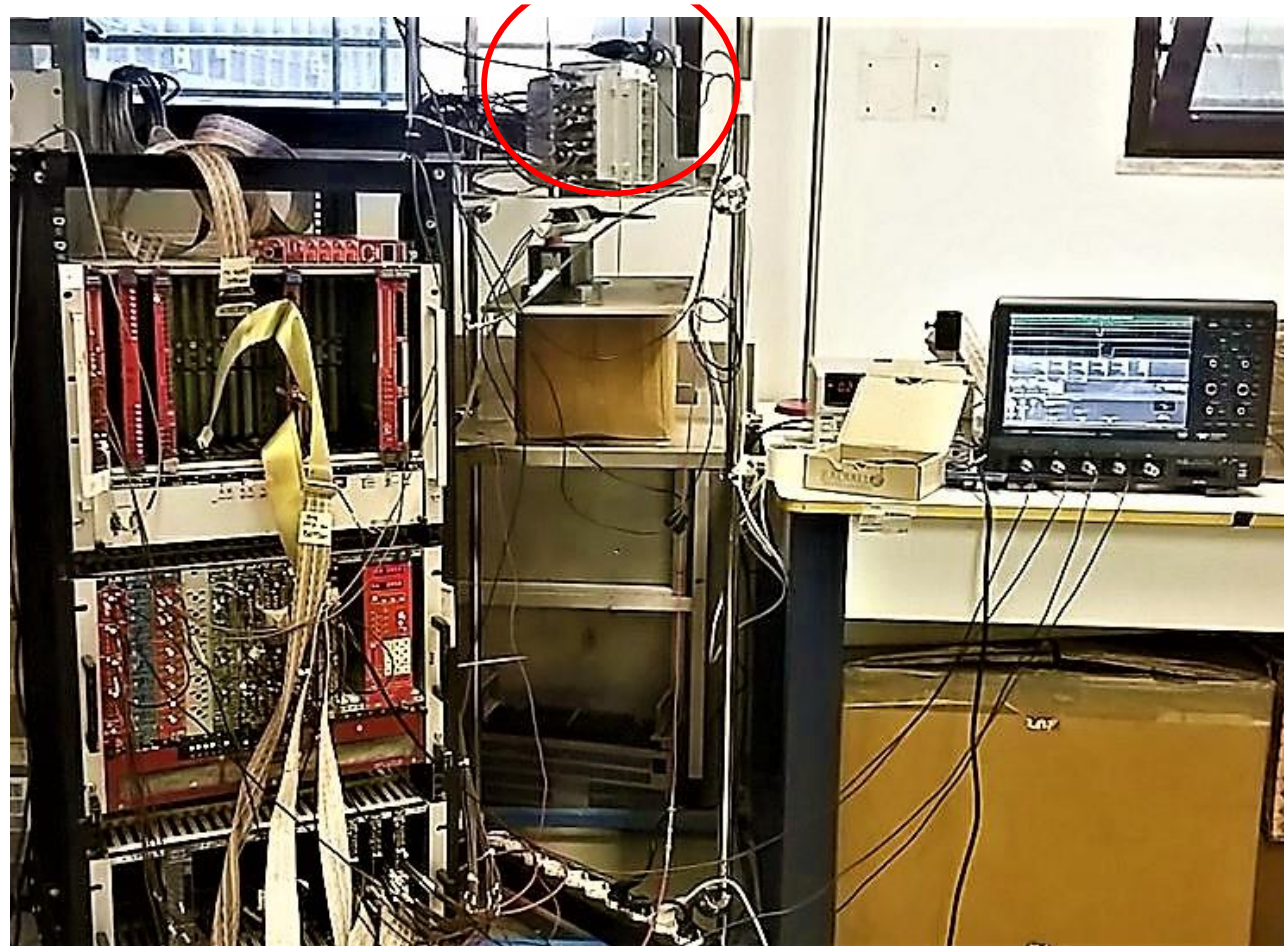# BEAM MONITOR STATUS

G. Battistoni, S. Brambilla, C. Boiano, Y. Dong, F. Gargano, I. Mattei, S. M. Valle

S. Colombi, M. Durante, S. Hild, C. La Tessa, M. Rovituso, P. Spinnato, F. Tommasino, E. Verroi

M. Marafini, R. Mirabelli, V. Patera, A. Sarti, A. Sciubba, G. Traini

FOOT Collaboration Meeting – 5/12/2017

- Dimensions: 11 cm x 11 cm x 20 cm.

- 2 layers of mylar at the beam entrance and exit.

- 12 consecutive staggered layers. (alternated horizontal and vertical wires)

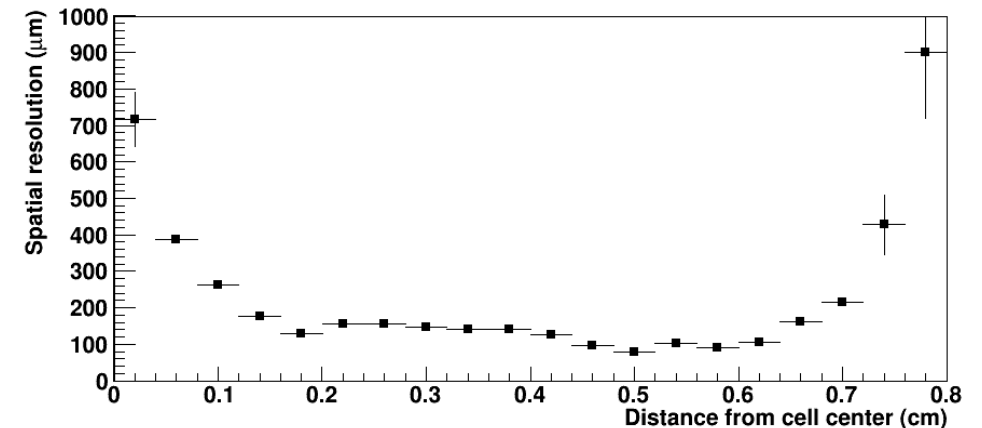- Each layer is composed of three rectangular cells, 16 mm × 10 mm (for a total of 36 cells).
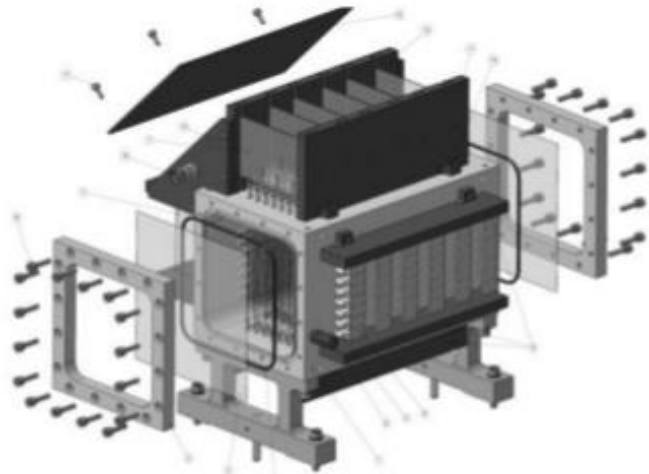
- Efficiency and resolution for protons and carbon ions at 80 MeV/u (LNS):
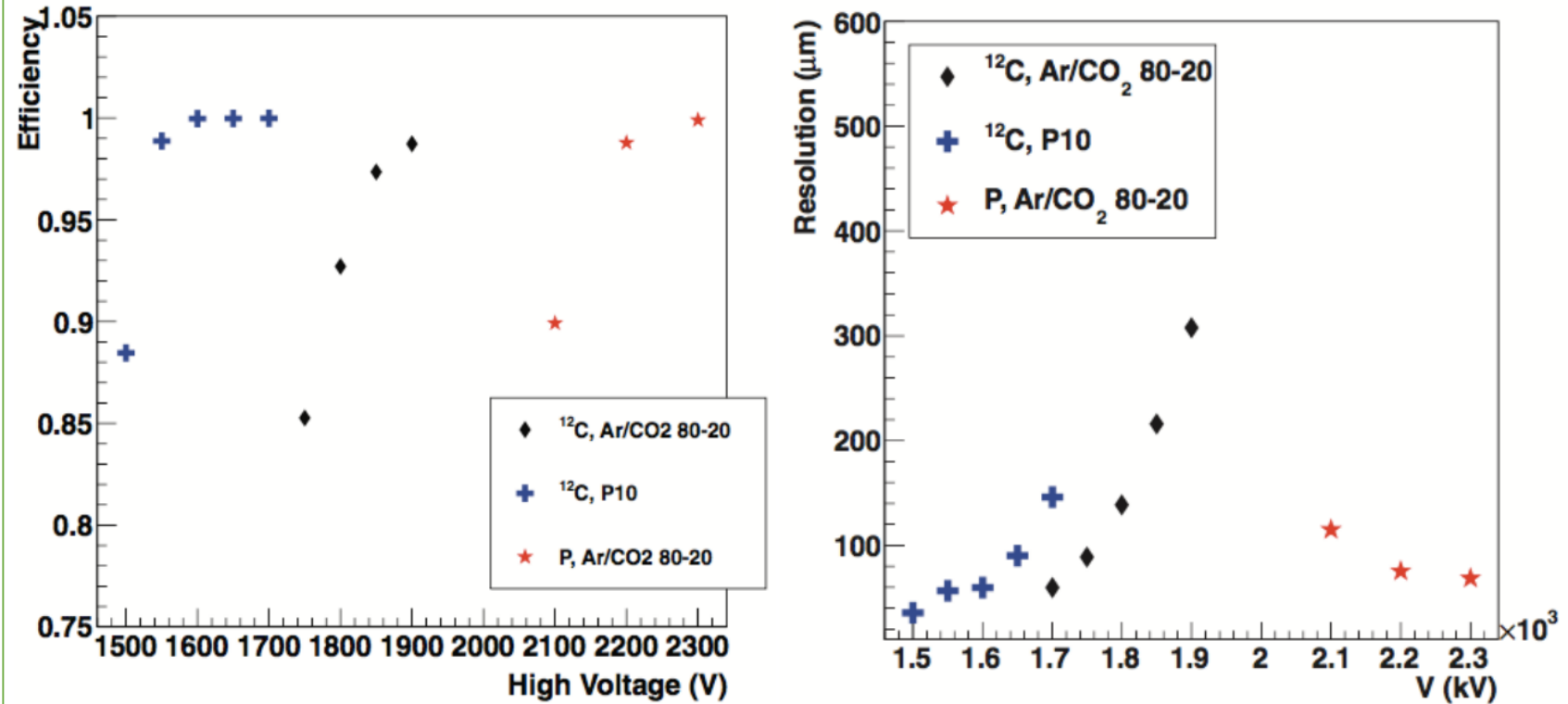
Paoloni 2012, Physics Procedia

- Resolution:
  12C at 400 MeV/u
  1.8 kV
  Ar/CO2 at 80/20
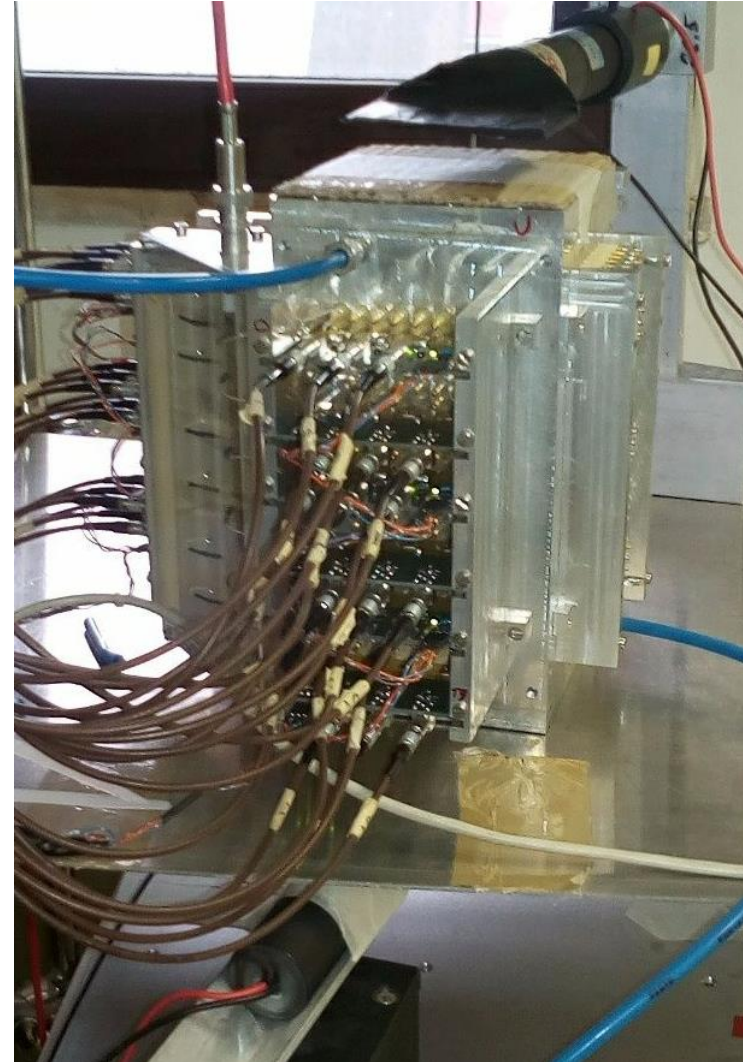 (GSI)

Abou-Haidar 2012, Jinst

2

BEAM MONITOR: THE RESTART

❖ **Purpose**

-Learn the hardware and the acquisition software adopted in the FIRST experiment.
-Restart the BM, check it's conditions detecting cosmic rays.

BEAM MONITOR: THE RESTART

❖ **Purpose**
-Learn the hardware and the acquisition software adopted in the FIRST experiment.
-Restart the BM, check it's conditions detecting cosmic rays.

❖ **Test experimental setup**
-BM placed between two scintillators read in coincidence used as external triggers.
-Gas system with Ar/CO_2 at 80/20 set "by eye".
-HV and LV power supply.
-2 x Phillips 7106 Camac discrimitator (16 Ch).
-CAEN V1190B TDC multihit (64 Ch).
-CAEN V1718 VME-USB2.0 Bridge.
-CAEN N93B Dual timer module.
-Analog discriminator and coincidence unit

BEAM MONITOR: THE RESTART

❖ **Purpose**
 -Learn the hardware and the acquisition software adopted in the FIRST experiment.
 -Restart the BM, check it's conditions detecting cosmic rays.

❖ **Test experimental setup**
 -BM placed between two scintillators read in coincidence used as external triggers.
 -Gas system with Ar/CO_2 at 80/20 set "by eye".
 -HV and LV power supply.
 -2 x Phillips 7106 Camac discrimitator (16 Ch).
 -CAEN V1190B TDC multihit (64 Ch).
 -CAEN V1718 VME-USB2.0 Bridge.
 -CAEN N93B Dual timer module.
 -Analog discriminator and coincidence unit

❖ **Reminder: FOOT BM electronics**
 -LV and HV power supply: MX100TP and N1470
 -TDC multihit (64 Ch): V1190B
 -Discriminator with ECL outputs: V895
 -Logic unit: N405/N455
 -Dual timer: N93B
 -Other modules: fan-in fan-out (N625), Scaler (V830)

5

BEAM MONITOR: THE RESTART

❖**Acquisition parameters**
-BM signals threshold set to 17 mV
-V1190B TDC: read the discriminated signals in a
2 μs time window, centered on the trigger time.
(5 ns double hit resolution).

TDC 64 channels

V1190B-2eSST

64 Channel Multihit TDC (100/200/800 ps)

- 3 programmable ranges: 100 ps LSB (19 bit resolution), 200 ps LSB (19bit) and 800 ps LSB (17 bit)
- ECL/LVDS inputs automatically detected
- 5 ns Double Hit Resolution
- Leading and Trailing Edge detection
- Trigger Matching and Continuous Storage acquisition modes
- 32 k x 32 bit output buffer
- MBLT, CBLT and 2eSST data transfer
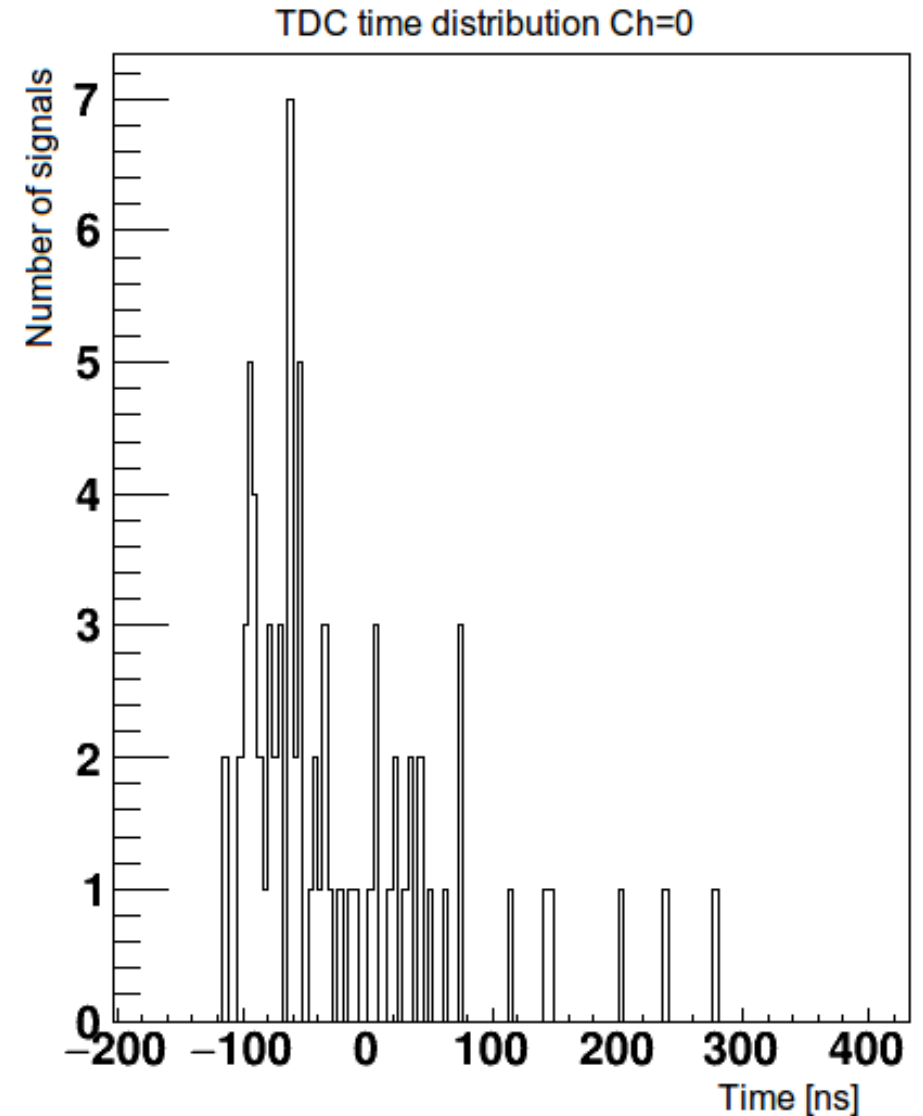- Multicast commands
- Live Insertion

BEAM MONITOR: THE RESTART

❖ **Acquisition parameters**
-BM signals threshold set to 17 mV
-V1190B TDC: read the discriminated signals in a
2 μs time window, centred on the trigger time.
(5 ns double hit resolution).

❖ **T0 evaluation**
-External trigger and BM signals time
information are biased by cables and electronics.
-Need high statistics to determine the minimum
arrival time for each BM readout channel.

TDC time distribution Ch=0

BEAM MONITOR: THE RESTART

❖ **Acquisition parameters**
-BM signals threshold set to 17 mV
-V1190B TDC: read the discriminated signals in a 2 μs time window, centred on the trigger time. (5 ns double hit resolution).

❖ **T0 evaluation**
-External trigger and BM signals time information are biased by cables and electronics.
-Need high statistics to determine the minimum arrival time for each BM readout channel.

❖ **Number of signals read by each cells**
- Great differences (min=56, max=198)

Chamber Occupancy

158	110	112	106	108	107	156	185	99	124	75	152
87	105	113	115	99	89	198	140	155	140	146	150
76	114	86	99	121	138	101	56	109	78	158	99

0 1 2 3 4 5 6 7 8 9 10 11

BEAM MONITOR: THE RESTART

❖ **Acquisition parameters**
-BM signals threshold set to 17 mV
-V1190B TDC: read the discriminated signals in a
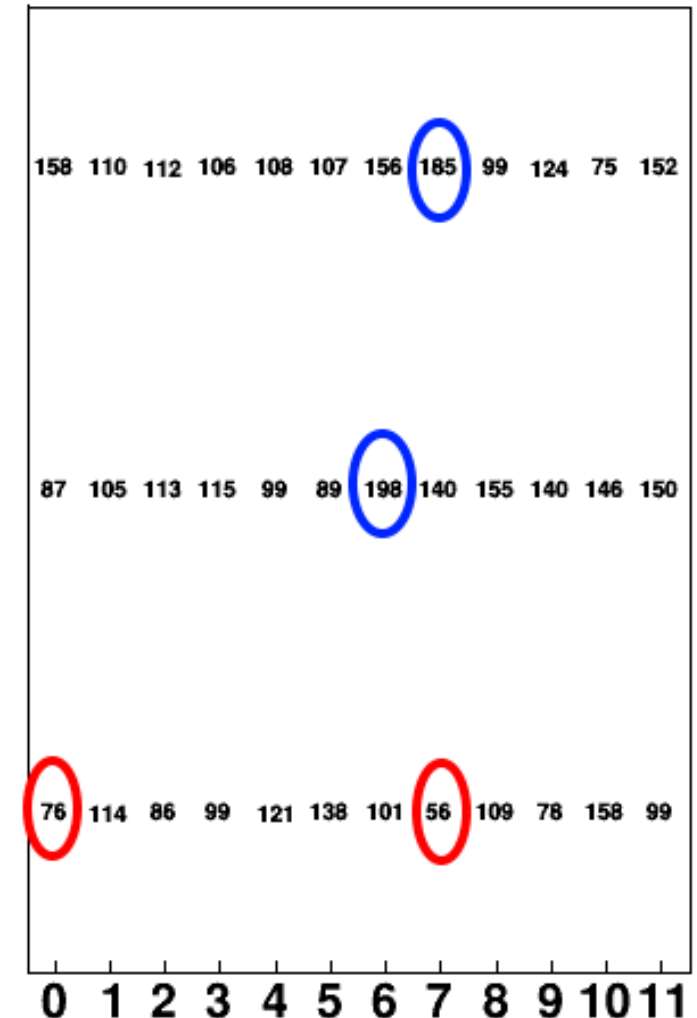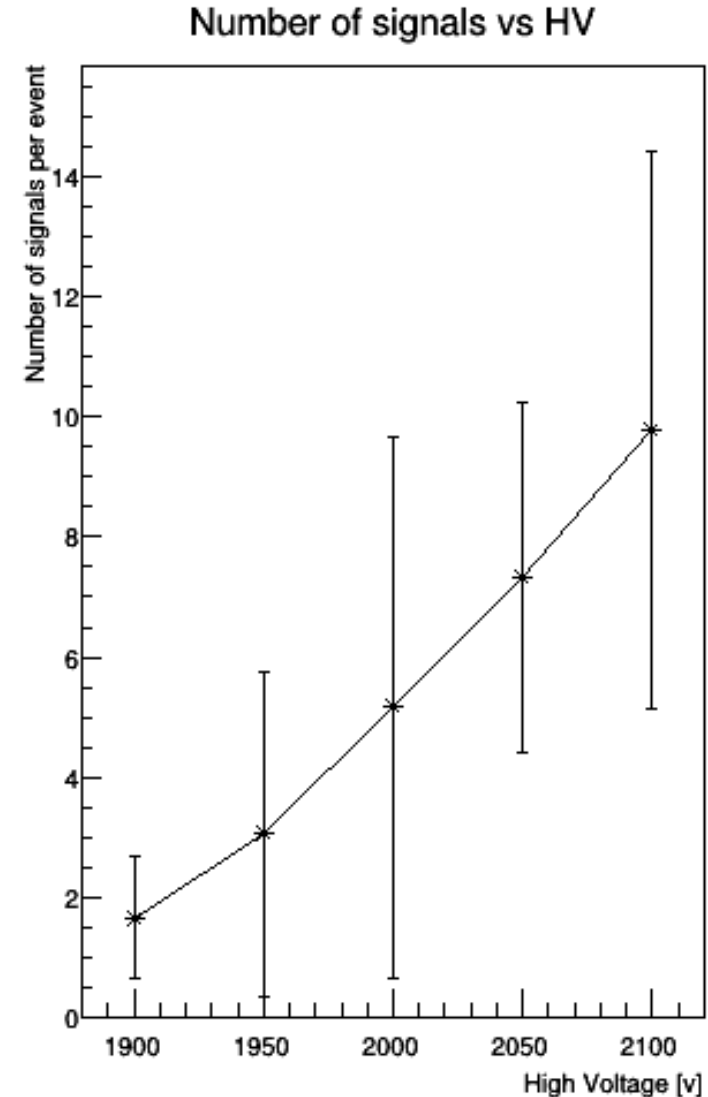2 μs time window, centred on the trigger time.
(5 ns double hit resolution).

❖ **T0 evaluation**
-External trigger and BM signals time
information are biased by cables and electronics.
-Need high statistics to determine the minimum
arrival time for each BM readout channel.

❖ **Number of signals read by each cells**
- Great differences (min=56, max=198)

❖ **Number of signals vs BM readout HV**

Number of signals vs HV

BEAM MONITOR: THE RESTART

❖ **Acquisition parameters**
   -BM signals threshold set to 17 mV
   -V1190B TDC: read the discriminated signals in a
   2 μs time window, centred on the trigger time.
   (5 ns double hit resolution).

❖ **T0 evaluation**
   -External trigger and BM signals time
   information are biased by cables and electronics.
   -Need high statistics to determine the minimum
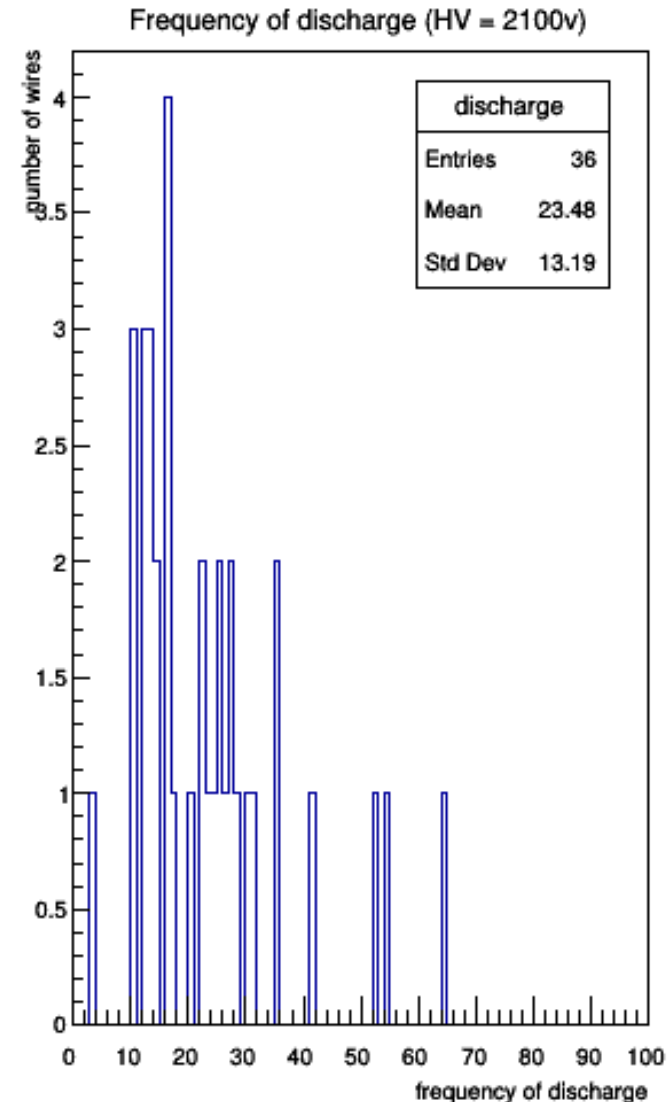   arrival time for each BM readout channel.

❖ **Number of signals read by each cells**
   - Great differences (min=56, max=198)

❖ **Number of signals vs BM readout HV**

❖ **Wire discharging rate**
   -HV = 2100 v --> 23%
   -HV = 2000 v --> 14%

Frequency of discharge (HV = 2100v)

discharge
Entries   36
Mean   23.48
Std Dev   13.19

BEAM MONITOR: THE RESTART

❖ **Acquisition parameters**
  -BM signals threshold set to 17 mV
  -V1190B TDC: read the discriminated signals in a
  2 µs time window, centred on the trigger time.
  (5 ns double hit resolution).

❖ **T0 evaluation**
  -External trigger and BM signals time
  information are biased by cables and electronics.
  -Need high statistics to determine the minimum
  arrival time for each BM readout channel.

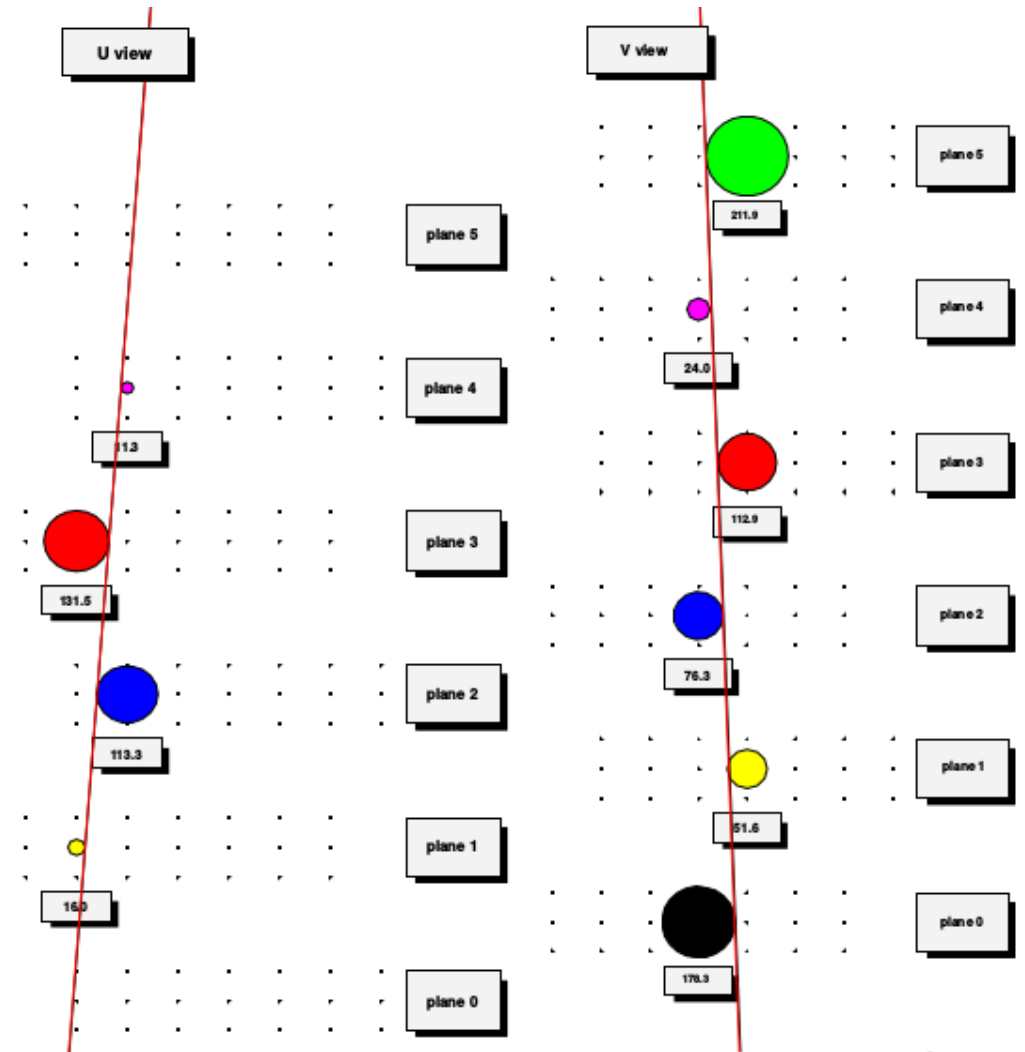❖ **Number of signals read by each cells**
  - Great differences (min=56, max=198)

❖ **Number of signals vs BM readout HV**

❖ **Wire discharging rate**
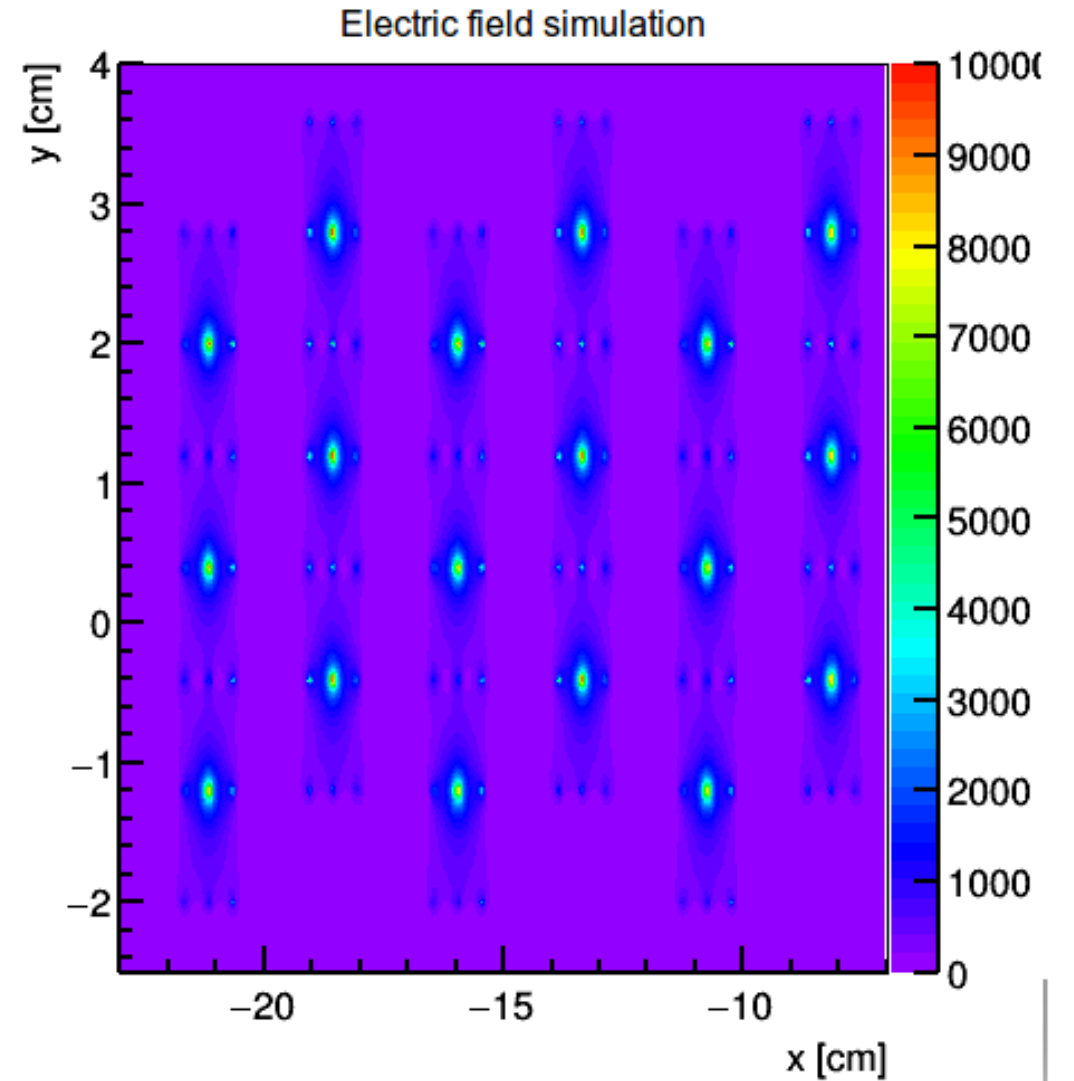 -HV = 2100 v --> 23%
  -HV = 2000 v --> 14%

❖ **Cosmic ray example (HV = 2100 v)**

TO DO LIST

❖ **Garfield++**
   -Drift parameters estimation.
   -Gas choice.

Electric field simulation

TO DO LIST

❖ **Garfield++**
   -Drift parameters estimation.
   -Gas choice.

❖ **Shoe reconstruction software**
   -Multi track reconstruction capability.
   -Simulation of particle waveforms and the electronics parameters (threshold, TDC etc.).

Amplitude [v]
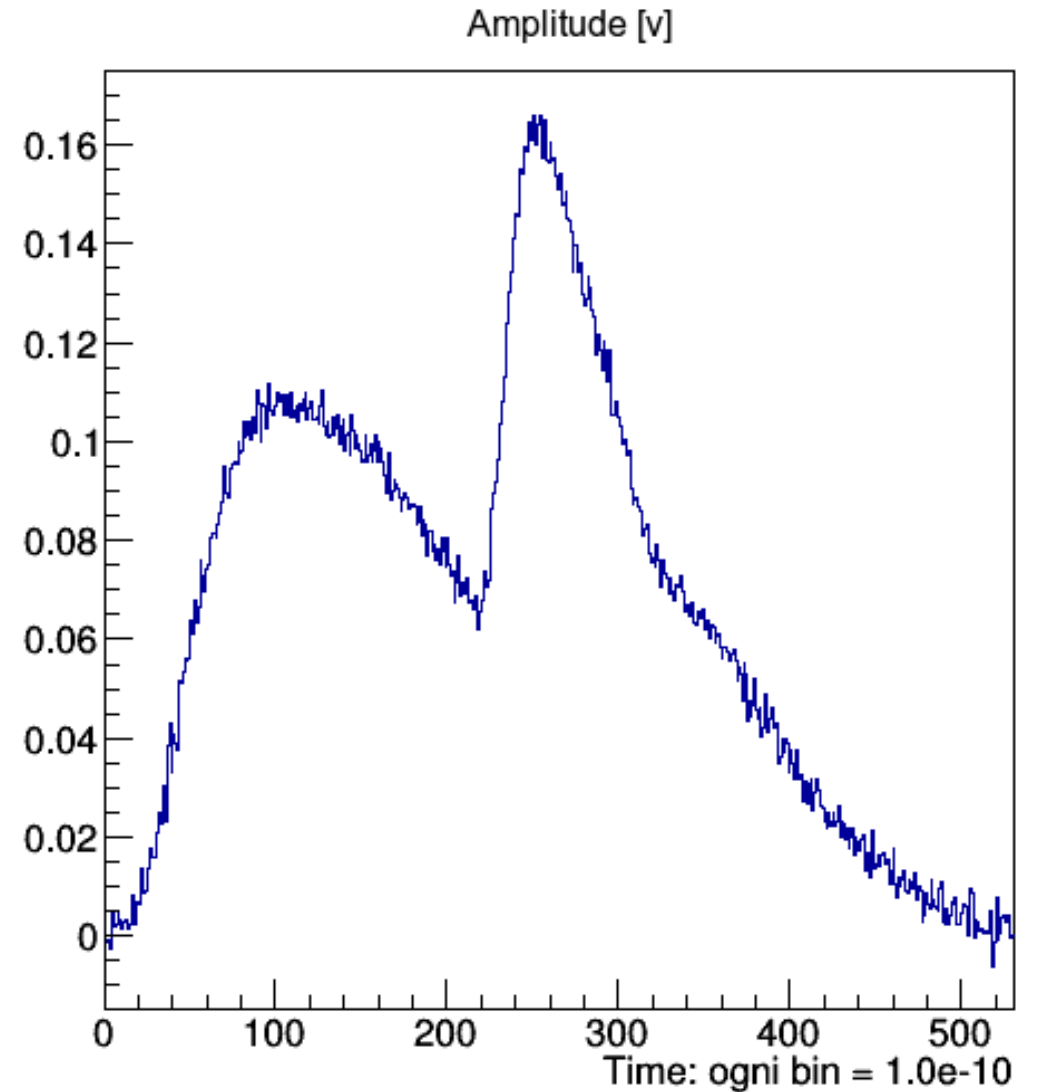
Time: ogni bin = 1.0e-10

TO DO LIST

❖ **Garfield++**
  -Drift parameters estimation.
  -Gas choice.

❖ **Shoe reconstruction software**
  -Multi track reconstruction capability.
  -Simulation of particle waveforms and the electronics parameters (threshold, TDC etc.).

❖ **Set up the gas system and the BM + Start counter mechanics (till first half of 2018)**

Figure 15. Interaction Region installation at GSI.

TO DO LIST

❖ **Garfield++**
   -Drift parameters estimation.
   -Gas choice.

❖ **Shoe reconstruction software**
   -Multi track reconstruction capability.
   -Simulation of particle waveforms and the electronics parameters (threshold, TDC etc.).

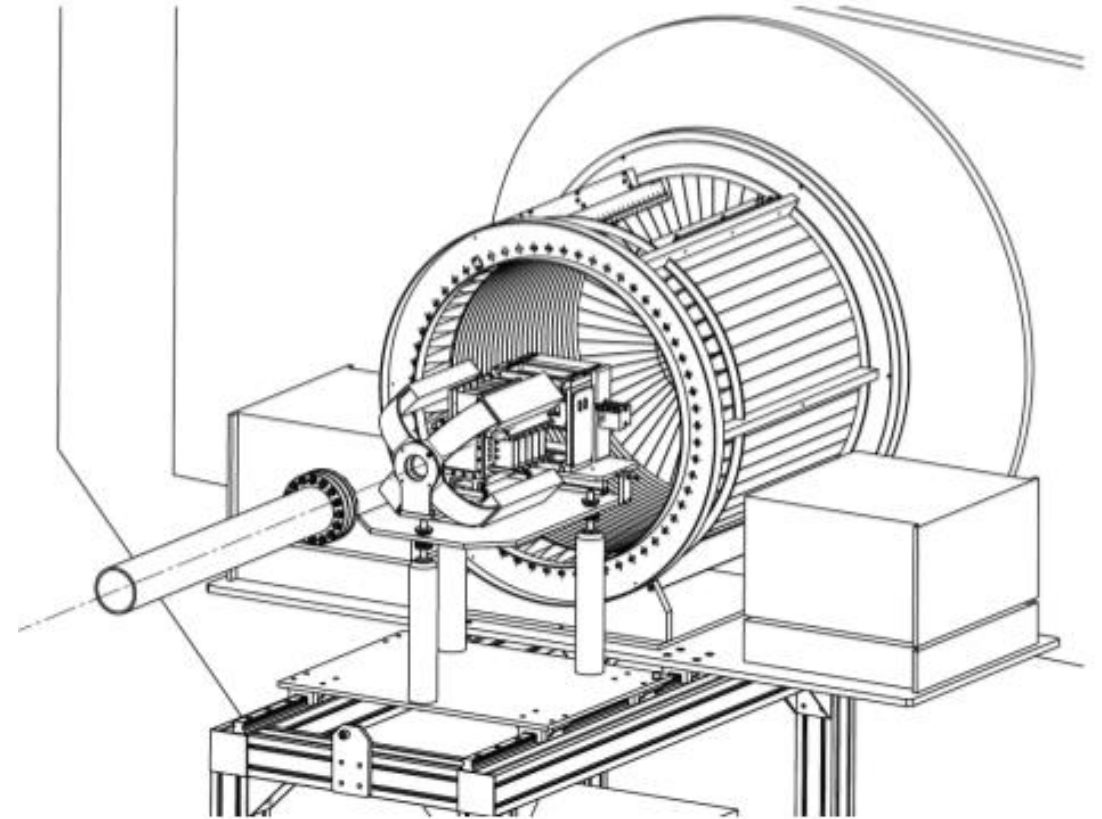❖ **Set up the gas system and the BM + Start counter mechanics (till first half of 2018)**

❖ **Calibration and tests**
   -Calibration of the space-time relations with two external detectors, preferably pixel or microstrip detectors with a spatial resolution <100 μm.
   -Evaluation of efficiency and spatial resolution.
   -ST rel, efficiency and spatial resolution depends on the incoming particle.
   -Trento? CNAO?

FIRST Space Time rel.

15

TO DO LIST

❖ **Garfield++**
  -Drift parameters estimation.
  -Gas choice.
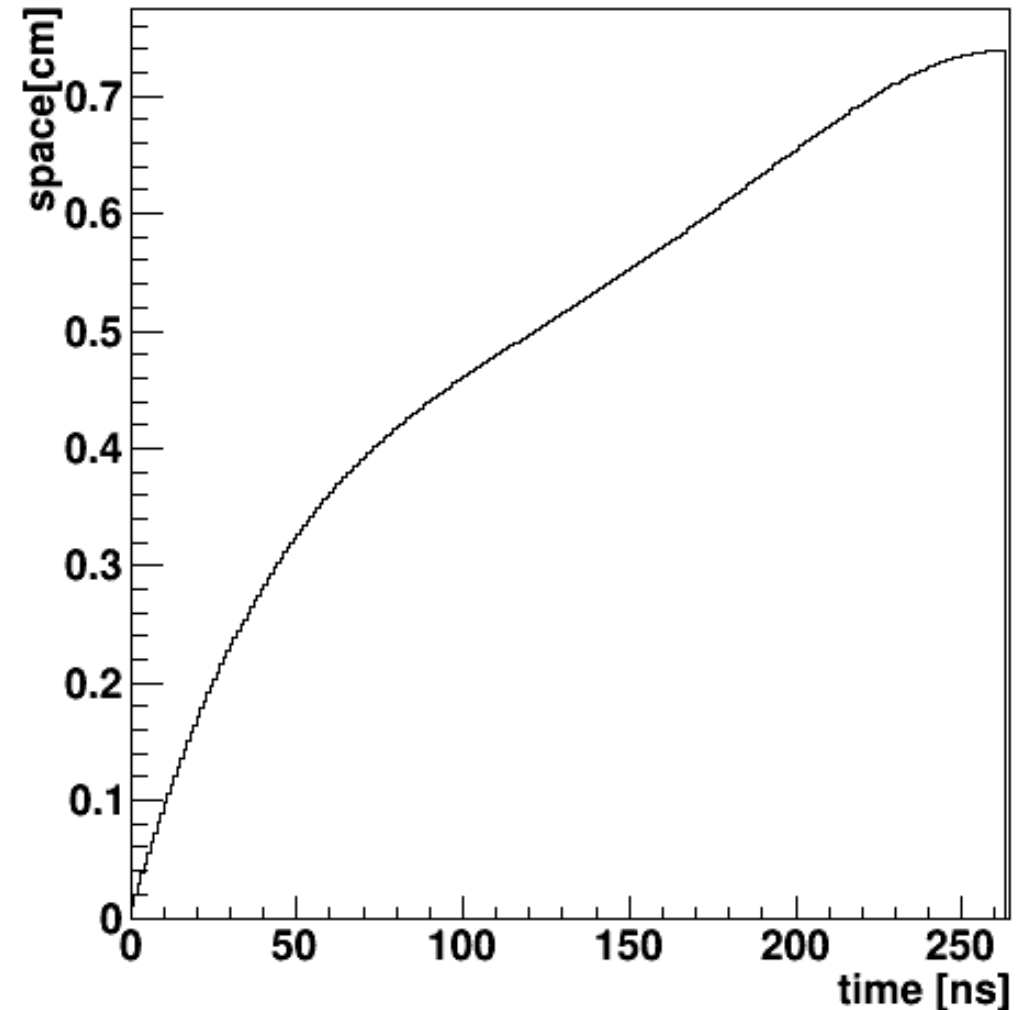
❖ **Shoe reconstruction software**
  -Multi track reconstruction capability.
  -Simulation of particle waveforms and the
 electronics parameters (threshold, TDC etc.).

❖ **Set up the gas system and the BM + Start counter
  mechanics (till first half of 2018)**

❖ **Calibration and tests**
  -Calibration of the space-time relations with two
  external detectors, preferably pixel or microstrip
  detectors with a spatial resolution <100 μm.
  -Evaluation of efficiency and spatial resolution.
  -ST rel, efficiency and spatial resolution depends
  on the incoming particle.
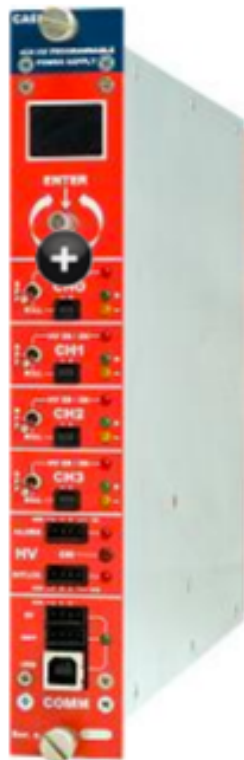 -Trento? CNAO?

❖ **Deadline: end of 2018**
  -Run with ECC and Start Counter?

Start counter

Beam monitor

ECC
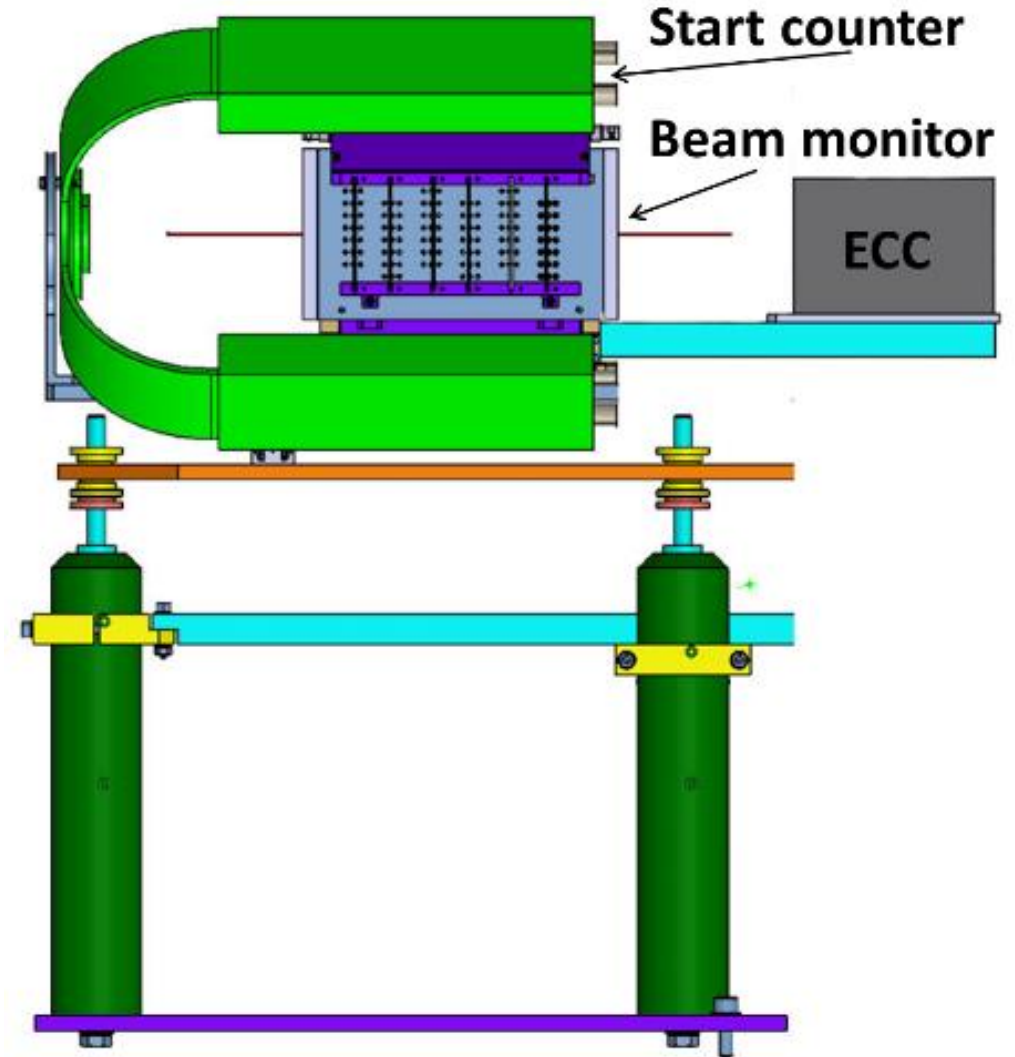
Back up slides

N1470

4 Ch Reversible 8 kV/3 mA (8 W) NIM HV Power Supply Module (USB)

+ Image

- 4 channels in 1U NIM module (2 & 1 channel versions also available)
- Low Cost and 2U/Desktop (with 110/220 Vac) versions available
- 8 kV / 3mA output ranges
- Max output power:
  - 9 W (<3 kV output)
  - 8 W (>3 kV output)
- Channels with individually selectable positive or negative polarity
- SHV coaxial output connectors
- Common floating return
- Max Ripple smaller than < 30mVpp
- 200 mV Vset resolution
- 50 nA Iset/Imon resolution
  - Imon-Zoom: 5 nA (Optional)
- Under/over-voltage alert, overcurrent and max. voltage protection
- Programmable ramp-up / ramp-down (1-500 V/s)
- Daisy-chain capabilty
- Graphic colour display
- Local and Remote control (USB2.0/RS485/RS232)
- Interlock logic for board enable and Individual channel kill
- Optional A1480 DC Input Power Equalizer
- Software Tool for remote control up to 128 channels

**HV
1 module**

1 channel is enough

**1 coaxial cable with SHV
connectors**

TDC 64 channels

V1190B-2eSST

64 Channel Multihit TDC (100/200/800 ps)

- 3 programmable ranges: 100 ps LSB (19 bit resolution), 200 ps LSB (19bit) and 800 ps LSB (17 bit)
- ECL/LVDS inputs automatically detected
- 5 ns Double Hit Resolution
- Leading and Trailing Edge detection
- Trigger Matching and Continuous Storage acquisition modes
- 32 k x 32 bit output buffer
- MBLT, CBLT and 2eSST data transfer
- Multicast commands
- Live Insertion

V895

Discriminator with ECL outputs

16 Channel Leading Edge Discriminator

- Thresholds individually programmable via VME
- ECL outputs with fan-out of two
- Selectable Updating/Non Updating mode
- Programmable output width
- Global VETO and TEST inputs
- Mask register for individual channel enable/disable
- OR, CURRENT SUM and MAJORITY outputs
- Libraries (C and LabView) and Software tools for Windows and Linux

Avoid NIM/ECL converter but it may be less simple to check signals

(3 modules are necessary)

Alternative: Leading edge low thresh. Discriminator
3 modules + NIM/ECL Converter

N845

16 Channel Low Threshold Discriminator

- Individually programmable thresholds
- Programmable output width
- TEST and VETO inputs
- OR and Current Sum outputs
- High sensitivity on small signals
- 4-digit Led display

N638

16 Channel NIM-ECL/ECL-NIM Translator and Fan Out

- 16 independent NIM to ECL/NIM and ECL to NIM/ECL channels
- NIM fan-out of two
- 300 MHz maximum operating frequency
- 2 COMMON IN input with a fan-out of 16 NIM and 8 ECL
- I/O delay from 1.5 to 3.5 ns, depending on input type

N405

Triple 4-Fold Logic Unit/Majority with VETO

- Three independent sections with 4 standard NIM inputs each
- AND, OR, MAJORITY function selectable for each section
- One auxiliary NIM output per section whose width is equal to the coincidence duration
- NIM shaped outputs with Fan Out of two
- One negated NIM shaped output per section
- One VETO input per section
- Front panel trimmer for output width adjustment on each section

N455

Quad Coincidence Logic Unit

- 4 identical independent sections
- Two inputs per section
- 130 MHz Max input frequency
- 6 ns double pulse resolution
- 10 ns I/O delay
- Switch selectable AND/OR logical function
- Adjustable output FWHM (4 to 650 ns)
- Overlap output
- Common Veto

N93B

Dual Timer

- Manual or pulse triggered START (NIM or ECL input)
- Monostable (retriggerable) or bistable operation
- NIM and ECL output pulses from 50 ns to 10 s
- Manual or pulse triggered RESET
- (NIM and ECL) END-MARKER output pulse
- VETO input

Additional modules
(triggering etc.)

N625

Quad Linear FAN-IN FAN-OUT

- Four independent sections
- Bipolar inputs
- Four 4 Input + 4 Output Fan in/Fan out sections
- 1 Channel Discriminator featured
- Inverting or non-inverting mode independently selectable on each section
- 100 MHz bandwidth.

V830

32 Channel Latching Scaler

- Available with either ECL or LVDS inputs
- 250 MHz counting frequency
- 32 bit channel depth
- 32 k x 32 bit multievent buffer memory
- Multichannel scaler operation with programmable dwell time from 1.2 μs to 1700 s
- BLT32/MBLT64 and CBLT32/CBLT64 data transfer
- Multicast commands
- Live insertion