Update: Lambda project

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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)
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
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
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

- Cryo-Tiger
- Vacuum flange
- heater
- cooling path
- module mechanics
- vacuum flange
- PCBs
Cooling and vacuum operation

- Cryo-Tiger inside
- Vacuum flange
- PCBs
- Chamber
- Window

Dimensions:
- 270
- 160
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
Medipix3 TSV

1. - connector
   + flexible
   - cooling

2. - PCB
   + space for cooling
   - cooling

3. - Positioning
   + no right angled connector
   - cooling

4. - wire bonding
   + space for cooling
   - cooling
Medipix3 TSV

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

Connected to read out

Right angled connector

Diff. pair + GND
Examples of 2 x 2 module connectors

<table>
<thead>
<tr>
<th>Number of pins</th>
<th>8 output lines</th>
<th>4 output lines</th>
<th>1 output line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal PCB</td>
<td>185</td>
<td>141</td>
<td>108</td>
</tr>
<tr>
<td>90° PCB</td>
<td>156</td>
<td>108</td>
<td>72</td>
</tr>
<tr>
<td>No. diff. pair lines</td>
<td>104</td>
<td>72</td>
<td>48</td>
</tr>
</tbody>
</table>

Full read out, 200 pins

Full read out, 180 pins

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

4 data out, 144 pins, cooling: 2.5 x 30 mm
Thanks for listening