

MEG 2

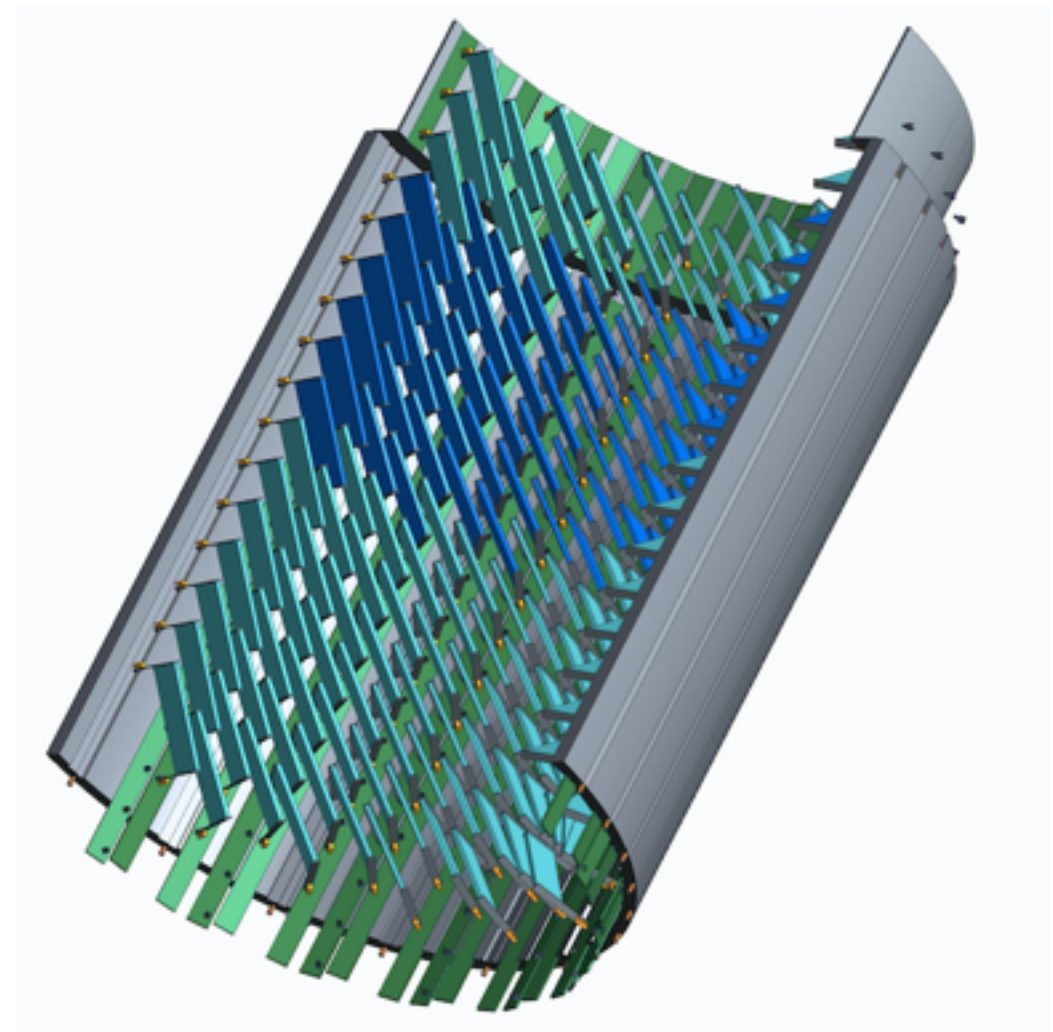
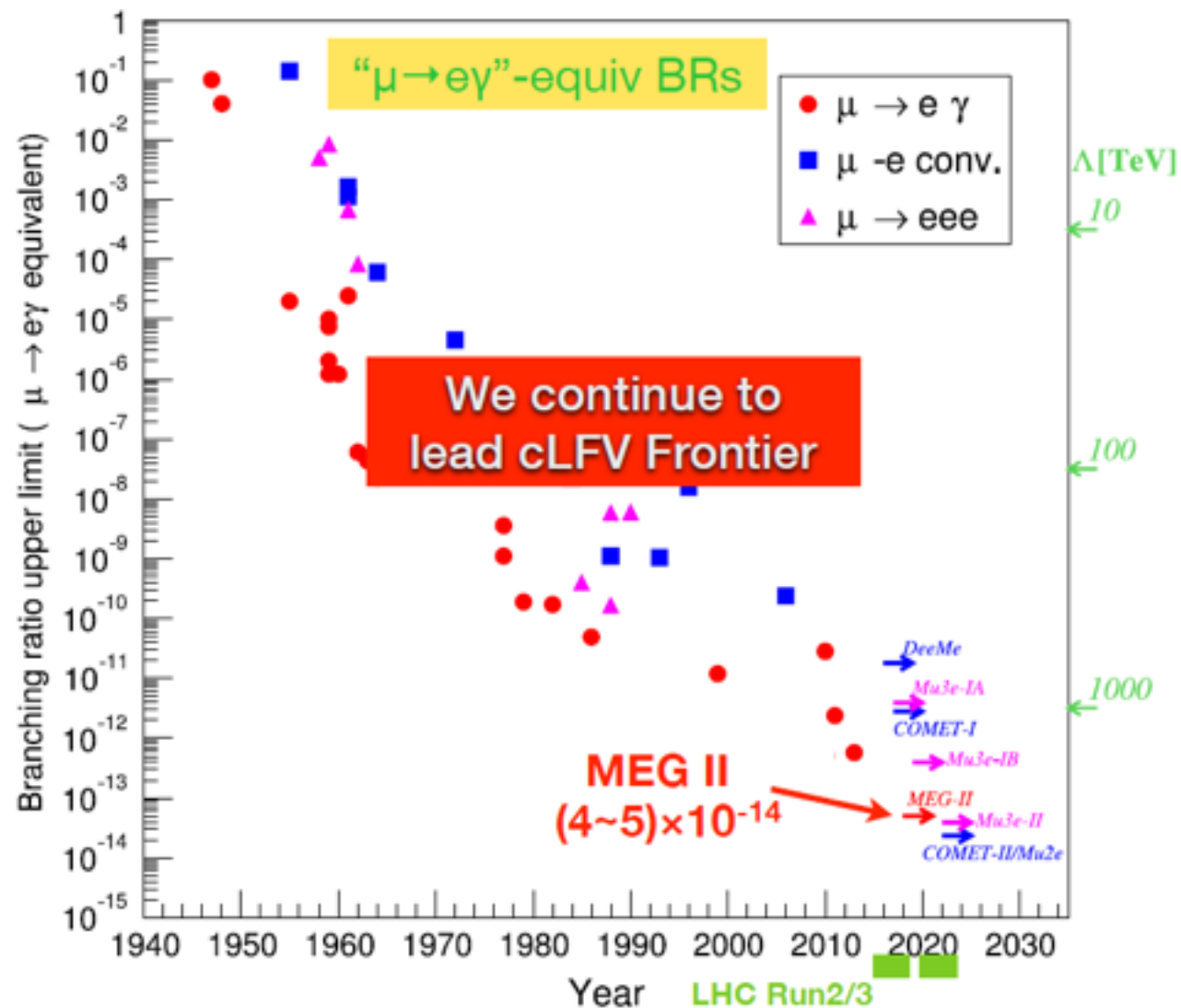
Cds Preventivi 2016
Flavio Gatti

MEG.

Investigazioni sulla fisica oltre il modello standard con la ricerca del decadimento che viola la Conservazione del Sapore Leptonico: $\mu \rightarrow e \gamma$.

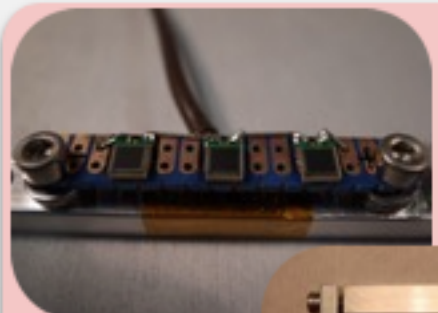
Una lunga storia che inizia con Pontecorvo

Genova responsabile del Timing Counter di MEG1. Ora Co-responsabile con Tokyo di un progetto più ambizioso con risoluzioni temporali di 30 ps

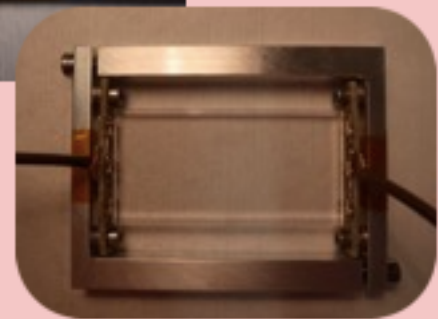


Single pixel R&D

Multipixel prototypes and test for final design





1st pixel prototype




probe single pixel


1st multi-pixel prototype



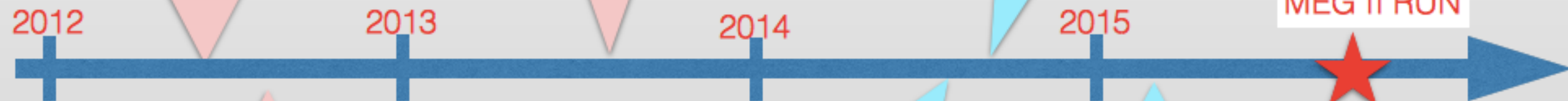
test @BTF, SiPMs choice



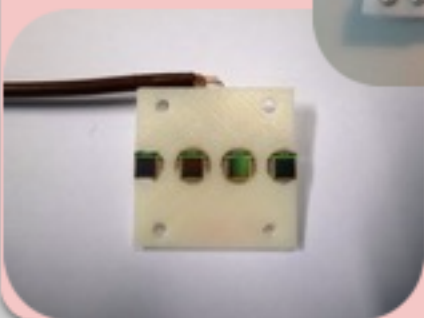

high rate test



test @PSI





2nd pixel prototype



comparison tests

2nd multi-pixel prototype

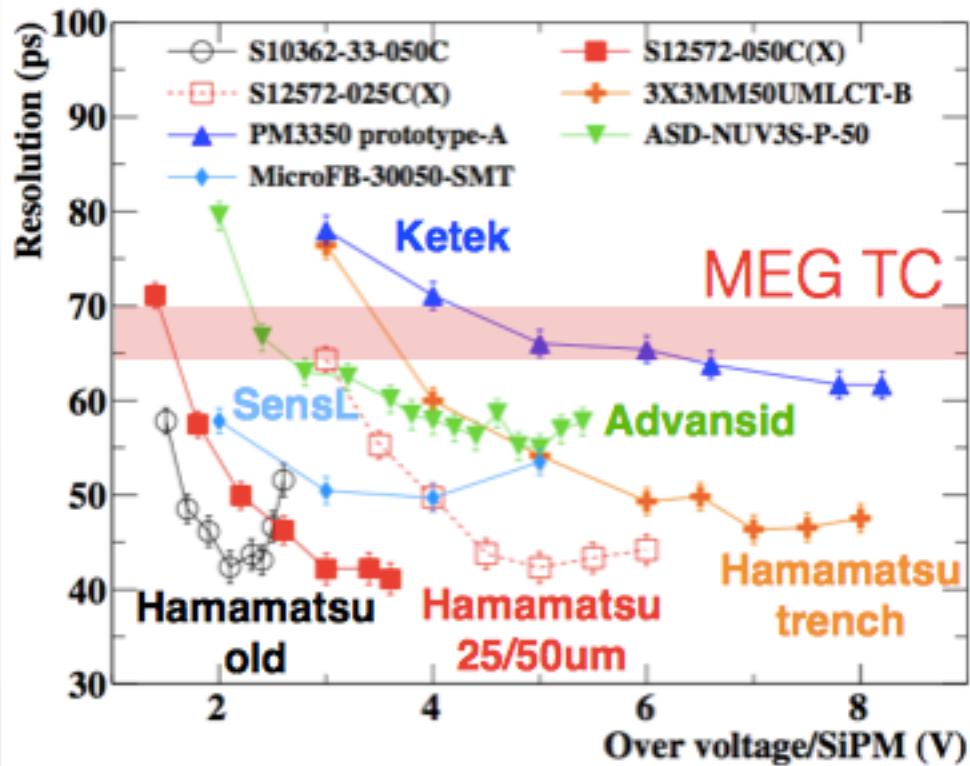


test @BTF backplanes readout

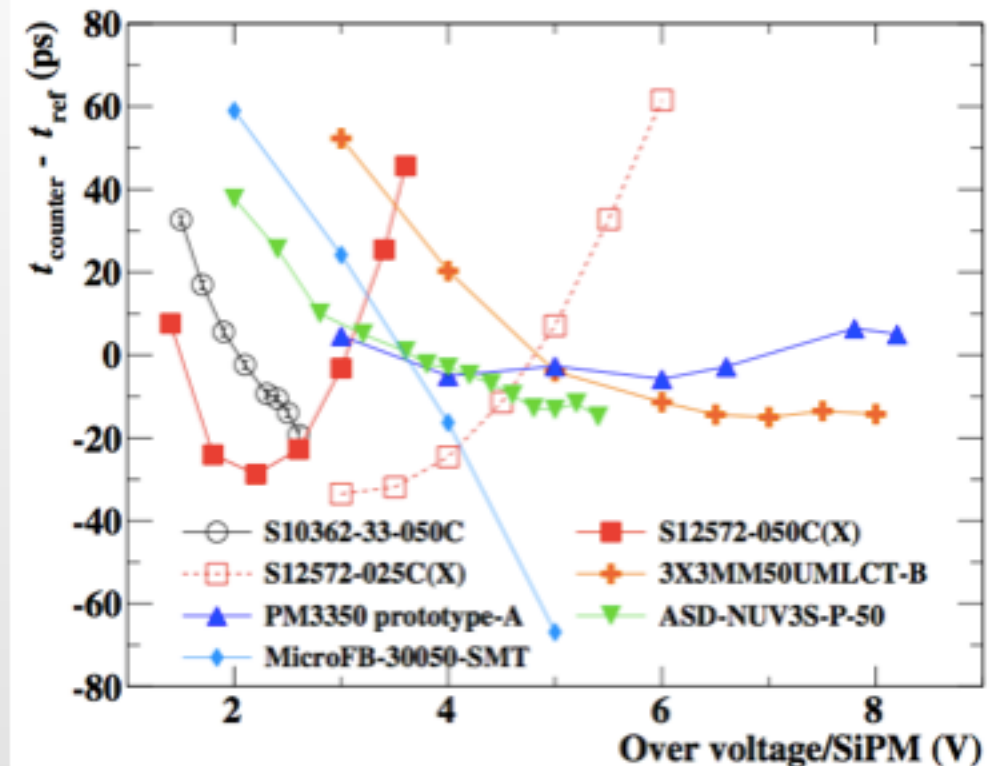
final TC construction



NOW!



Best time reso with **Hamamatsu** device...but almost all devices work better than previous TC bar.



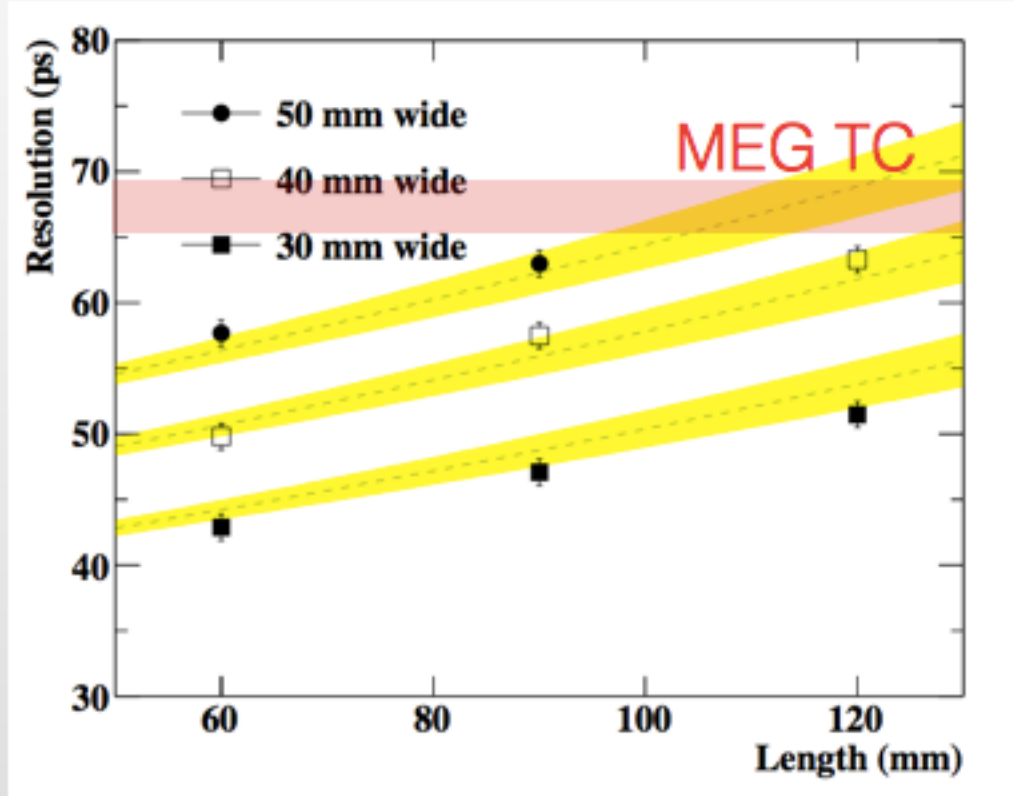
Advansid and **trench** devices are **more stable** as a function of over voltage and temperature.

HPK old	HPK new	HPK new 25um	HPK trench	Ketek	Advansid	SensL
2.5	5.5	2.8	0.1	0.1	0.2	0.8

Temperature coefficient: ps/°C

Temperature stability is a crucial parameter for our detector: $\Delta T \rightarrow \Delta V_{BD} \rightarrow \Delta V_{OV}$

Measurements with 4 SiPMs array in series connection (HAMAMATSU S10362-33-050C).



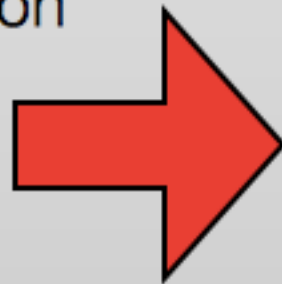
Properties	BC418	BC420	BC422	BC422Q
LY(%Anthracene)	67	64	55	19
Rise time (ns)	0.5	0.5	0.35	0.11
Decay time (ns)	1.4	1.5	1.6	0.7
Wavelength (peak, nm)	391	391	370	370
Attenuation length (cm)	100	110	8	8
Resolution (ps)	48±2	51±2	43±2	66±3

measured with 60 x 30 x 5 mm³ pixels

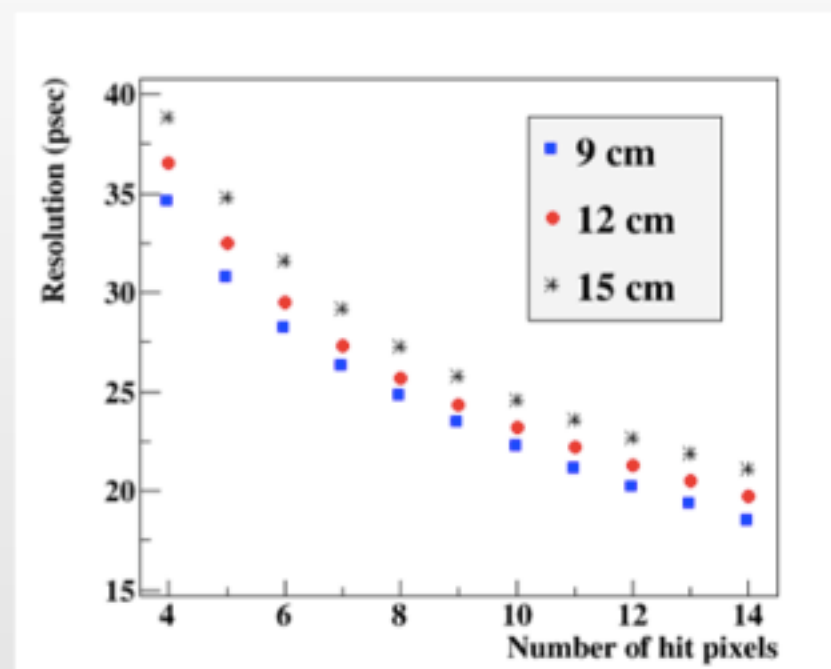
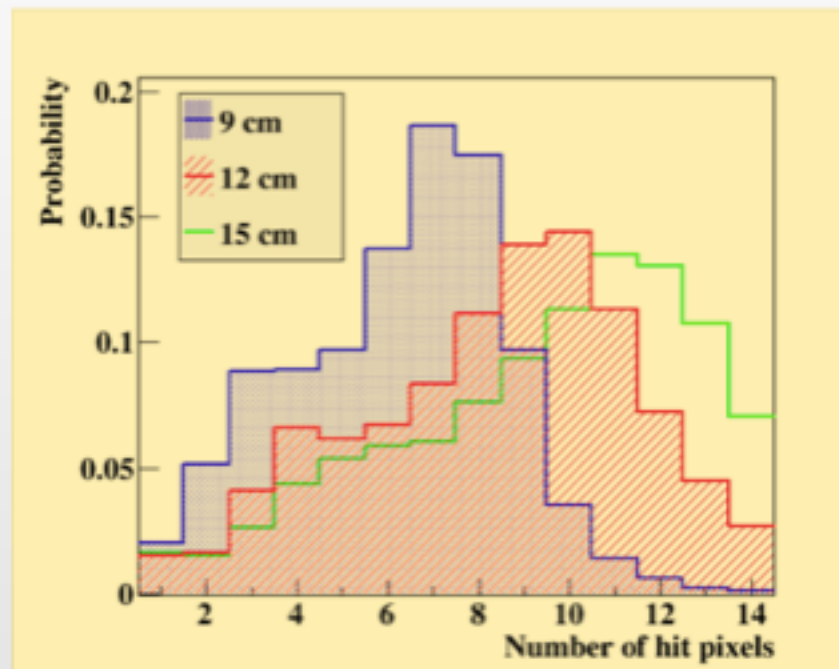
All the configurations showed a **resolution better than 70ps** (same as old TC reso).

The final choice is done taking into account many factors:

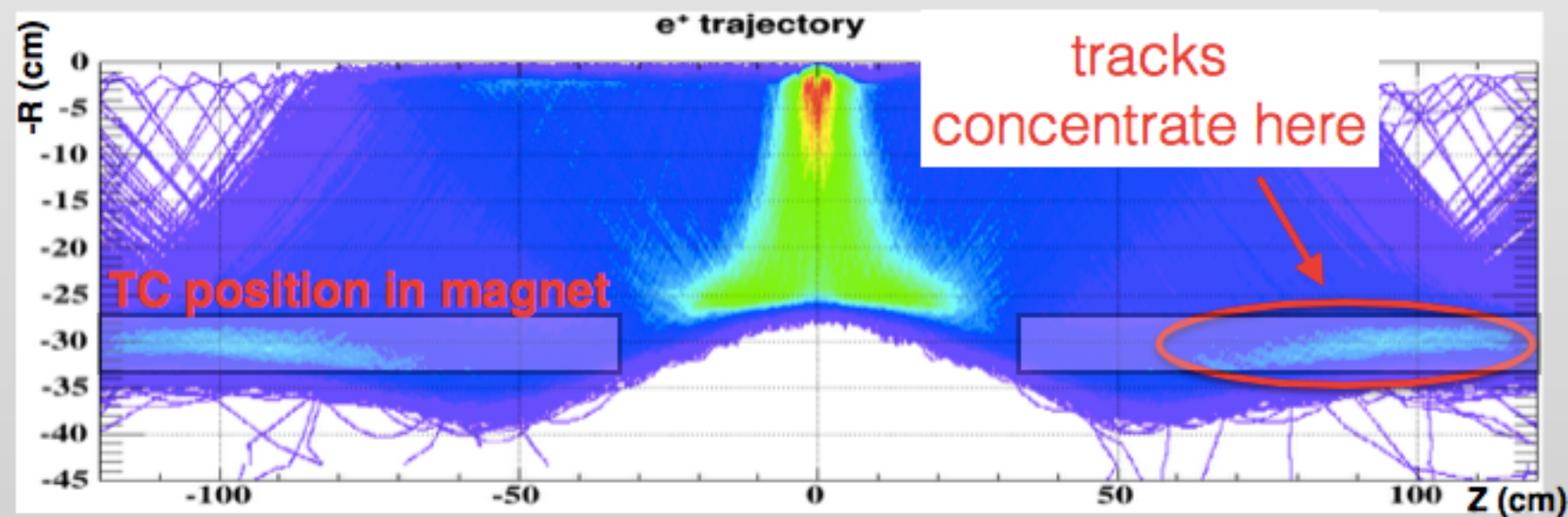
- intrinsic single pixel resolution
- expected number of hits
- efficiency
- number of channel
- costs



Numbers to be evaluated
on Monte Carlo
simulation...



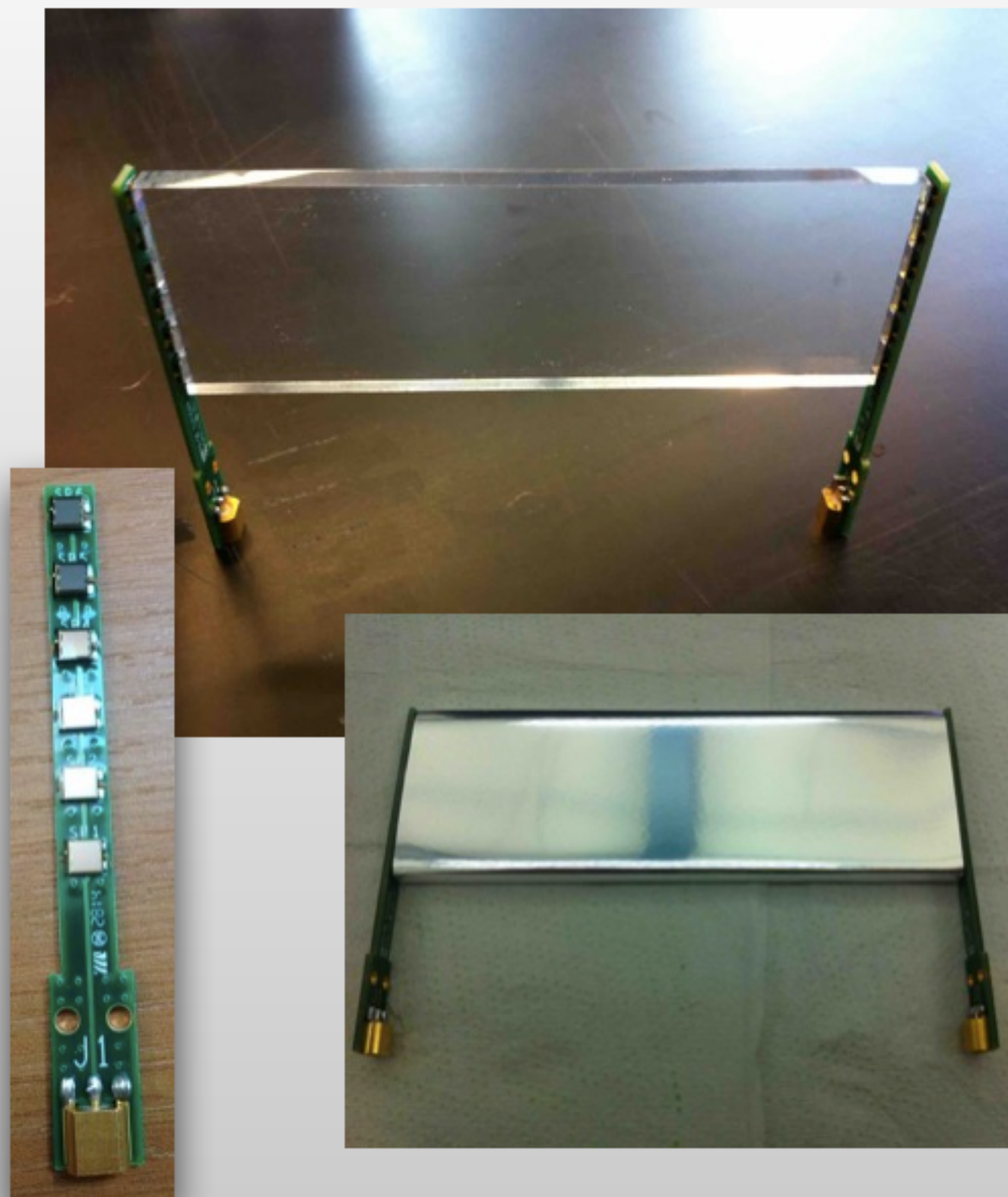
120mm length pixel
is the best
compromise between
hit multiplicity, time
resolution and
number of channels.



tracks envelope in a gradient magnetic field (MEG COBRA magnet)

**different pixel
height** (40 or 50
mm) increases
efficiency

- Double side read-out with **6 SiPMs (ASD-NUV3S-P) array** mounted in series connection on a PCB:
 - increase sensor coverage;
 - small material budget along positron trajectories: **PCBs act also as frame.**
- **120 x 50 (40) x 5 mm³ fast plastic scintillator (BC422)** coupled with optical cement, wrapped with reflector (3M mirror).
- Impact time and position reconstructed with sum / difference of single array time.
- **MCX connector for backplane plugging** (no cables on TC).



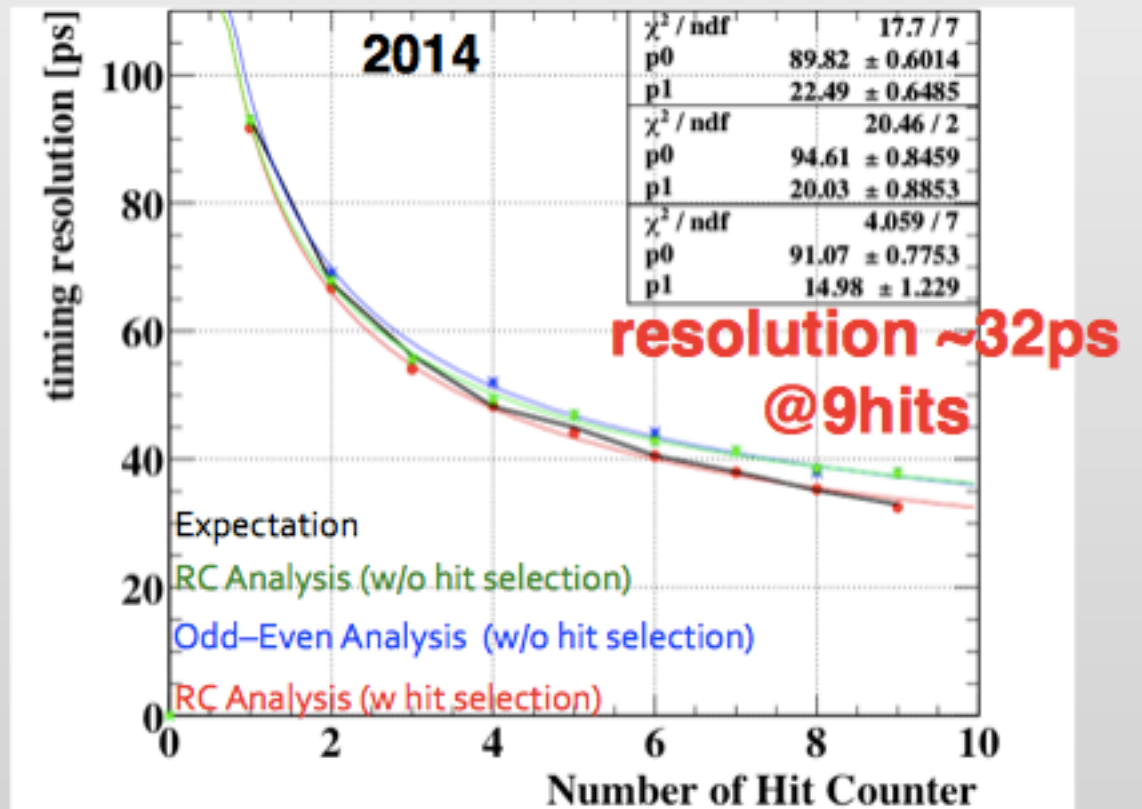
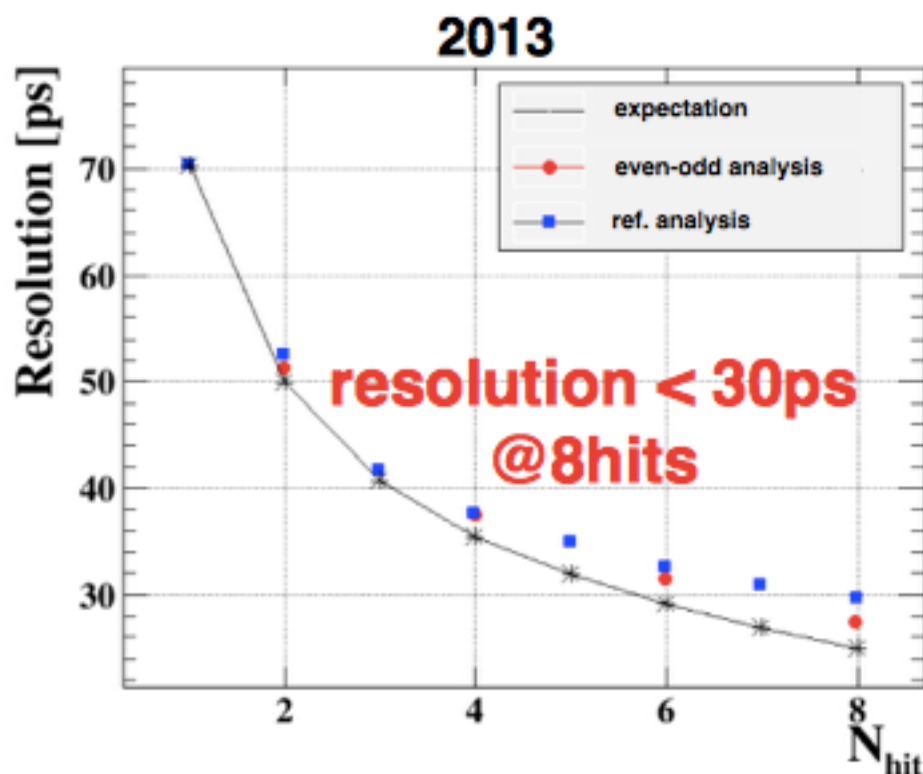
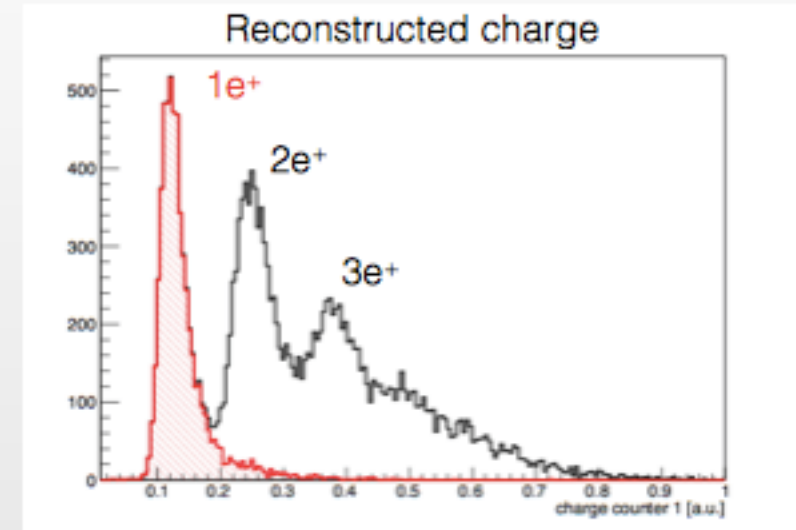
Time resolution evaluated as the width of

$$\Delta T(N) = T_{ref} - \frac{1}{N} \sum_{i=1}^N T_i$$

RC analysis

$$\Delta T(N) = \frac{1}{\sqrt{2}} \left[\frac{1}{N/2} \sum_{j=1}^{N/2} T_{a_j} - \frac{1}{N/2} \sum_{i=1}^{N/2} T_{b_i} \right]$$

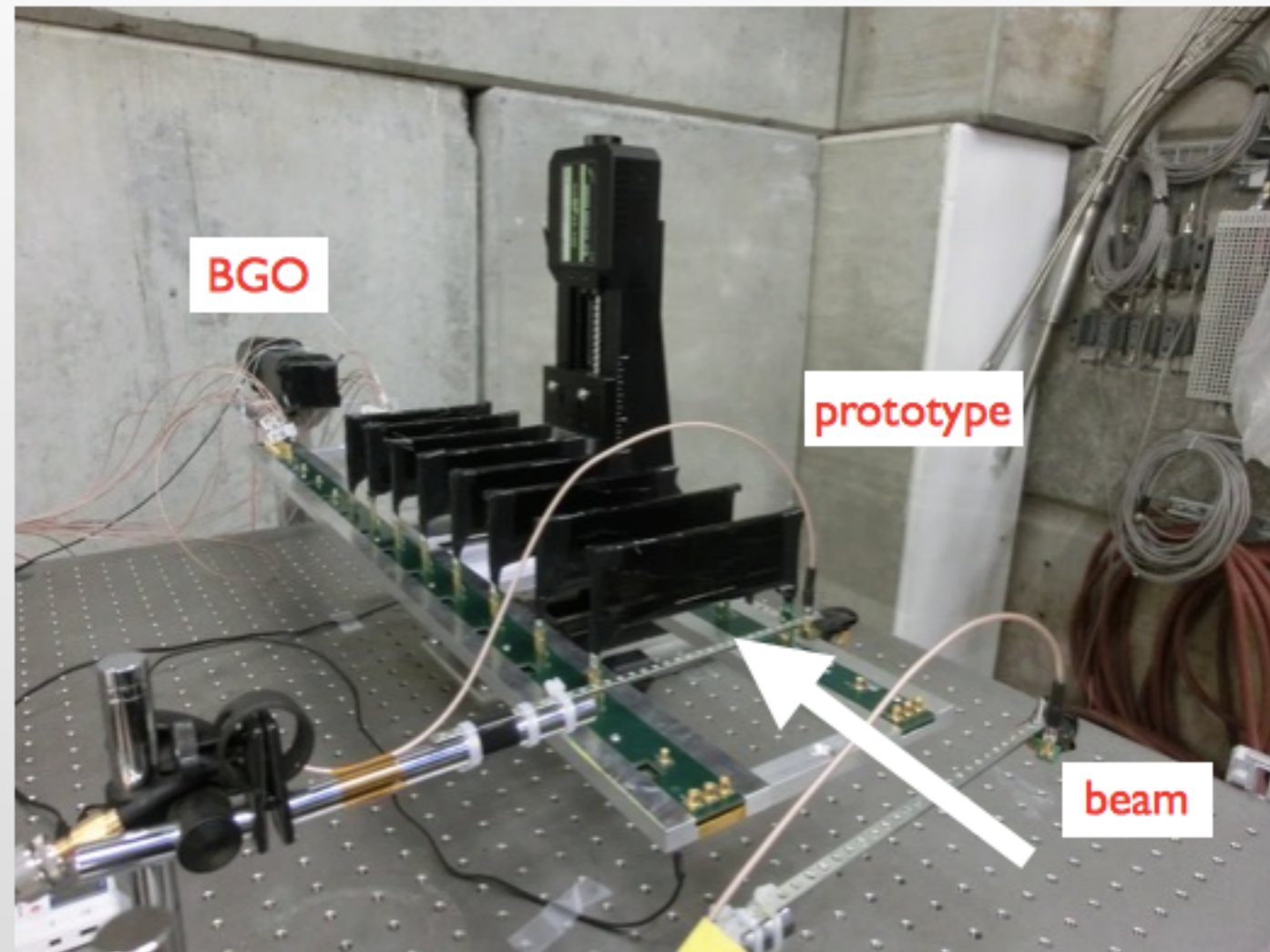
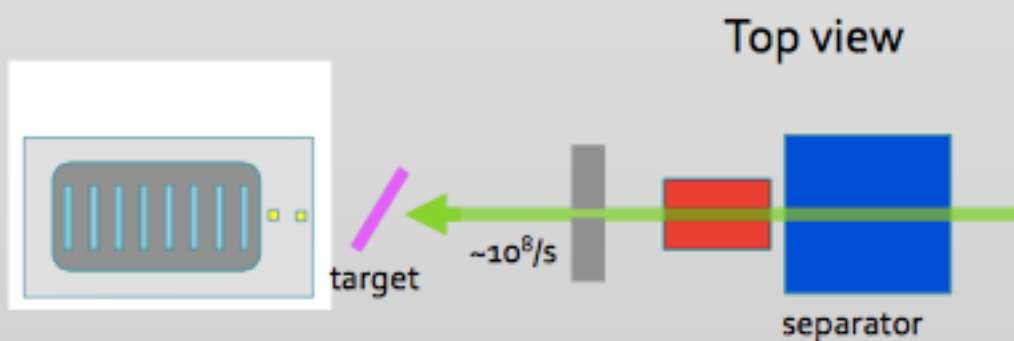
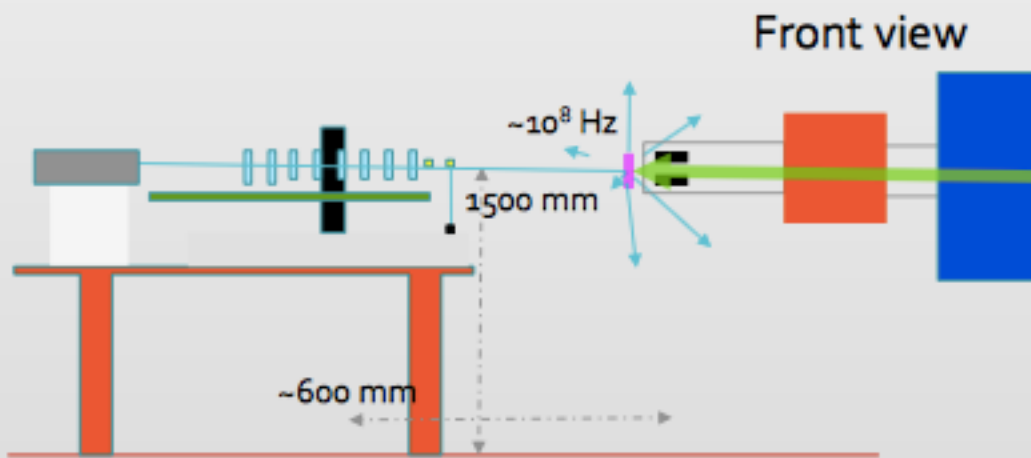
Odd/even analysis



Differences due to:

- Longer pixel (120mm vs 90mm)
- Different SiPM model

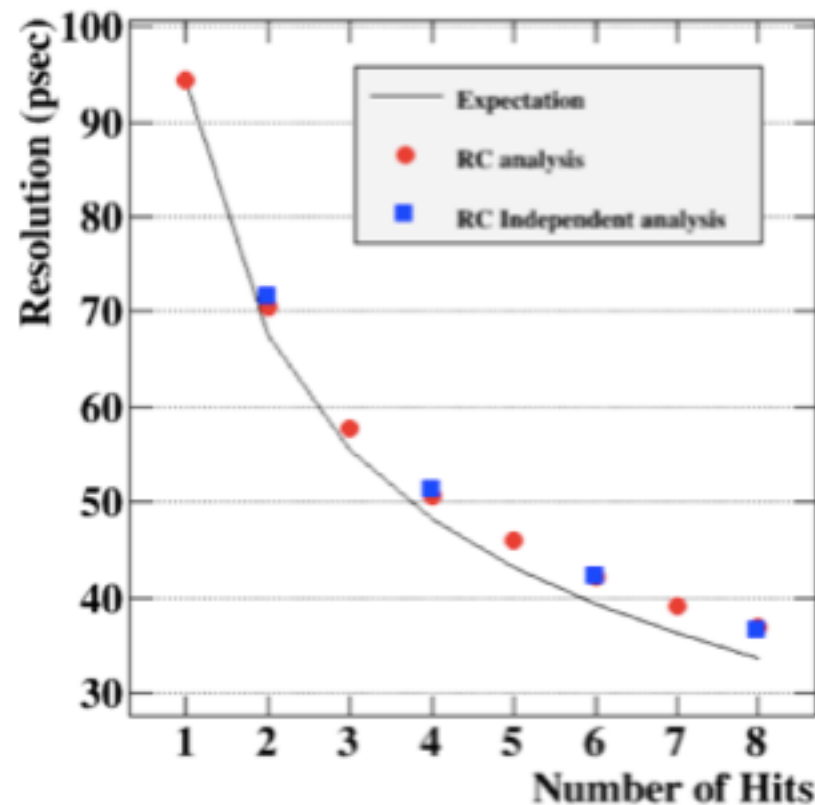
- e^+ from Michel decay
- hit rate as expected in MEG II



- μ -beam ($\pi e5@PSI$), $\sim 10^8$ Hz DC beam
- **8 counters** mounted on **backplanes**
 - 6 $120 \times 40 \times 5 \text{ mm}^3$ + 2 $120 \times 50 \times 5 \text{ mm}^3$
 - **final pixel layout**
 - 2 RC counters (trigger/selection)
 - BGO calorimeter (beam monitoring)

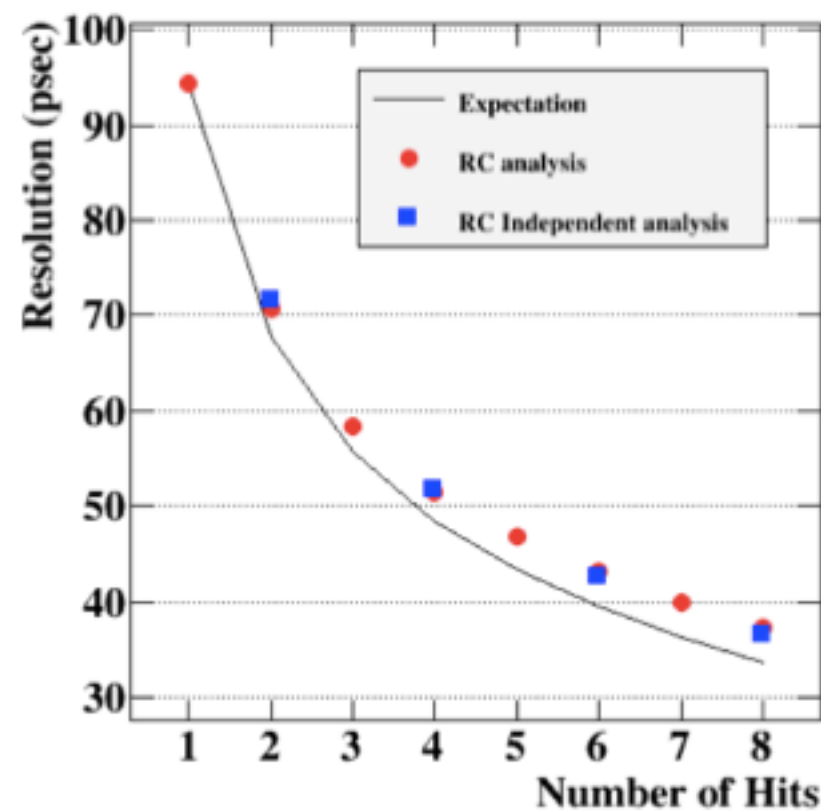
20-60KHz

Resolution vs. Number of Hits (lower rate)



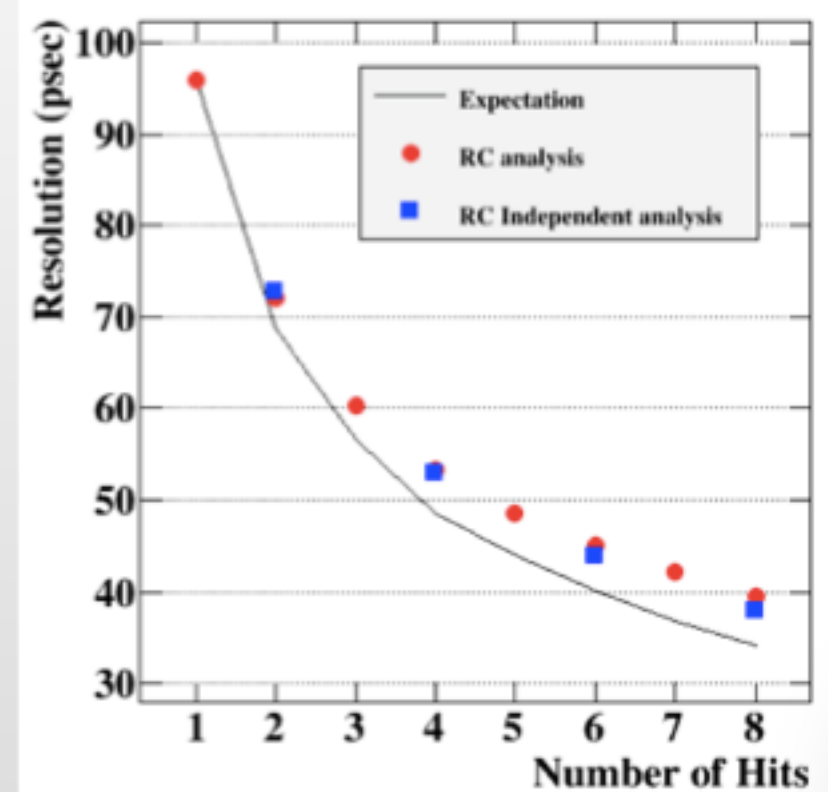
50-150KHz (MEG expected)

Resolution vs. Number of Hits (expected rate)



90-290KHz

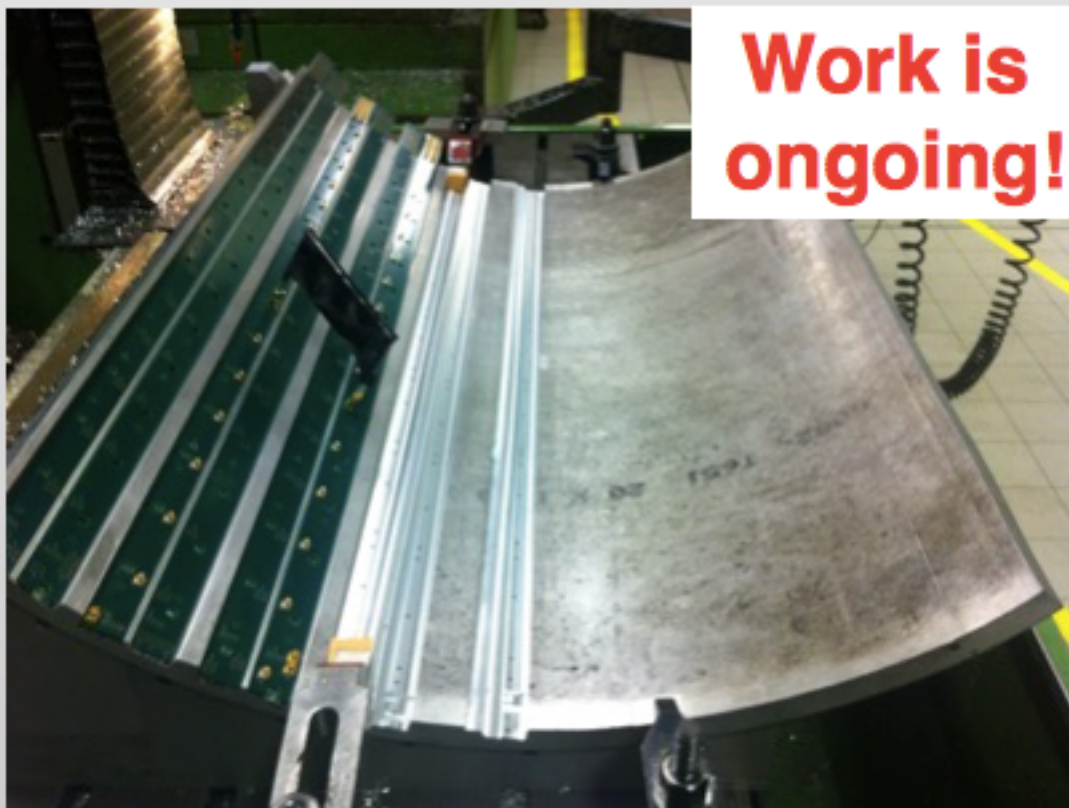
Resolution vs. Number of Hits (higher rate)



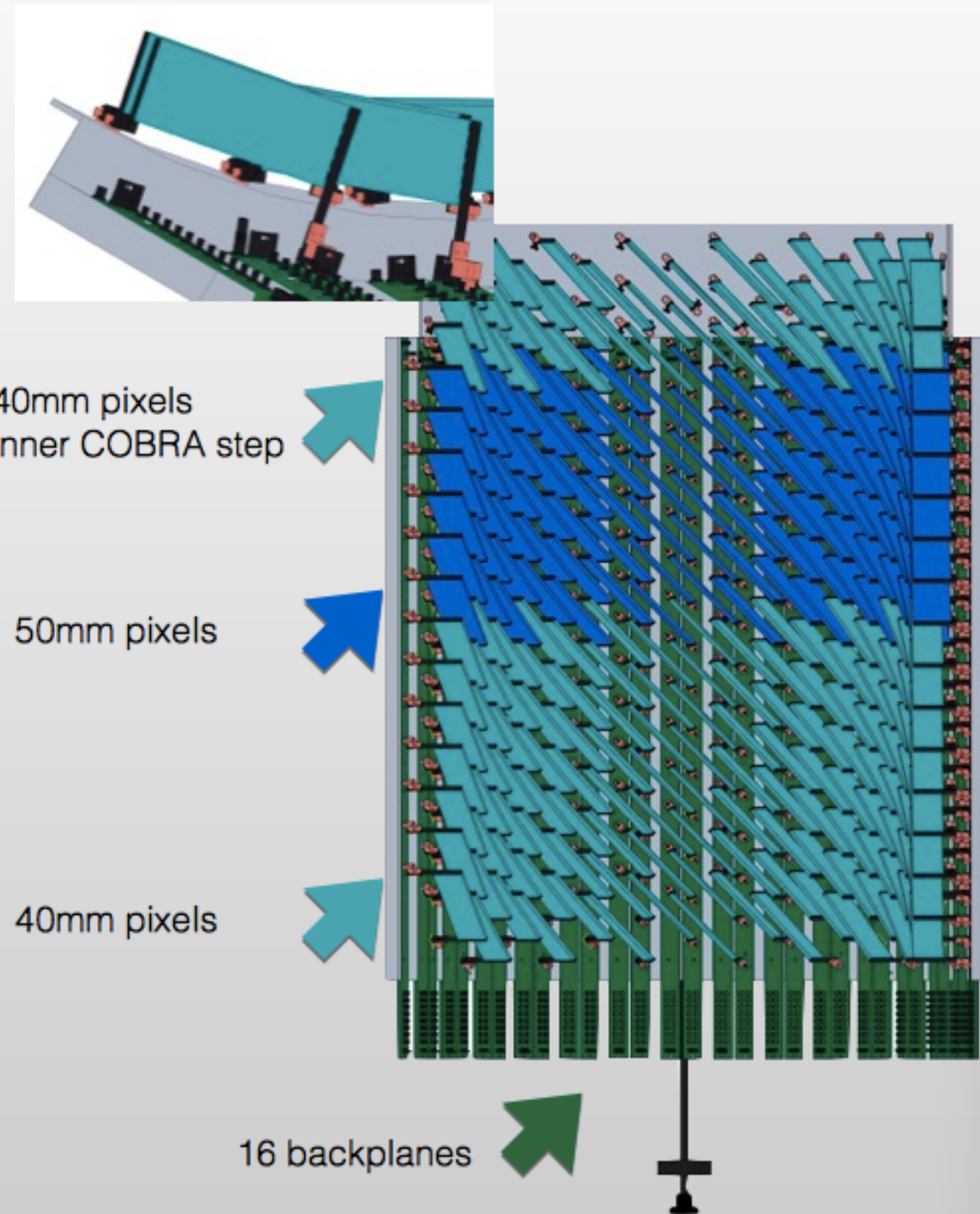
Resolution does not depend from beam rate in the range ~20-300 kHz.

~35ps resolution was found at the expected MEG II rate (~150 kHz).

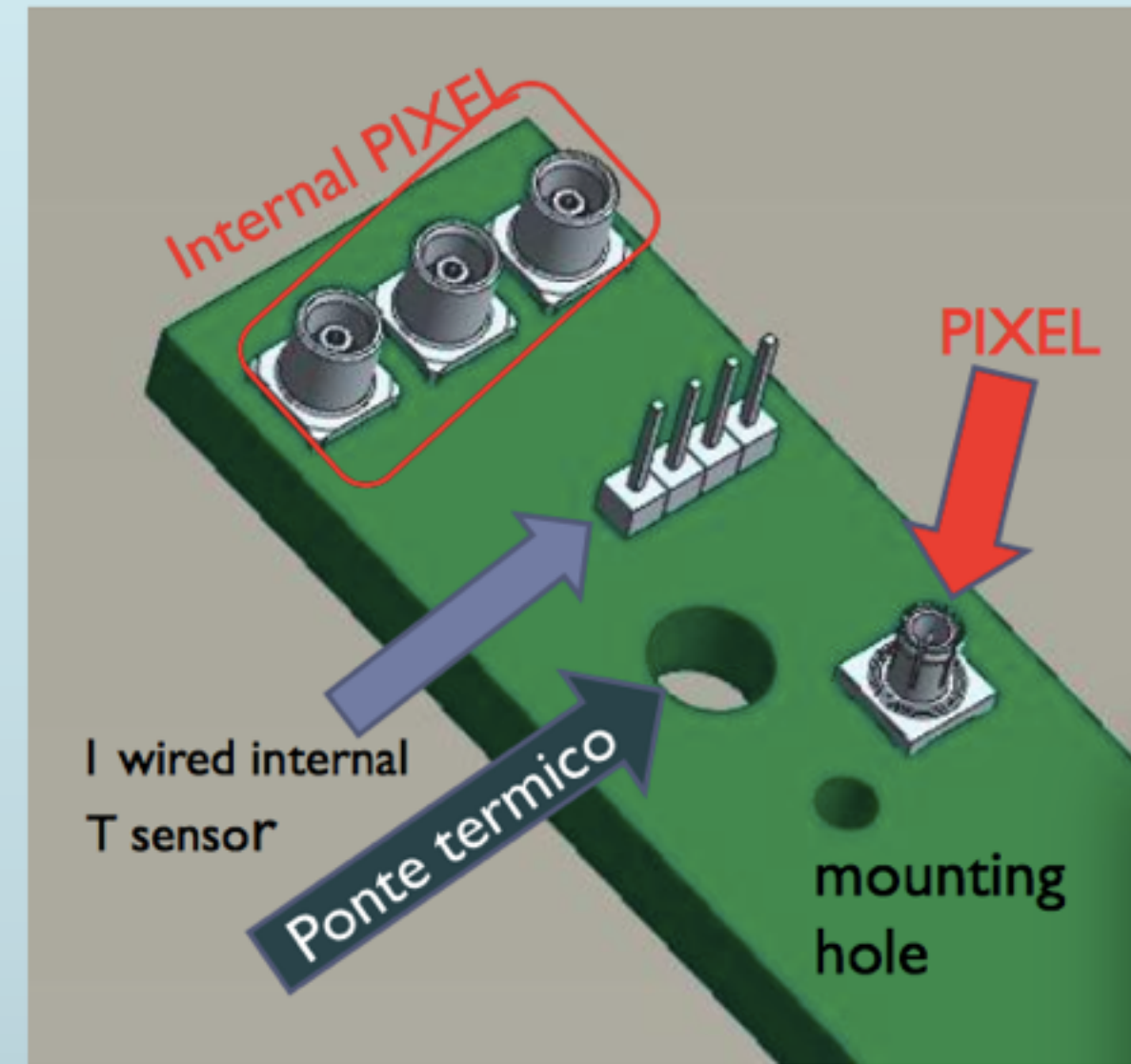
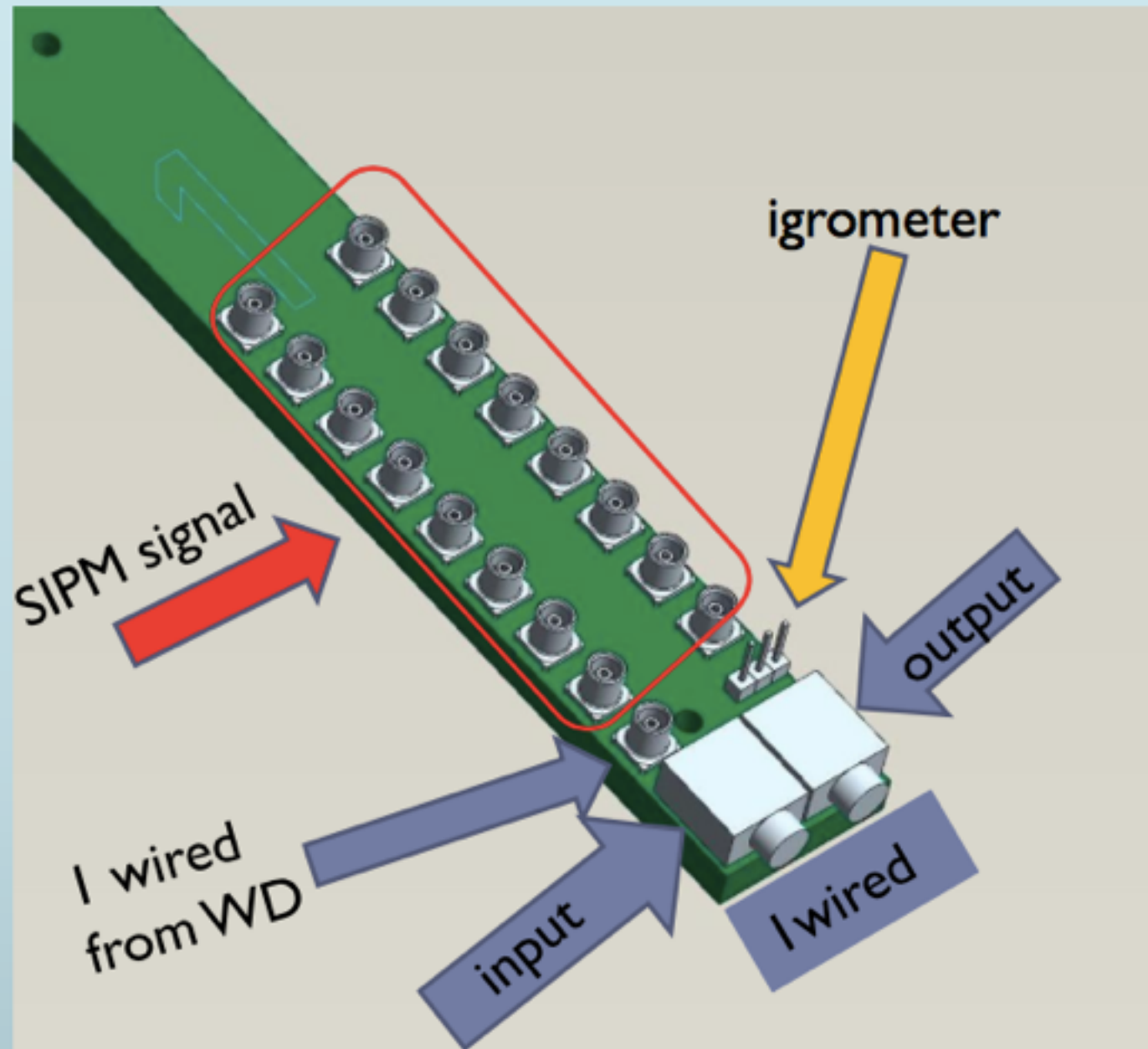
- 256 **pixels** connected to **backplanes**
- **different heights** in different TC regions.
- optimized layout (fit mechanical constraints from magnet and DCH).
- expected reso $\sim 30/35$ ps



Work is ongoing!



details



- Contributi significativi
- Matteo De Gerone: coordinamento Design/Fab/Test
- F.Siccardi: Pixel & bus PCB design/fab/test
- A. Bevilacqua: Integration and Test

Anagrafica

Anagrafica MEG-1

	MEG
Gatti F	40
De Gerone M	80
Biasotti M	40
Pizzigoni G	80
totali FTE	2.4

Impegni servizi

EXP	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	SEPTEMBER	OCTOBER
MEG	Off.Mec.: End of Fabrication and Commissioning 4 mu								
Strutt Timing Counter Commissioning	Dis.Mec.: Final support 2 mu								