TS/DEM/PMT Activities

-Electronic circuit manufacturing:

"Conventional" : PCB ; Flex rigid; flex

"Medium density" : Thick film , SBU (Micro via)

"High density" : Thin film , MCM-D , MCM-C

Rui De Oliveira

4/05/2004

But also…

--Advice on Materials: (substrates, dielectrics, low mass, high conductivity, low intrinsic radiation, high temperature, degassing problems etc…)

--Advice on Technologies: made at CERN or outside.

--Give our expertise to solve problems with outside productions. (documented reports on defects and conclusions).

-- No developement or design but close collaboration with different groups to give them knowledge to end up with manufacturable objects.

--Set up technologies to follow universities and CERN needs mostly on components for detectors.

3 examples of such collaboration!

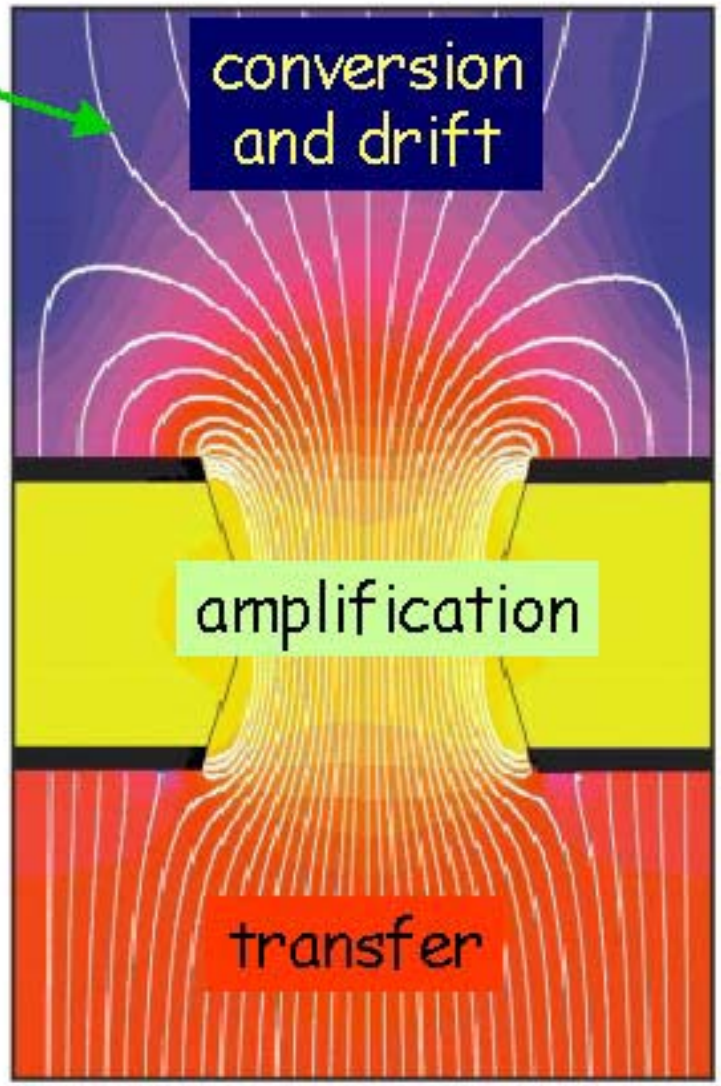
-GEM LHC-B
-ALICE tracker Aluminum bus
-GEM based pixel detector

GEM LHC-B

Gas Electron Multiplier

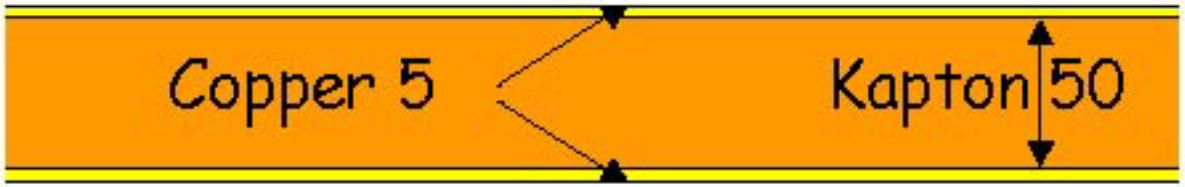
By applying a potential difference between the two copper sides an electric field as high as 100 kV/cm is produced in the holes acting as multiplication channels.

Potential difference ranging between 400 - 500 V

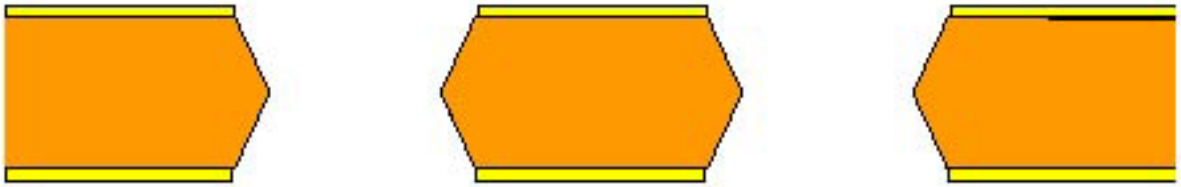


GEM foil construction (CERN)

Photolithographic technology used
for printed circuit board construction

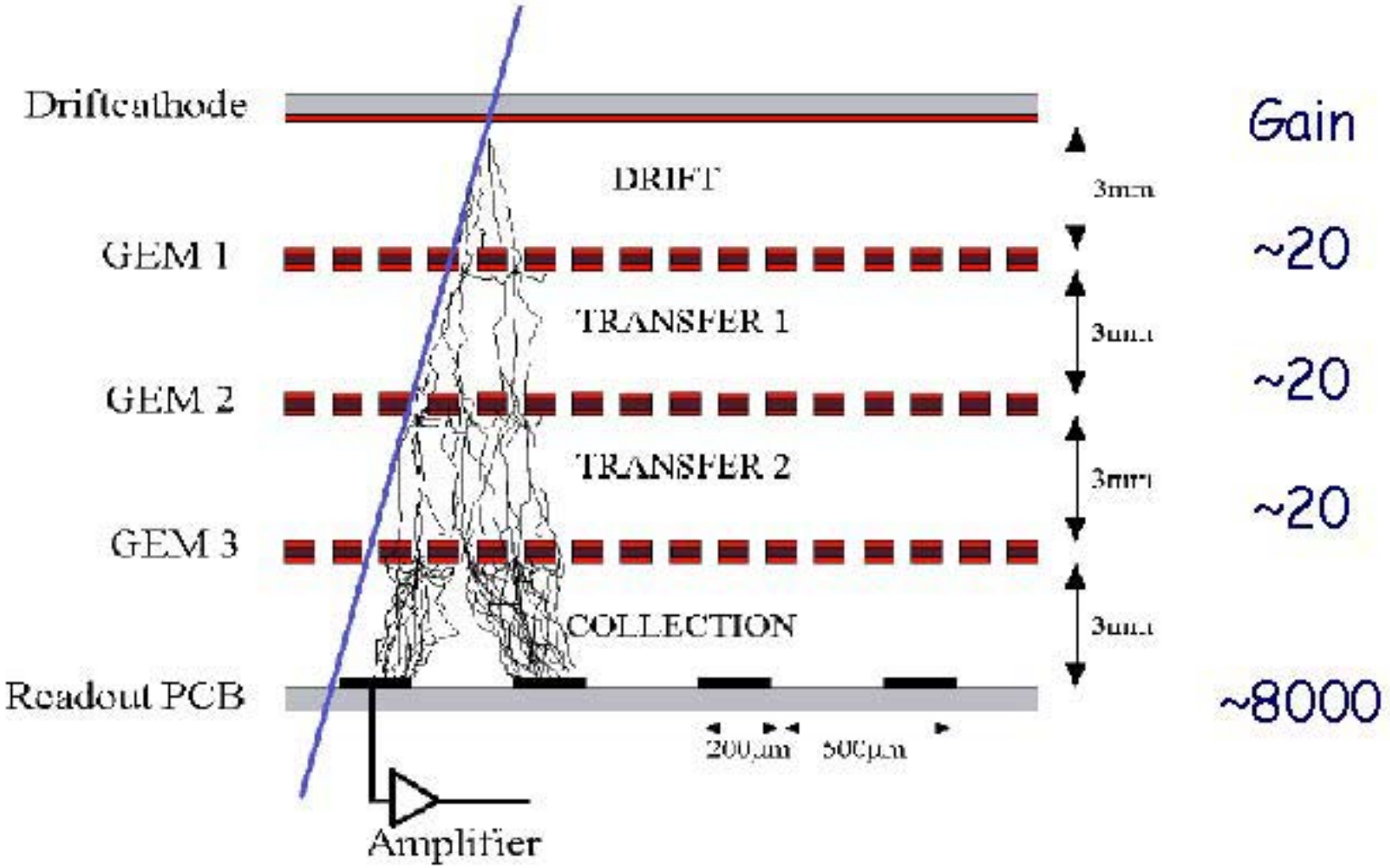


Copper etching by
chemical solution

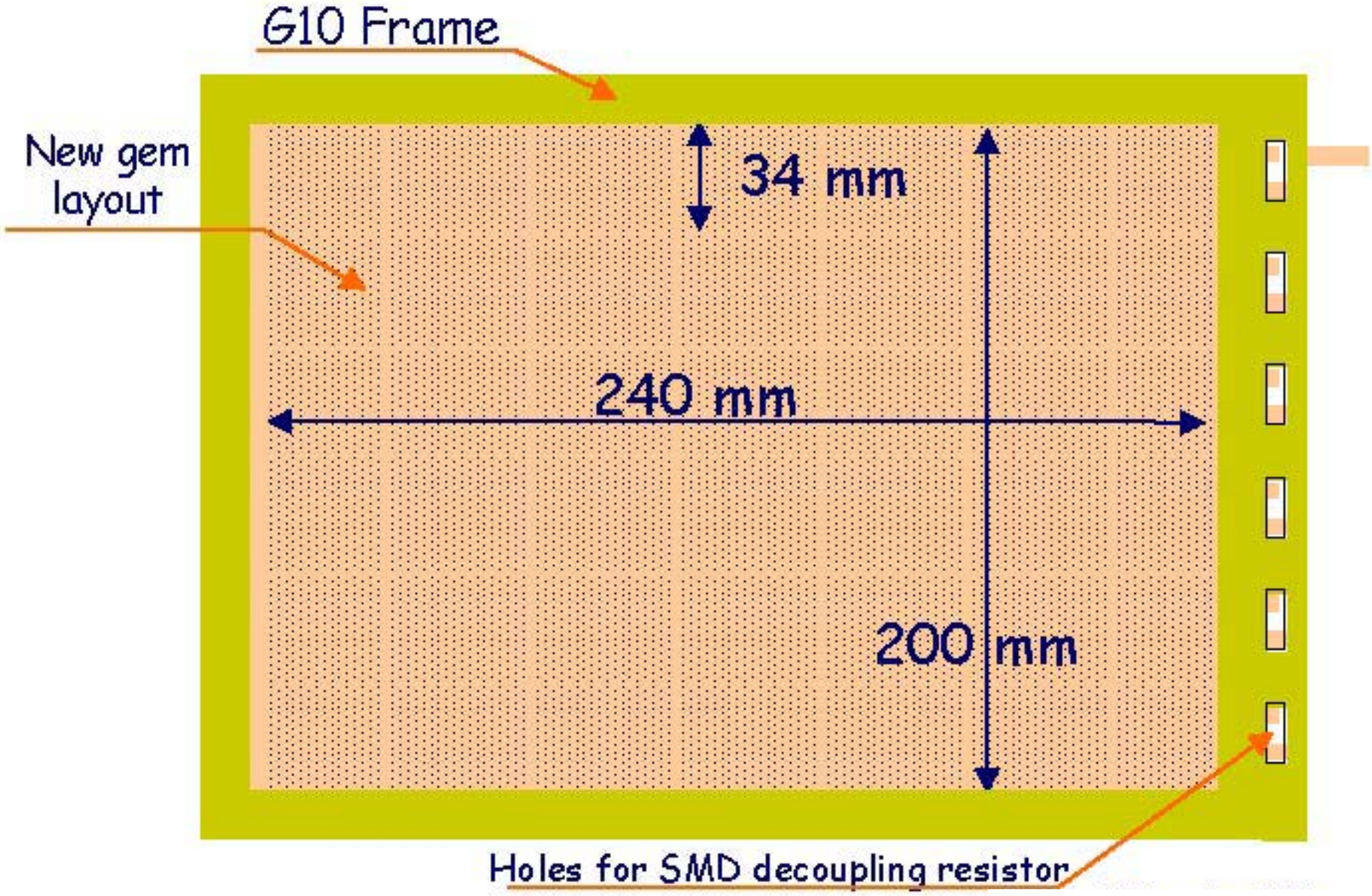


Kapton etching using
the copper mask

Triple GEM geometries



New GEM Foil


G10 Frame
New gem layout
34 mm
240 mm
200 mm
Holes for SMD decoupling resistor

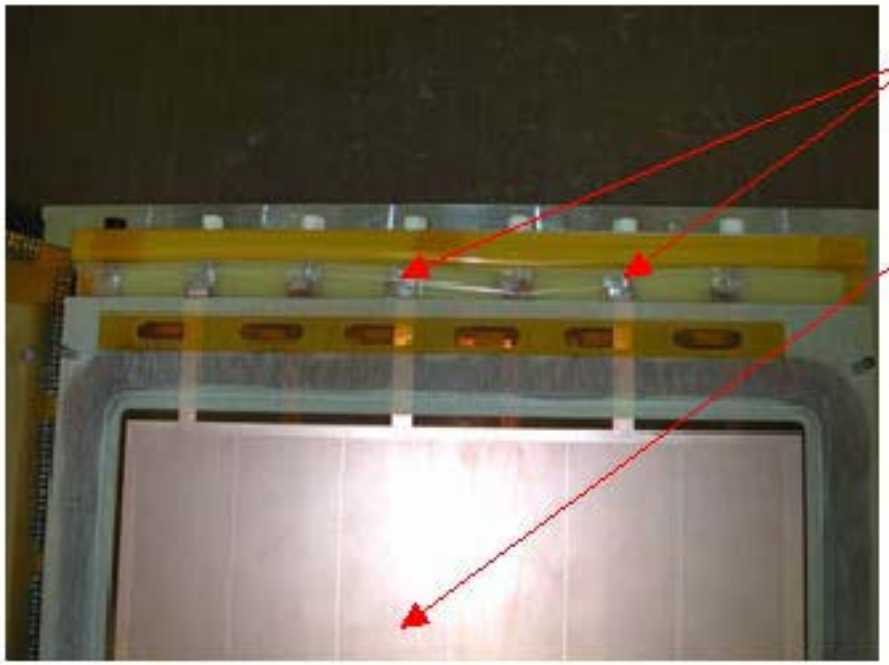
Module-0 construction

The GEMs are stretched.

The G10 frames glued on the GEM foil

In the frames 6 holes house
1M SMD resistors for HV decoupling

Module 0 assembling

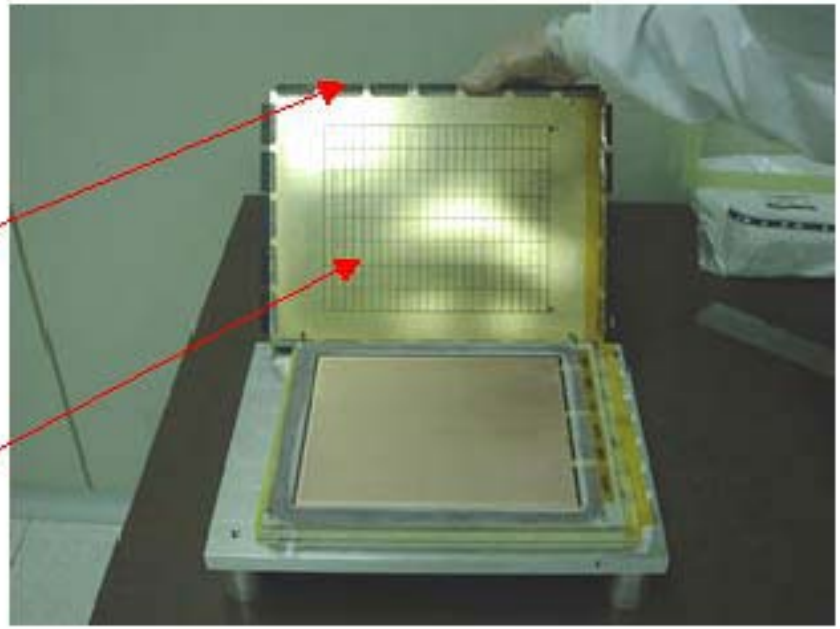


The HV GEM contacts are soldered on the Drift Cathod Panel

The GEM are assembled without internal spacers

Connector for FEE
(ASDQ 25 mV/fC)

The GEM stack is closed with the Readout Pad Panel



ALICE Aluminum bus

ALICE PIXEL DETECTOR

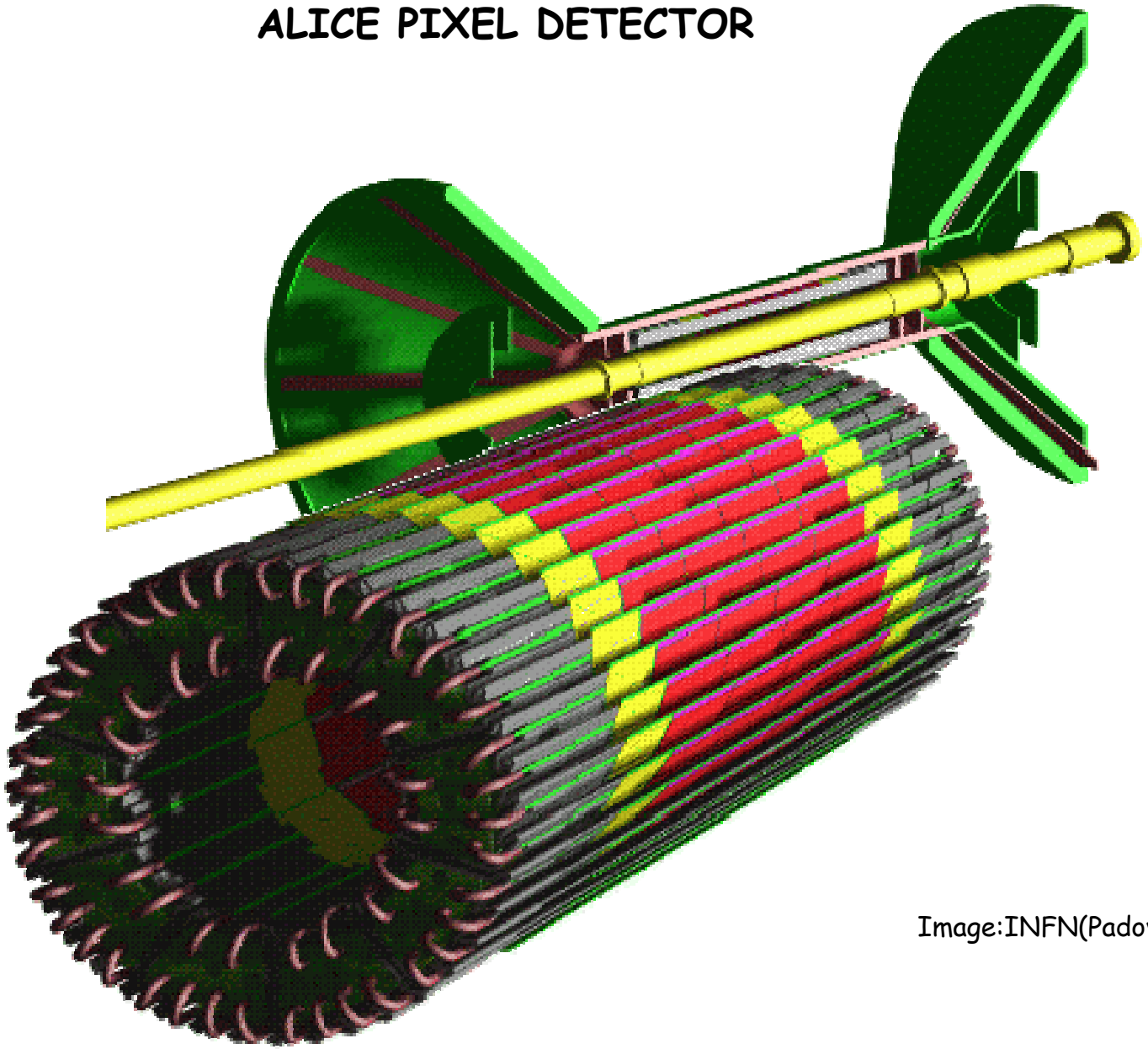
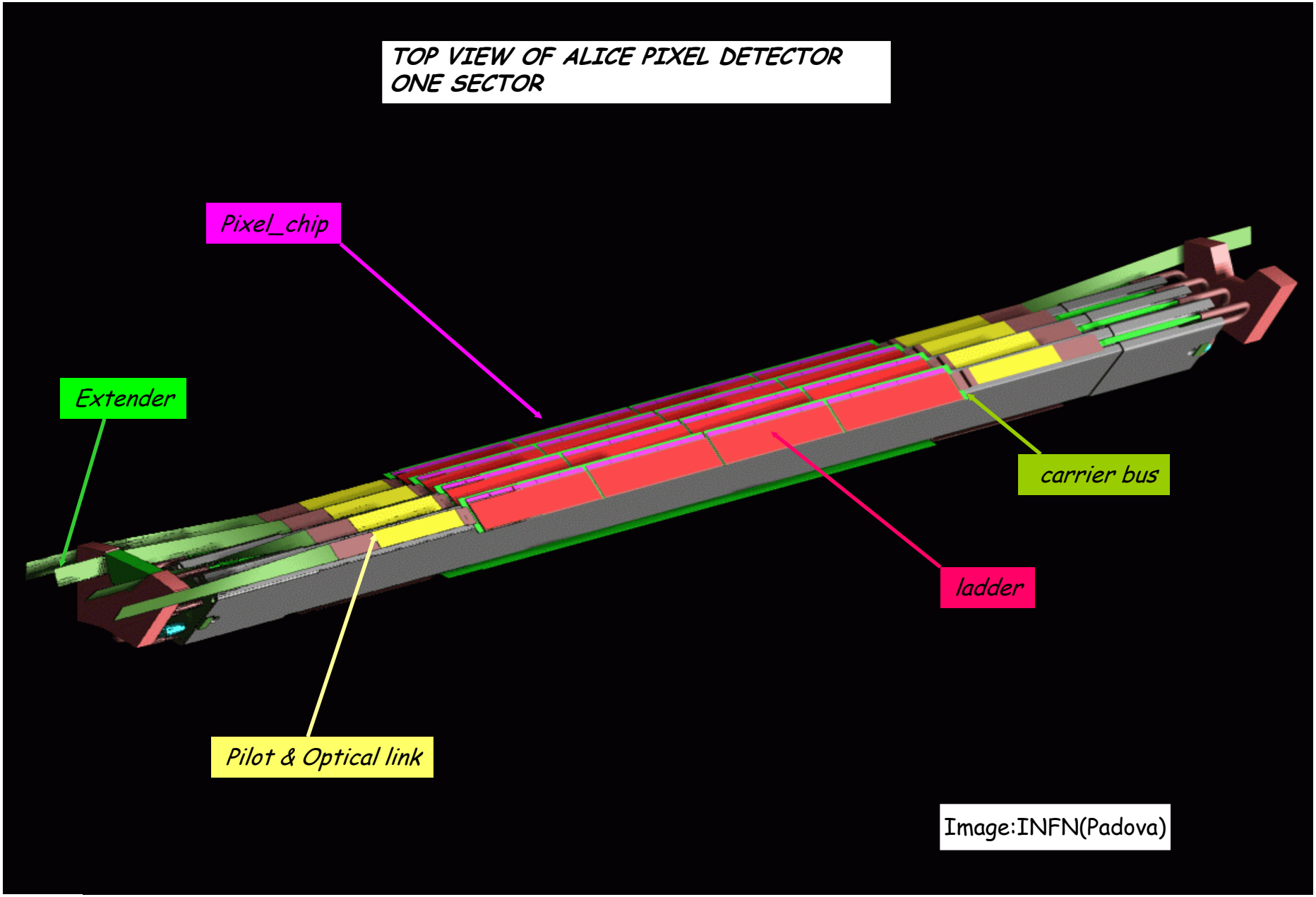
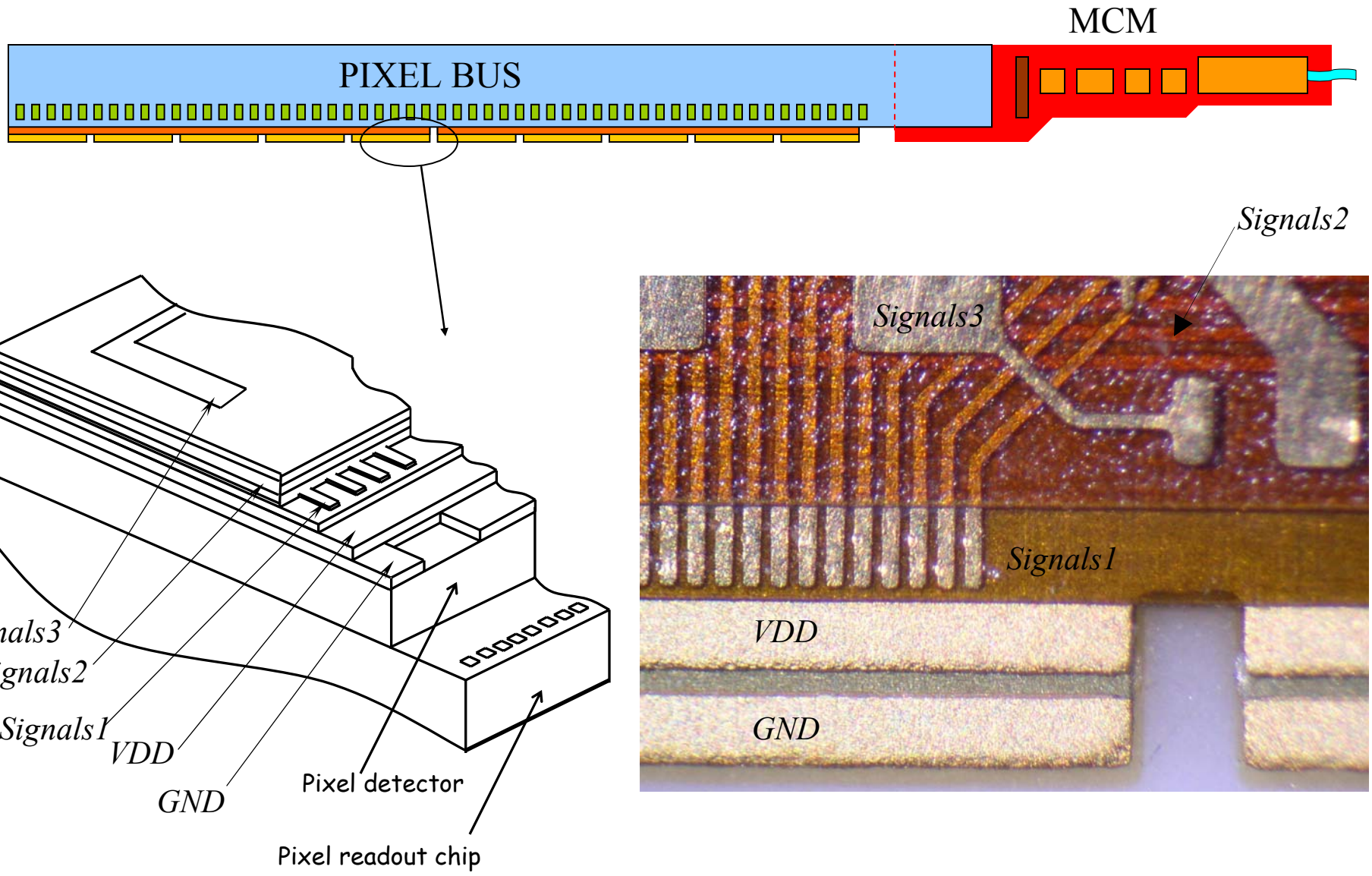


Image:INFN(Padova)

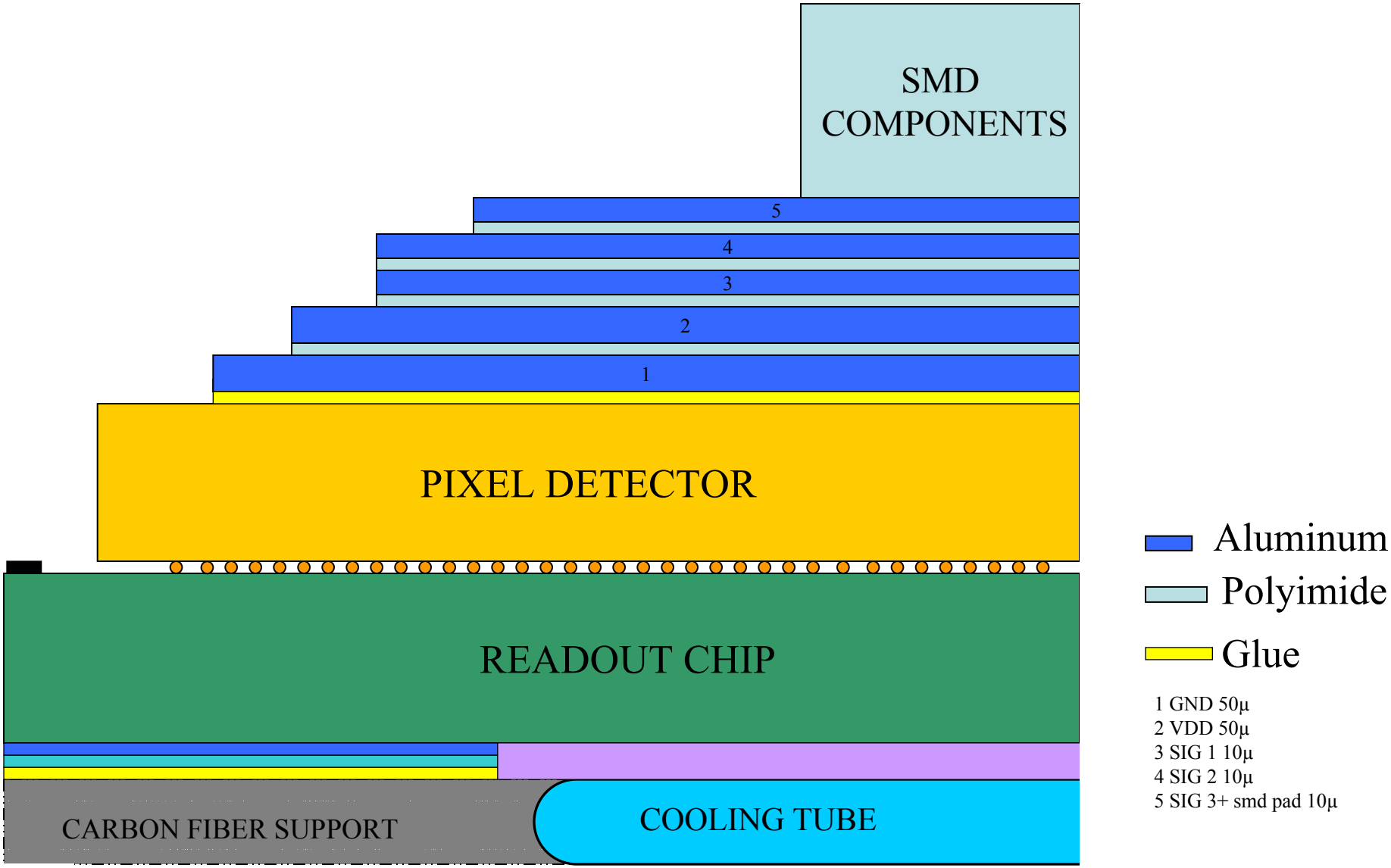

TOP VIEW OF ALICE PIXEL DETECTOR
ONE SECTOR
Pixel_chip
Extender
carrier bus
ladder
Pilot & Optical link
Image:INFN(Padova)

Carbon mechanical support cell

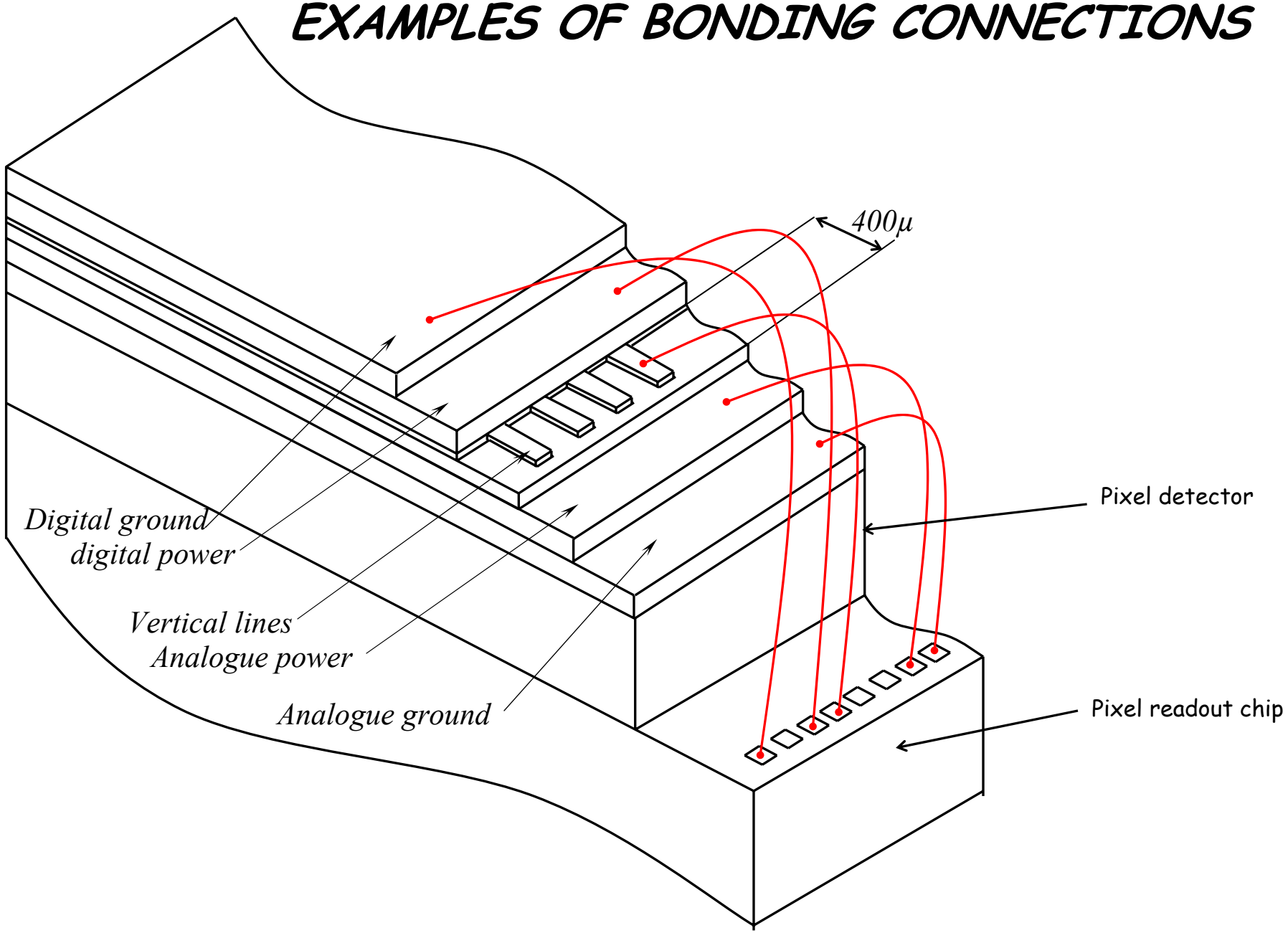
PIXEL_BUS & PILOT MCM (right side)



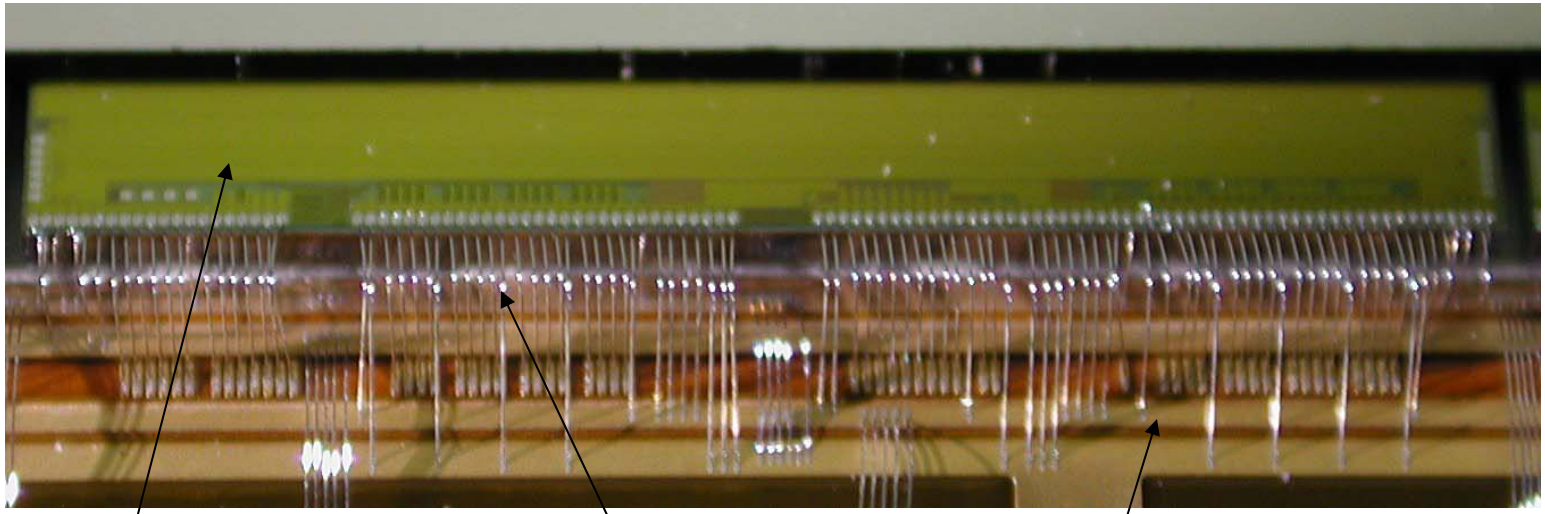
PIXEL BUS CROSS SECTION



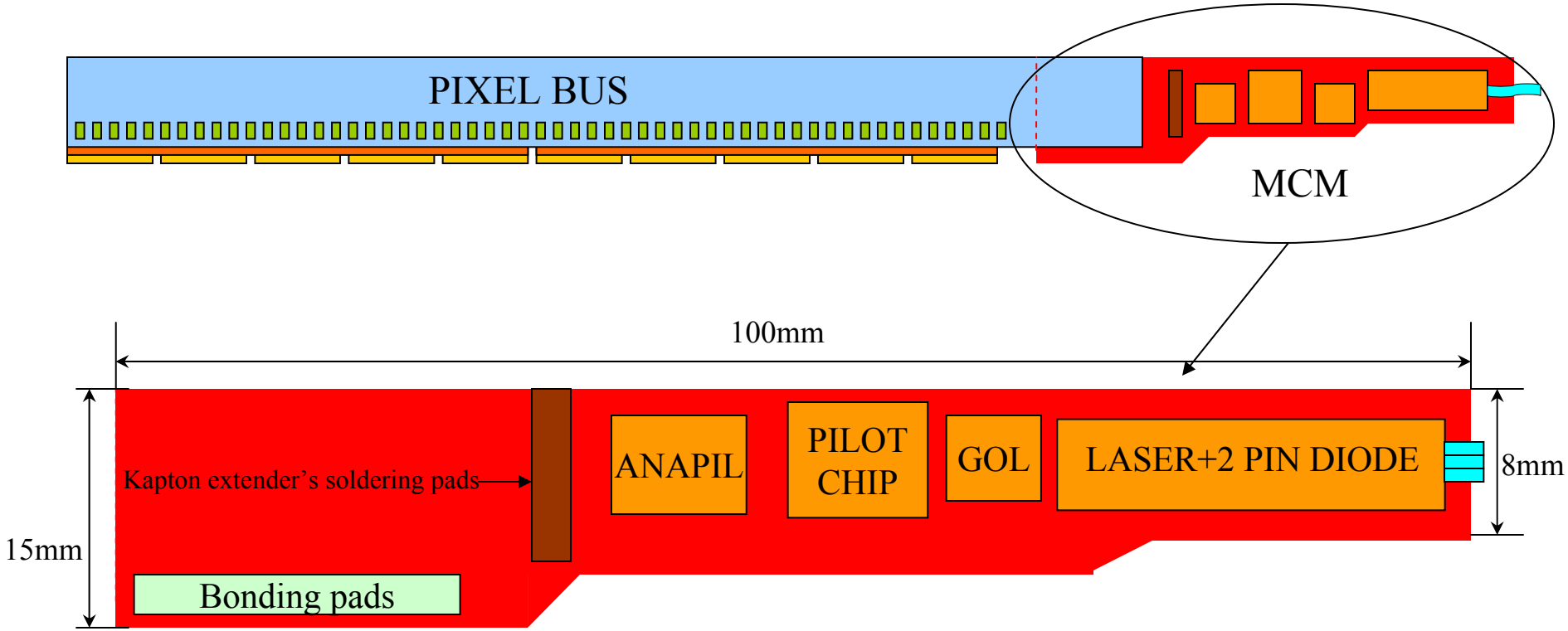
EXAMPLES OF BONDING CONNECTIONS

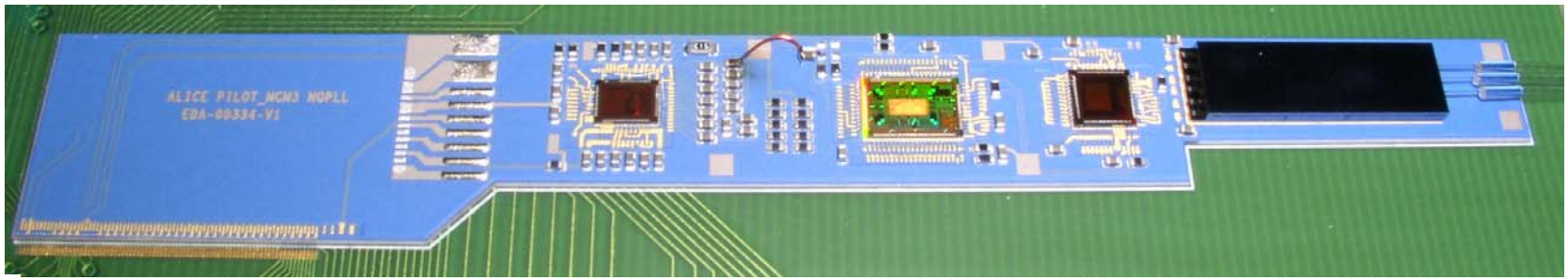


Bonding Close up view



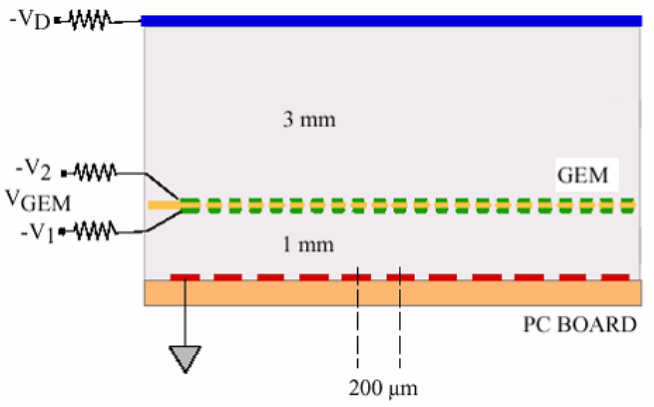
PIXEL_BUS & PILOT MCM (right side)

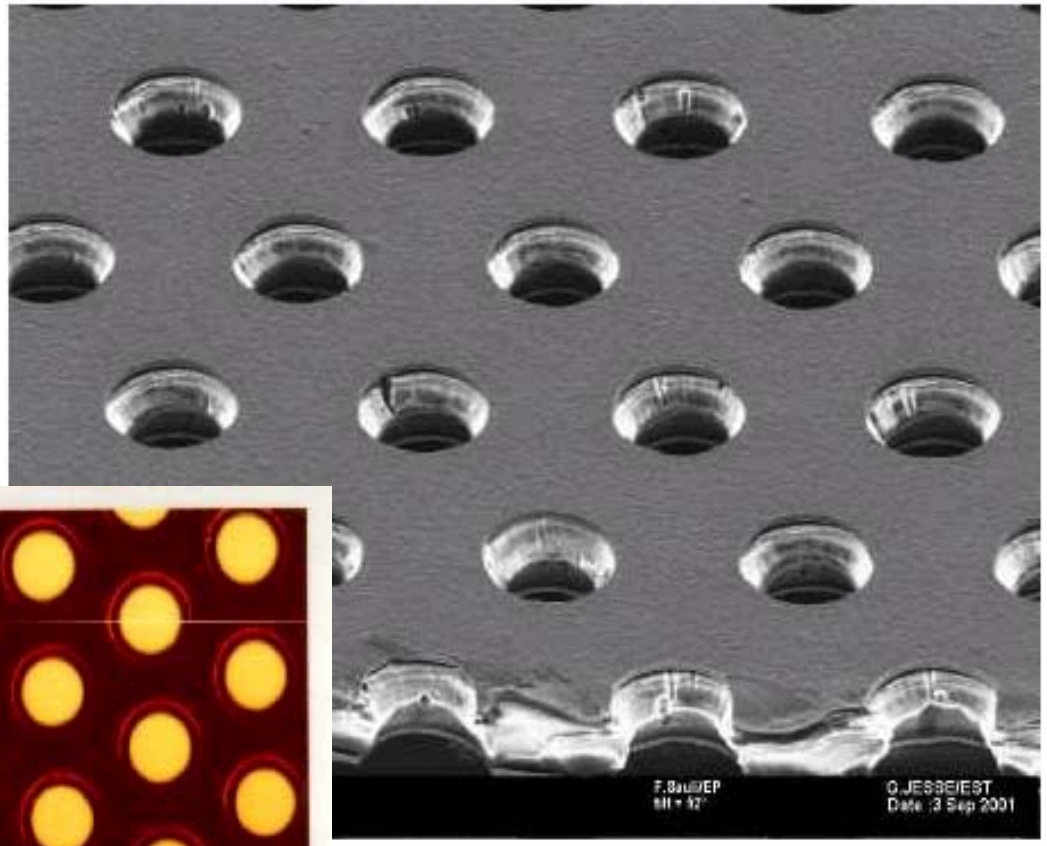


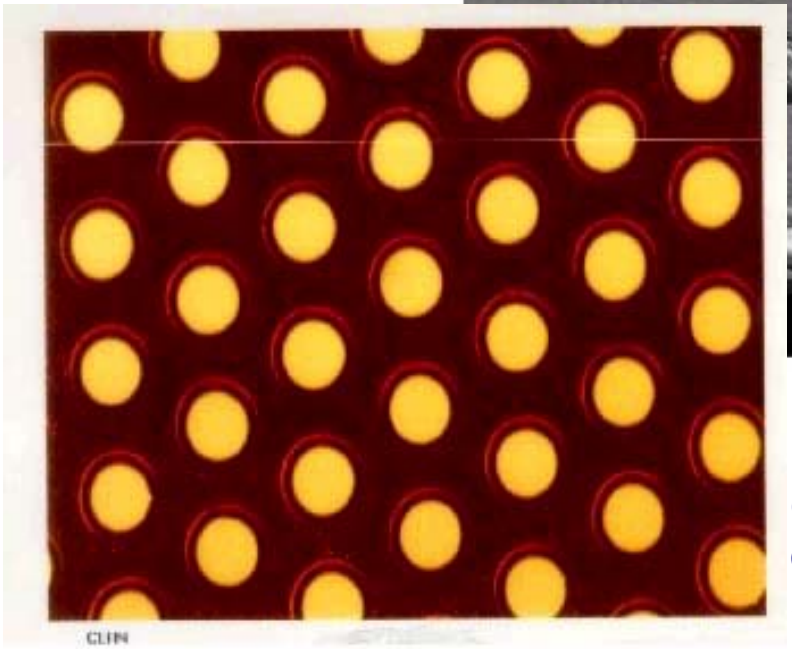


GEM based pixel detector

The GEM amplifier



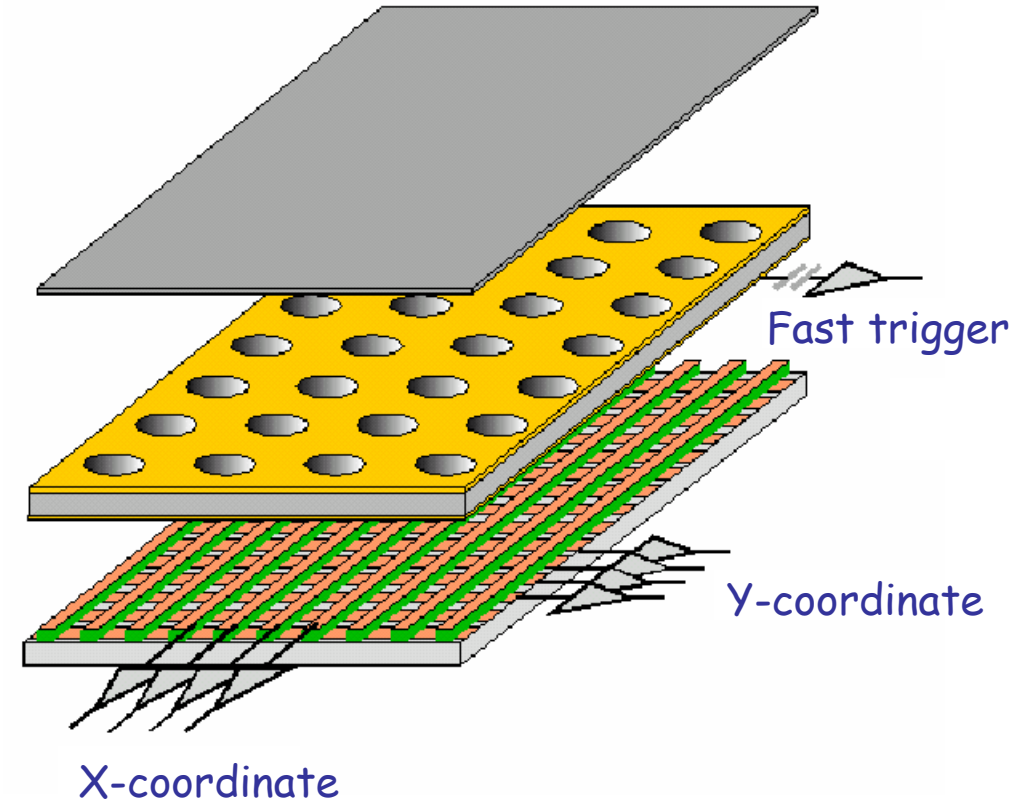




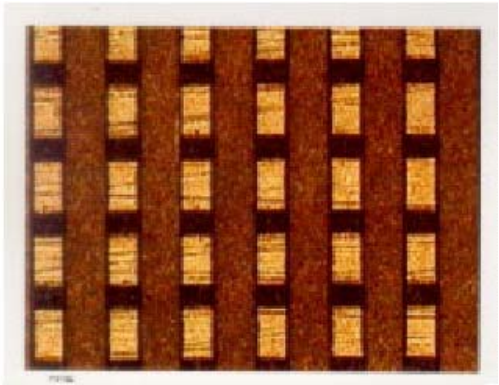
The most interesting feature of the Gas Electron Multiplier (GEM) is the possibility of a full decoupling of the charge amplification structure from the charge collection and read-out structure.

Two-dimensional Readout Concepts

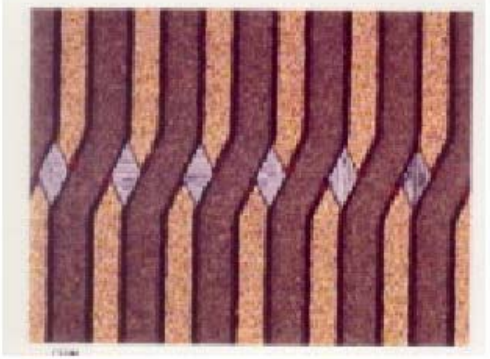
Amplifying structure and read-out structure can be optimized independently of each other.
The electron charge is collected on strips, pixels or pads on the read-out board. A fast signal can be detected on the top GEM electrode for triggering or energy discrimination.



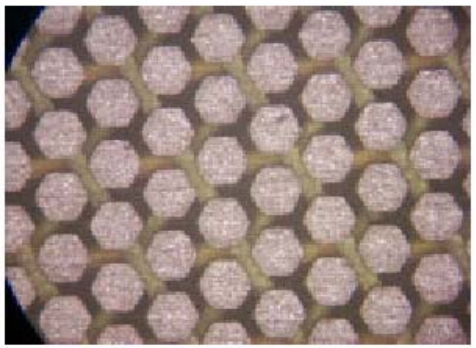
Cartesian



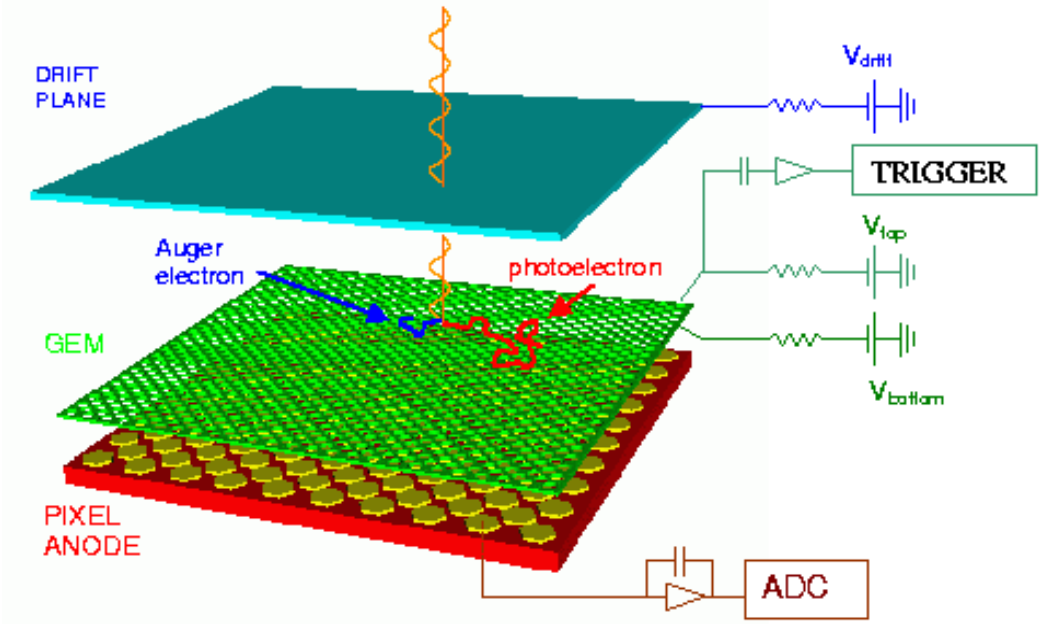
Small angle

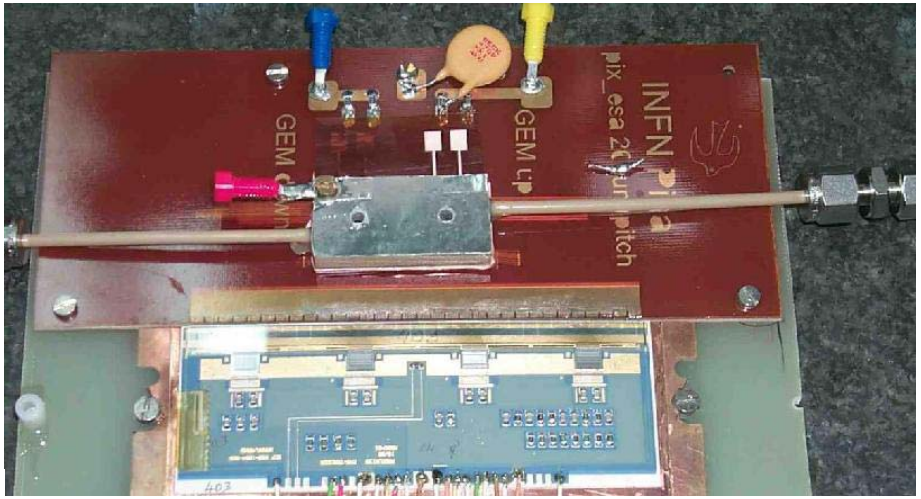


Pixels

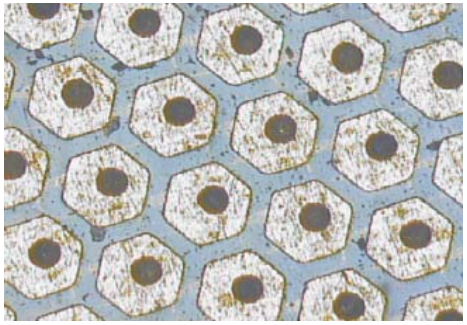


Pixel read-out: an example, the PCB approach





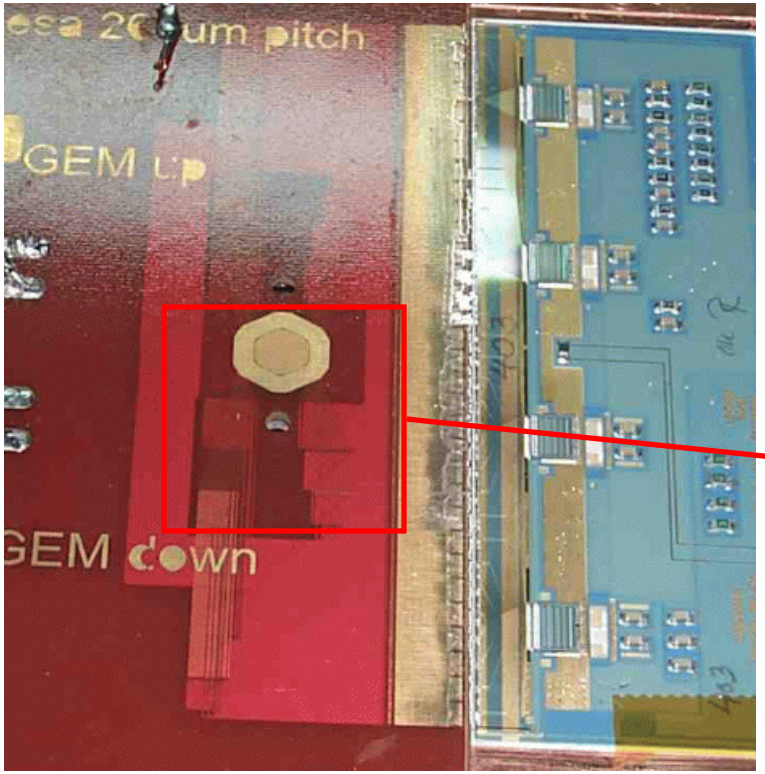
Read out plane



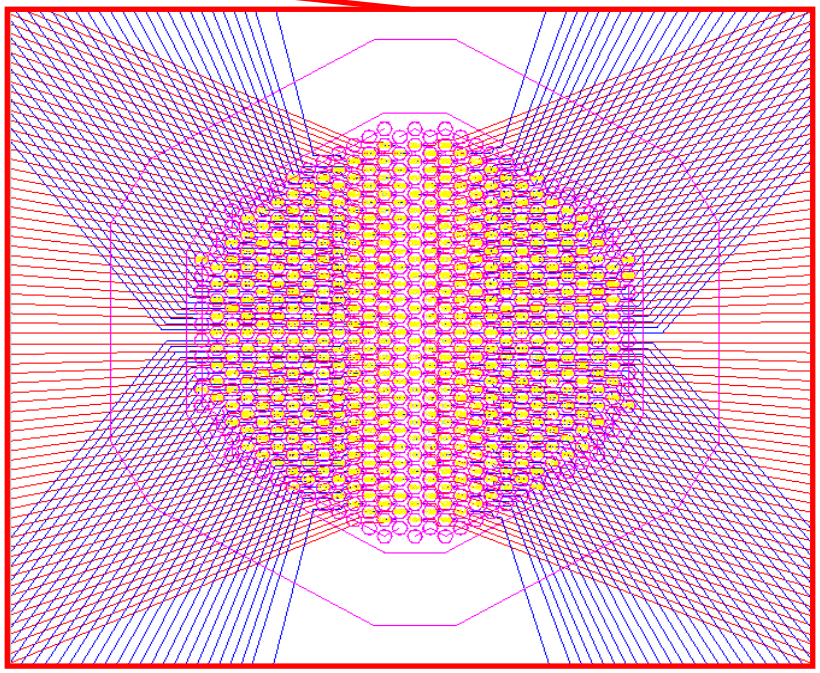
- GEM pitch: 90 μm
- GEM holes diameters: 45 μm, 60 μm
- Read out pitch: 260 μm
- Absorption gap thickness: 6 mm

512 electronic channels from a few mm^2 active area are individually read out by means of a multi-layer PCB fan out

PCB approach

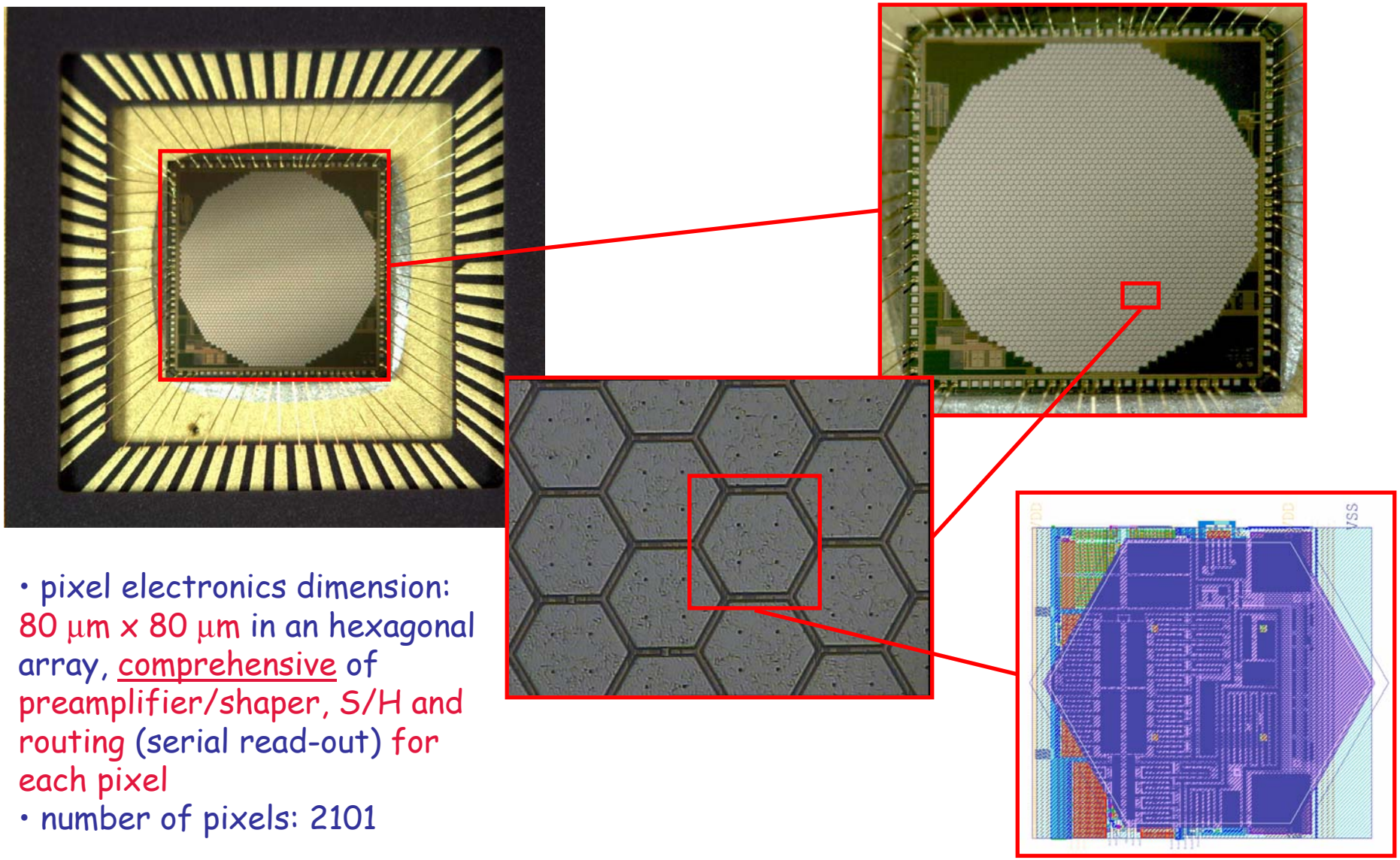


- 6 layers SBU (sequential build up) with 40um microvias.
- Minimum track width and space 40um



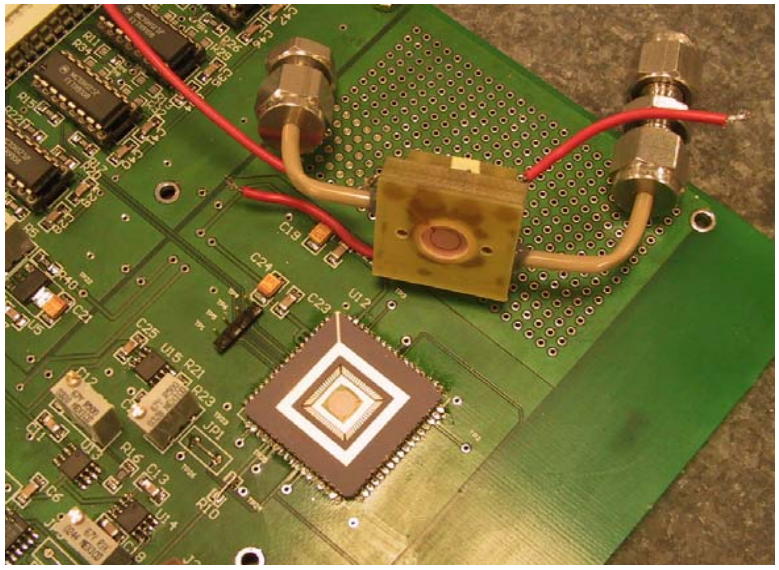
• Crosstalk between adjacent channels (signals traveling close to each other for several cm).
• Not negligible noise (high input capacitance to the preamplifiers).

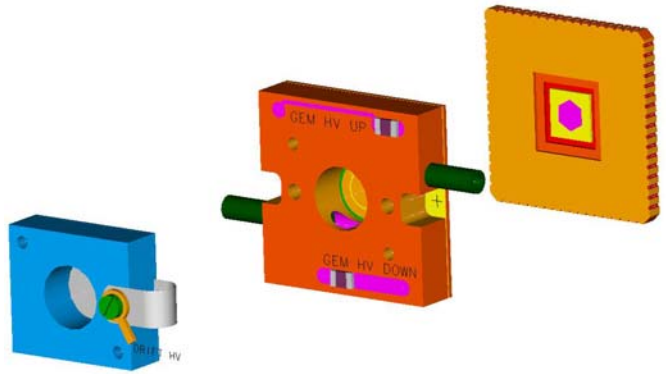
The collecting anode/read-out chip

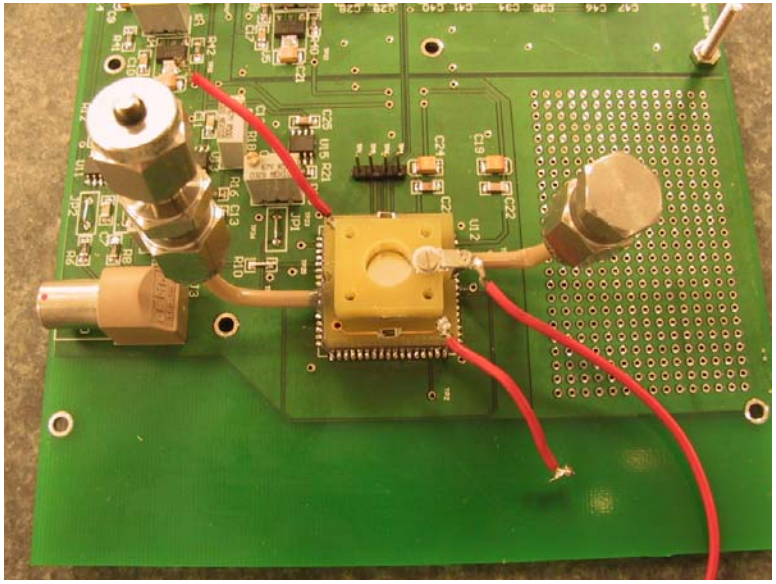


- pixel electronics dimension: 80 μm x 80 μm in an hexagonal array, comprehensive of preamplifier/shaper, S/H and routing (serial read-out) for each pixel
- number of pixels: 2101

PIXIE: the PIXel Imager Experiment

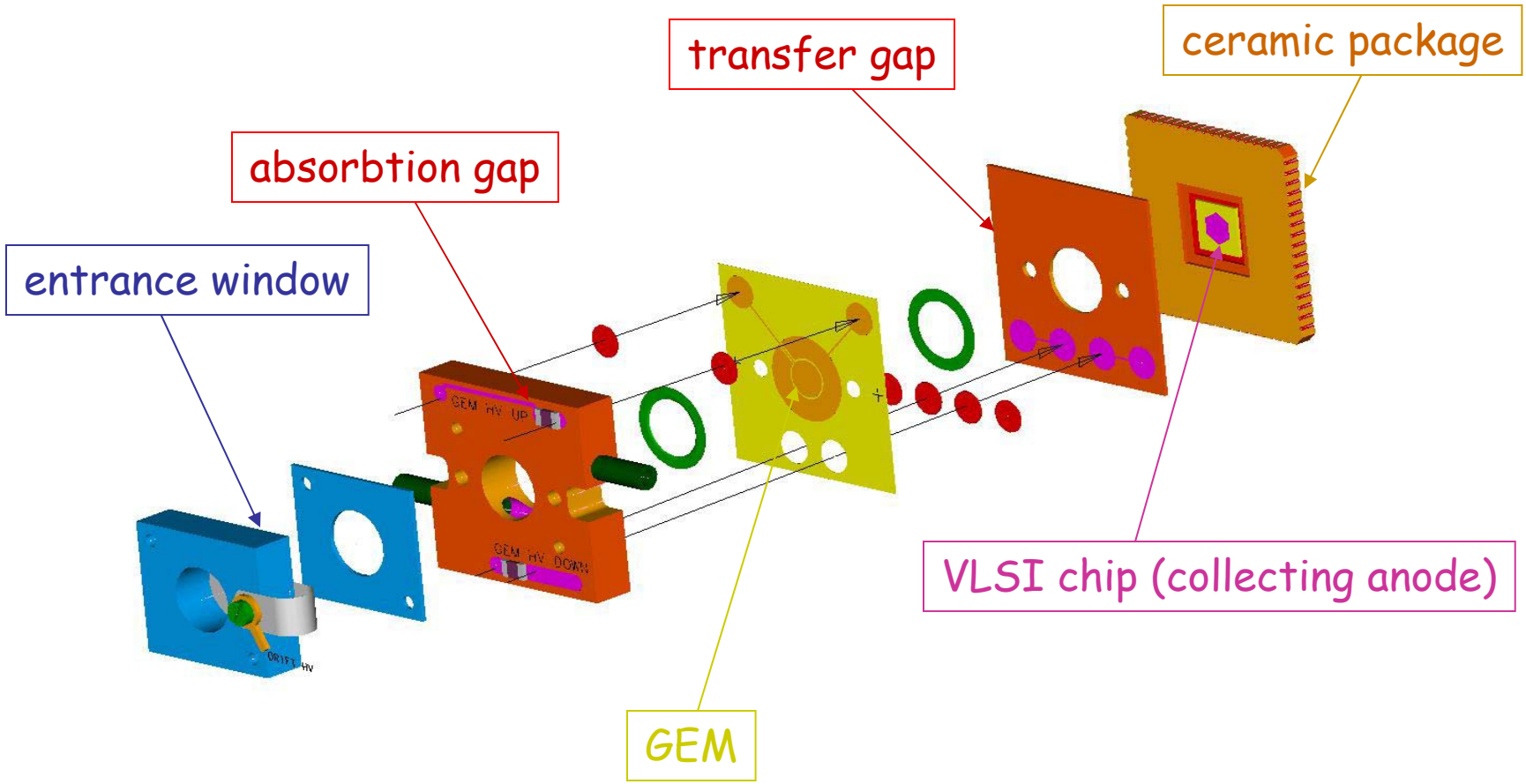






Detector and associated electronics are the same thing!

Exploded mechanical assembly



Conclusions

Trends:

-Low mass circuits (aluminium tracks , carbon substrates)

-Circuits with increased density SBU Microvias

-Increase in Gas detector projects

Thanks to :

Mr Fabrizio Murtas (LNF-INFN) for the informations concerning LHC-B GEMs

Mr Michel Morel (CERN) for details and slides concerning ALICE bus

and Mr Ronaldo Bellazzini (INFN PISA) for GEM pixel detector