 1 module (other module OK)



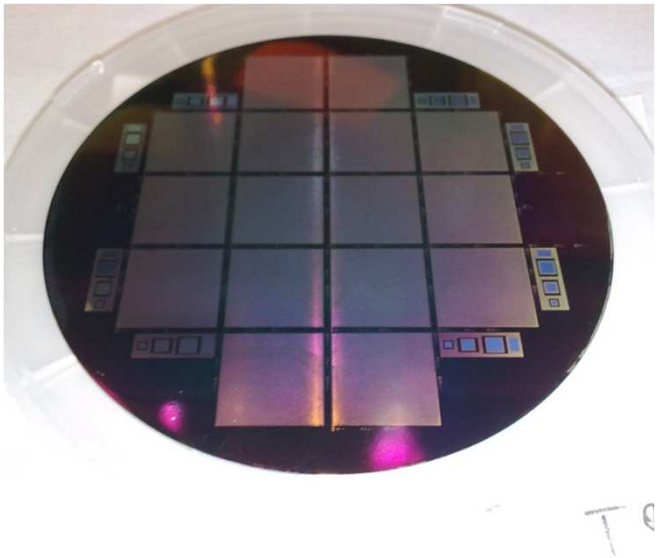
Germanium sensors

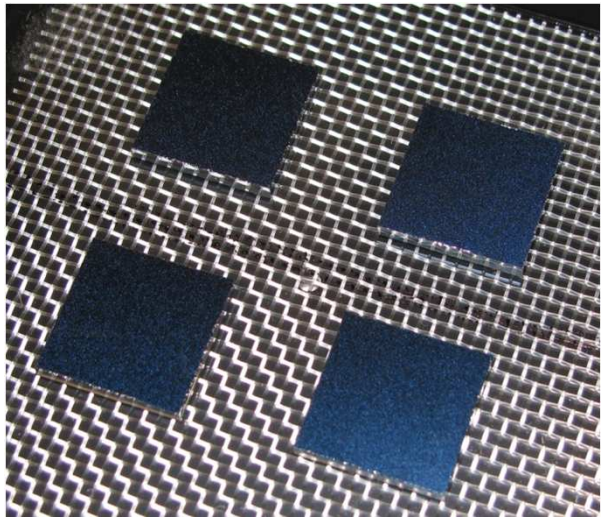
55µm pitch Ge sensors produced by Canberra (Lingolsheim)

- 2 x 90mm wafers with single Medipix3 sensors

Indium bump bonding at IZM

- Processing conditions optimised to avoid damage to Ge & bump height tested
- Currently bonding HPGe sensors to Medipix3





Optical Ge dummies bonded to Si

Update: Lambda project

New sensor production

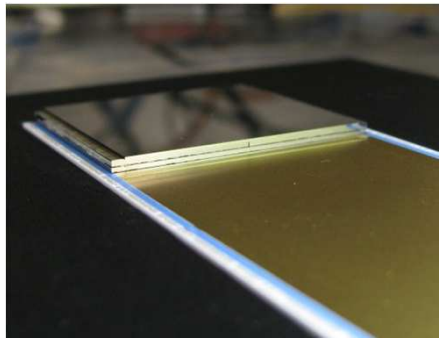
Development of readout system and mechanics

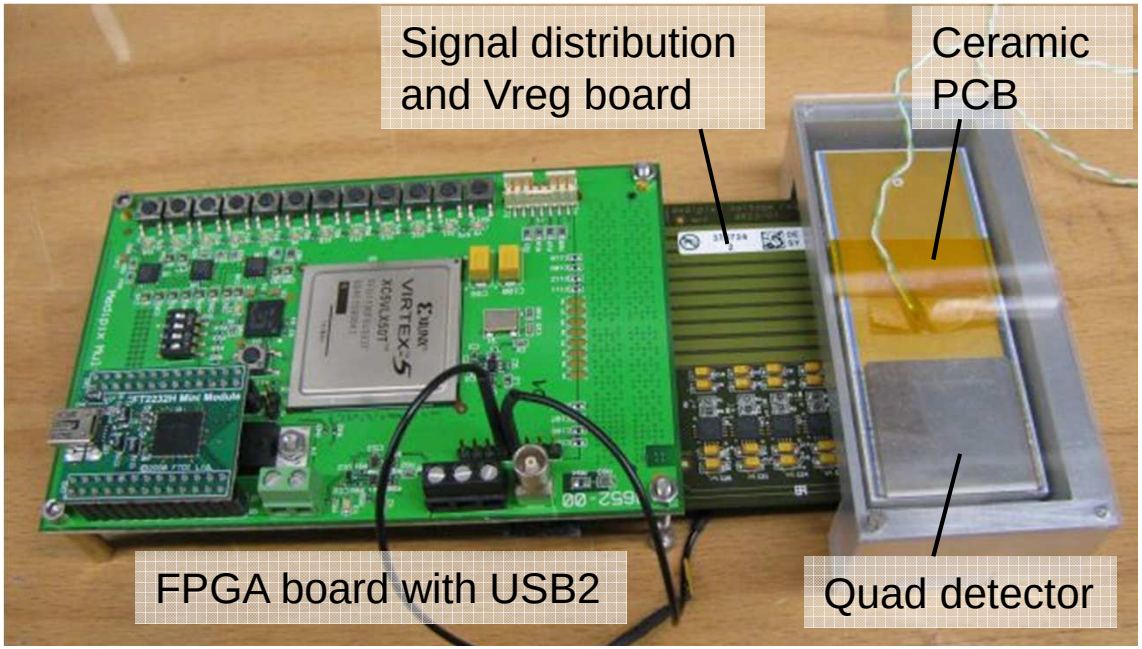
Ideas for TSV-compatible board development

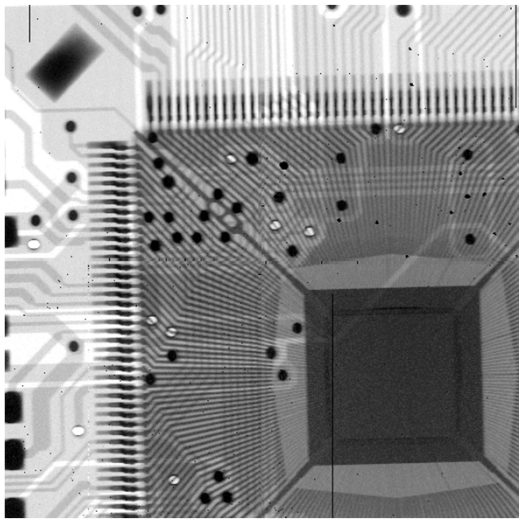
Lambda project

Lambda prototype:

- First PCBs beginning of 2011
- Quad silicon sensor
- Readout board with USB2





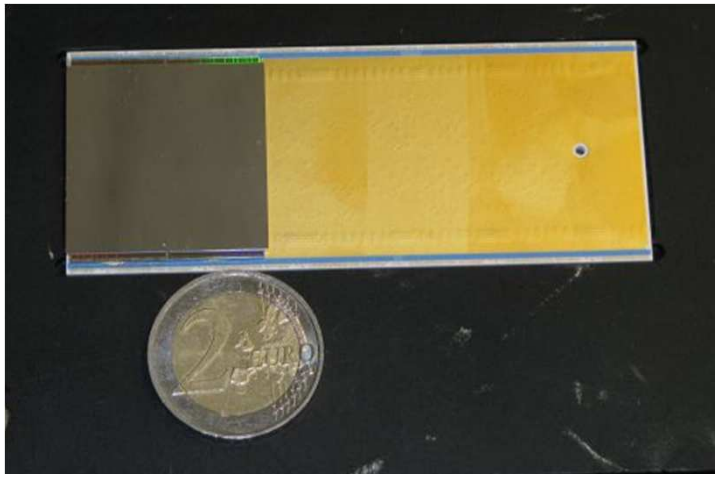


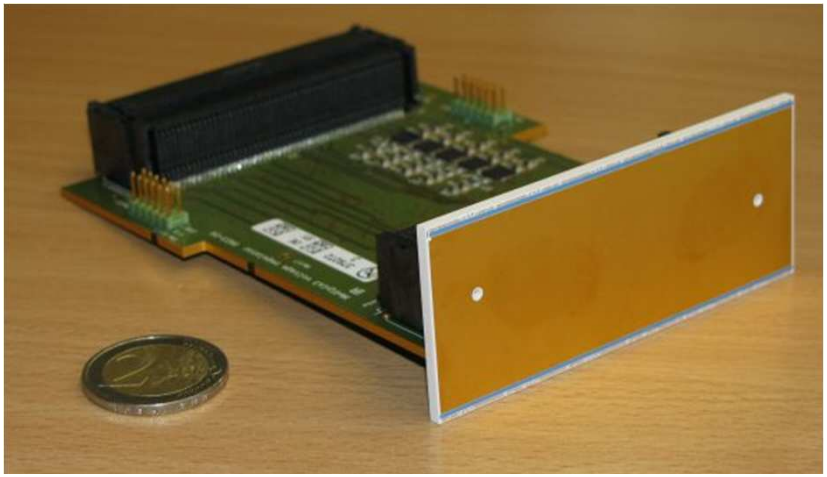
X-ray image of circuit board

Lambda project

Redesign of module ceramic:

- Not all “power” wire bond pads used
- Nonuniform pixel behaviour along chip, and some strange glitches
- Reason: voltage drop along the chip
- ►redesigned ceramic board





Right-angled connection to readout

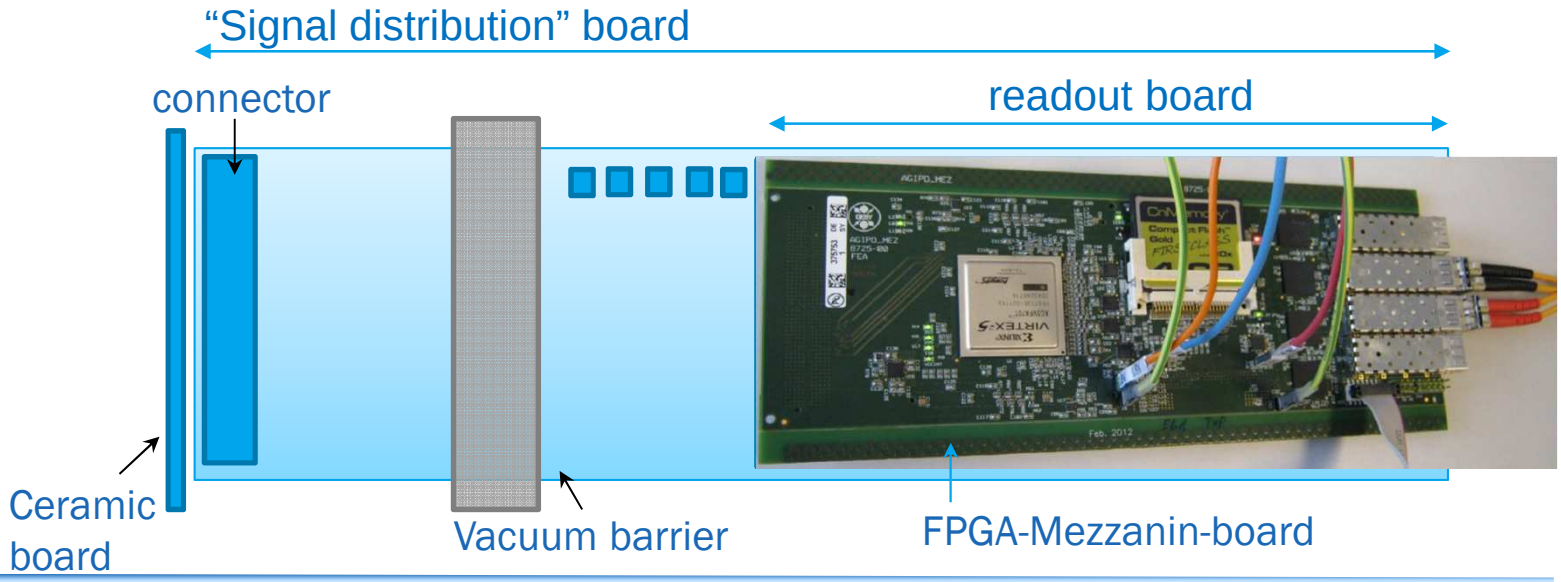
High-speed readout system

Common high-speed readout board developed by DESY

- 4 * 10 Gigabit Ethernet links available
- Large on-board RAM for burst operation
- Currently being tested

“Signal distribution” board connects to detector head

- Powering, DACs and ADCs, etc.
- Now being assembled



Cooling and vacuum operation

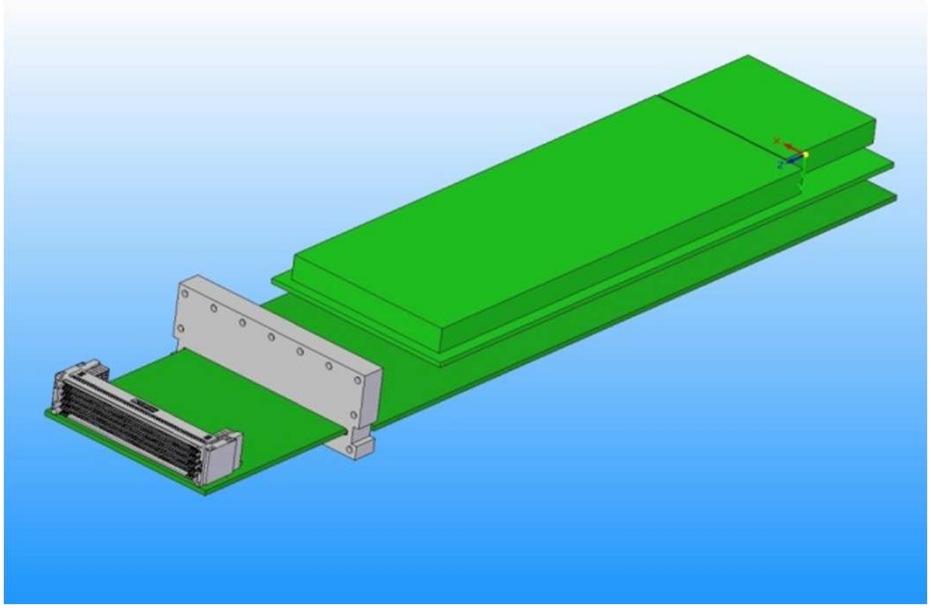
Germanium detector should operate about -70ºC in vacuum

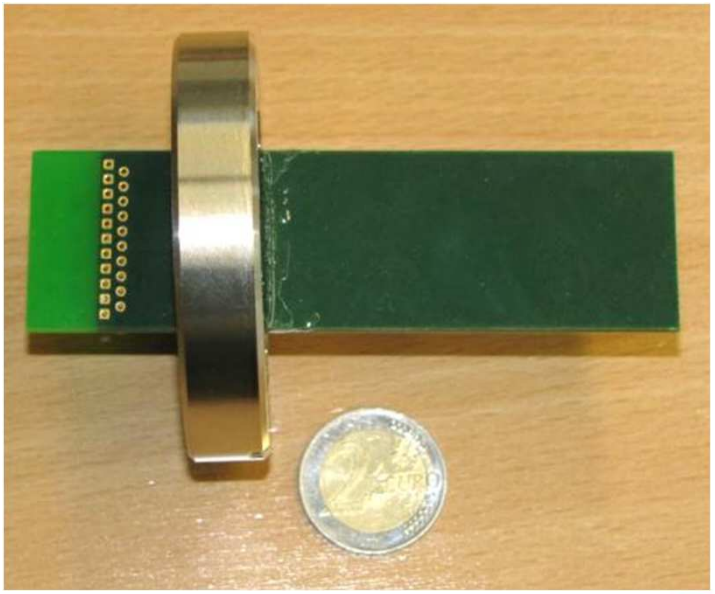
- Ceramic PCB allows CTE matching and reasonable thermal conduction

First tests have whole system in vacuum chamber

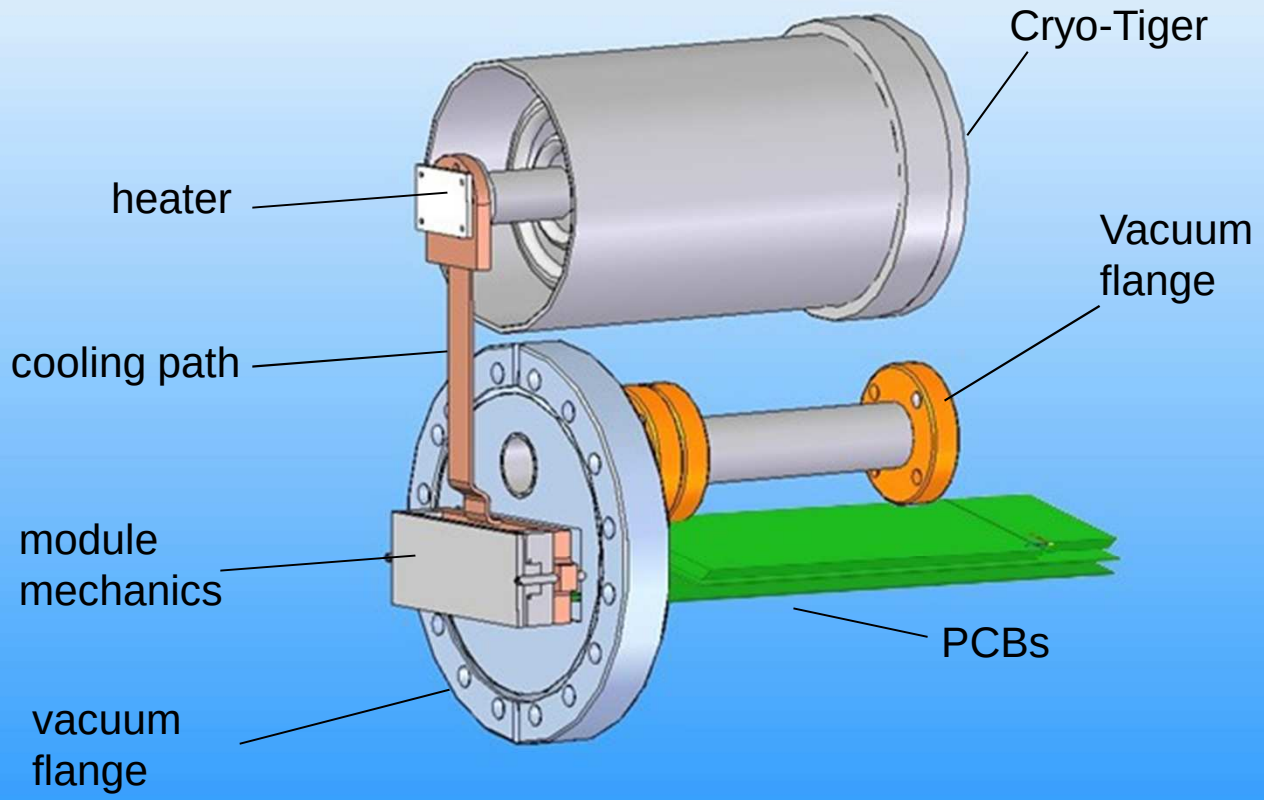
Full systems will have vacuum barrier glued to SD board

- First tests of vacuum barrier successful

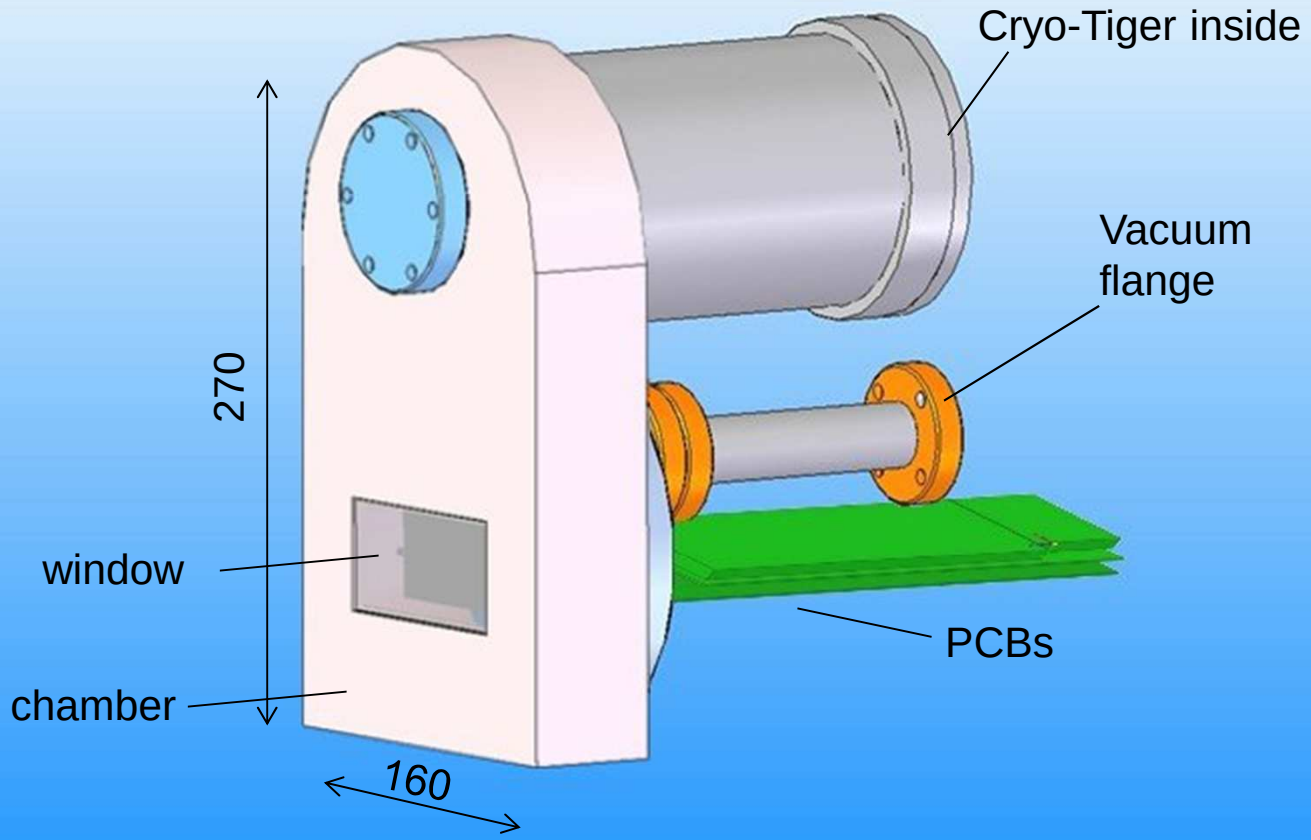




Cooling and vacuum operation



Cooling and vacuum operation



Update: Lambda project

- New sensor production
- Development of readout system and mechanics
- Ideas for TSV-compatible board development

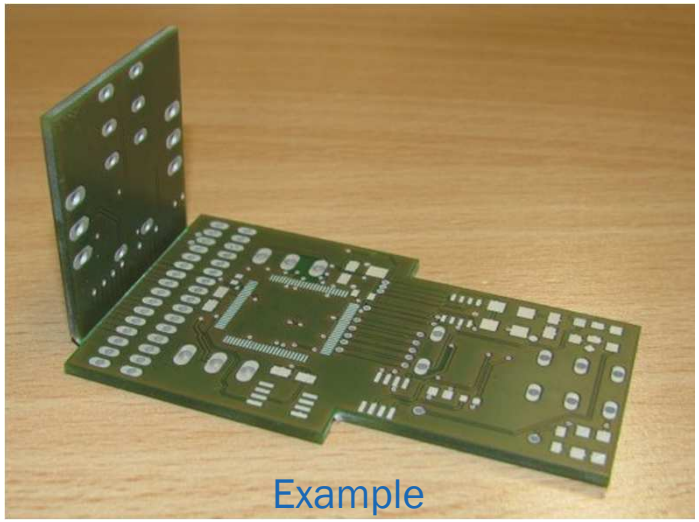
Medipix3 TSV

- Existing 2 x 6 system could be modified for TSVs
  - Already using ceramic board to improve thermal match and cooling
  - Signal routing to BGA probably easier
  - Smaller sensors could be soldered to 2 x 6 module
- Could we build small modules (2 x 2)?
  - More flexible
  - Better yield of good modules
- Technical challenges
  - High speed readout >180 lines
  - Either multiple connectors or open pin field (less efficient)
  - Loss of wire bonding space makes fitting connectors and mechanics harder

Right-angle PCBs

Right-angle PCB

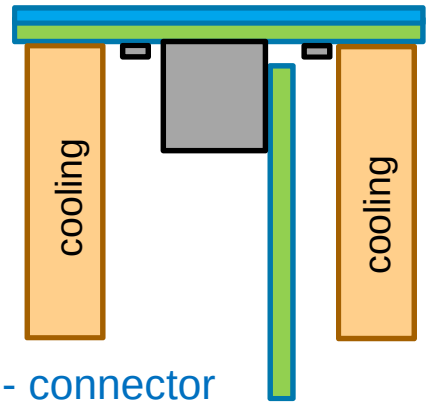
- Called: Wirelaid technic
- company: Jumatech (maybe others)
- Can be used for all FR4 PCBs
- ~ 1 line each 1-2 mm
- Could be used for powering
- differential pair routing impossible



Example

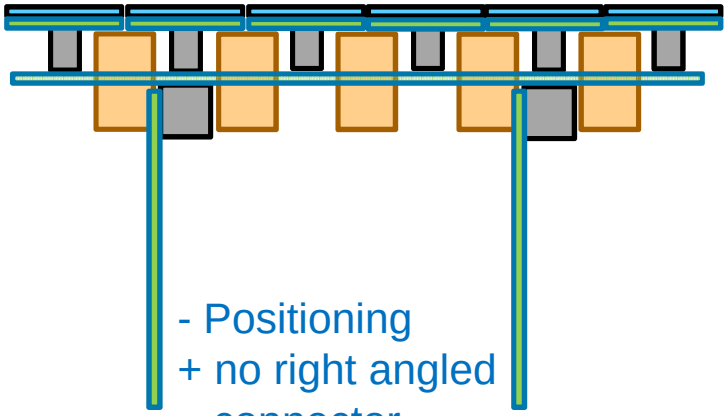
Medipix3 TSV

1



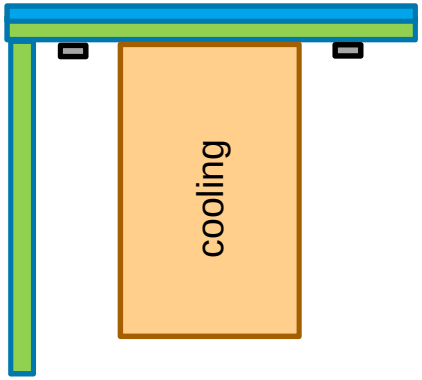
- connector
+ flexible

3



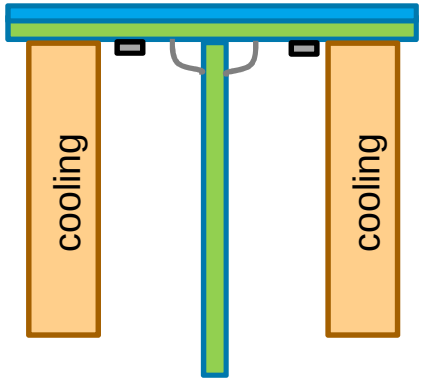
- Positioning
+ no right angled connector

2



- PCB
+ space for cooling

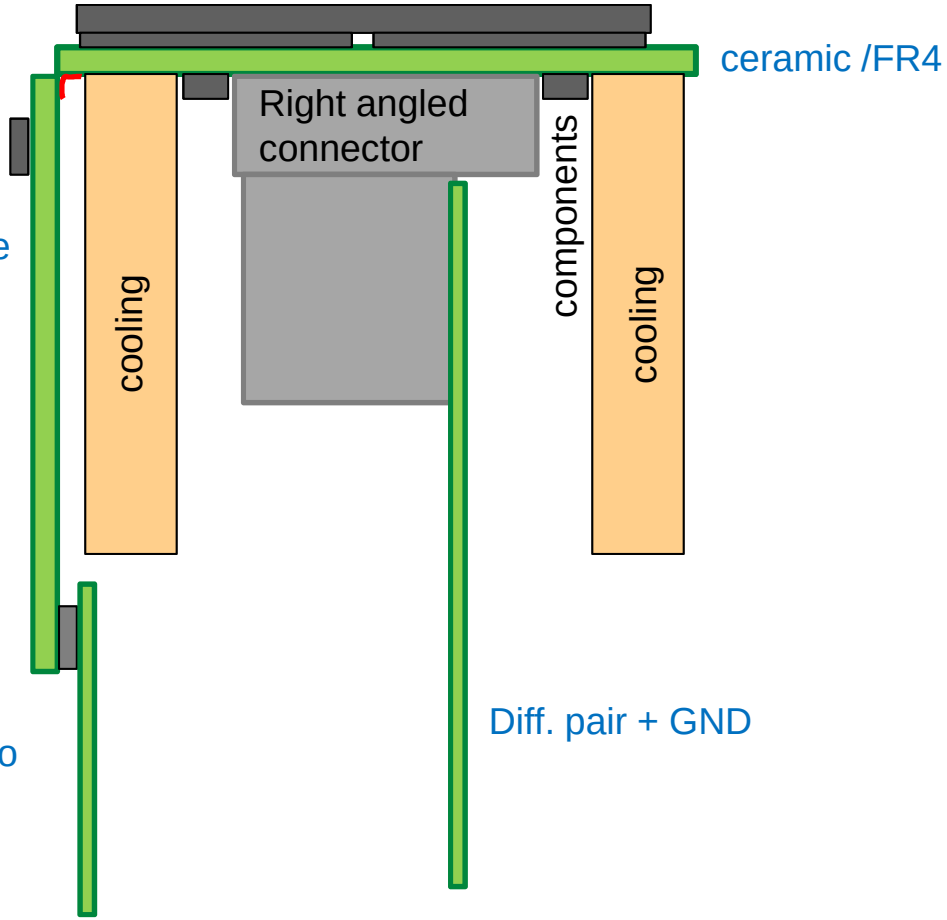
4



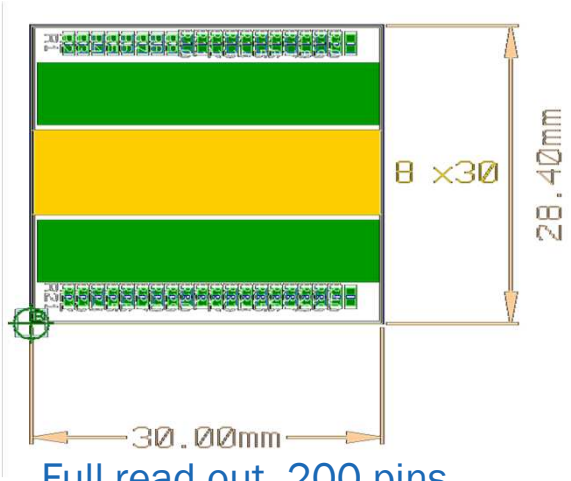
- wire bonding
+ space for cooling

Medipix3 TSV

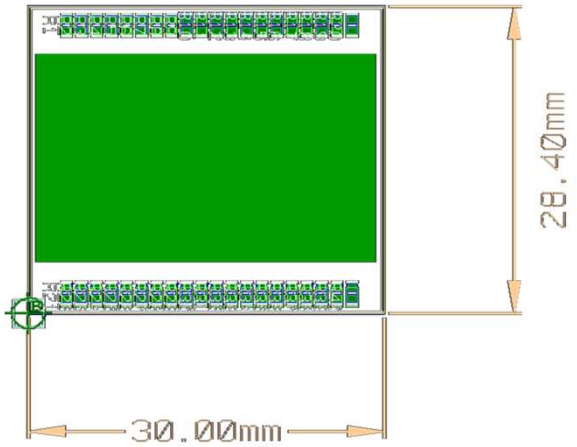
- Board with voltage regulators
- power supply
- ~16 data lines



Examples of 2 x 2 module connectors

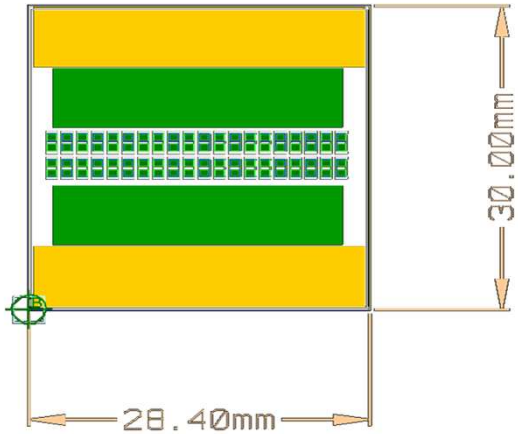


Full read out, 200 pins

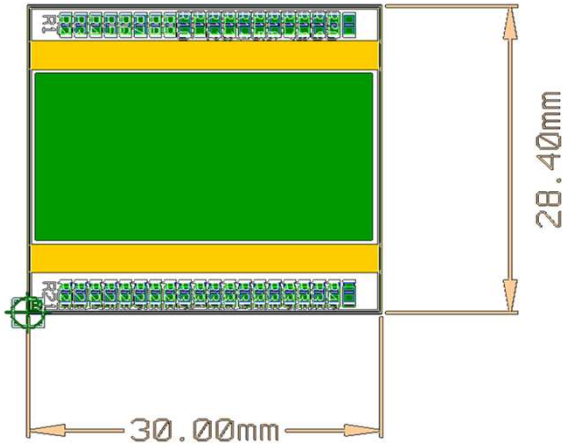


Full read out, 180 pins

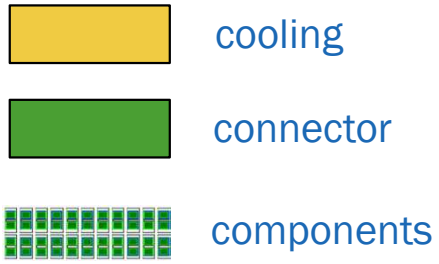
Number of pins	8 output lines	4 output lines	1 output line
Normal PCB	185	141	108
90°PCB	156	108	72
No. diff. pair lines	104	72	48



90° PCB, Full read out,
160 pins,
cooling: 6 x 30 mm



4 data out, 144 pins,
cooling: 2,5 x 30mm



Lambda project + Medipix3 TSV

Thanks for listening