

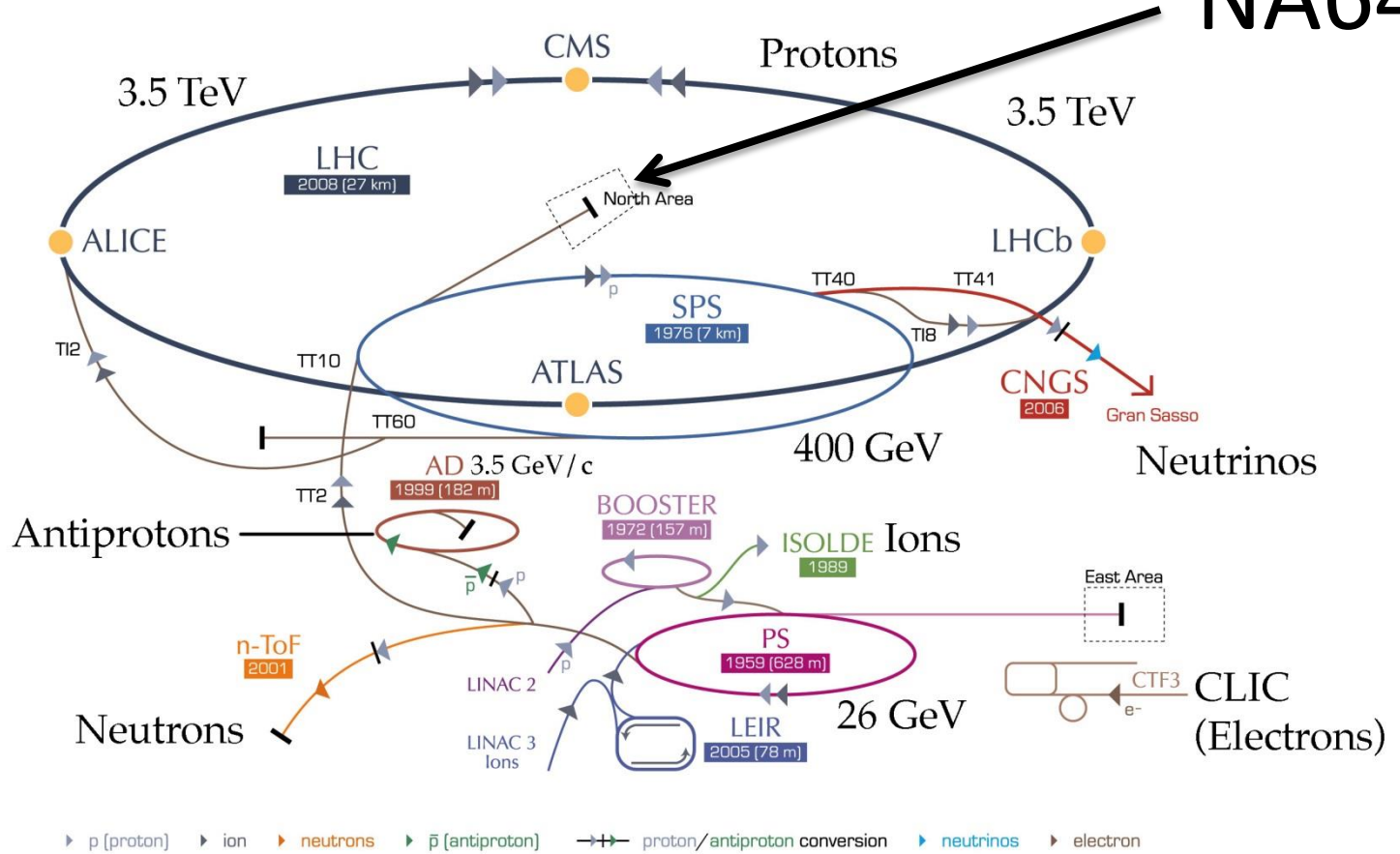
# Straw tubes for the NA64 experiment at CERN

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JINR

# CERN's accelerator complex (2010)

# NA64



LHC Large Hadron Collider   SPS Super Proton Synchrotron   PS Proton Synchrotron

AD Antiproton Decelerator   CTF3 Clic Test Facility   CNGS Cern Neutrinos to Gran Sasso   ISOLDE Isotope Separator OnLine DEvice  
 LEIR Low Energy Ion Ring   LINAC LINear ACcelerator   n-ToF Neutrons Time Of Flight

# The goal of experiment

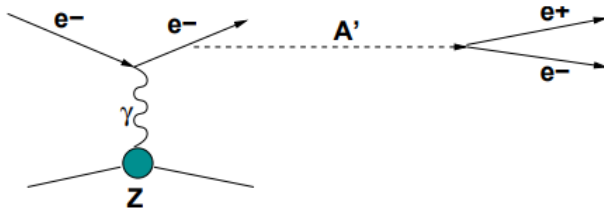
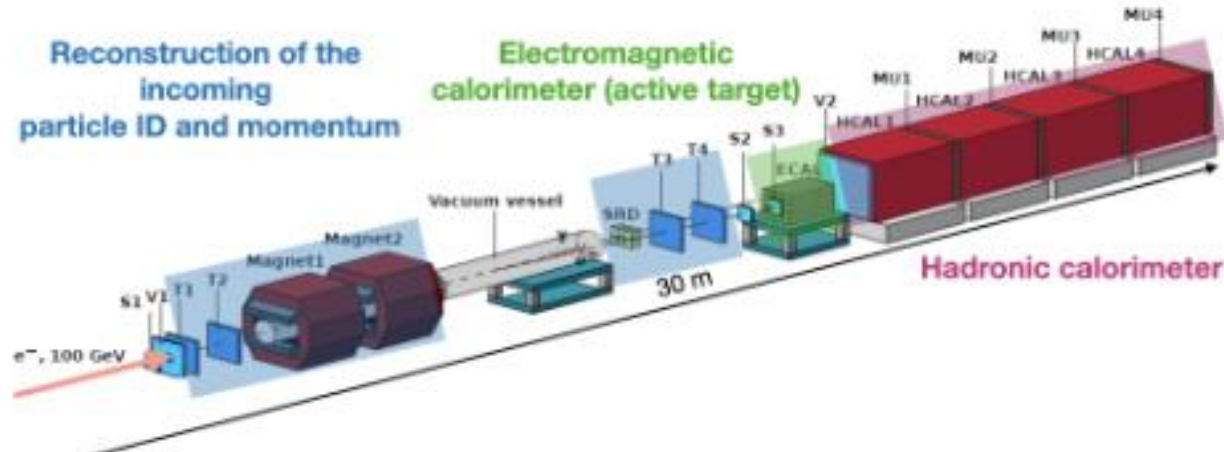


Diagram illustrating the massive  $A'$  production in the reaction  $e^-Z \rightarrow e^-ZA'$  of electrons scattering off a nuclei ( $A,Z$ ) with the subsequent  $A'$  decay into an  $e^+e^-$  pair.

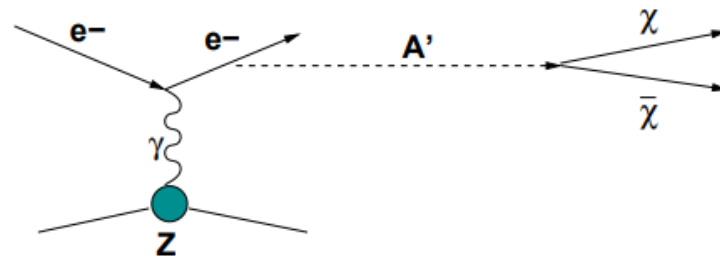
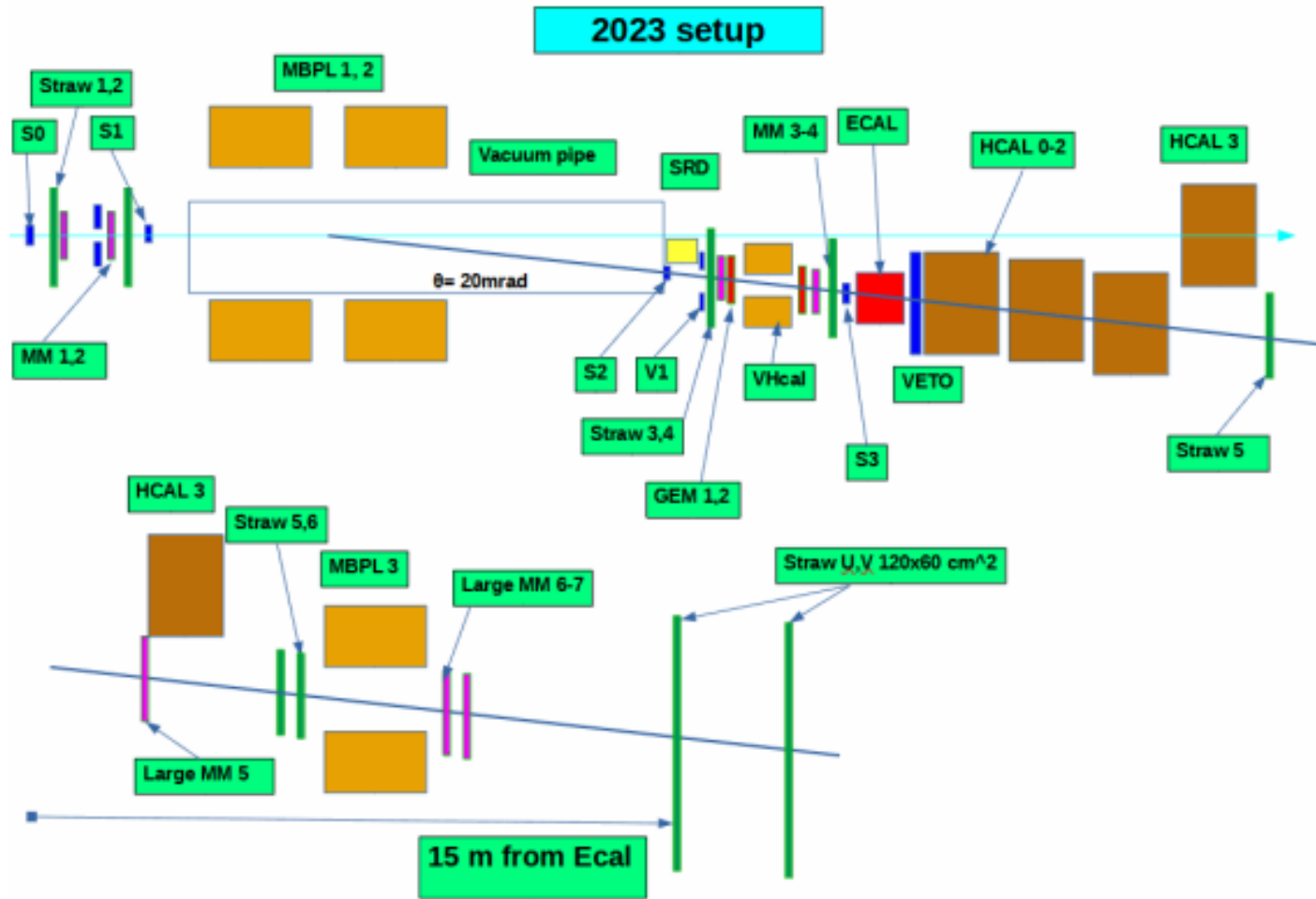


Diagram illustrating the massive  $A'$  production in the reaction  $e^-Z \rightarrow e^-ZA'$  of electrons scattering off a nuclei ( $A,Z$ ) with the subsequent  $A'$  decay into a  $\chi\bar{\chi}$  pair.

# NA64 experiment



TRIGGER = S0 x S1 x S2 x S3 x V1 x Veto

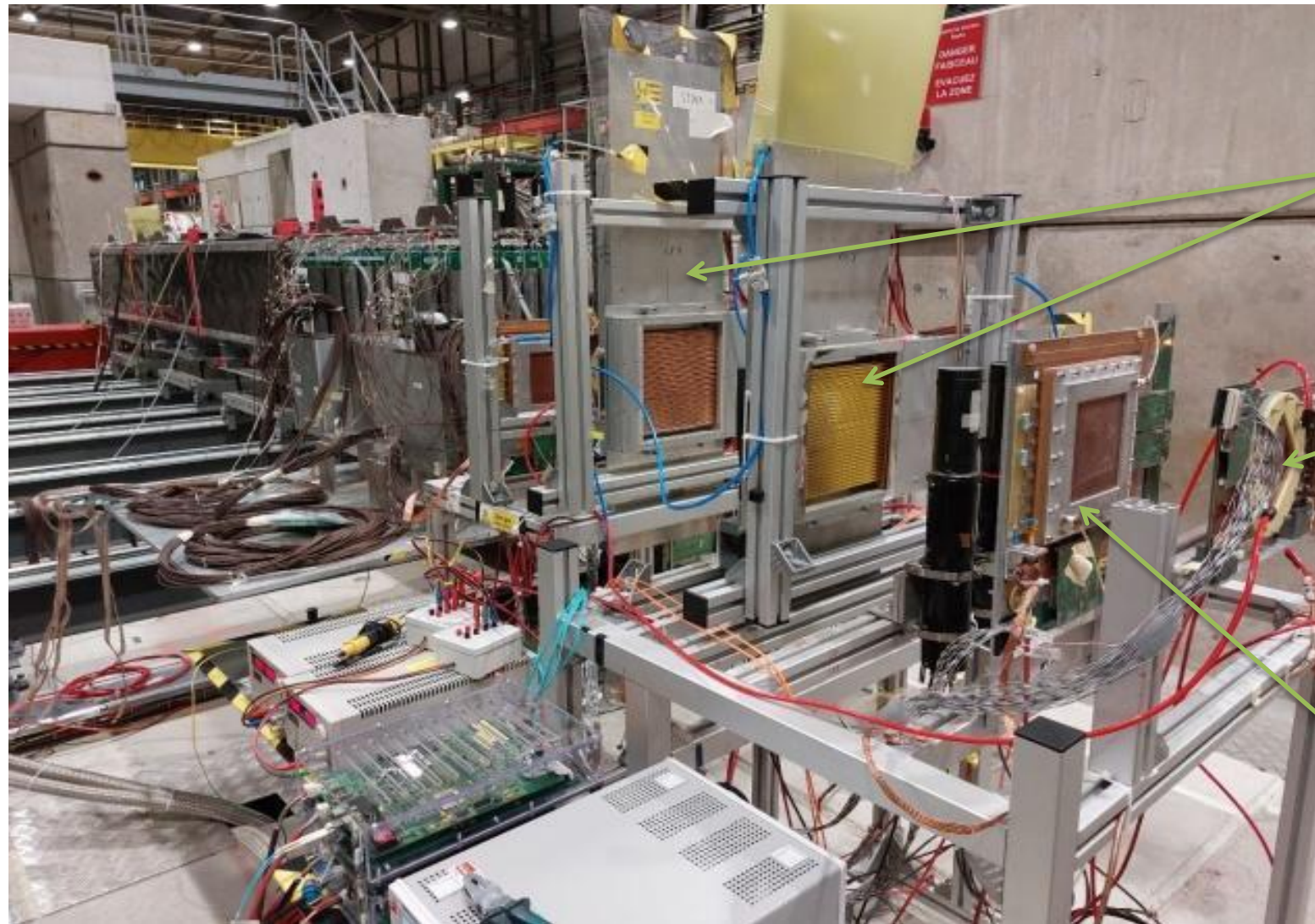
ECAL and HCAL

MM, GEM, Straw

MBPL

SRD

# NA64 trackers



Straw

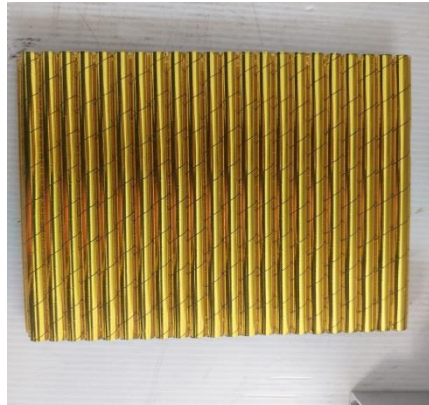
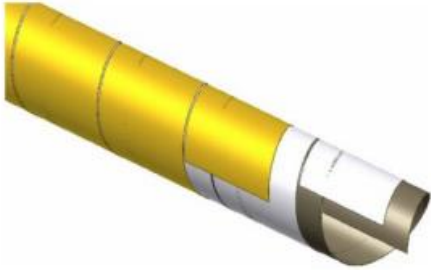
MM

GEM



# Production of straw chambers I

Glueing 2 overlapping strips



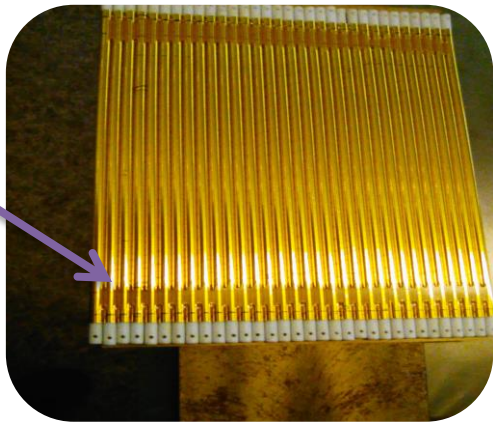
Straw tubes contains two overlapped capton strips. Thickness of external and internal layers are 40 and 12,5 microns respectively

Singel straw tubes are glued to each other in order to create a plane

Each plane is offset by the radius of the tube to cover the entire volume



# Production of straw chambers II



- each tube in the plane has a hole for uniform gas supply



- layer of straw are made hermetic from each ends with in and out tubes for gas mixture

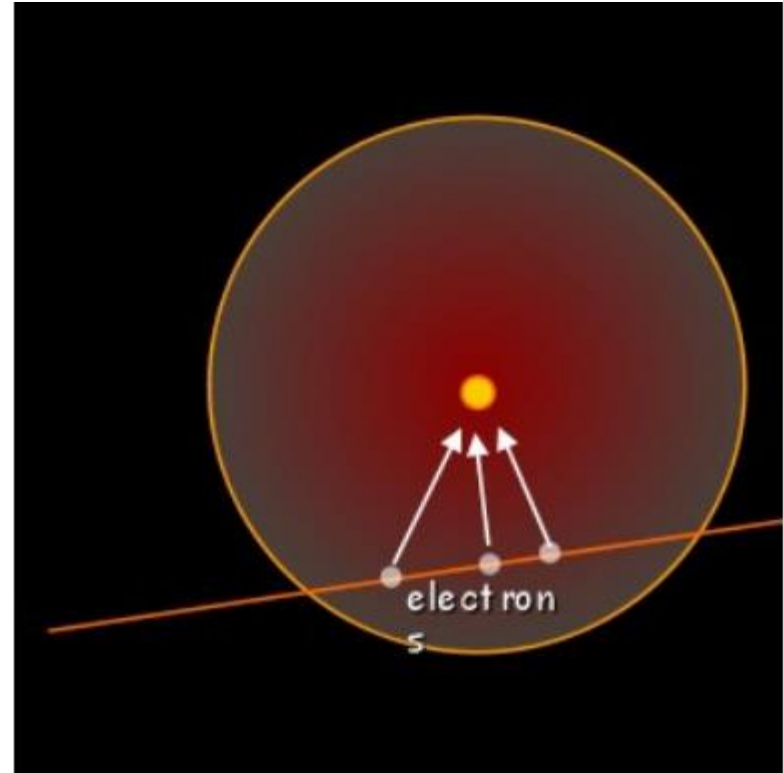
- As any other proportional chamber

## How straw tube works?

The first 10ns - ~100ns differ depending on gas and electric field

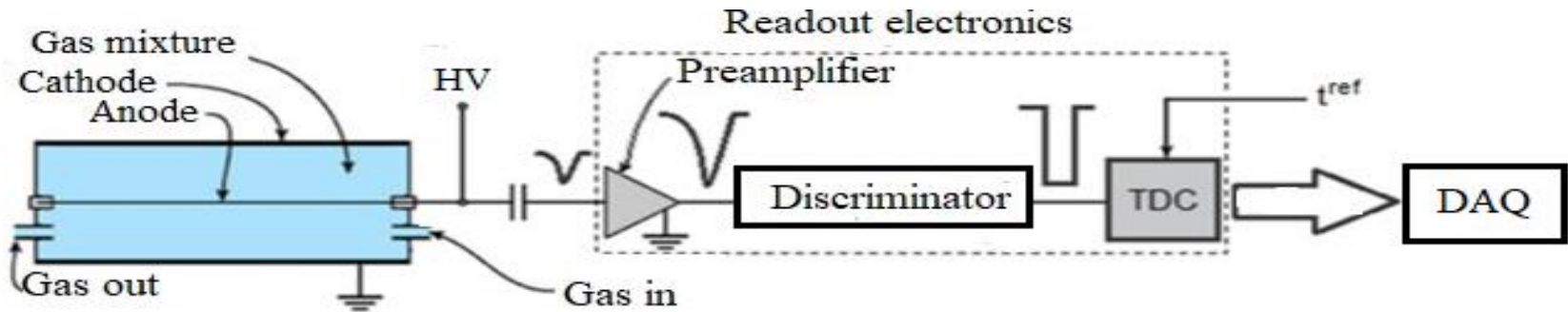
The tail lasts until last ion arrival, can be ~100-s microseconds

NA64 Straw detectors filled Ar/CO<sub>2</sub>(80/20)





# Signal formation



The moment of passage of the particle through the tube is set by the operation of external detectors, which, as a “Start” signal, is fed to the Time Digital Converter (TDC) and is indicated on the diagram as  $t_{ref}$ . A charged particle, ionizing a gas mixture, forms a track of positive ions and electrons. Electrons drift towards the wire and, in the region of a strong field near its surface, as a result of impact ionization form an avalanche with a duration of 1–2 nsec. The positive ions formed in the avalanche slowly drift from the anode to the cathode, inducing a signal on the anode wire. This signal, amplified by the preamplifier, is digitized by a threshold discriminator and arrives as a "Stop" signal at the time at the TDC.

# Frontend electronics I

Mother board

Mother board has 32 channels(2 board)



Amplifier

Amplifier contains 64 channels



TDC

Receives information from 64 channels



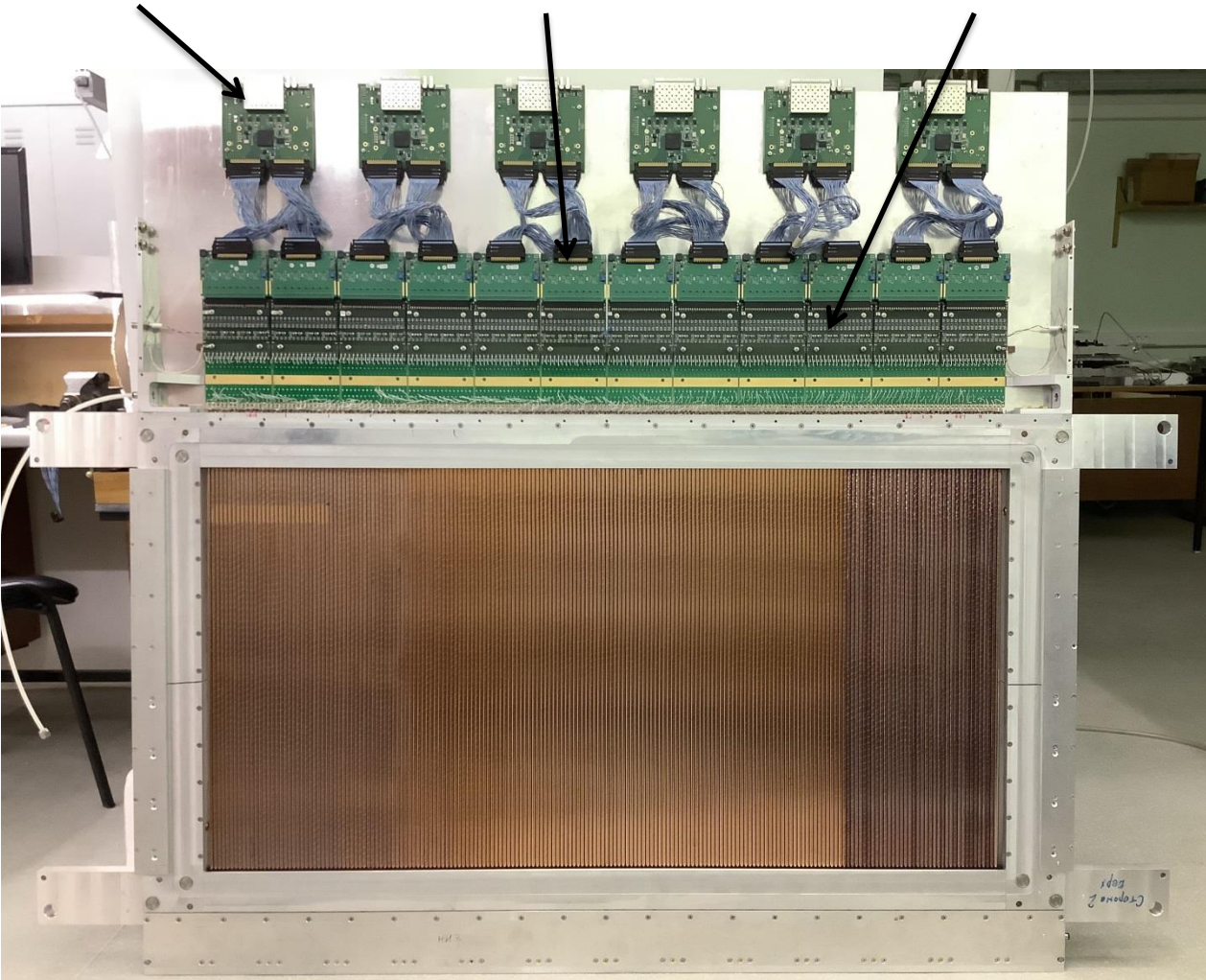
DAQ

# STRAW DETECTORS AT NA64

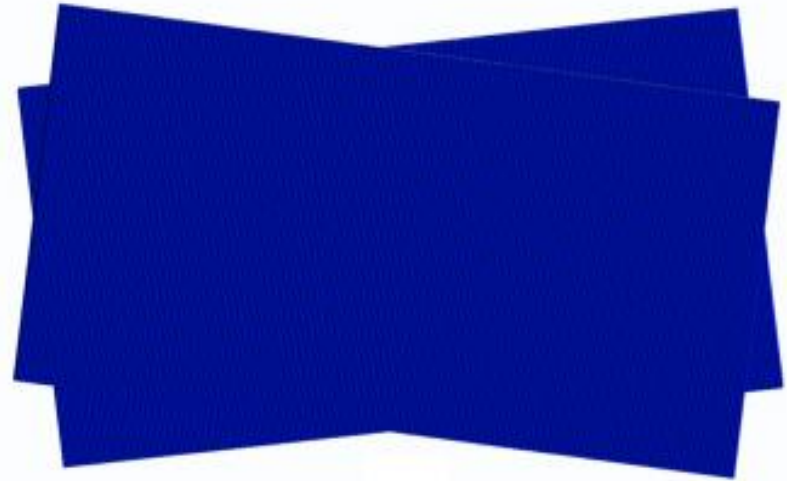
TDC

Amp

Motherboard



# Other pictures of chambers

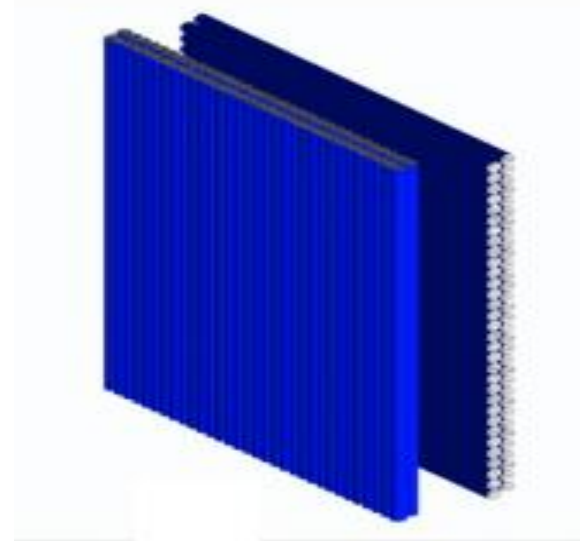


1 UV station

- active area 1200x600 mm
- 4 layers UUVV
- tube length 600 mm
- 192 tubes
- incline angle  $\pm 7^\circ$



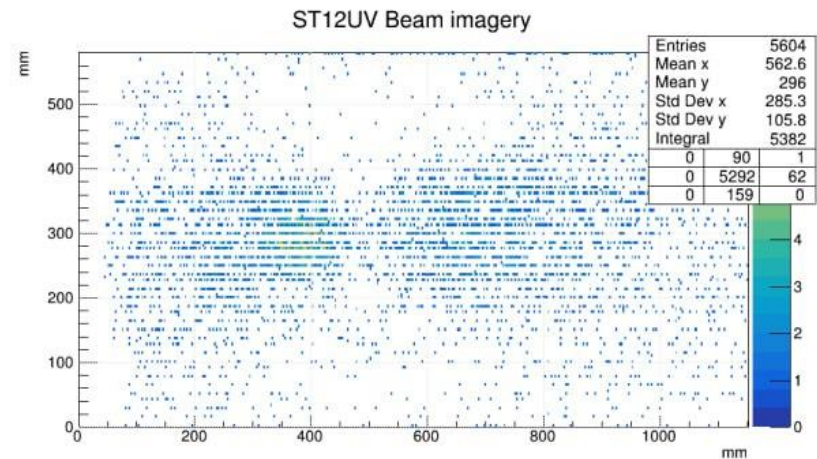
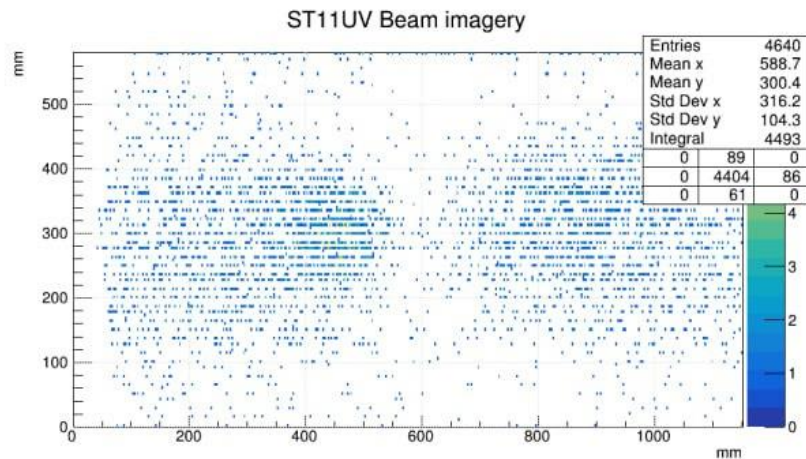
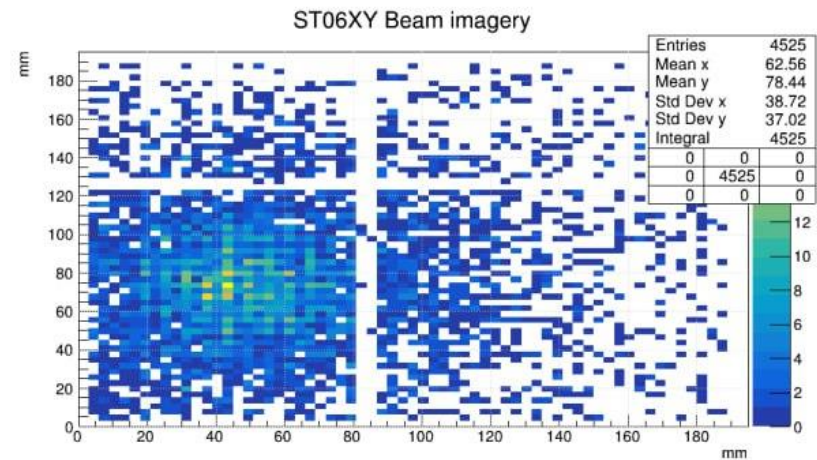
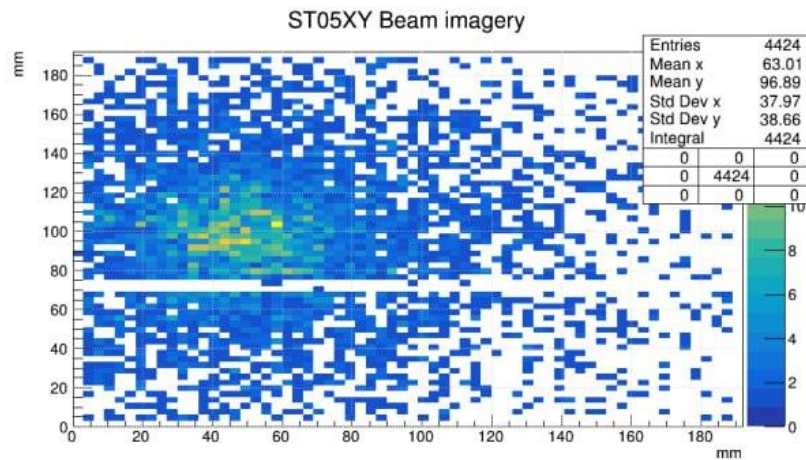
# Other pictures of chambers



4 XY station

- active area 200x200 mm
- 4 layers XXYY
- tube length 200 mm
- 32 tube

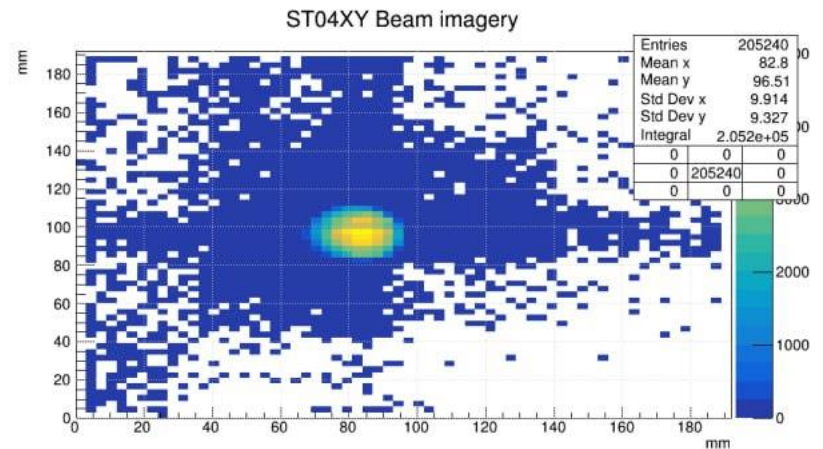
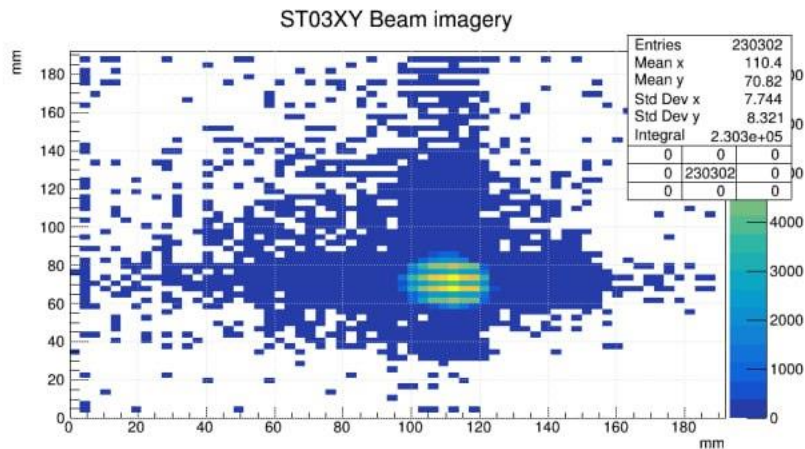
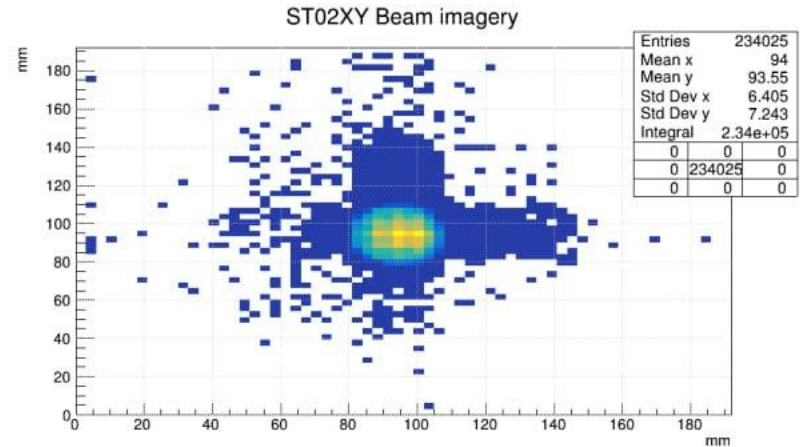
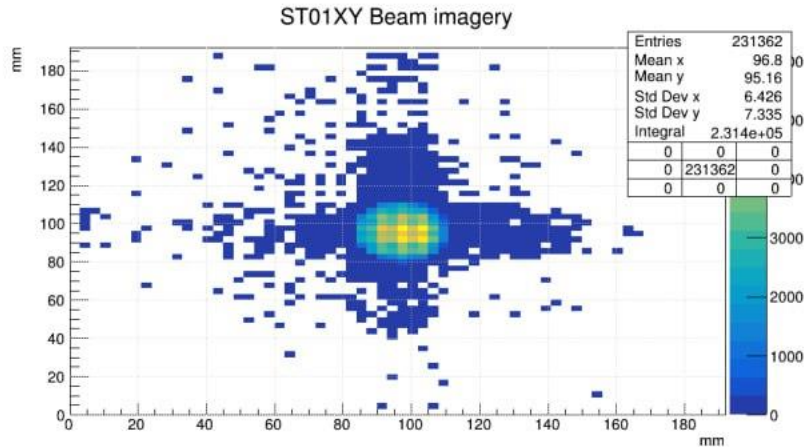
# Performance of straw detectors



- Straw detectors online monitoring during the 4-5 sec. spill with  $6.2 - 6.8 \times E6$  e/spill.



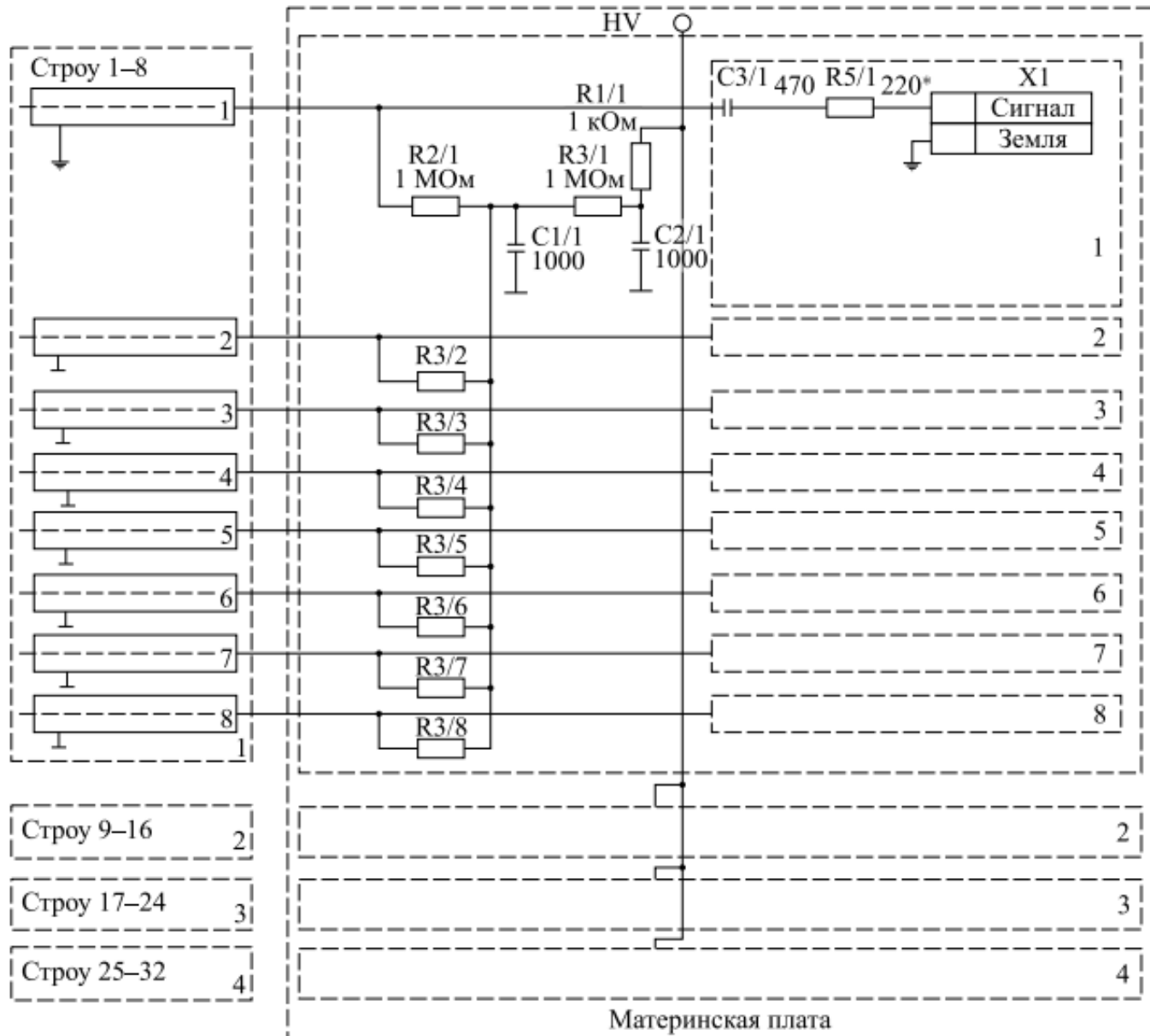
# Performance of straw detectors II



- Straw detectors online monitoring during the 4-5 sec. spill with  $6.2 - 6.8 \times E6$  e/spill.

Thank you

# Backup for frontend (Motherboard)



# Backup for frontend (Amplifier)

