Activities in Wuhan
TopMetal sensor & ALICE ITS upgade

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CCNU

ALICE ITS Upgrade and O2 Asian Workshop 2014

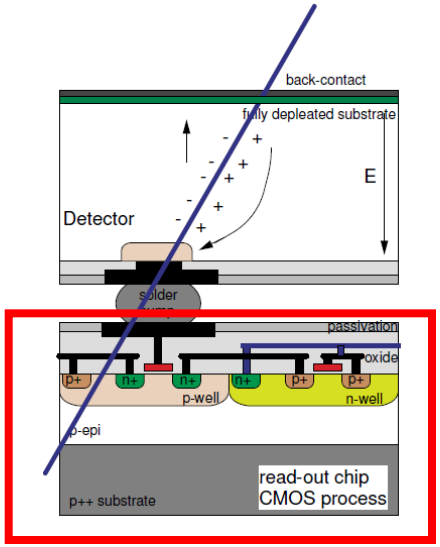
outline

- TopMetal sensor design test & application
- ALICE ITS sensor : temperature sensor
- ALICE ITS test and assembly : infrastructure & pattern recognizatiom
- ALICE ITS readout : SRU & UDP+TCP
- summary

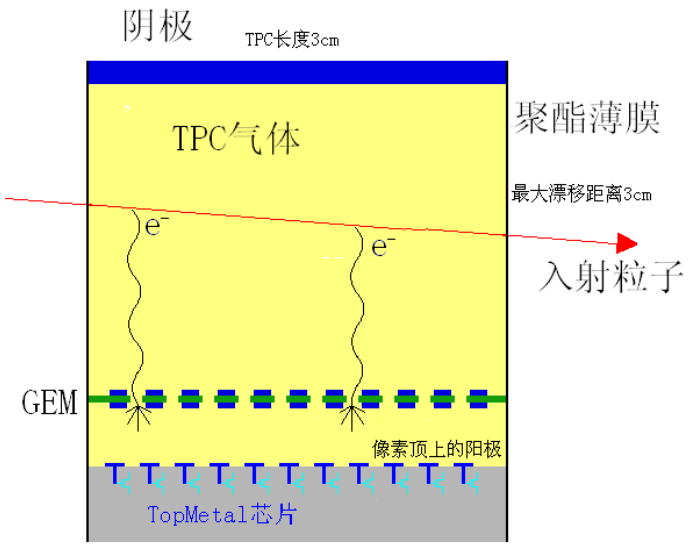
The idea of TopMetal sensor

silicon isn't the ideal detector material

the readout chip of hybrid detector can be used like a independent detector



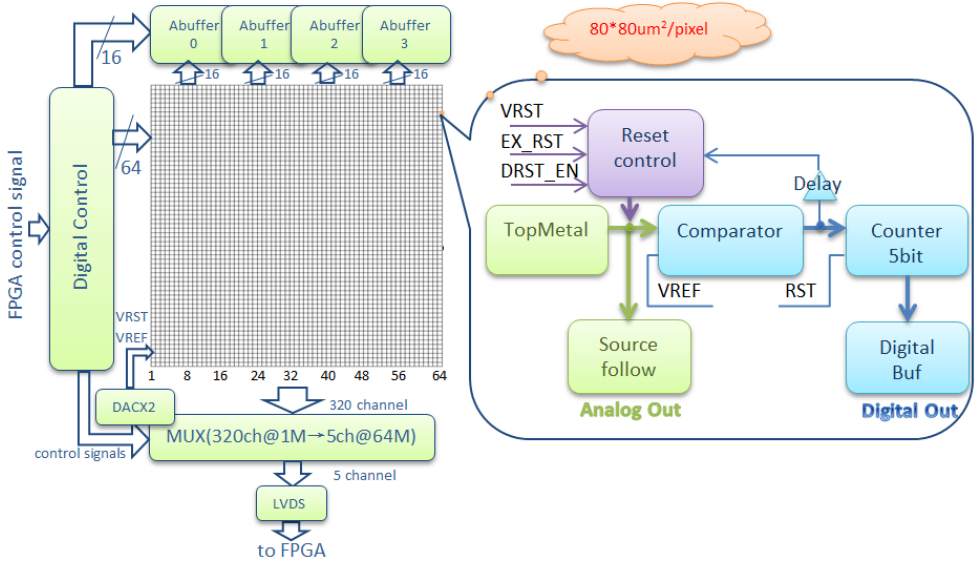
TopMetal sensor



the top layer metal opento the air, collecting charge drifted to it

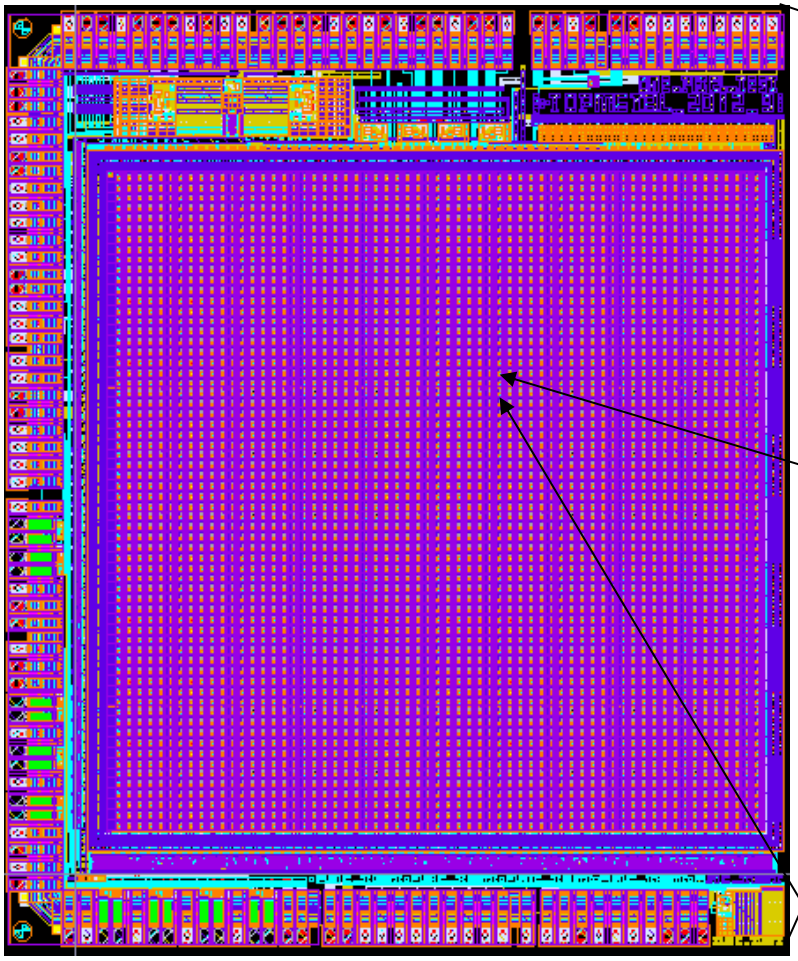
advantage：

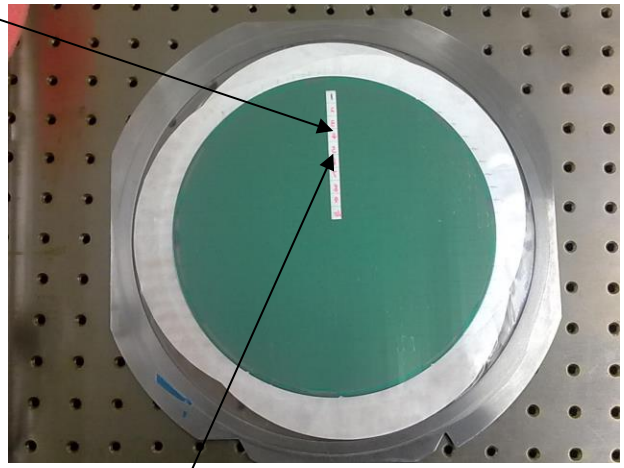
direct collecting charge
coupled with other type of detectors



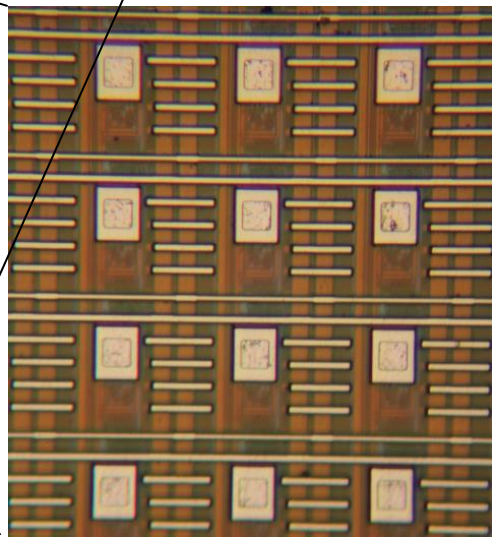
TopMetal structure

TopMetal wafer



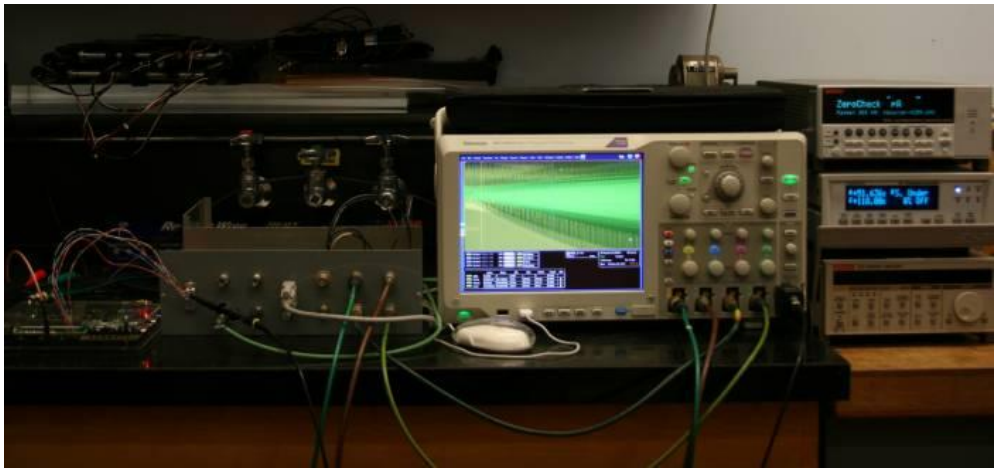


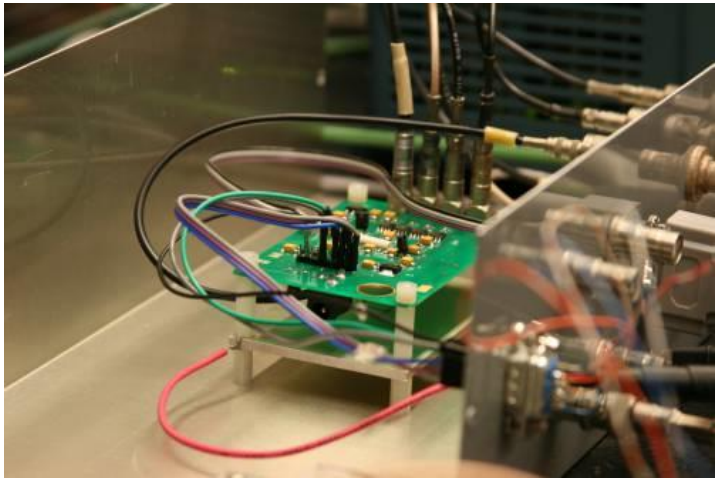
topmetal wafer

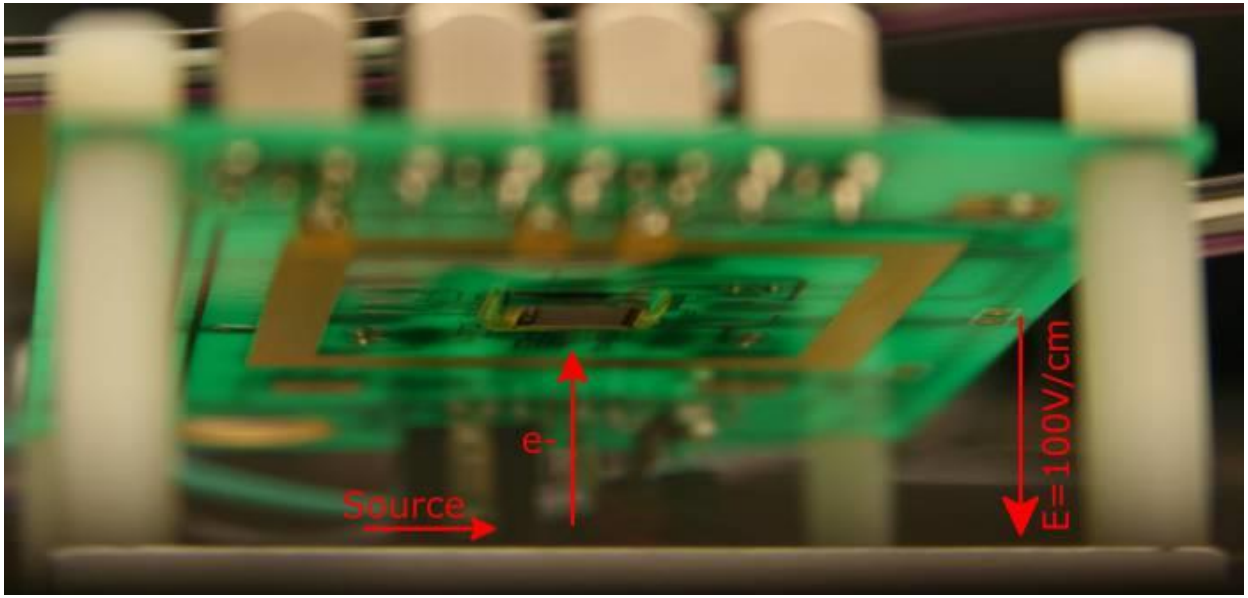


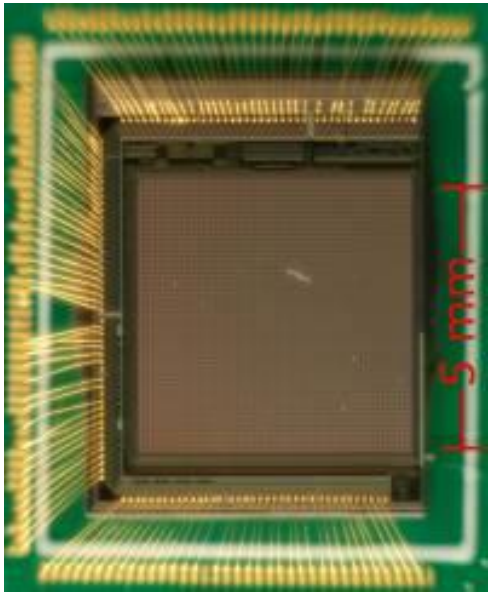
Topmetal microscope picture （pitch 80um）

TopMetal test setup

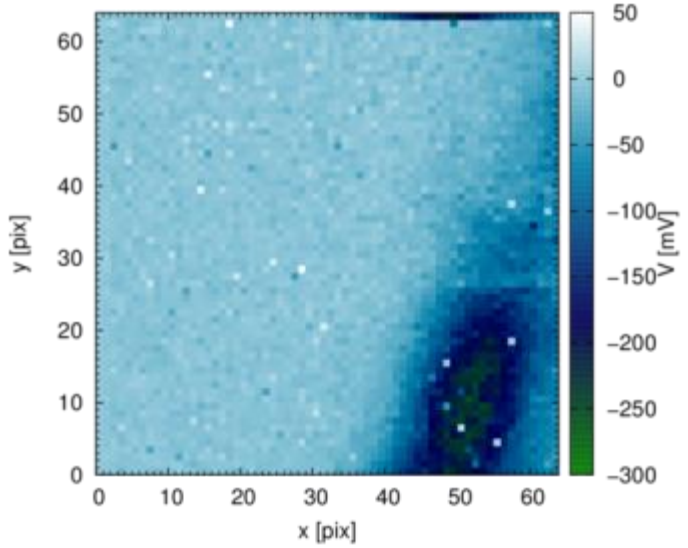


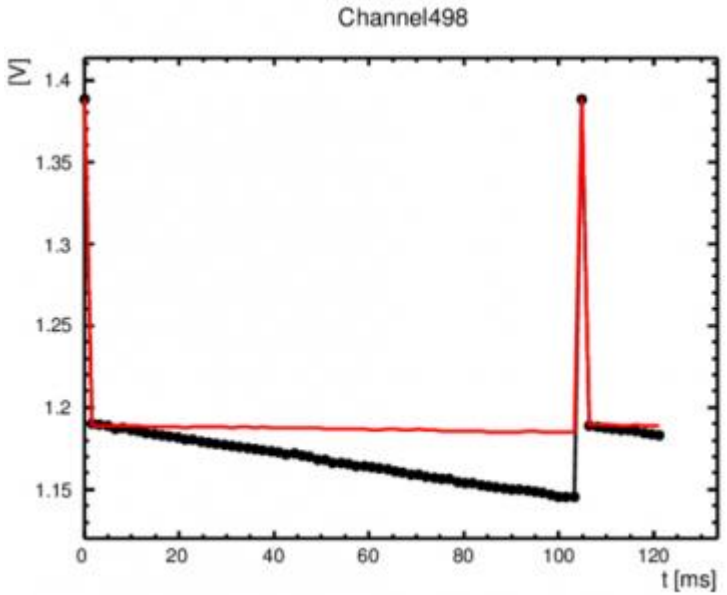


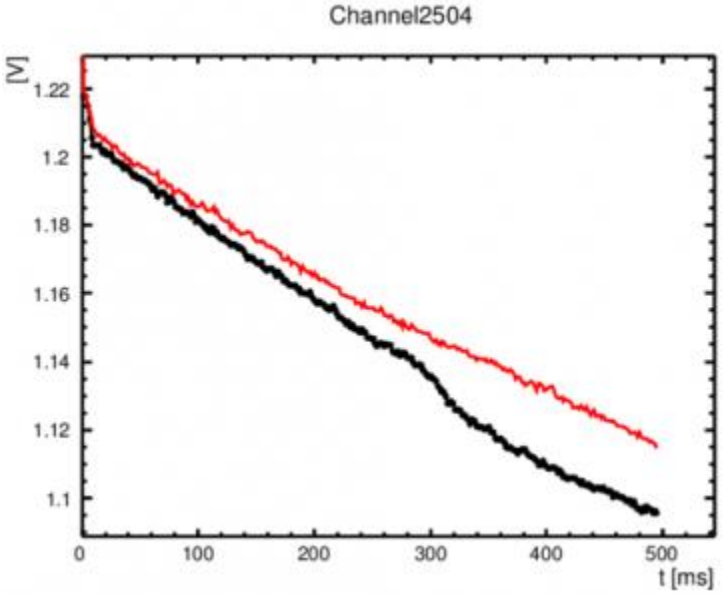




TopMetal test

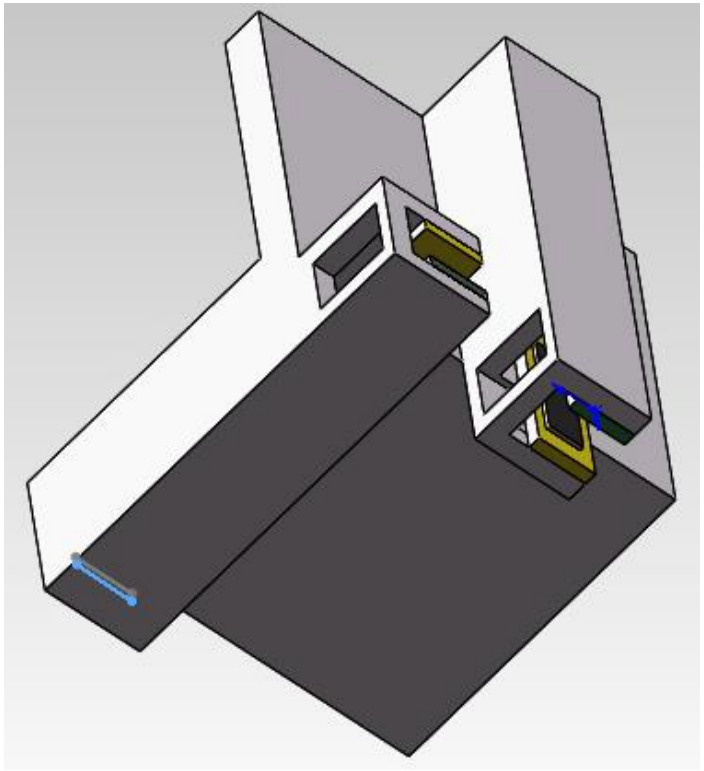






peak: reset
red line（no source）
black source（with source）
Source：Am241，5.4MeV alpha
bottom left：charge burst

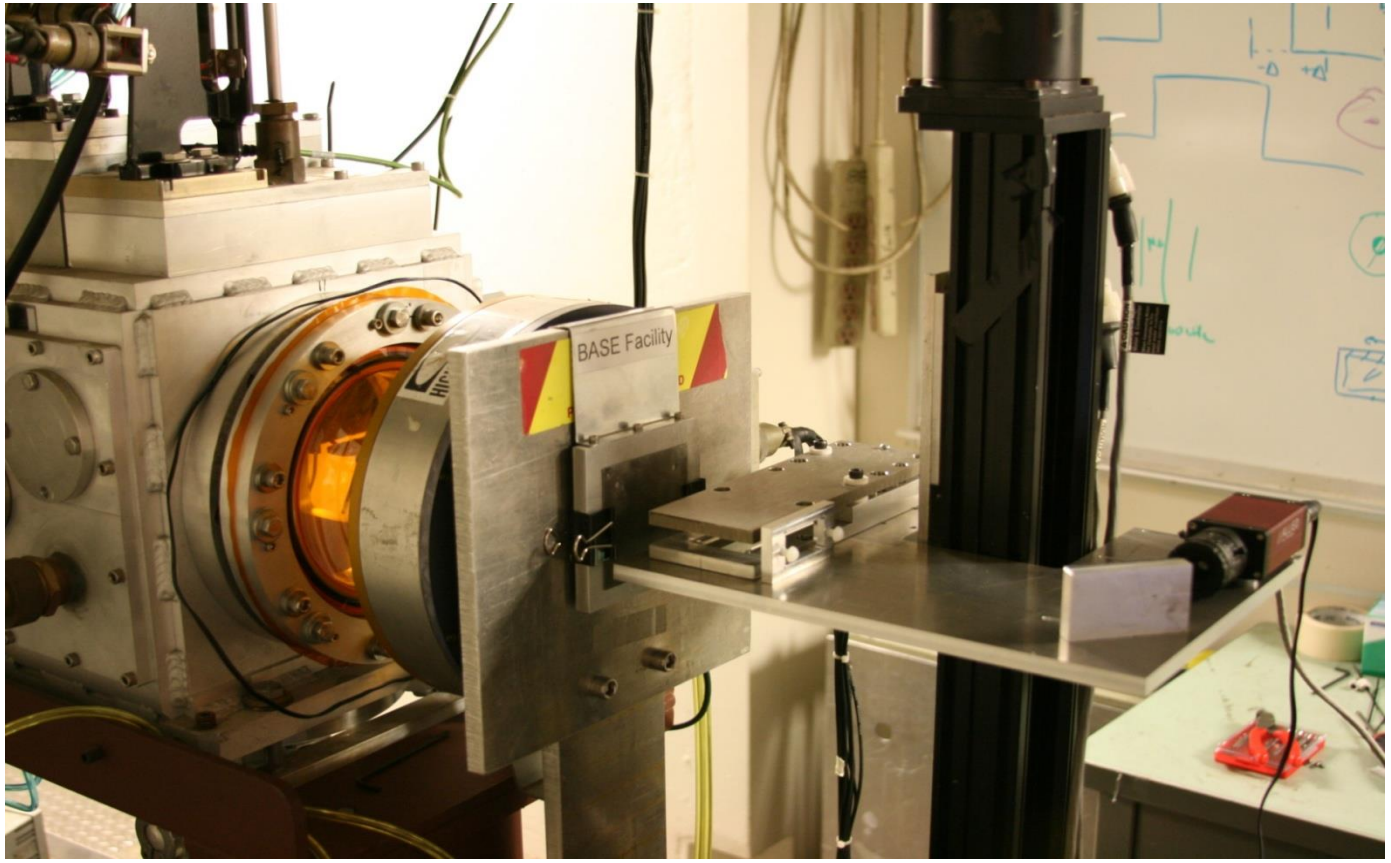
Beam monitor



integration time： 1ms
beam current： 1pA
resolution： <1um

for hadron therapy
1， high precision
2， no radiation damage
3， low radiation length
4， linear extension

Beam test at the 88 cyclotron, LBNL

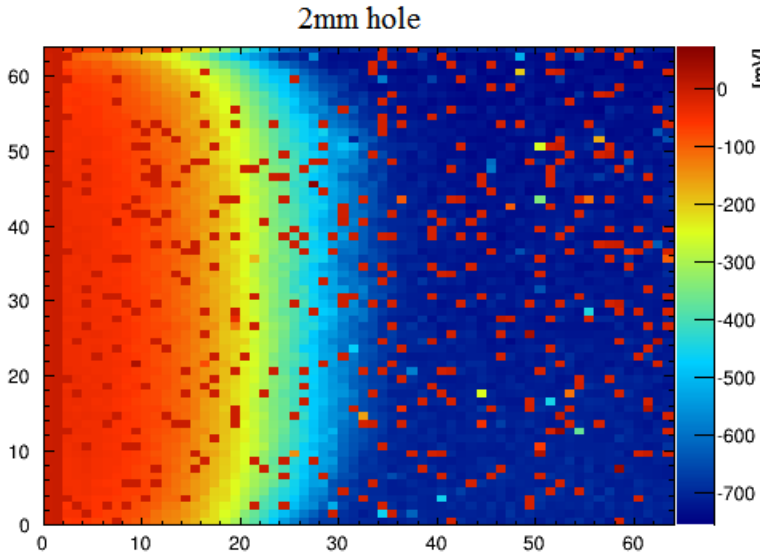


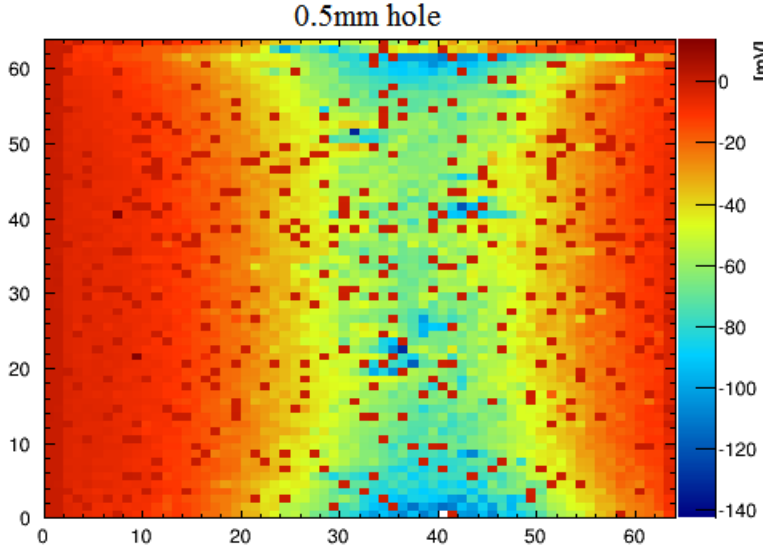
Beam monitor in air

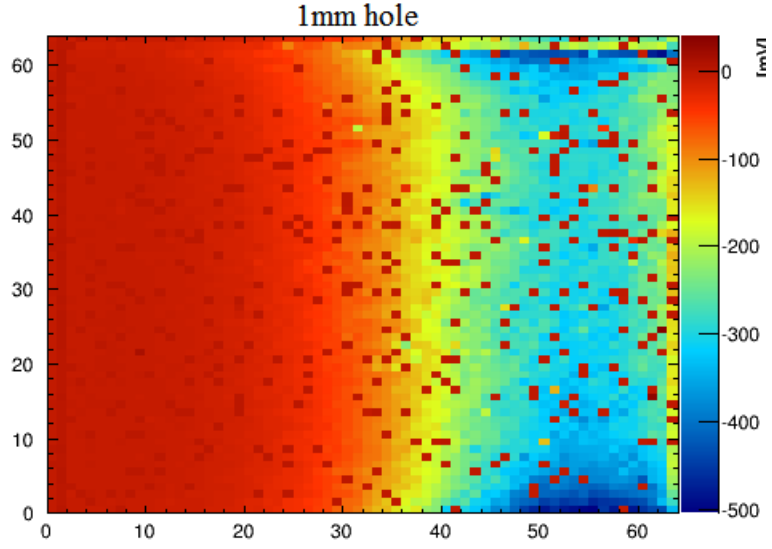
13.5MeV proton from Cyclotron; 20nA over 3x3 inch area

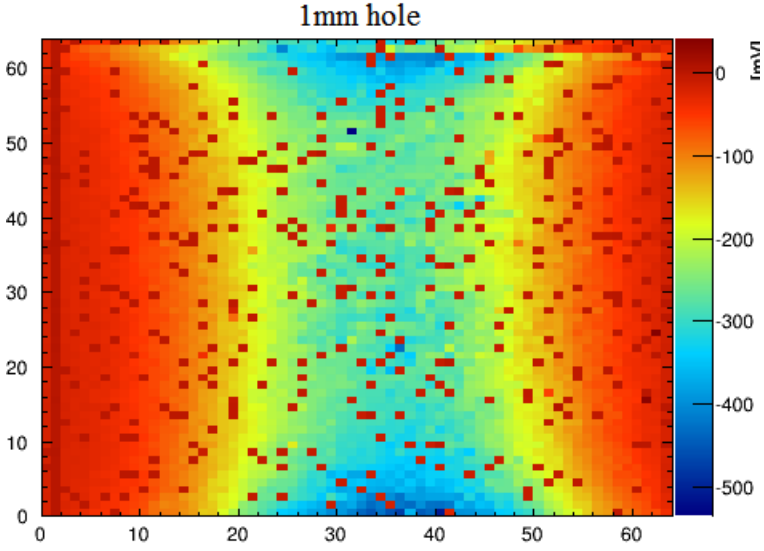
Collimated with a pinhole, as small as 0.1mm diameter

Beam test at the 88 cyclotron, LBNL









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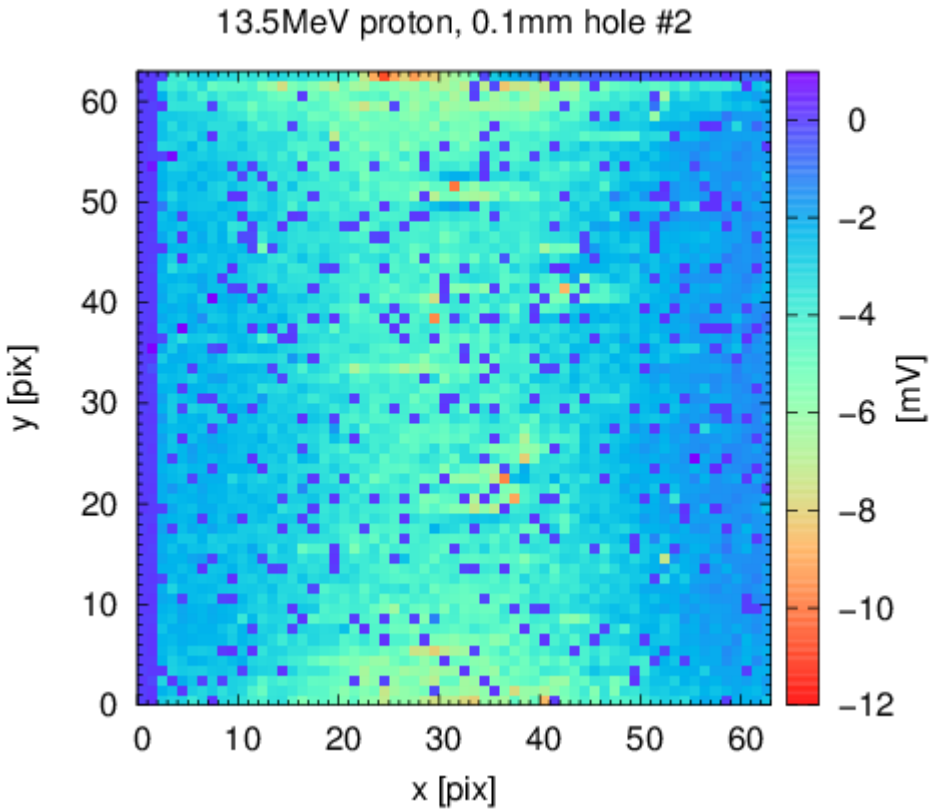
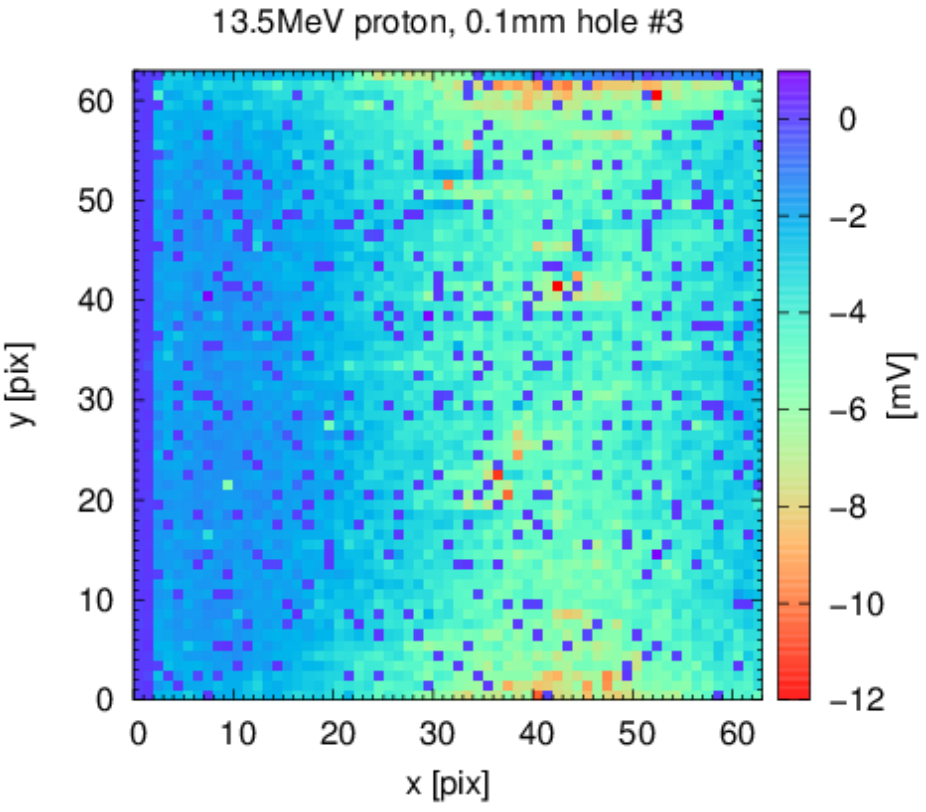
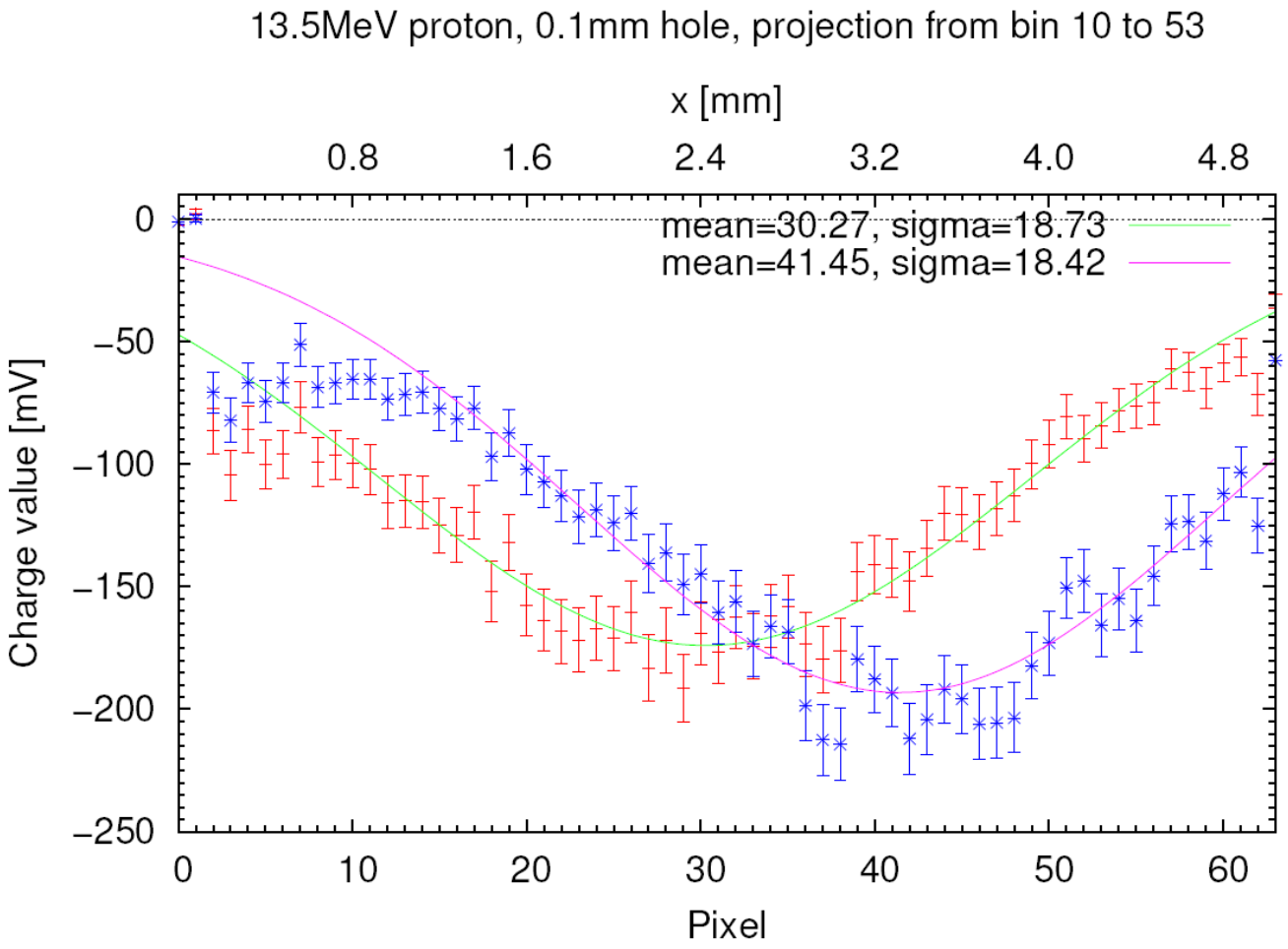




Beam curent 20fA

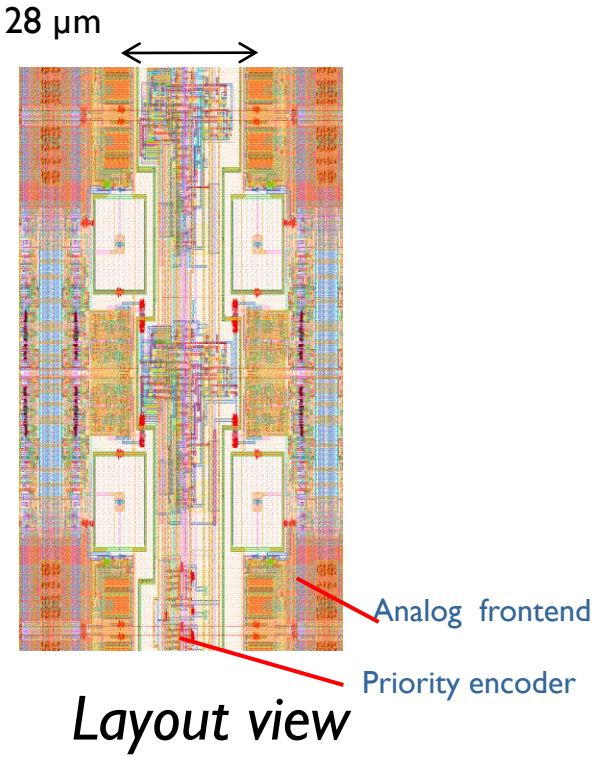
Beam test at the 88 cyclotron, LBNL



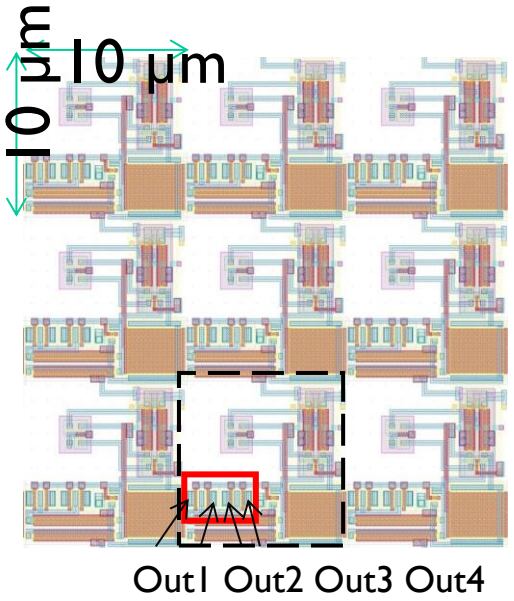
ALICE ITS upgrade

- ALICE ITS sensor : temperature sensor
- ALICE ITS test and assembly : infrastructure & pattern recognizatiom
- ALICE ITS readout : SRU & UDP+TCP
- summary

ALICE ITS sensor



Layout view



readout and OrthoPix

- sensor design（2 student）

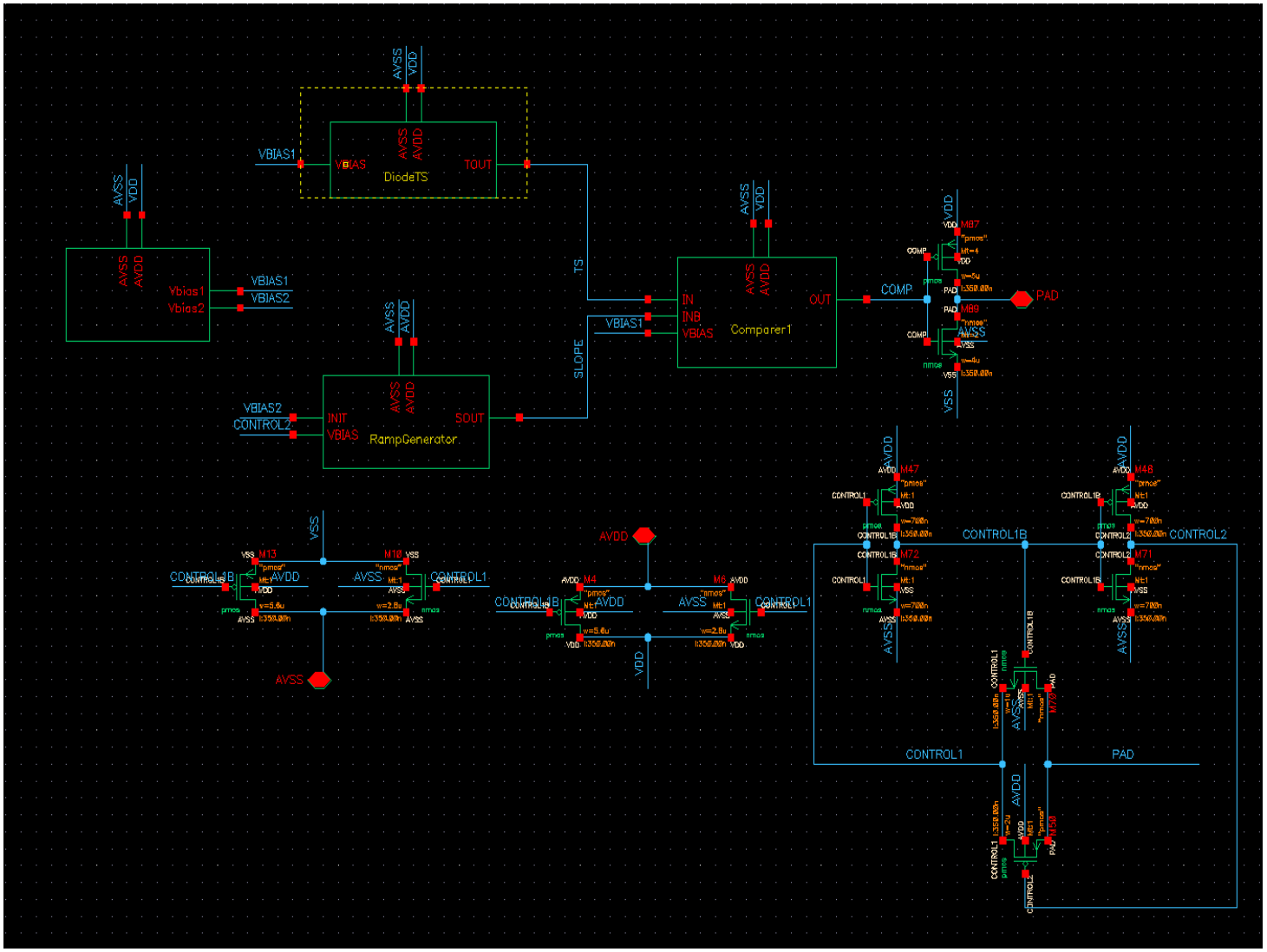
Temperature sensor

Temperature sensor on the chip gives real-time temperature to
1, show the relation between cooling and power consumption
2, calibrate the sensor performance on different temperature

single pad temperature sensor

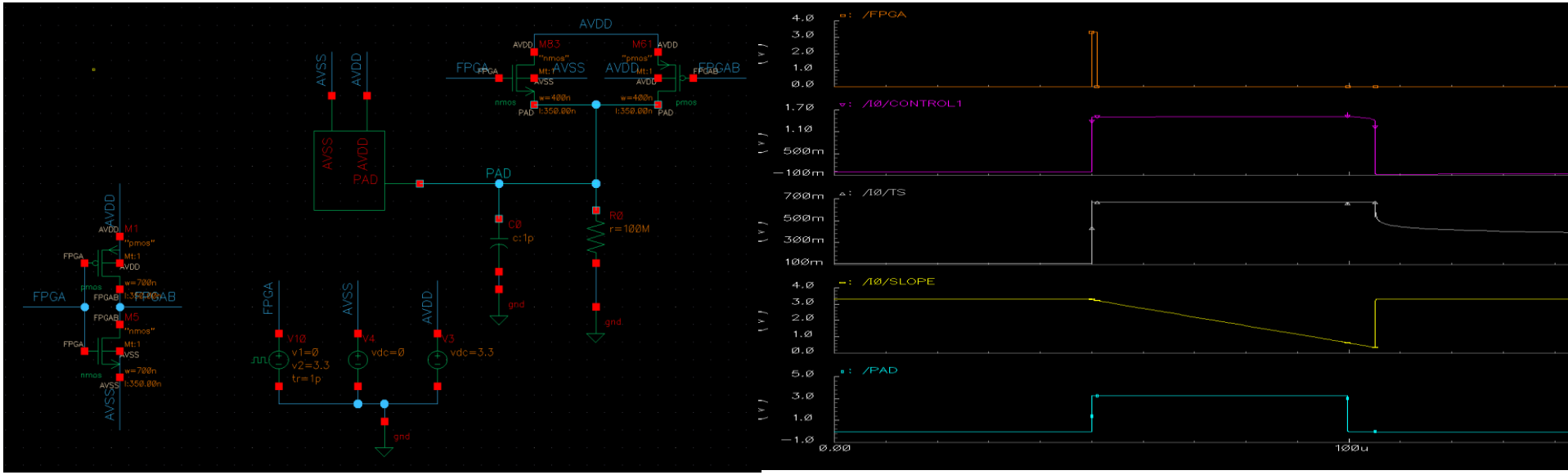
1、1 pad digital signal
2、power consumption
~5uA(working)
~1pA(idle)
3、FPGA directly connect to the pad

Temperature sensor structure



diode+slope+comparator

Temperature sensor testbench

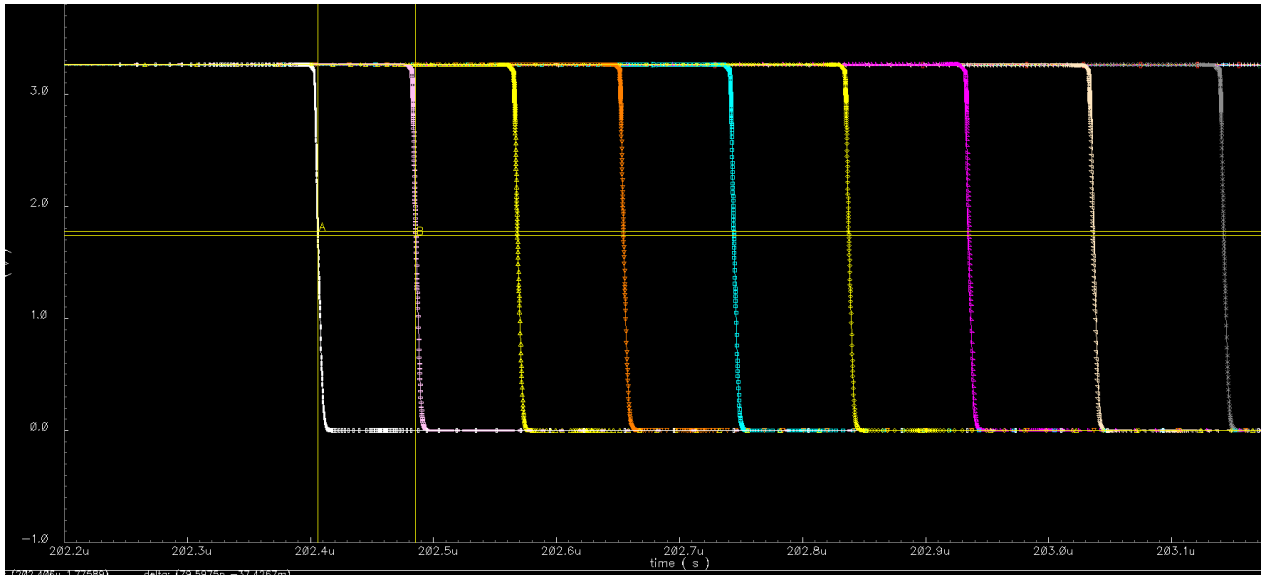


1、FPGA send rising edge to pad. The circuit starts while FPGA dirve the pad to high impedence mode.

as the circuit starts, the slope voltage will pass the diode voltage on the input of the comparator, the comparator will drive the pad to low.

2、FPGA count the time betweet the rising edge and falling edge to the diode voltage.

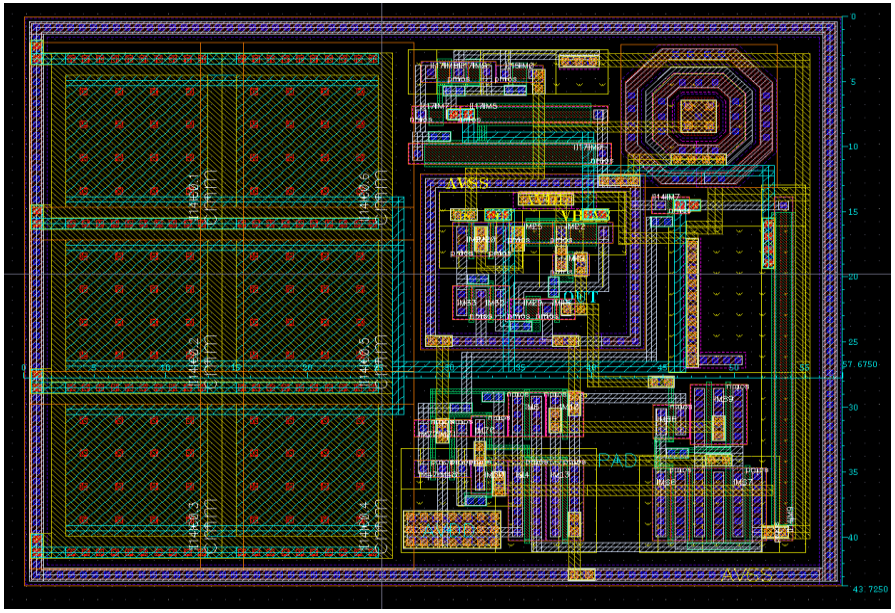
Temperature sensor performance



-40℃-85℃

resolution: 0.08℃

58um*44um (.35um)



ALICE ITS test and assembly

- ladder assembly
- ladder test
- module assembly
- module test

Test and assembly infrastructure

- 150 square meters clean room
- 50 square meters machining shop
- simple modeling carbon fiber

Pattern recognizatiom

1,using camera or microscope to take picture.
2,analysing the picture to get the position and orientation of the sensor
3,control the movement of probe station or precision rail to act on the sensor

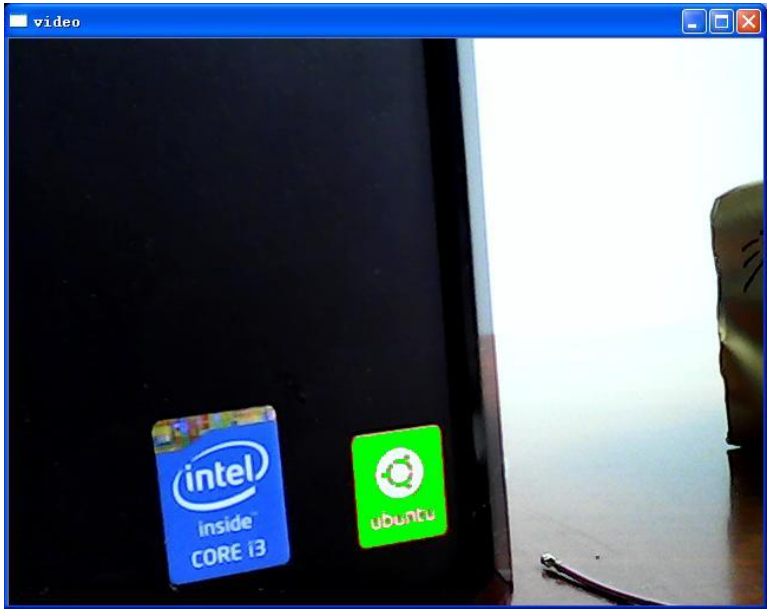
probe test the sensor
assembly the sensor to ladder

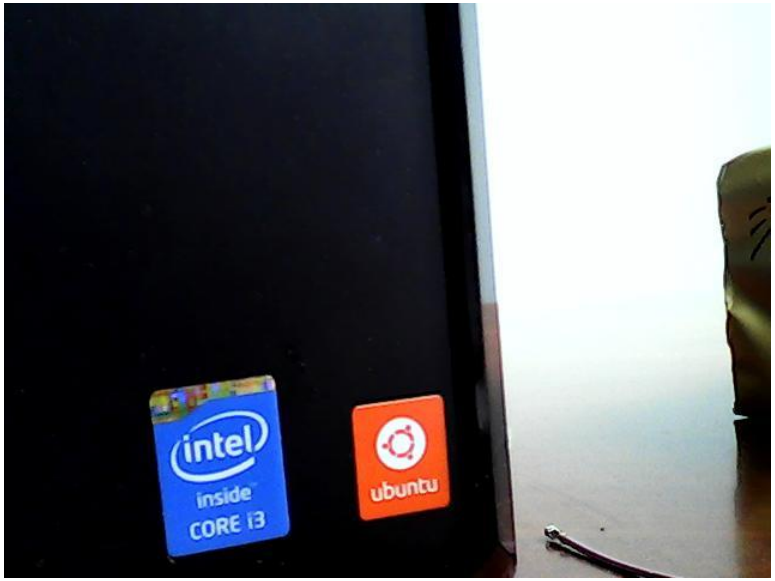
saving labor
higher precision

more time to train the code

Pattern recognizatiom

- openCV + root software environment in windows
- With PC camera now; installing camera on rail system is the next step





ALICE ITS readout

For digital data transmission only

1,SRU (from digitized point to RORC)

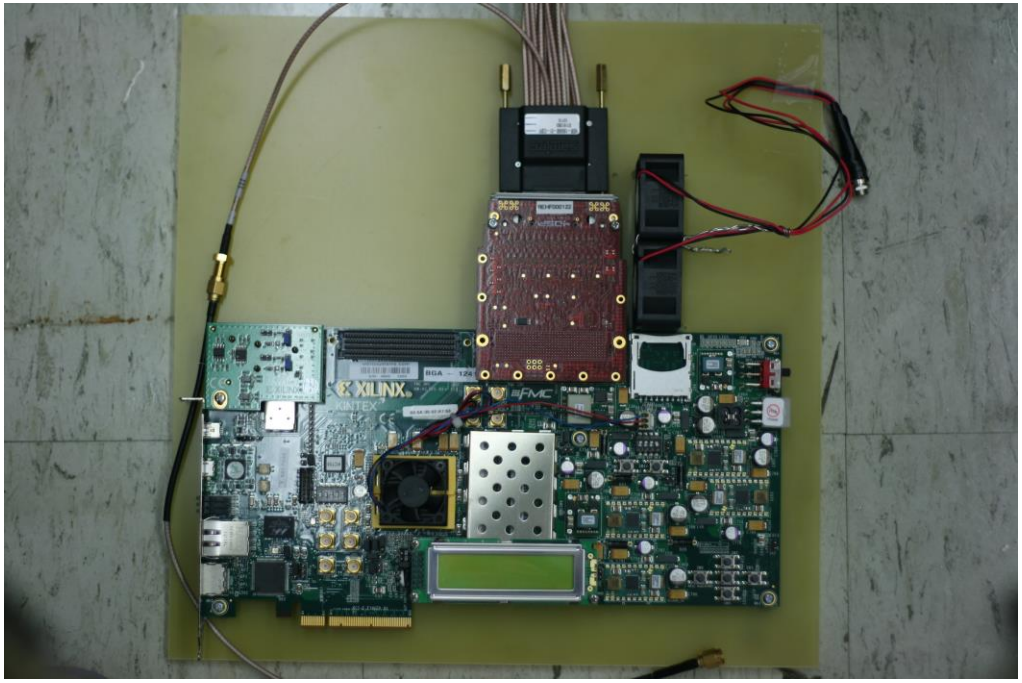
2,UDP+TCP solution (from digitized point to either net card;No DDL included)

UDP+TCP solution

- the same function like DDL
- higher speed 10Gb/channel
- industry standard; update with industry
- compatible to router
- FPGA xilinx K7; board KC705
- cheaper and simpler in construction

UDP+TCP solution

- works on LBL beam monitor test
- UDP part has some problem in frimware yet



summary

- TopMetal sensor can be used in beam monitor

- temperature sensor
- pattern recogizatiom
- UDP+TCP