MPGD-NEXT A R&D INFN PROJECT

TASK 3 :
HIGH PERFORMANCE MICROMEGAS

GROUPS:
INFN NAPOLI AND ROMA TRE

M. Iodice

Paddy Meeting

November 4th, 2016

PROJECT TIMELINE

In a three year R&D project we aim to:

✔ **1. Optimize the design of resistive micromegas with small size pad readout; [successful]**

✔ **2. Optimize the construction; [Two prototypes built. Ongoing – Very good progress]**

2017

3. Optimize the parameter of construction **(resistivity**,…) and operations (gas mixture,…);

4. Establish the optimal trade-off between dimensions and channel routing to read-out electronics;

5. Establish safe operation up to a rate of O(1MHz/cm^2)

6. Achieve good spatial and temporal resolutions (~100 μm and few ns respectively);

7. Start a process of technology transfer to industries.

ACTIVITY PROFILE

GANTT CHART as of July 2016 -- REVISED

activity	2016				2017				2018			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Simulation and Design of MM with pixelated anode												
Construction and tests of the first small prototype (10x10 cm2)												
Construction and TESTS of an improved small size prototype												
Design, construction and test of second generation small prototype (new Resistive Layout												
Design and Construction of MM with EMBEDDED ELECTRONICS for Large Size Detectors												
Construction of large size prototype (~40x40 cm2) and cosmics tests												
Test-beam and High Irradiation Tests												

- The first MM mini-pad Prototype has shown some limitations. A second small size prototype with a different construction technique has been built in 2016 and currently under tests. First data ARE VERY PROMISING !

- We already started to investigate a scalable solution for the Front-End Readout. One more step in the R&D is needed.
- THIS IS A very exciting and challenging STEP !

MPGD_NEXT R&D at INFN (Napoli, Roma Tre)

Fundings 2016 -- 2017

MPGD_NEXT, assegnazione 2016

	MISSIONI		CONSUMI		INVENTARIO		TOT		NOTE
	rich.	ass.	rich.	ass.	rich.	rich.	rich.	rich.	
BA	3		49	3 + 17 ant.			52	20	promessa di altri ~27 keuro per I chip se progetto pronto
LNF	10		19	10+ 5 ant.			29	15	
NA	3		10	6			13	6	
RM3	3		4	4	10		17	4	
TS	3	6 + 5 sj	36	18			39	29	le missioni sono per tutti !
TOT	22	11	118	63	10	0	150	74	aggiungendo I 27 keuro in prospettiva il totale effettivo va a 101
									NOTA GENERALE:
									si possono chiedere integrazioni se ben motivate (come ci dira' Antonio)

MPGD_NEXT, assegnazione 2017

	MISSIONI		CONSUMI		INVENTARIO		TOT		NOTE
	rich.	ass.	rich.	ass.	rich.	rich.	rich.	rich.	
BA	4								
LNF	10								
NA	3		19	9			22	9	
RM3	3		8	8			11	8	
TS	3	6 + 5 sj							le missioni sono per tutti !
TOT	23	11	27	52	0	0	33	17	

Bookkeeping

MPGD_NEXT, contabilita' 2016

	MISSIONI		CONSUMI		NOTE
	Ass	SPESE	Ass.	SPESE	
NA	0,5 + 0,5 + 0,7	1	6	1,75	Avanzo al 2 Nov 2016 : Cons. ?? ; Miss. ??
RM3	0,5 + 0,5	1	4	1,75	Avanzo al 2 Nov 2016 : Cons. 2,25 kE
CERN				1,8	

Paddy2: 5824 CHF ~5300 Euro
Client budg 29120 (34.0%), T232300 (33.0%), T239500 (33.0%)
(Apr. 2016)

MPGD_NEXT contabilita' 2017

Contabilita	MISSIONI		CONSUMI		NOTE
	Ass	SPESE	Ass.	SPESE	
NA	0,5 + 0,5 s.j.	0	9	0	
RM3	0,5 + 0,5 s.j.	0	8	0	
CERN					

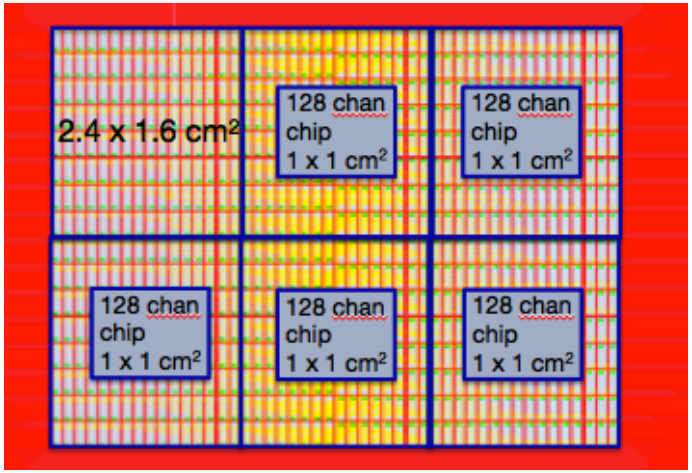
We have something like >20 kE ? (plus CERN)

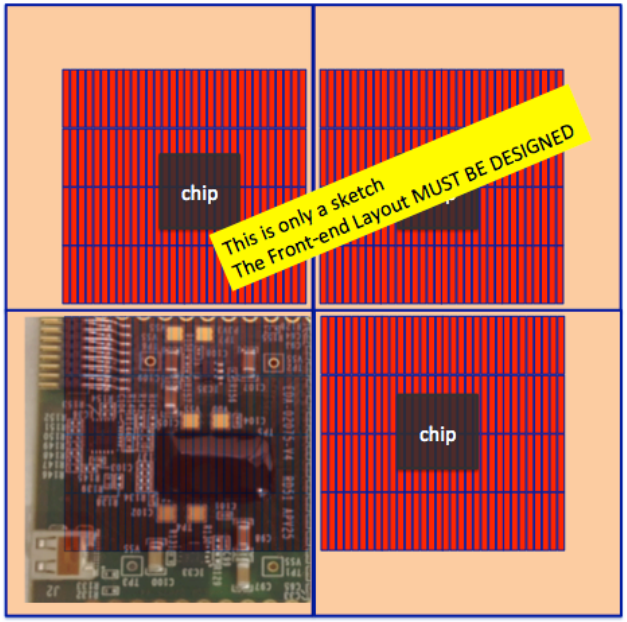
- Prototype with embedded electronics (see next slides >10 kE)
- Other prototype? TO BE DECIDED

CURRENT STATUS: PROTOTYPE UNDER CONSTRUCTION

A scalable prototype with embedded Front-end electronics

Basic idea :



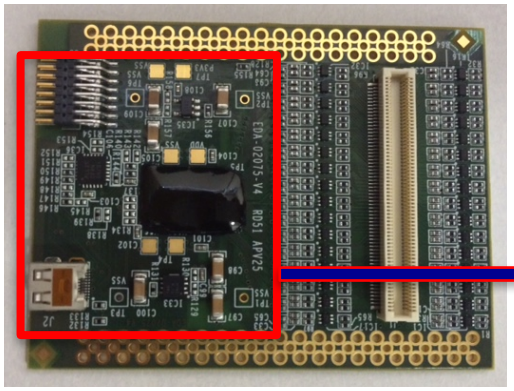


Back wire bonded chip and Front-End Components

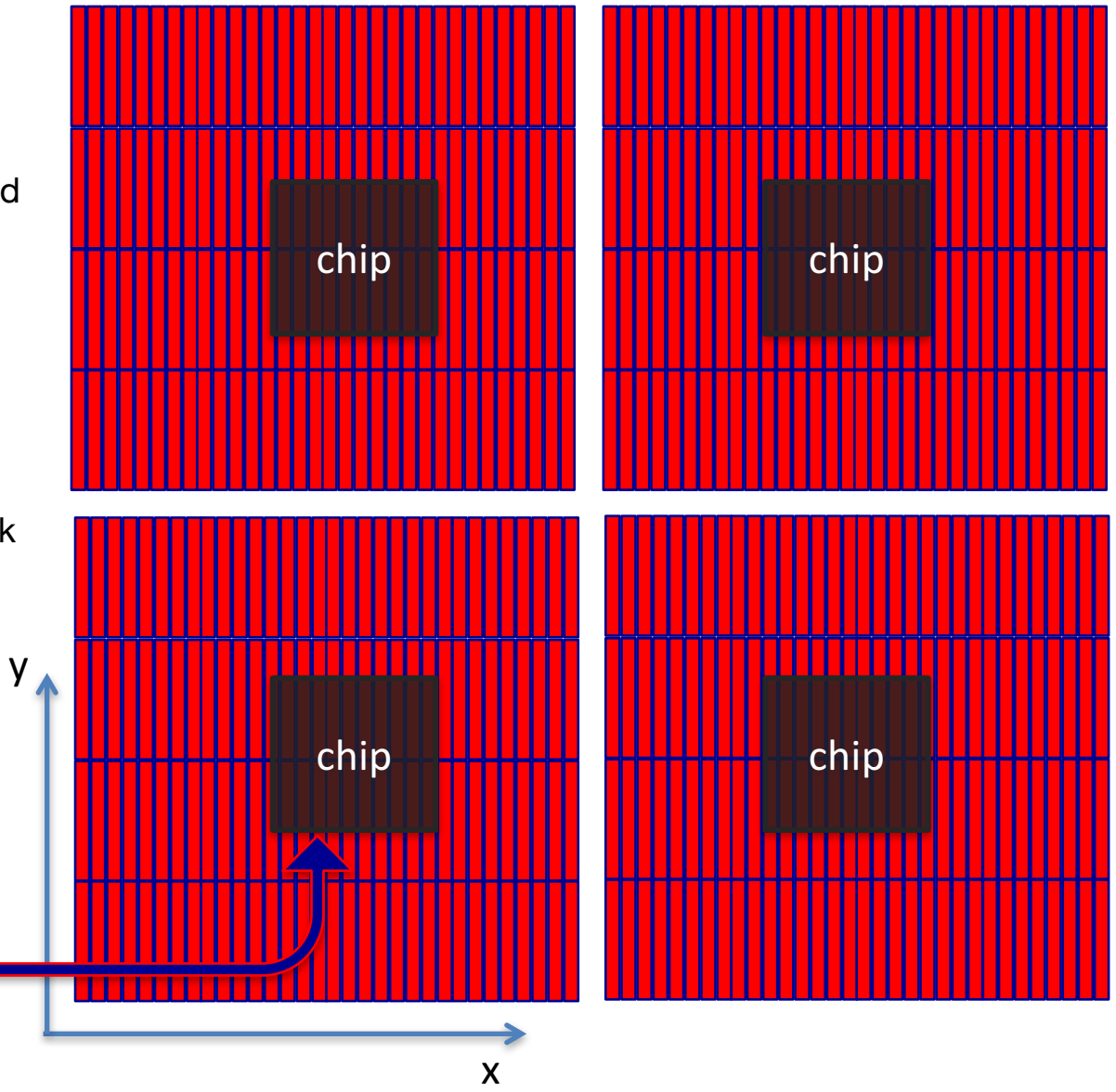
A realistic implementation

LAYOUT OPTION 1

- Divide in 4 regions with 32x4 mini-pad
- Pitch x: 1 mm
- Pitch y: 8 mm
- Each pad is 0.8 mm x 7.8 mm
- Space between pads is 0.2 mm
- Each region is 32x32 mm2
- Each region can be readout by a back wire bonded APV25 chip with associated Front-end electronic reassembled on the detector board



APV25 Hybrid by RD51



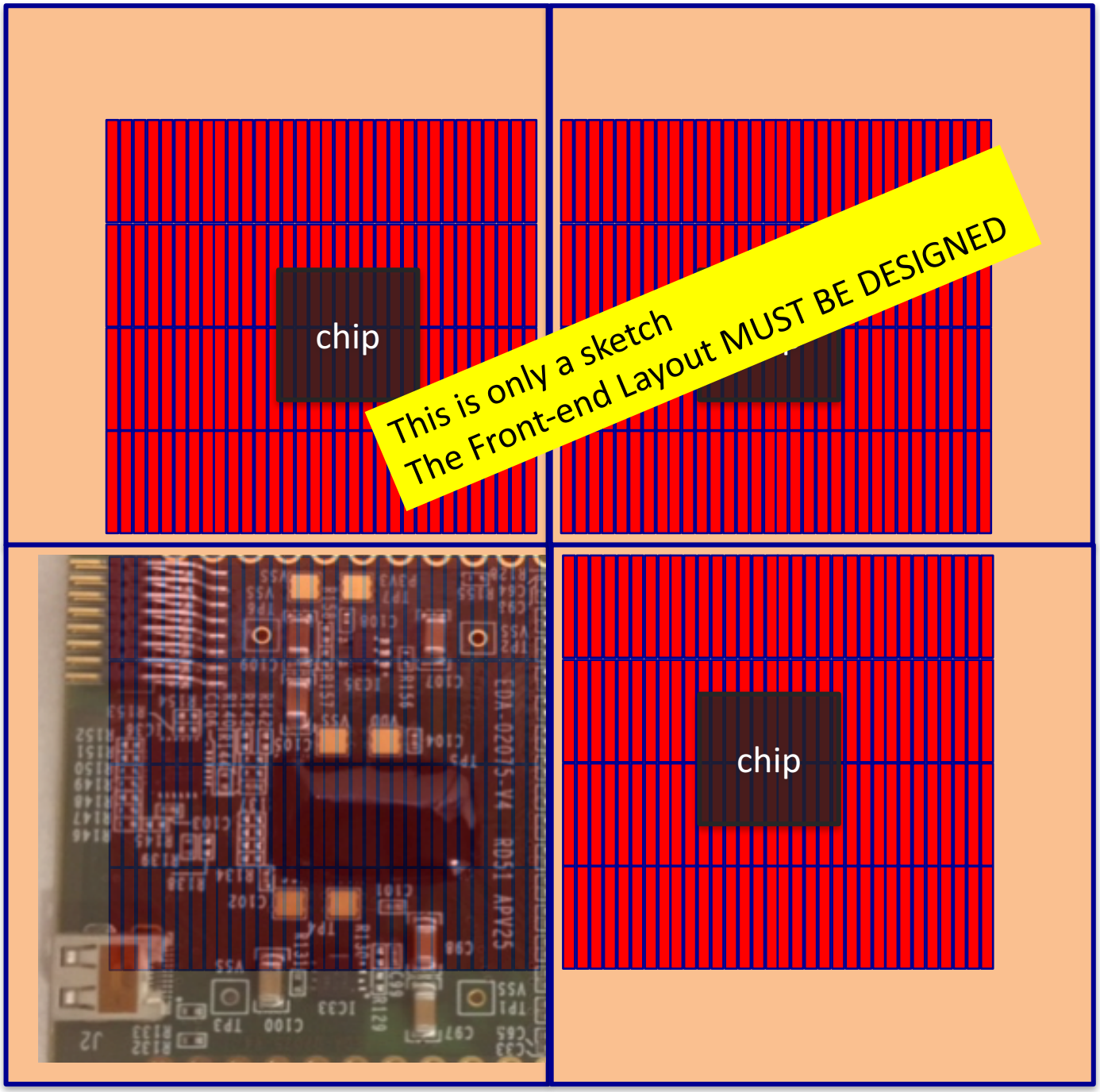
LAYOUT OPTION 1

- 4 regions 32x4 mini-pad

- **For the present development the area available for the Front-end, including mini-HDMI connectors, can be larger.**
  For example up to 40x40 mm2
  (IF NEEDED)

Final detector
4 regions

- 4x (32x32)mm2 active area
- Up to 4x(40x40)mm2 Front-end surface
- 4 “master-like” APV hybrids
- 4 μHDMI connectors

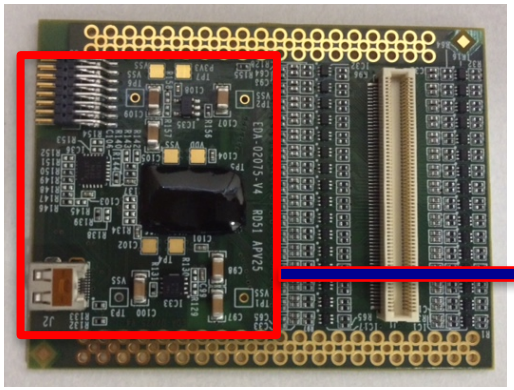


Back wire bonded chip and Front-End Components

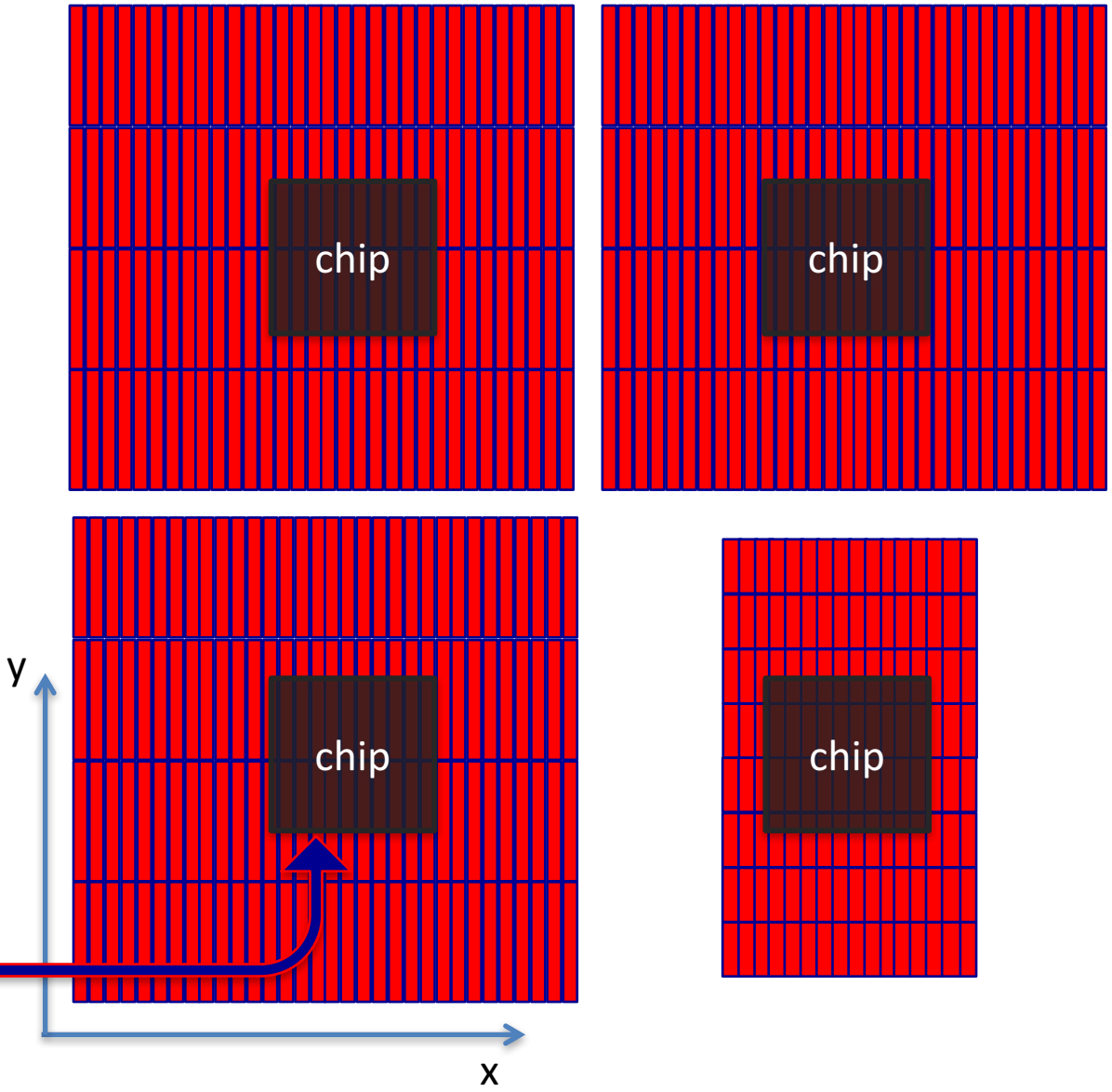
Test of one region with same layout as the “old” mini-pad MM

LAYOUT OPTION 2

- Divide in 4 regions
- **3 Regions with 32x4 mini-pad**
  - Pitch x/y: **1 mm - 8 mm**
  - Each pad is 0.8 mm x 7.8 mm
- **1 Regions with 16x8 mini-pad**
  - Pitch x/y: **1 mm - 3 mm**
  - Each pad is 0.8 mm x 2.8 mm
- Space between pads is 0.2 mm



APV25 Hybrid by RD51



Production of one detector with embedded electronics cost

Production of one detector with embedded electronics by Rui De Olivera:

Layout:	4000 CHF
resistive layers + BULK	4000
8 layer PCB	2000
Component assembly	1000
Mechanics	1000
TOT	12 kCHF (subject to variations up to +/- 20 %)

FIRST TIME A MPGD DETECTOR WITH EMBEDDED READOUT ELECTRONICS WILL EVER BE PRODUCED !!!

A CHALLENGING, FUNDAMENTAL STEP THAT CAN OPEN NEW SCENARIOS FOR HIGH GRANULARITY – HIGH RATES DETECTION !!!

Layout designed. Now moving to the construction phase