

# Tracking detectors

Plamen Boutachkov

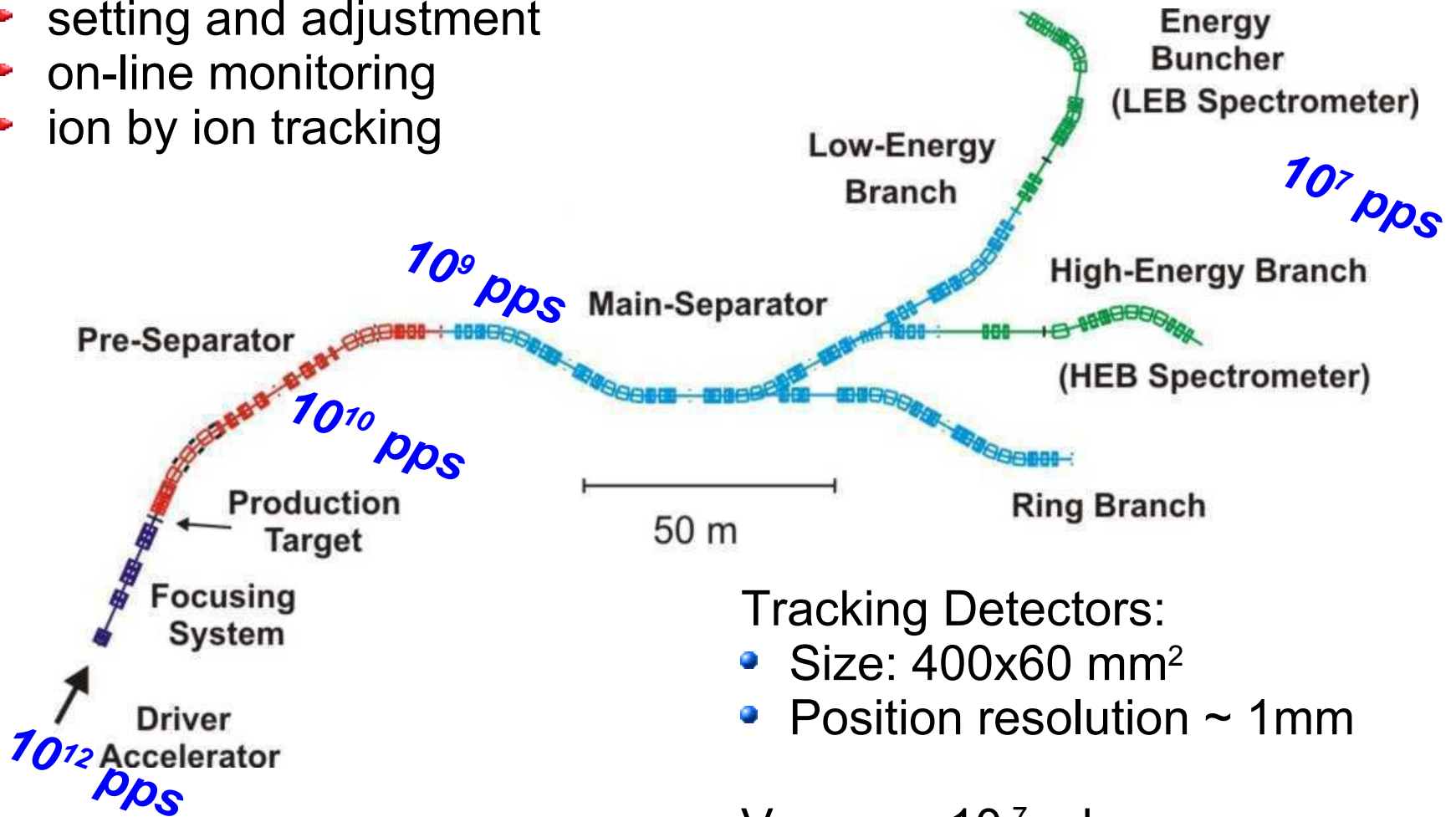
GSI, Darmstadt, Germany

- "Tracking on FRS and Super FRS." B. Sitar
- "R&D of a large area in-beam scintillation detector for fast-timing measurements with relativistic heavy-ion beams." R. Hoischen
- "Results from the slowed down beam test at GSI" Plamen Boutachkov
- "Development of a large scale, sed-based beam profile monitor" M. Pfeiffer
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# Super-FRS

Detectors for:

- setting and adjustment
- on-line monitoring
- ion by ion tracking

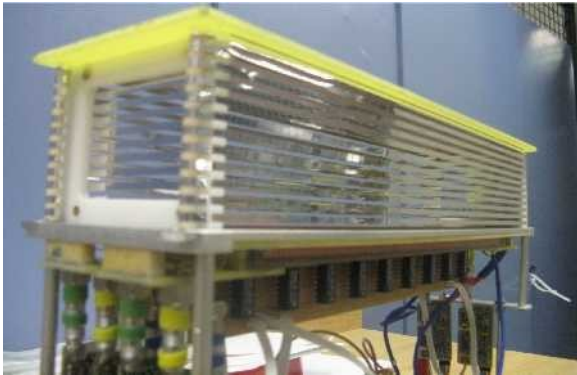


Tracking Detectors:

- Size:  $400 \times 60 \text{ mm}^2$
- Position resolution  $\sim 1 \text{ mm}$

Vacuum:  $10^{-7}$  mbar

# C-pad TPCs



- TPC field cages of 24 cm wide and 6, 8, 10 or 12 cm high are available
- 7 TPCs with complete electronics are available on FRS for measurements on the air
- 3 TPCs are available on FRS for measurements in vacuum
- Internal resolution of TPC in x-direction of  $\sigma_x = 88 \mu\text{m}$  has been reached
- Internal resolution of TPC in y-direction of  $\sigma_y = 38 \mu\text{m}$  has been reached
- Tracking efficiency better than 97% for  $^{238}\text{U}$  ions at 1 GeV/u is available up to 100 kHz ion intensity

# Beam Profile Monitor

active volume :  $240 \times 120 \times 6 \text{ mm}^3$

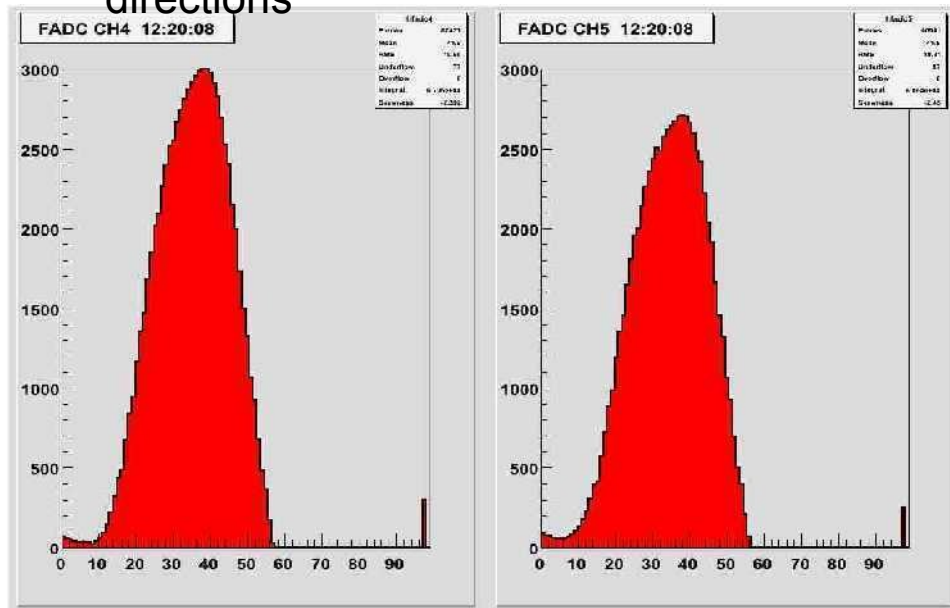
fast extracted  $^{12}\text{C}$  beam, energy 200-400MeV/u

intensity:  $10^4 - 1.6 \cdot 10^9$  part./spill

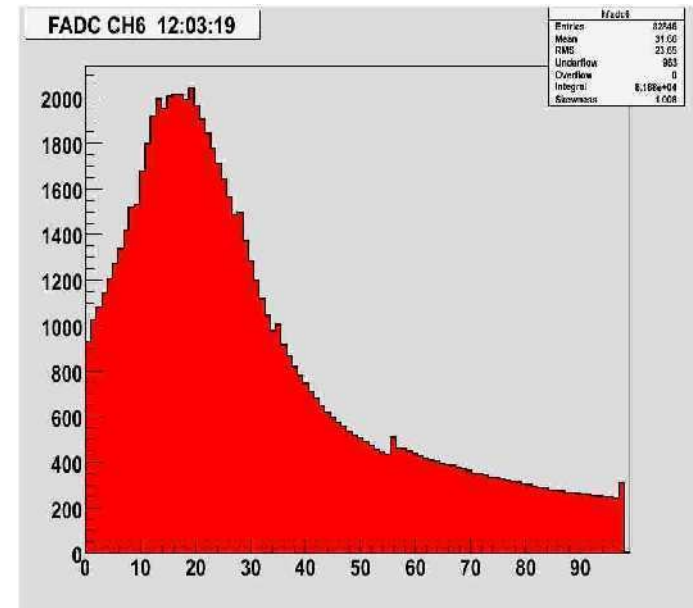
spill length : 300ns



beam profile in X and Y directions



Z profile (spill structure)

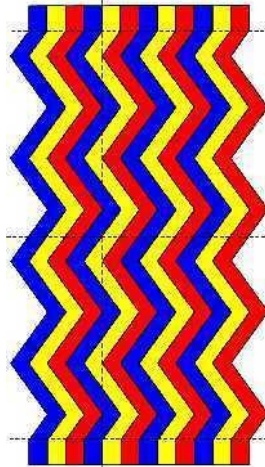


## ***GEM TPC development***

- 3 stage GEM stack has been developed and tested at Helsinki Lab.
- Field cage, gas box, chevron + delay line read-out and electronics has been developed and tested at Bratislava Lab.
- Tests with  $^{55}\text{Fe}$  source were performed at Bratislava Lab.
- Tests on the ion beam were performed on FRS at GSI



**Chevron structure for a GEM TPC**

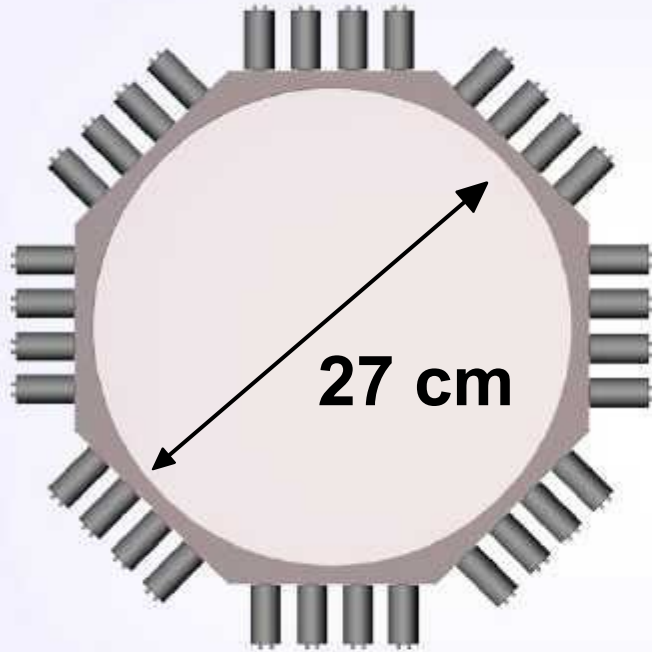


$$\sigma_x \approx 400 \mu\text{m}$$

$$\sigma_y \approx 300 \mu\text{m}$$

**intensities over 100 kHz should be developed and tested**

# Ultra-Fast timing



More PMTs ->  
Cover more solid angle  
+ Less "dead spots"

Set-up:  
32 PMTs on BC-420  
CFDs+TDC (25ps/bin)

Needs:  
Very good position info  
(tracking) for correction

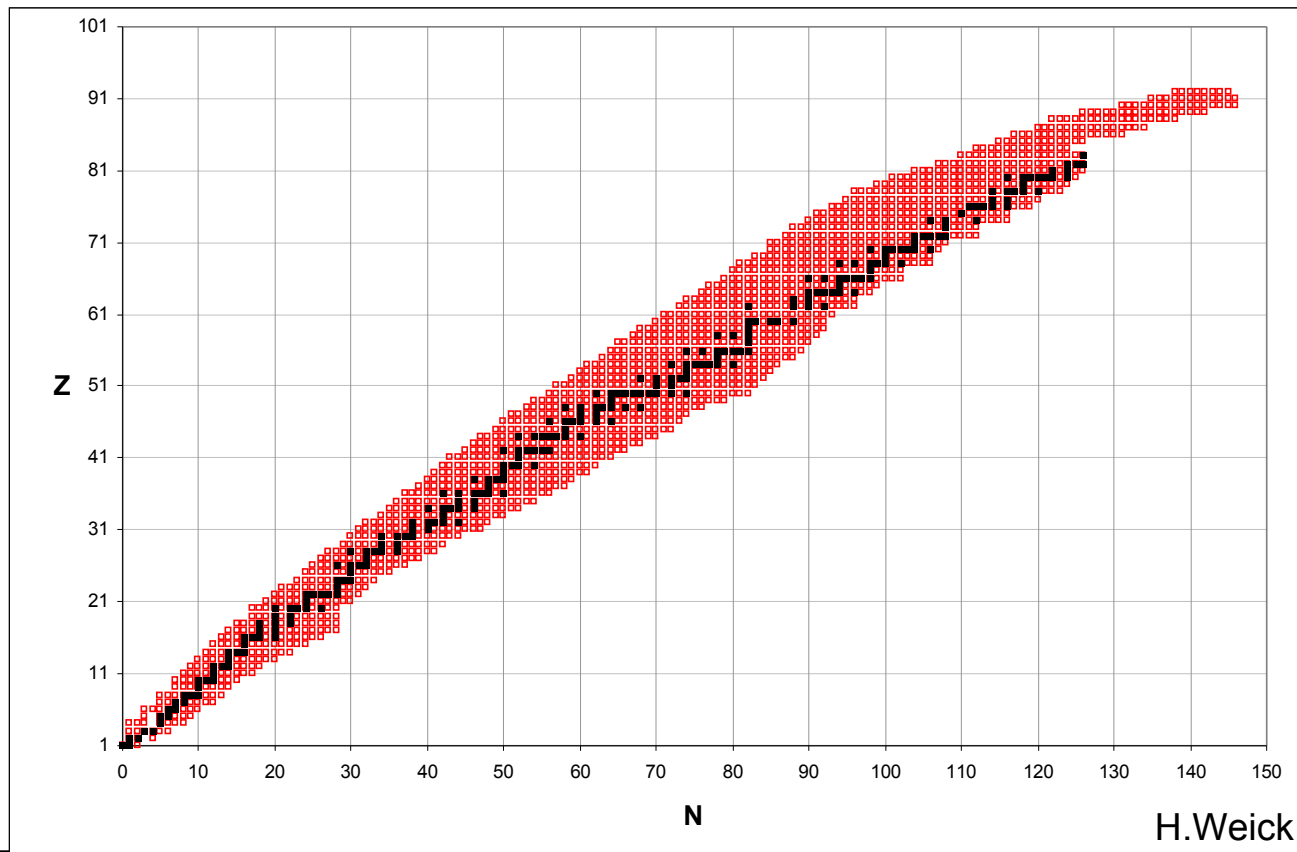
FRS000:  
12 ps, 10 ps sigma  
with position correction

LYCCA-0:  
Start 12ps sigma  
Stop 15ps sigma  
without position corr.

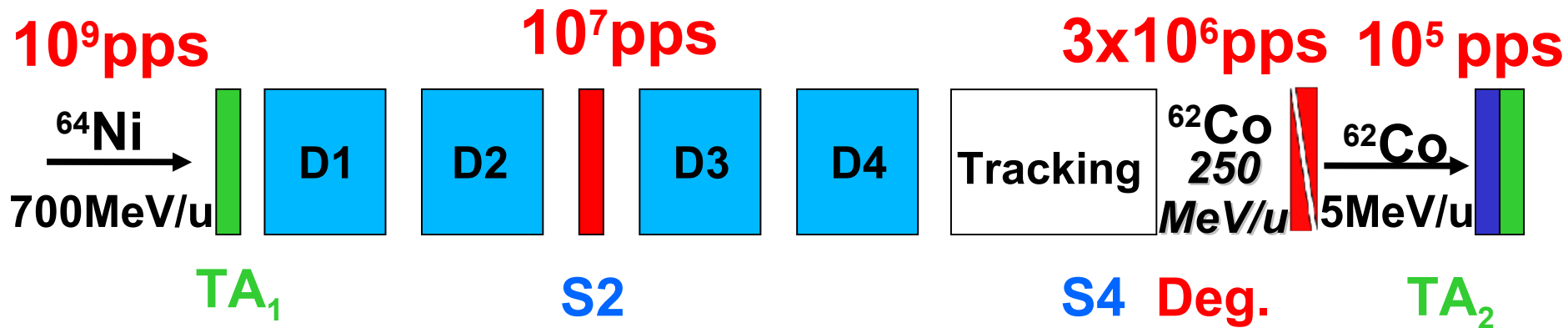
# *Objective of the slowed down beams projects at GSI*

Obtain *5 MeV/u* to *10 MeV/u* RIB to be used for secondary reaction studies at Super FRS

*RIB with sufficient luminosity for slow down experiments at S-FRS*



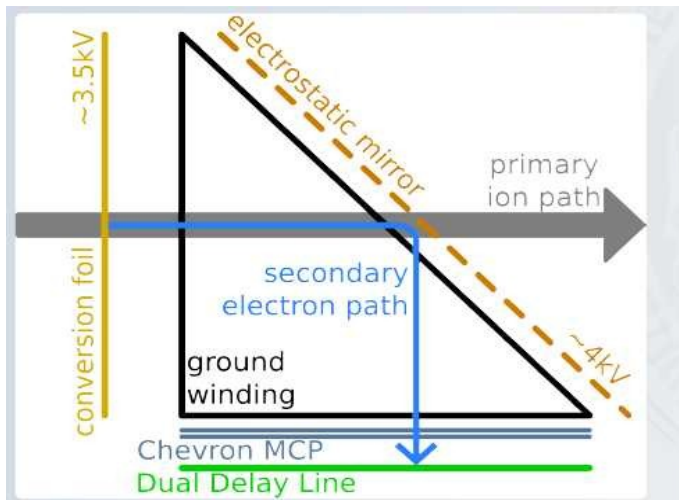
# Slowed down beams projects and FRS



- 80 % of the beam particles survived slowing down.
- Energy spread after slowing down to 10 MeV/u is 8 MeV/u.  
The predicted energy spread is 9 MeV/u.
- Contaminants due to the reactions in the degrader are of the order of 2%



# Development of large scale SeD



## Tentative specs

- active area 80 x 100 mm<sup>2</sup>
- overall transparency per unit >70 %
- TOF resolution in sub-ns region
- spatial resolution ~1 mm

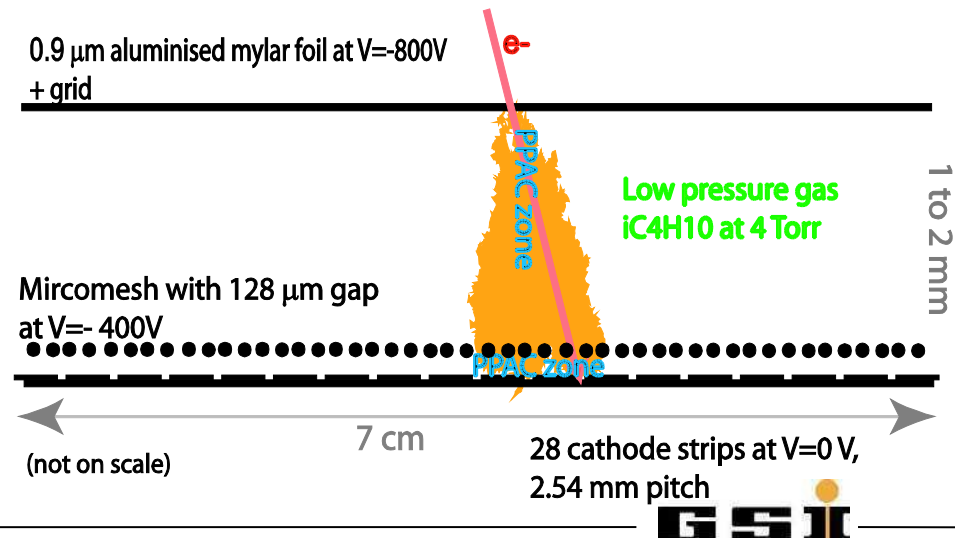
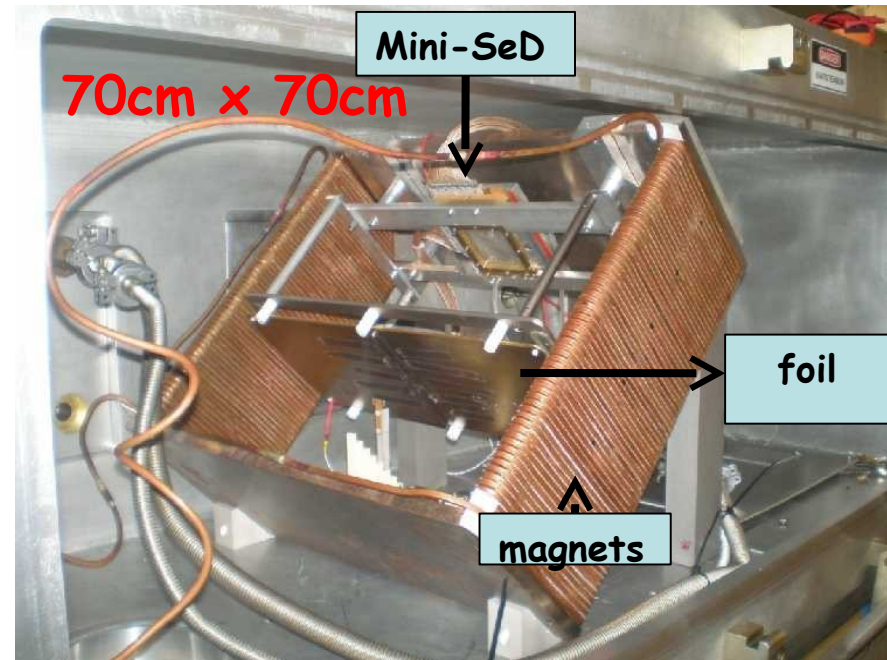
	measured FWHM [mm]	simulated FWHM [mm]
X1	10.197(5)	7.388(273)
X2	17.930(5)	11.164(685)
Y1	7.766(3)	7.425(243)
Y2	13.776(45)	10.981(625)

$\Delta T(\text{FWHM}) \sim 200\text{ps}$

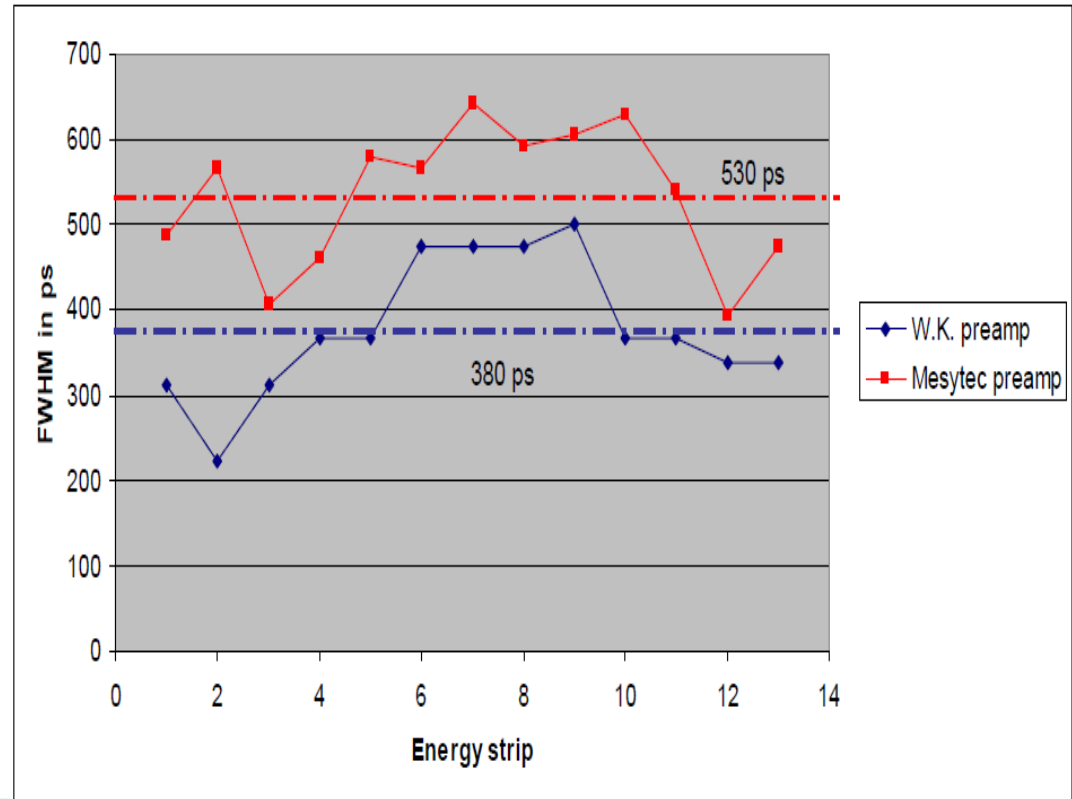
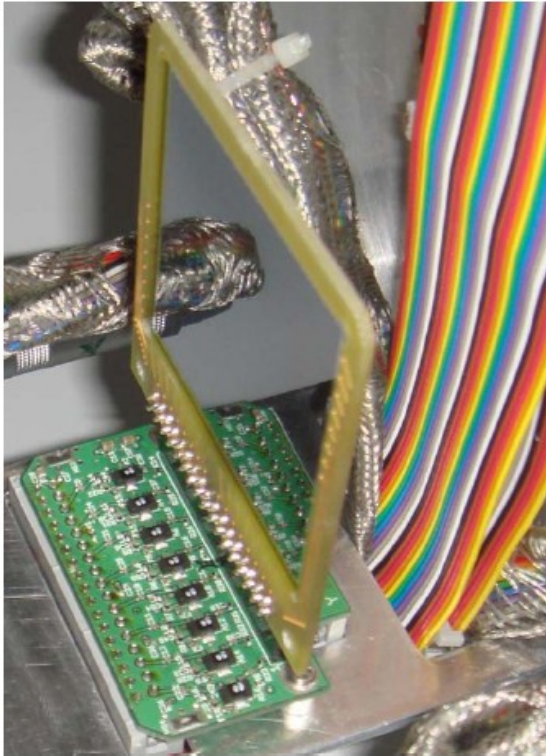
150 mm active area diameter, circle shaped MCPs are available

# Low Pressure Gas Detectors

- A prototype of beam tracking detector has been built at Saclay. mini-SeD. Tests have been carried out and an in-beam experiment at GANIL has been performed.
- The miniSe-D shows a time resolution of  $(150 \pm 80 \text{ ps})$  and a spacial resolution of  $(\text{FWHM} = 1,3 \pm 0,1 \text{ mm})$ .
- A 2D SeD prototype and a **Micromegas prototype** have been also tested, with similar characteristics
- The SeD prototypes have been proved with beam intensities of  $10^6$  pps, and work well, although time resolution is worse (170 ps for 2D-SeD).
- A new preamplifier for SeD, based on CPLEAR, has been developed. Test with pulser show that it has lower noise and higher amplification.



# Fast timing with Si-detectors



- MFA-32, Mesytec
- 32ch fast preamplifier
- Eight fast outputs
- Position obtained through readout of a resistive chain

# Tracking detectors

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