Proposal to use the EUDET pixel telescope for resolution and equivalent epi-layer thickness studies of the MAPS developed in the INFN P-ILC and DIGIMAPS projects

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9th June 2008

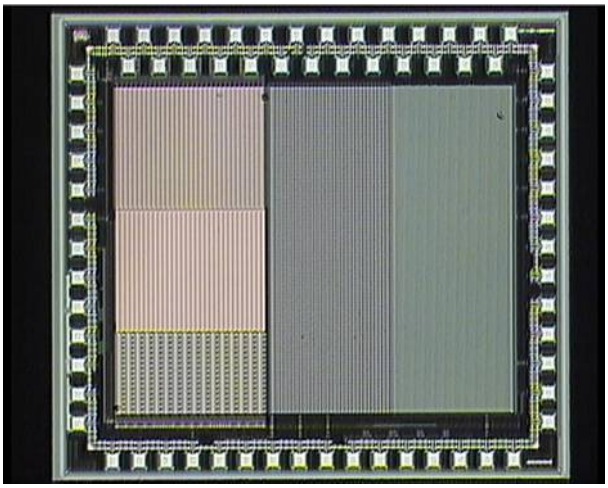
1. Introduction

The INFN (National Institute of Nuclear Physics) supports two research project in the MAPS (Monolithic Active Pixel Sensors) sensor detector area: P-ILC (Proposal for the Internaational Linear Collider) and DIGIMAPS (DIGItal MAPS). The purpose of those projects is to study the possibility of low mass, high space resolution and fast readout sensors to built vertex detectors for the new high high energy e+e- colliding accelerators. In this framework we want to study the possibility of implementing an on pixel sparsification architecture and we designed a testing MAPS chip in the ST 130nm technology that we want to test using the EUDET telescope as tracking reference. For this purpose we would like to request the use of the EUDET telescope in the Transnational Acces program foreseen in the project.

2. Motivation

The overall chip, presented in the picture, is organized in two large areas. On the right hand side there are 10 different matrices housing 512 or 2048 pixels each, with different pitches (10 or 20 um) and sensing diode readout structure (3T or SB) used to test the performances of the technology from the signal and noise level point of view. On the left hand side we have eight sub-matrices with 25um pitch housing 256 pixels each with different parts of the sparsified architecture previously described. All matrices can be readout using common

decoders to select row and column switches that supplies the analog, and the fired signal for the sparse side, to common output OTA to drive external pads.



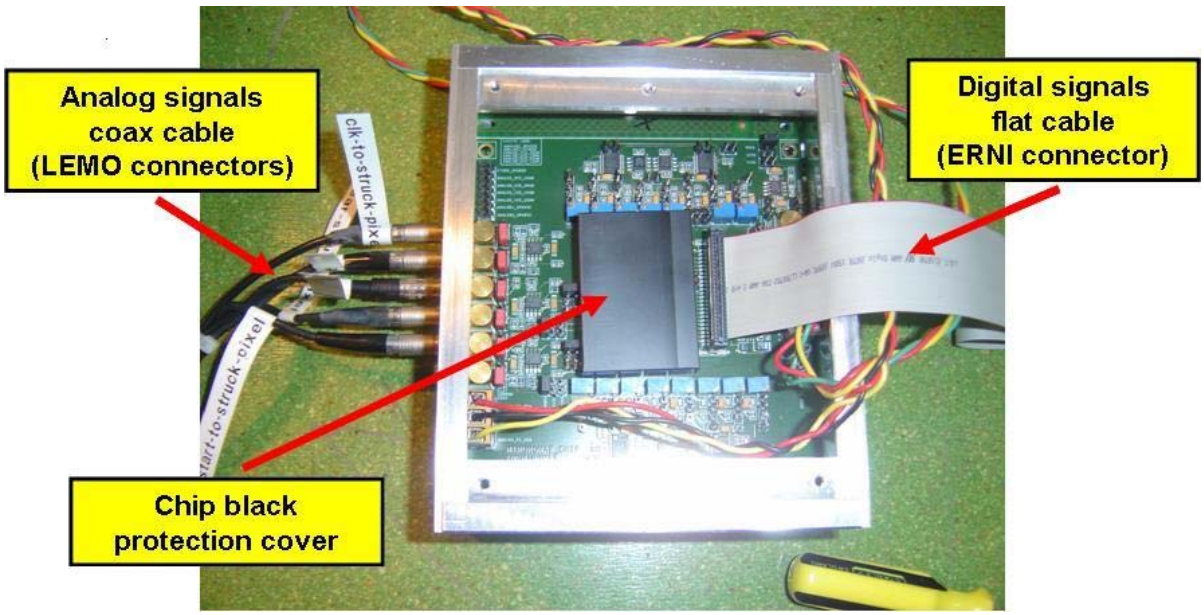
The matrices of the non-sparsified part, on the right hand side, are designed with different parameters combinations listed in the following table.

Parameter	Value 1	Value 2
Pixel structure	3T	SB
Pitch	20 μm	10 μm
Diode dimension	1 μm x 1 μm	1.5 μm x 1.5 μm
SF transistor size	Small gain	Large gain
Power supply	2.5 V	1.2 V

The non-sparsified side of the sensor will allow us to determine the best configuration in terms of spatial resolution, by measuring cluster size and residuals using tracks from the reference telescope, and the epi-layer thickness by measuring the MPV (Most Probable Value) of the distribution of the charge released in the sensors by the high energy tacks available in the CERN test beam. For those measurements we will take advantage of the very fine space resolution of the EUDET telescope, and based on the results of this test we will adapt the design parameters of the future sensors.

3. Prototype to be tested

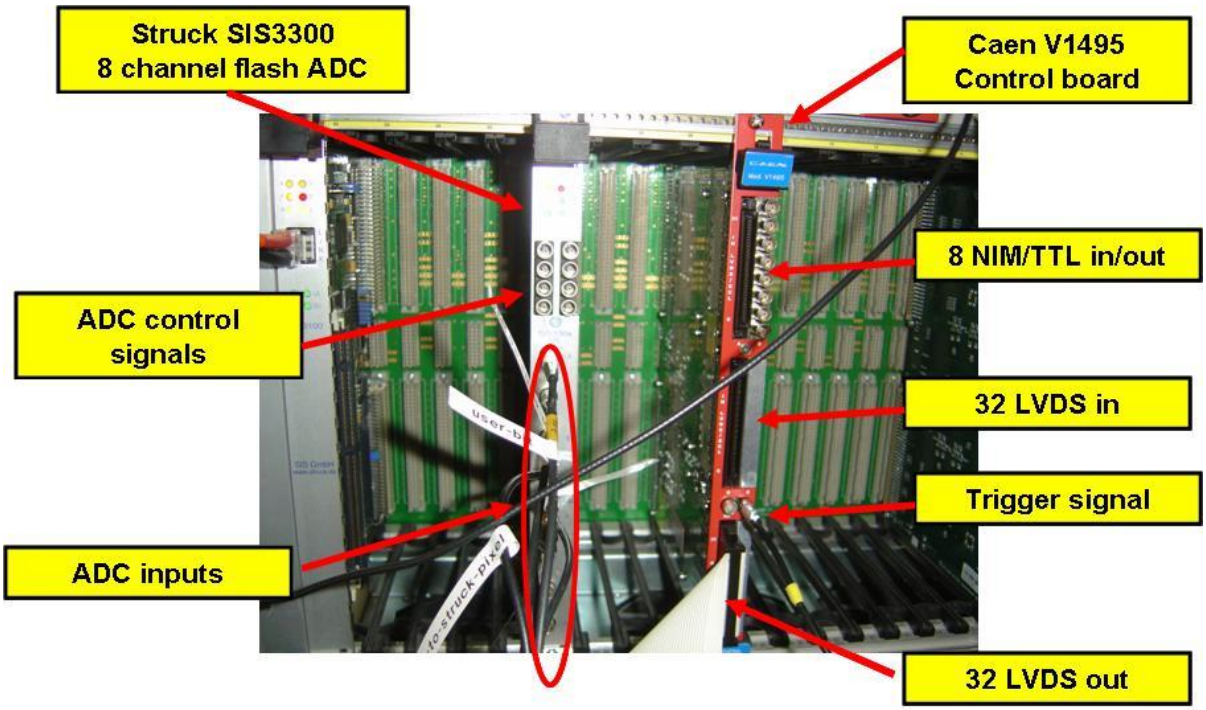
The prototype sensor we want to test in the CERN test beam is glued and bonded on a test (Mimoroma2_chip) board shown in the picture that implements the following functionalities: buffering the analog output signals, producing by 16 DAC channels all needed control voltages and the generation of all power supplies for the sensor under test. The board is housed in a shielded box that will be in thermal contact with an external Peltier cell to control the sensor temperature.



4. Data Acquisition

The data acquisition system we will use is based on commercial VME boards shown in the following picture. One fast sampling 8 channels ADC module (Struck SIS3300 plus the PCI to VME interface) to sample and acquire the analog signals produced by the detector under test, then a general purpose timing generator, the V1495 CAEN VME module, that produces all needed timing signals to control the readout ADC and to provide all needed timing for the chip under test. This timing module will take care also the synchronization with the overall telescope data acquisition using the trigger signal provided by the TLU and counting the event number in an internal

trigger counter register readable through VME. All the needed timing signal provided to the Mimoroma2_chip testing board are provided by an interface card (Mimoroma2_patch) that translates the levels provided by the V1495 module and optically decouple them to avoid ground loops.



5. People and Funds

The people that will partecipate to the test are members of the collaboration P-ILC and DIGIMAPS and are from Rome Tre INFN section and University of Insubria (Como). They are: Janusz Mlynarczyk, Eleuterio Spiriti from Rome Tre and Antonio Bulgheroni, Silvia Bonfanti and Loretta Negrini from the University of Insubria. We would like to request the costs of the trip and for the stay at CERN one week for four people, three from Como University and one for Rome Tre.

6. Conclusions

This test beam is an unique possibility to realize the essential measurements listed in the test that are fundamental figure of merits of the pixel detectors we want to develop. The precise tracking informations that the EUDET telescope will provide is a key point for those measurements and will be essential in the performance measuments and for the optimization of the future detector design.