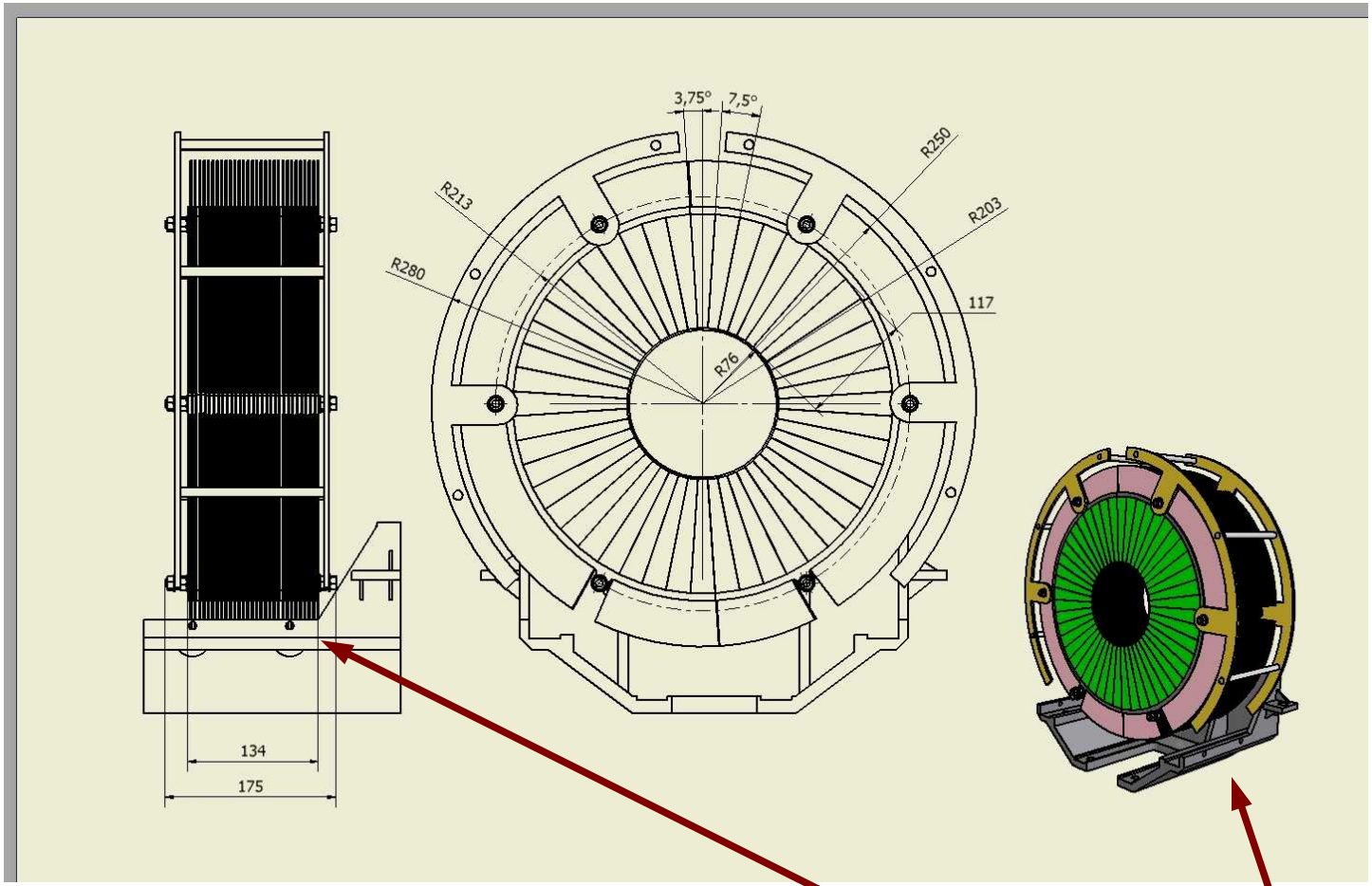
Connectivity issues for LumiCal (BeamCal) at ILC

- Readout electronics is taking shape
- We are starting to attack system problems (spatial constraints, cabling, connectors...)
- Why only now ? We are only few people

Marek Idzik
AGH-UST Kraków

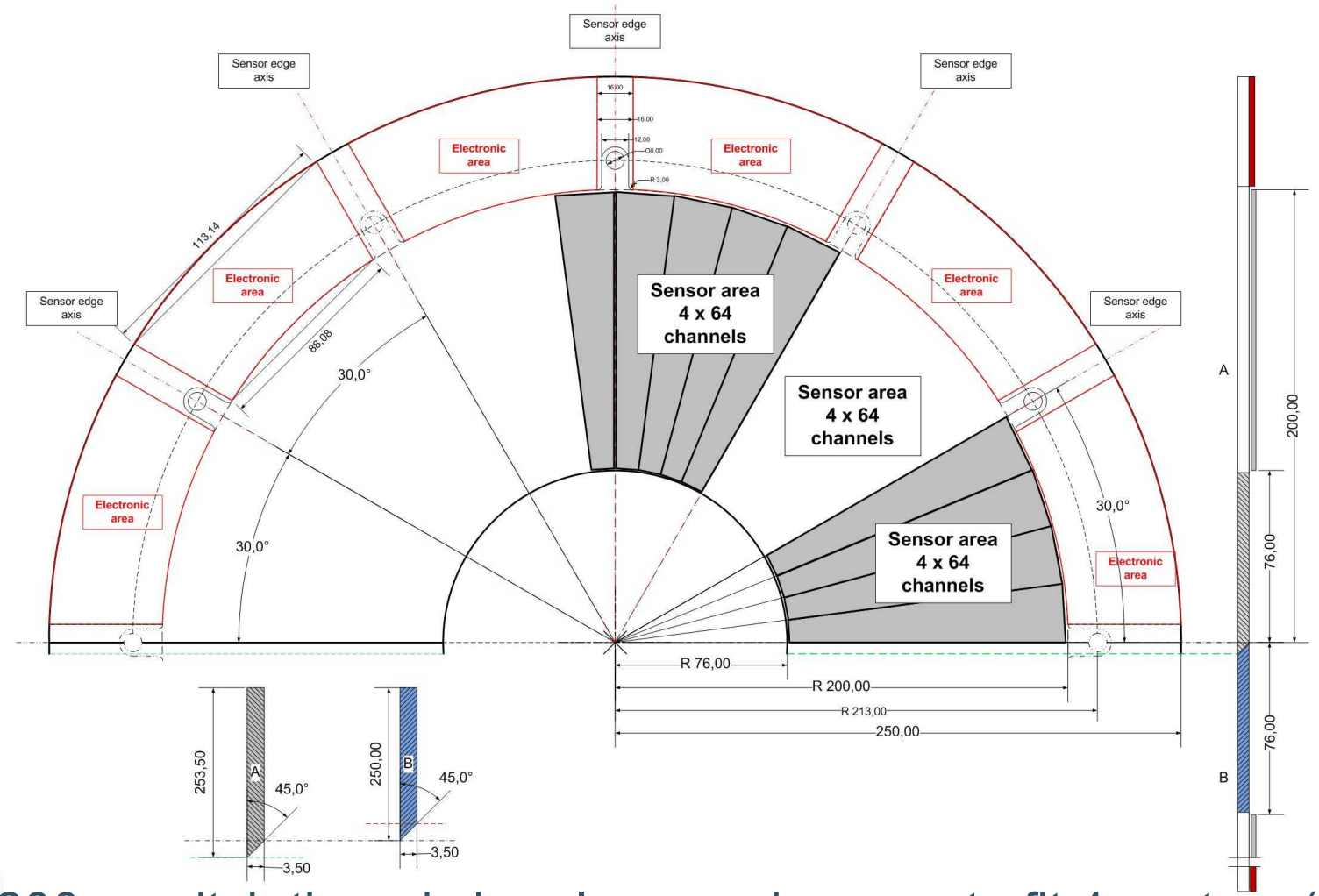
Kraków 16/9/2010

LumiCal detector



- ((pad x 64=sector) x 48 = plane) x 30 = 92160, LumiCal barrel
- Constraints for electronics+cabling: thickness of single plane ~4.5mm, available space = few cm beyond R=20cm

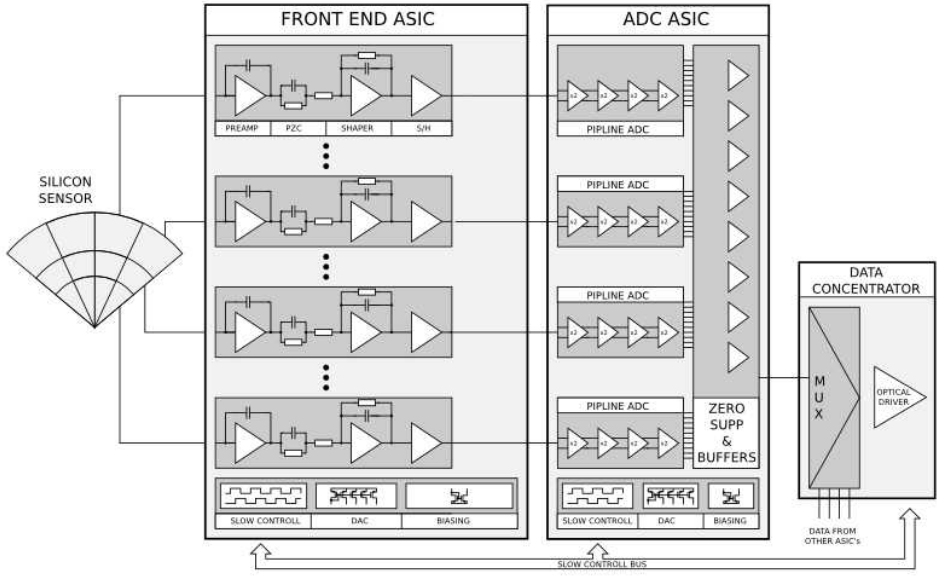
LumiCal detector half-plane



With 200um pitch there is barely enough space to fit 4 sectors (256 channels) between tungsten holders (at least 32 channels per ASIC)

Readout electronics

- Front-end ASICs 32(64) channels
- ADC ASICs 32(64) channels
- Data concentrator FPGA (or ASIC) per ~4 sectors (256 chan), containing transmitter (differential wires to send out data)
- One of data concentrators/plane will collect and send out the data
- Low voltage (LV) power supply delivery (cables, connectors, regulators?)
- High voltage (HV) delivery

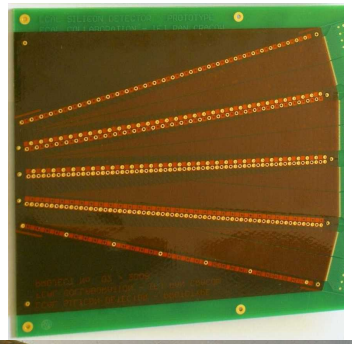


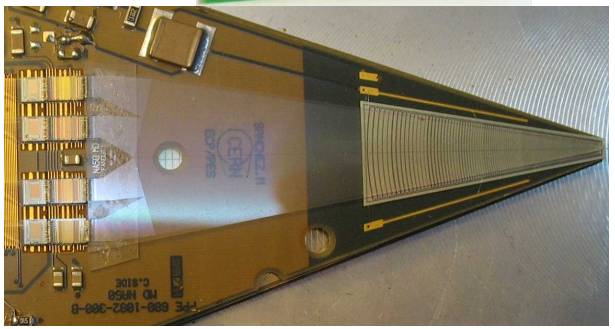
Main connectivity issues
similar for LumiCal and BeamCal

- Sensor – front-end connection
- Sending data out of LumiCal (BeamiCal) plane
- Delivering power supply (LV, HV)
- Testbeam temporary connectivity solutions
- Power pulsing will certainly add some problems...

Sensor-frontend connection

- Kapton fanout
  - +small C, +already existing
- Glass fanout
  - +small C, +rigid
- Fanout integrated on sensor
  - +fully integrated, -large C,L_{par},R_{par}, -price
- Other ?





NA50 example

Technology issues: bonding, bump-bonding ?

Sending Data out

- LumiCal data rate per plane per train
  - Worst case: 64pad•48sec•3000bx•10bit=88Mb,
    TX between trains: 88Mb/200ms=440Mbit/s
  - Average MC: 64•48•10hit/train•30bit=0.9Mb,
    TX between trains: 0.9Mb/200ms=4.5Mbit/s
- Data can be collected by single FPGA (or ASIC) per half-plane and send out by wires

Technology issues: thin connectors ?

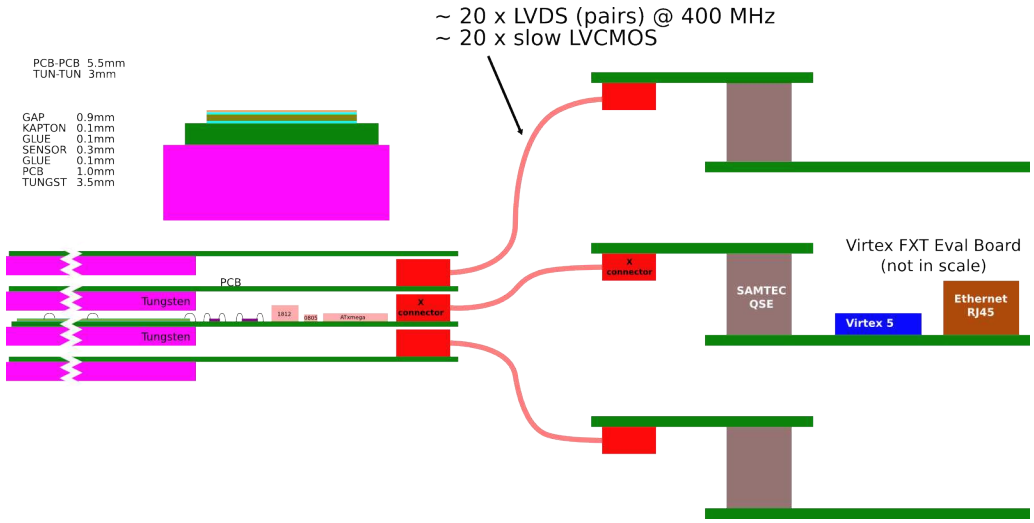
Power supply

- LV power consumption estimation per barrel
  - ~15mW/chan•64pad•48sec•30planes=1.4kW, 1.4kW/3.3V>**400A !**
  - Regulators, what type, where ?
  - Power pulsing....
- HV power consumption is negligible, only HV isolation is an issue

Technology issues: cables/connectors ?

Testbeam issues

- On short term scale prototypes of LumiCal sectors will be read by standard FPGA evaluation boards
- Connectivity schemes need to be solved



Technology issues: thin dense connectors, fast (~400MHz) wire connection ?

First Testbeam Setup

- PCB board with biasing circuitry
- Silicon sensor with fanout
- 5 front-end ASICs bonded
- External ADCs and the rest...