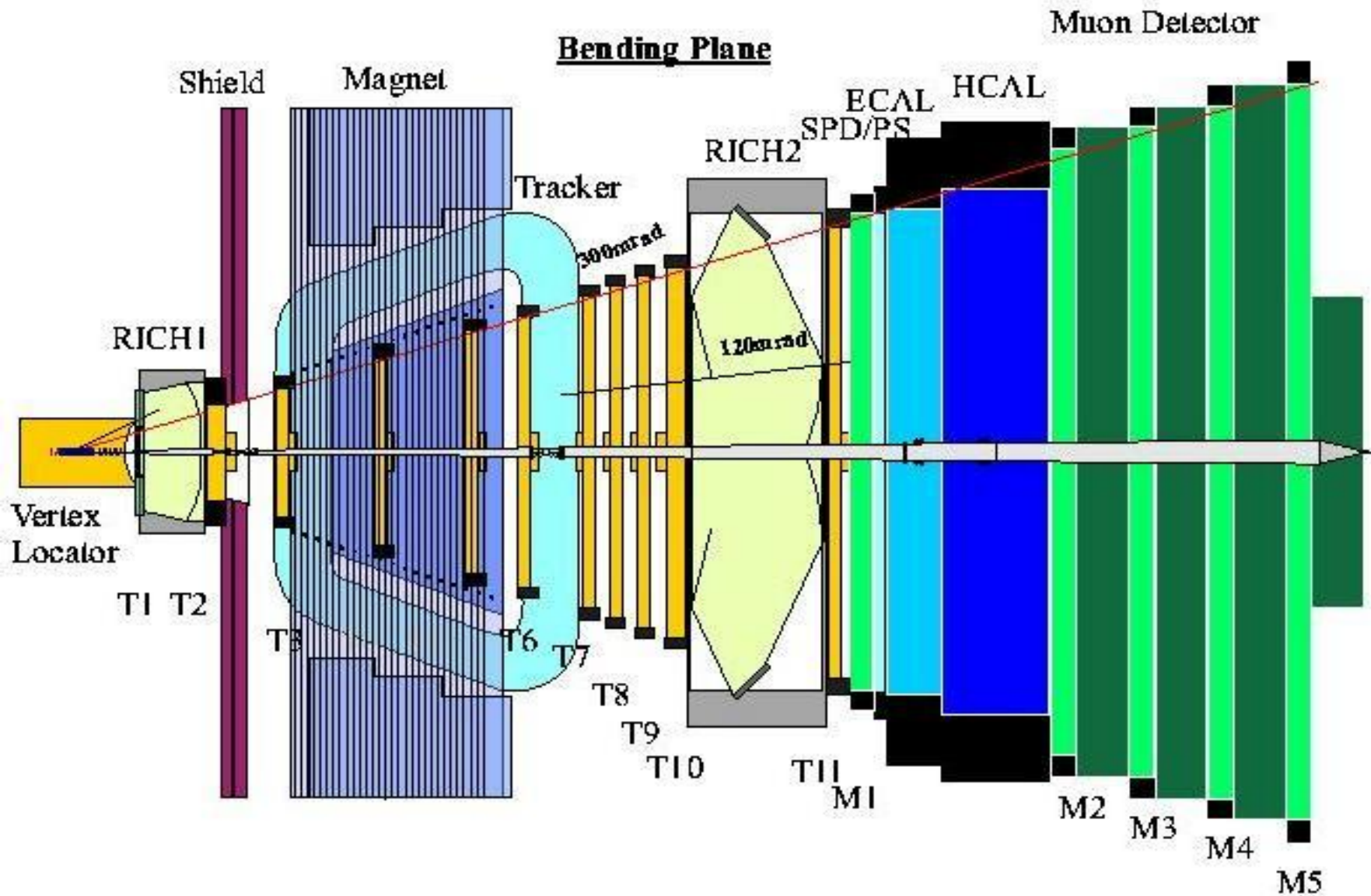


# PNPI in LHCb

Status report for 2003

A.Vorobyov

HEPD Scientific Board meeting,  
December 26,2003



# LHCb MUON SYSTEM

## Goals:

1. Muon identification
2. Trigger with Pt cut at  $>1.2$  GeV/c

## Strategy:

1. **Stand-alone mode** ( using information only from Muon Stations)
2. **Pad structure** (  $24 \times 4$  cm<sup>2</sup>,  $12 \times 2$  cm<sup>2</sup>,  $6 \times 1$  cm<sup>2</sup>,  $3 \times 0.5$  cm<sup>2</sup> )

1. *M. Borkovsky, A. Tsaregorodtsev, A. Vorobyov*

The LHCb Level-0 Muon Trigger, LHCb 98-02

## Background:

$10^3$ -  $10^5$  charged particles/cm<sup>2</sup>xsec

2. *N. Sagidova, A. Tsaregorodtsev, A. Vorobyov*

GCALOR Studies of Background in LHCb Muon Chambers

LHCb 98-059

# LHCb MUON SYSTEM

## *Detector technology:*

Modest space resolution (pad size)

High time resolution ( <3ns rms)

High efficiency ( >99% in 20ns window)

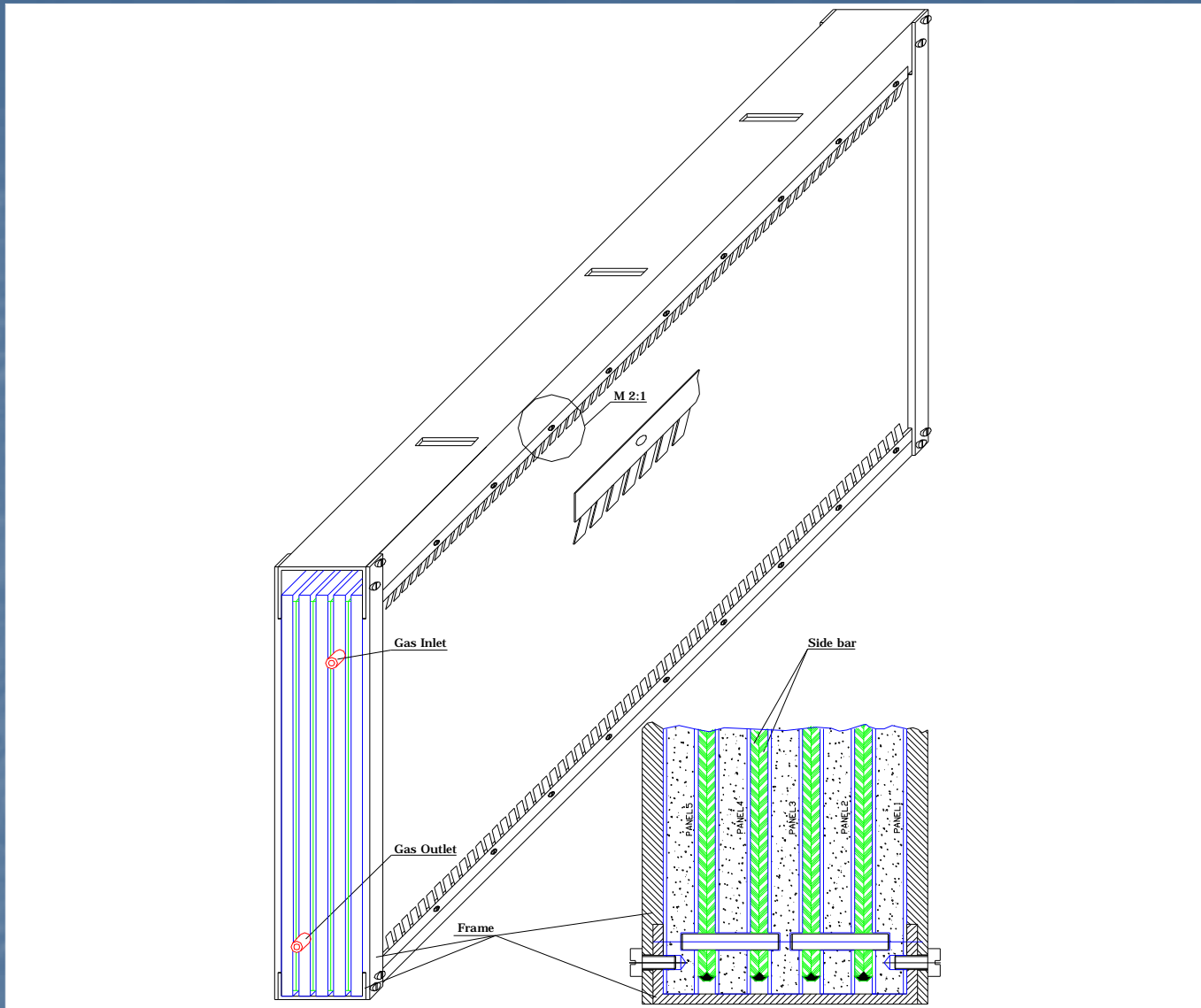
High rates (  $10^5$  /channel\*sec)

Slow aging (up to 1 C/cm wire)

## *Our proposal:*

### 3. Wire / cathode pad chambers

LHCb Note 2000-003



*Wire chamber for LHCb Muon System*

## Muon Detector sideview

Arrangement of chambers in Y via overlapping Projectivity of chamber sizes from M1 to M5

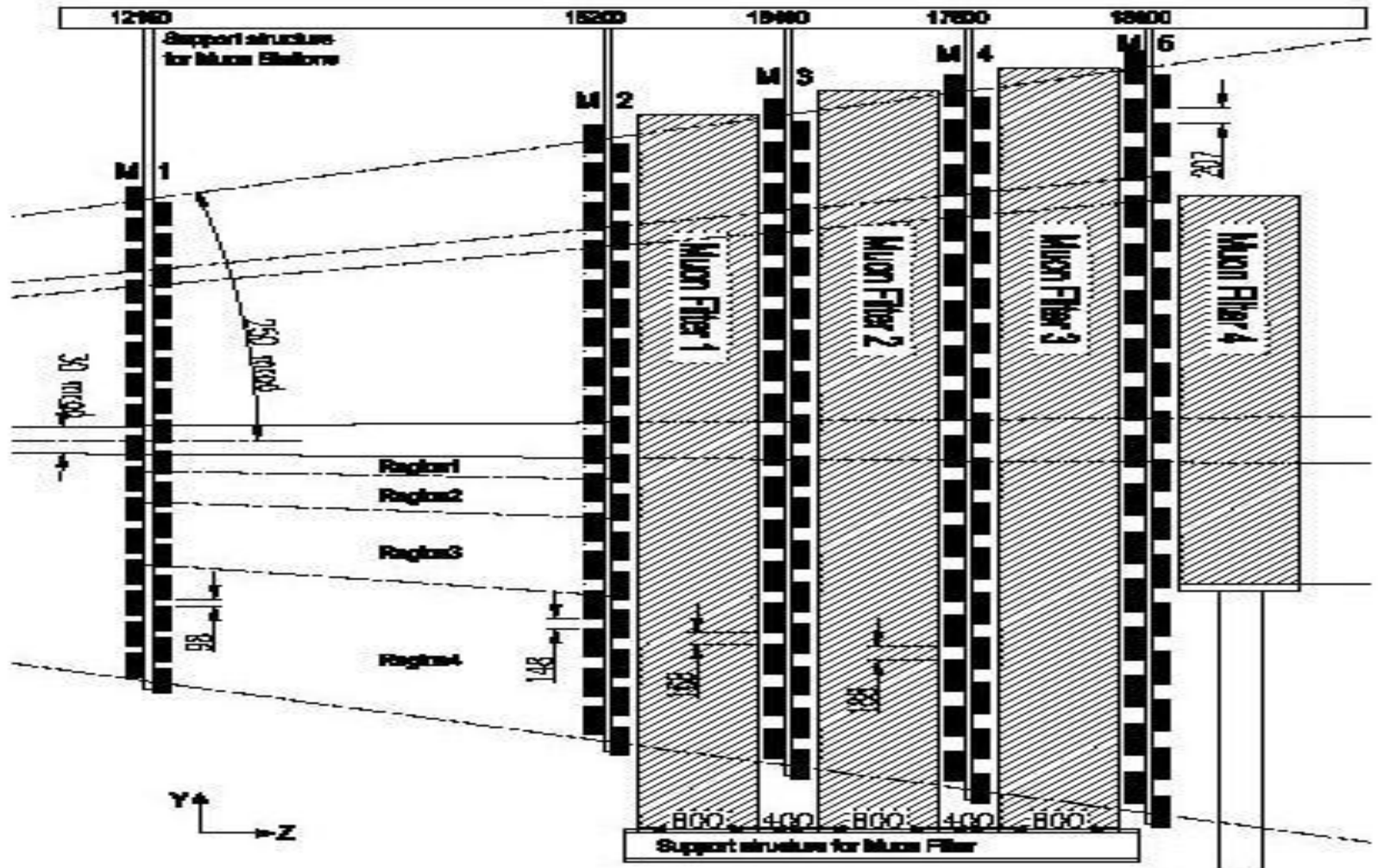
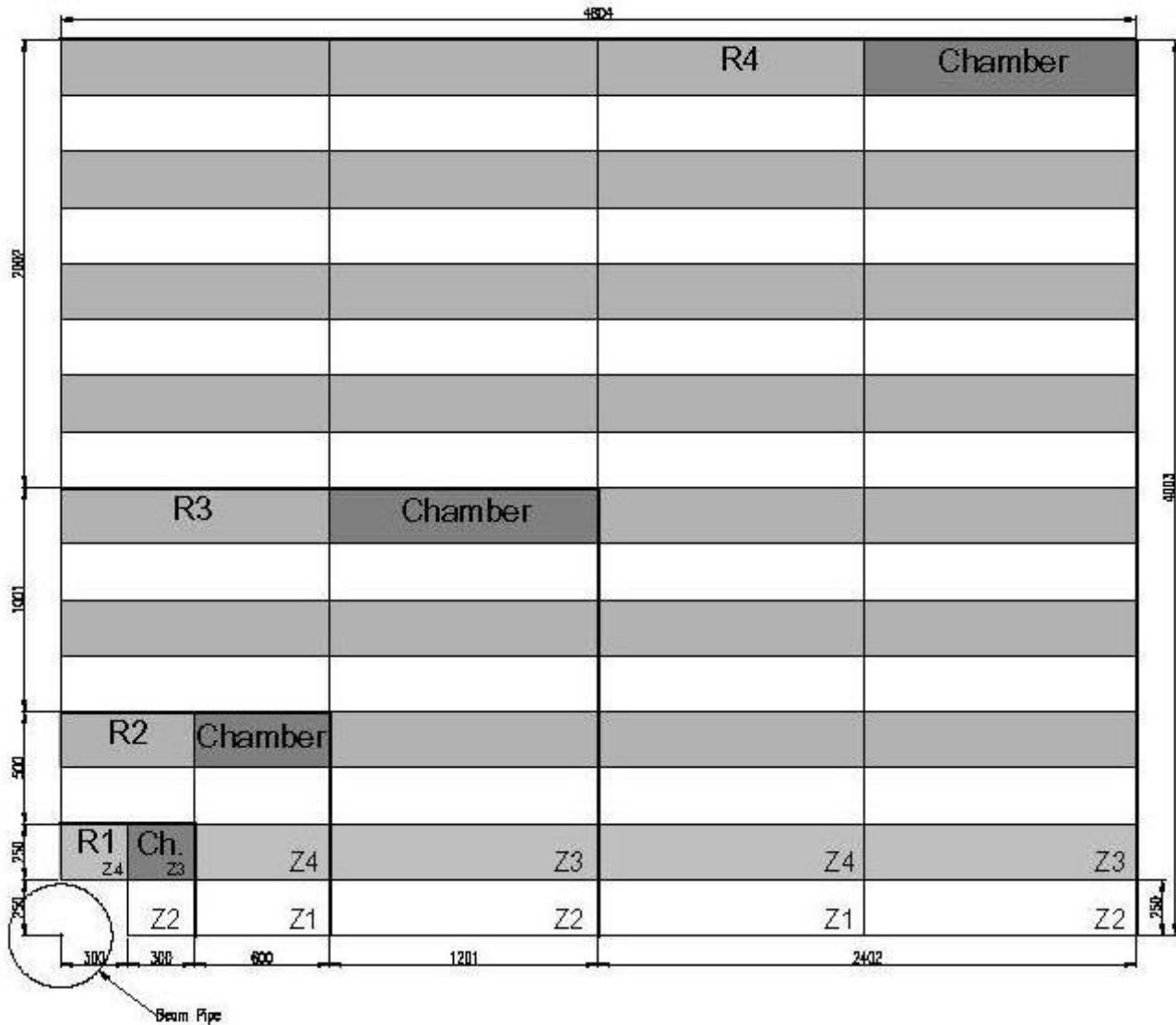
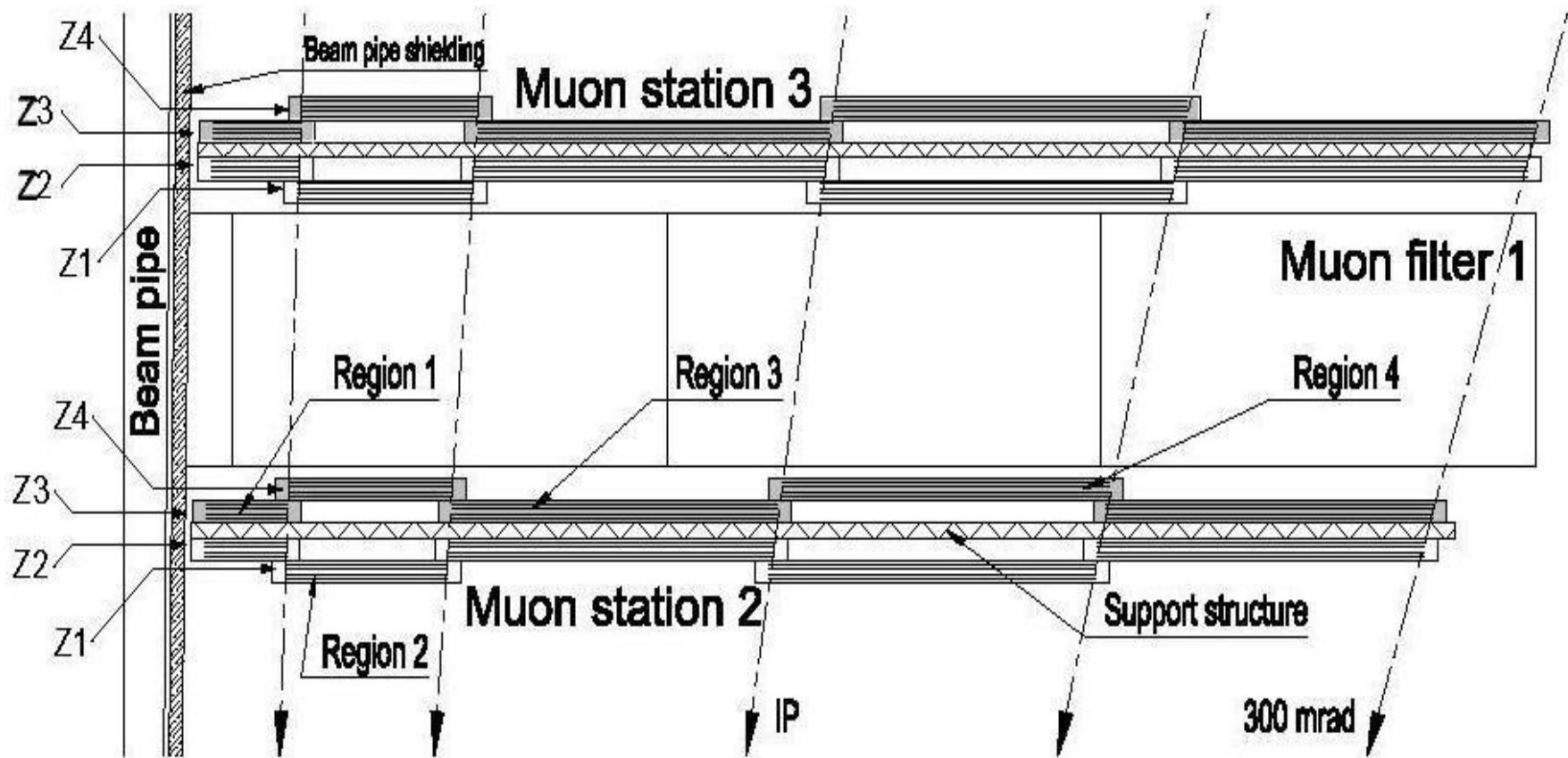


Figure 7 Side view of the muon system in the  $y, z$  plane



**Figure 8**  $x,y$  view of a quarter of station M2, one chamber in each region is highlighted. The rows of chambers marked in a darker shade are in positions  $z_{3,4}$  behind the support structure, those not marked are in  $z_{1,2}$  in front of the support structure.



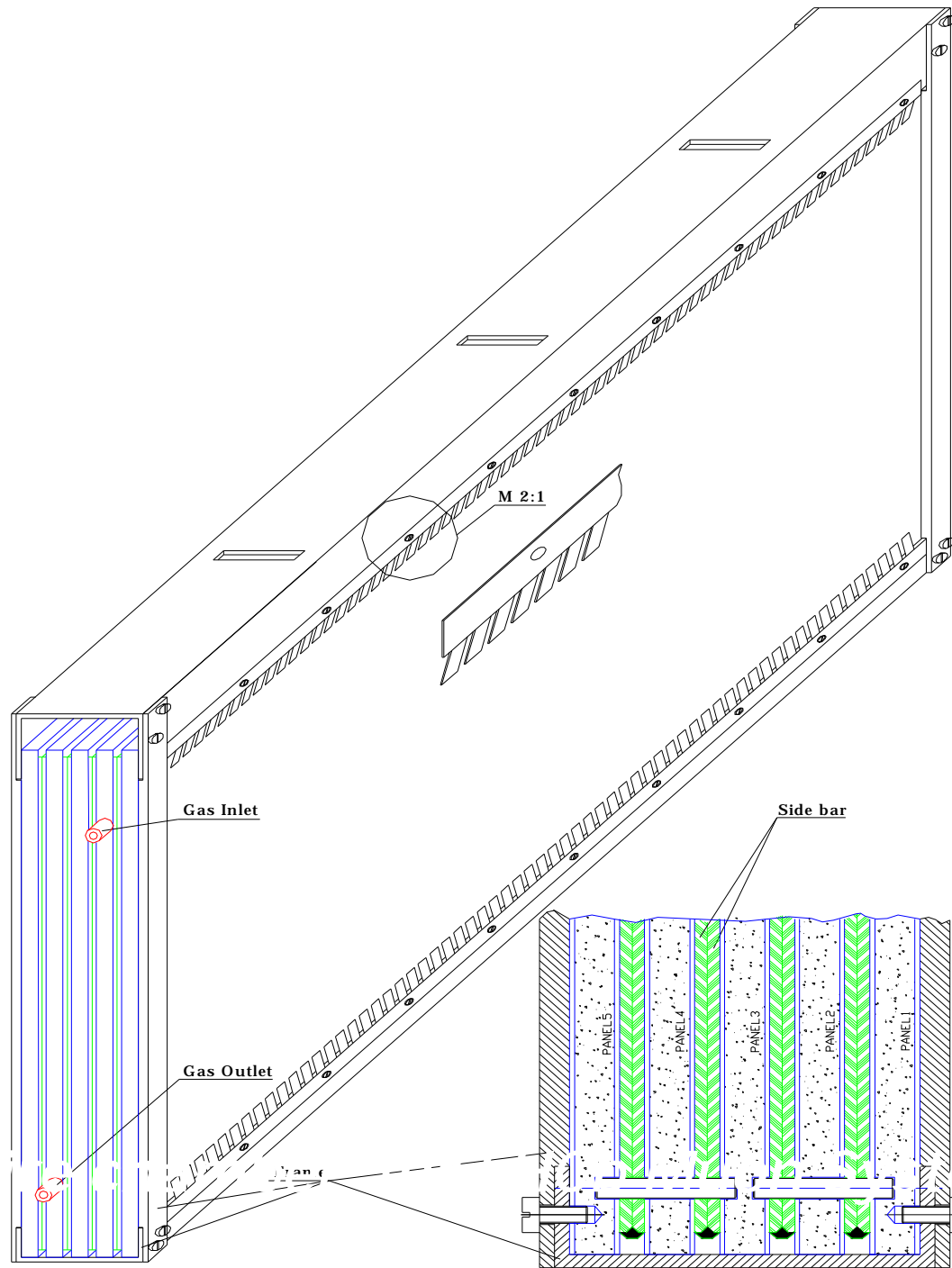
**Figure 9** Partial view of the muon system in the  $x,z$  plane at  $y = 0$ . There are two sets of chamber positions indicated in different colours, before and after the chamber support, in each station. Each set indicates the position of the chambers in a horizontal row, the other set of positions correspond to the chambers in the rows directly above and below this row. The projectivity of the chambers to the interaction point has been indicated. The four sensitive gaps in each chamber are also indicated.



# Development of LHCb Muon Chambers

*B.Bochin, S.Guets, A.Kashshuk, V.Lazarev, N.Sagidova, E.Spiridenkov,  
A.Tsaregorodtsev , G.Velichko, An.Vorobiev, A.Vorobyov*

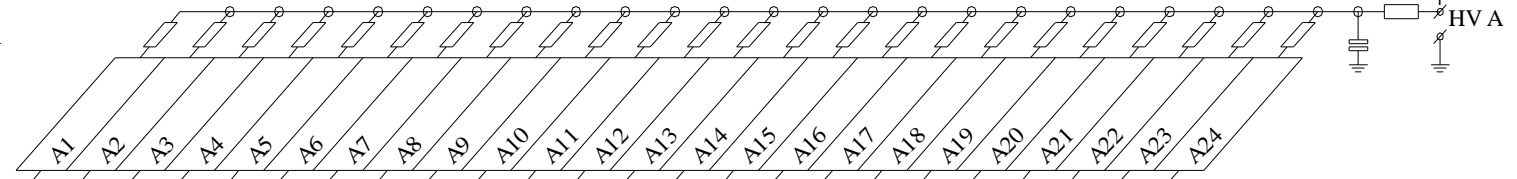
3. Wire Pad Chamber for LHCb Muon System,  
LHCb 2000-003
4. Beam tests of WPC-7 prototype of the wire pad chambers  
for the LHCb Muon System,  
LHCb 2000-102
5. Beam tests of WPC-8 and WPC-9 prototypes of the wire pad  
chambers for the LHCb Muon System,  
LHCb 2001-025
6. Test results of a full size prototype of the muon chambers for  
region M2/R4 of the LHCb Muon System  
LHCb 2002-025



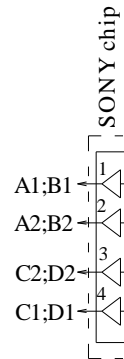
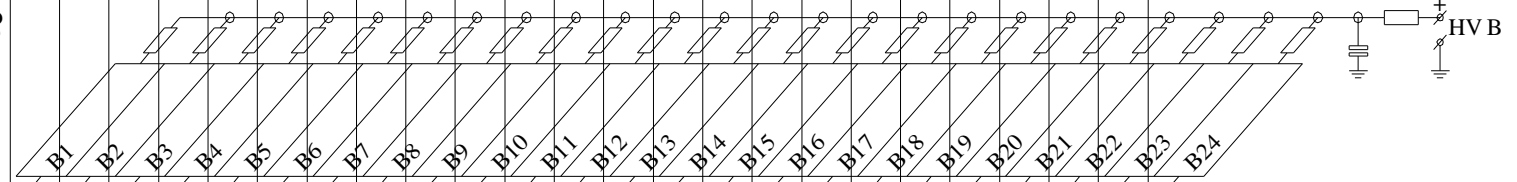
# *wpc parametrs*

<b><i>ANODE -CATHODE DISTANCE</i></b>	<b><i>2.5 MM</i></b>
<b><i>WIRE SPACING</i></b>	<b><i>2.0 MM</i></b>
<b><i>WIRE DIAM</i></b>	<b><i>30 MKM</i></b>
<b><i>GAS MIXTURE</i></b>	<b><i>Ar /CO2 /CF4</i></b>
<b><i>HV</i></b>	<b><i>2.9 KV</i></b>
<b><i>GAS GAIN</i></b>	<b><i>10<sup>5</sup></i></b>

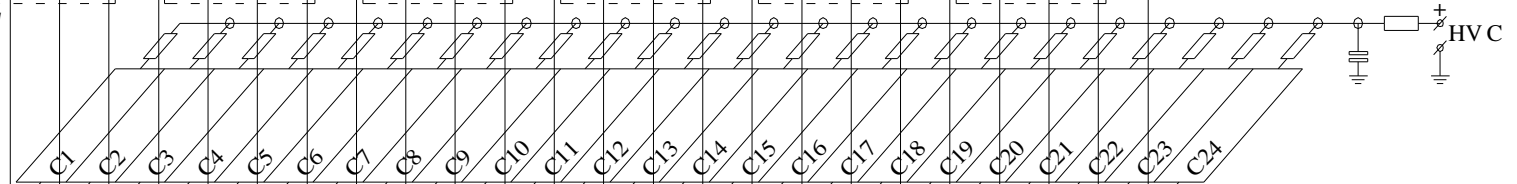
*Plane A*



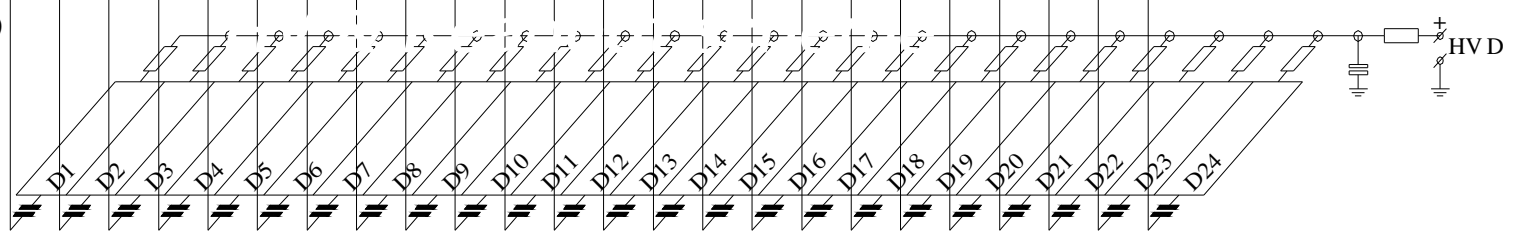
*Plane B*

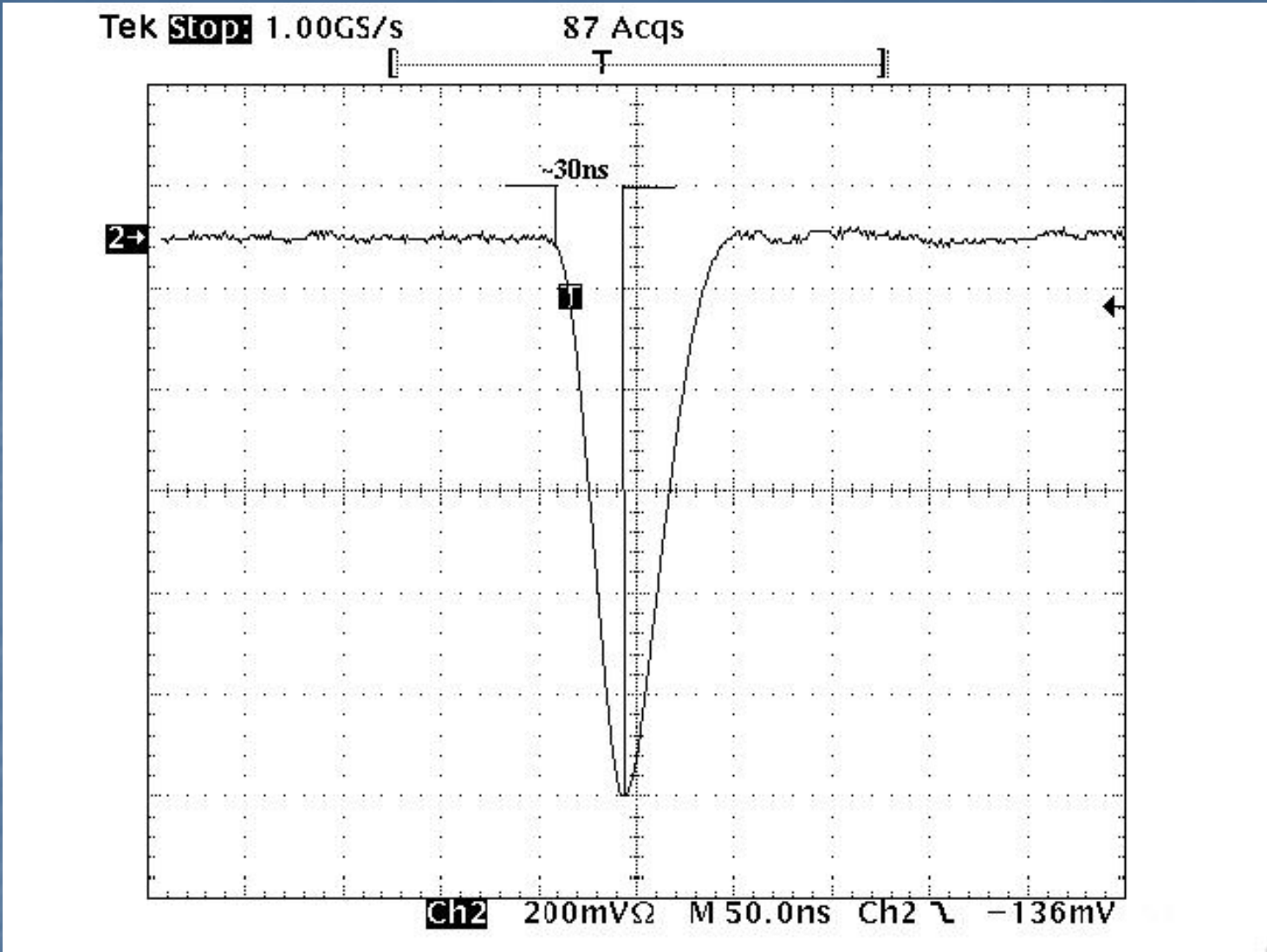


*Plane C*

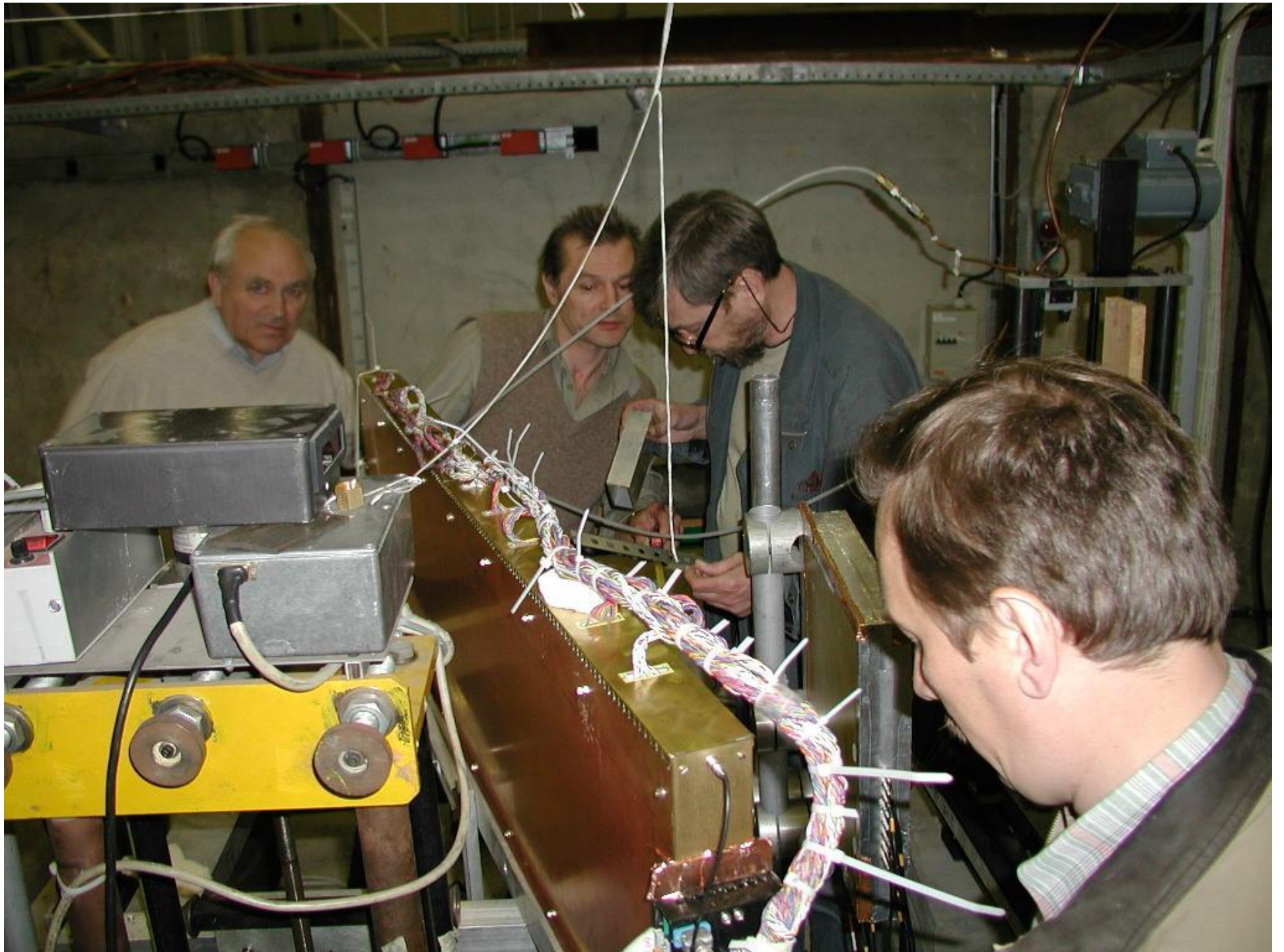


*Plane D*



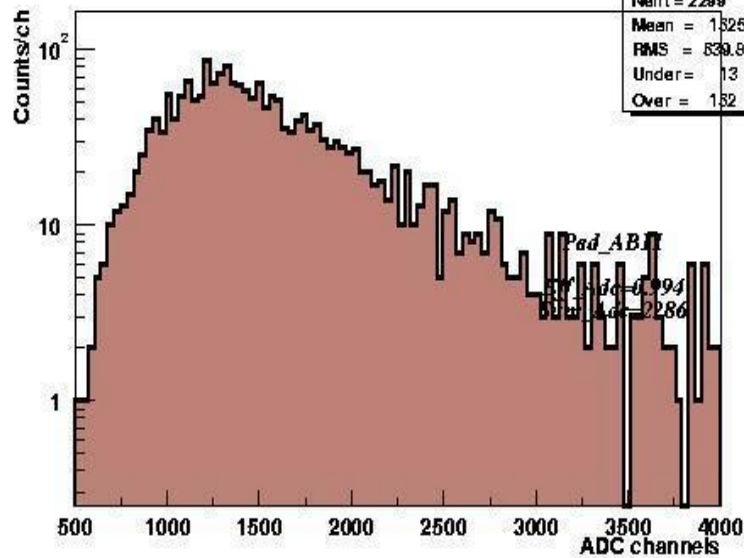


Shape of the signal from a wire pad

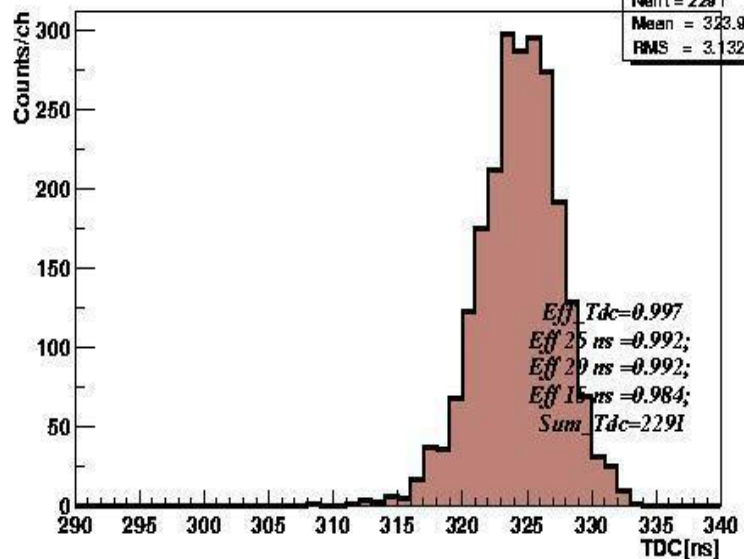


Run\_19792. Tr1=14959. Tr2=5981. Tr3= 2299

Pad\_AB11

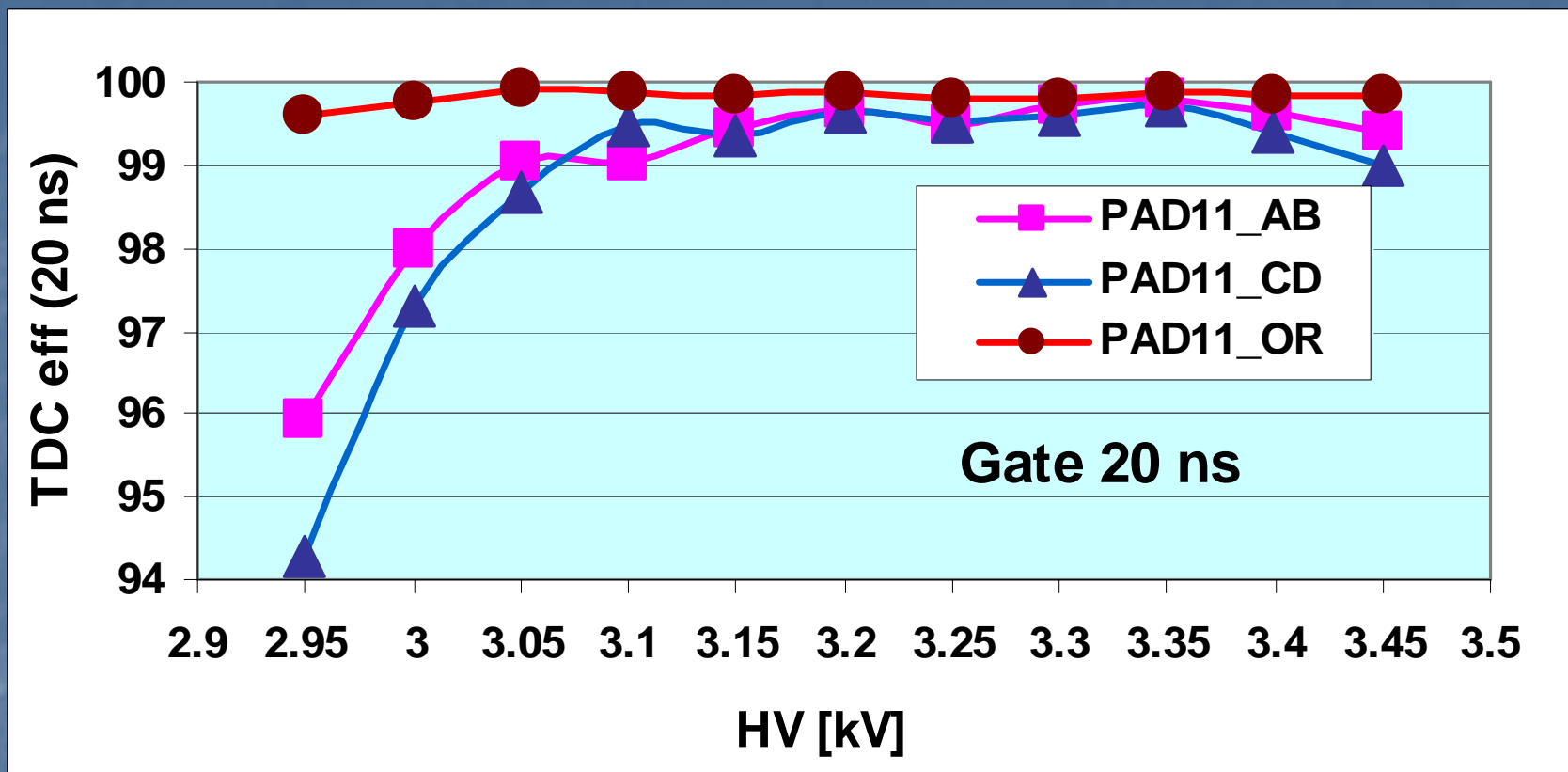


Pad\_AB11



An example of ADC and  
TDC distributions.  
Plane AB. Thresh = 30  
mV.  
Beam on pad 11.  
HV=3.1 kV.

Time resolution = 3.13 ns (rms)  
Efficiency in 20ns window = 99.2%

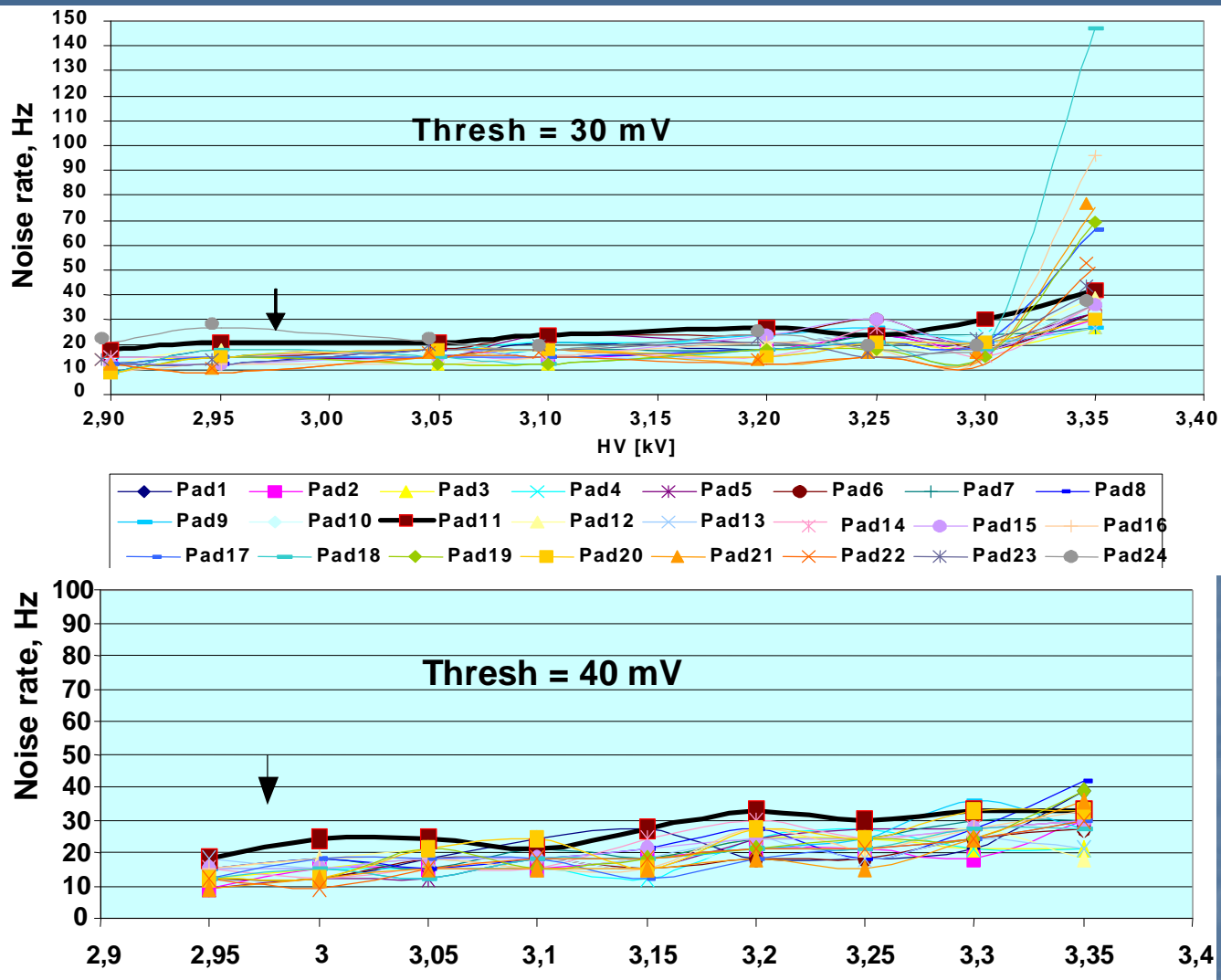


Efficiency for double-gap and four-gap modes

Beam intensity 50 kHz

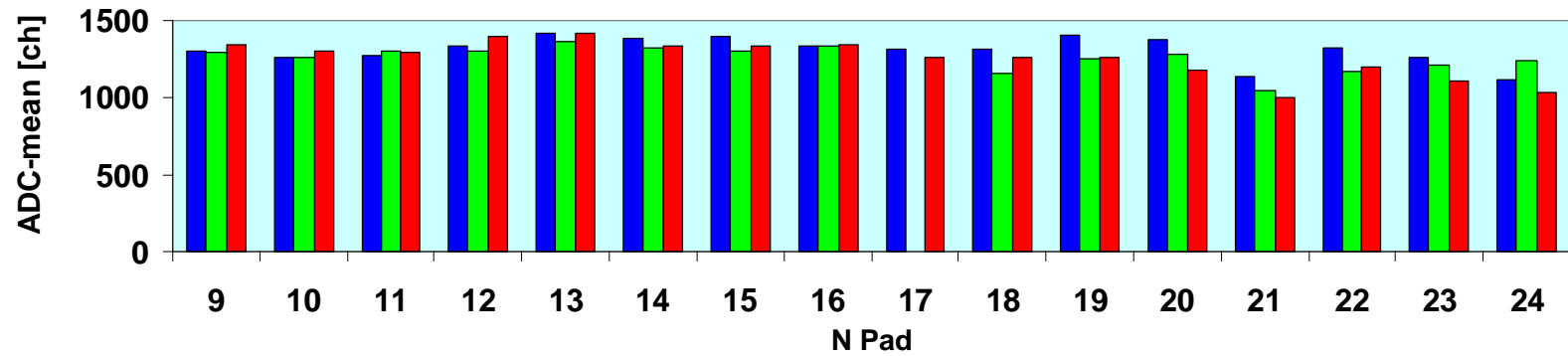
20ns time window



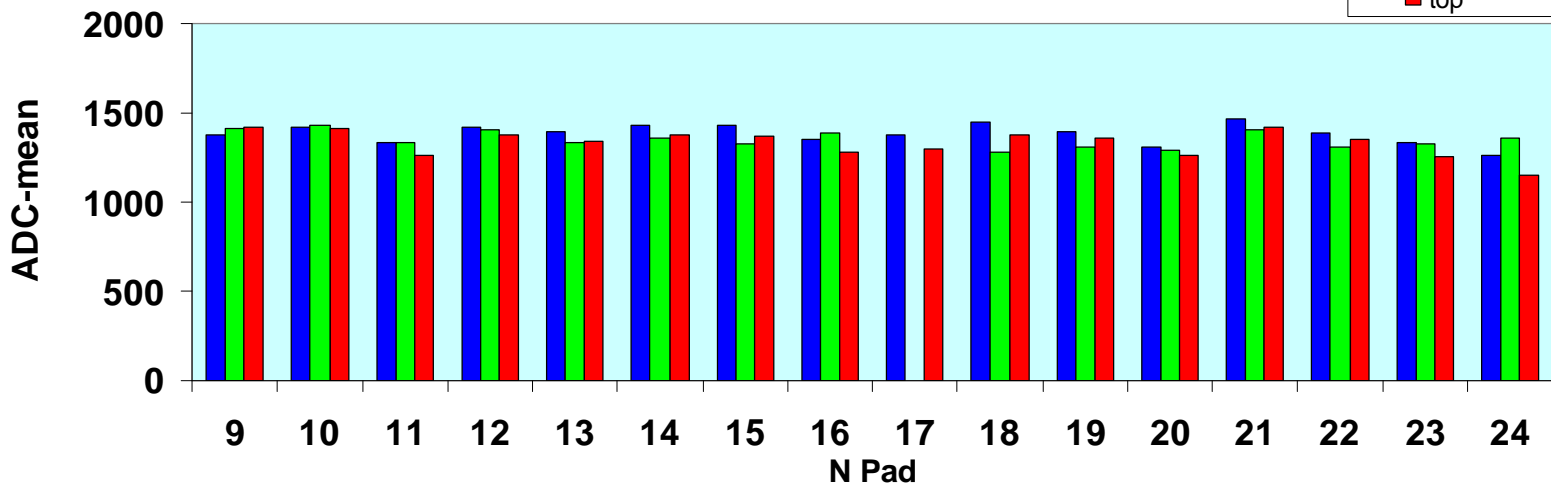


Noise rates between beam spills for various thresholds.  
 Ar(40%)+CO2(50%)+CF4(10%).  
 Plane AB. Beam on pad 11.  
 Arrows indicate positions of HVmin.

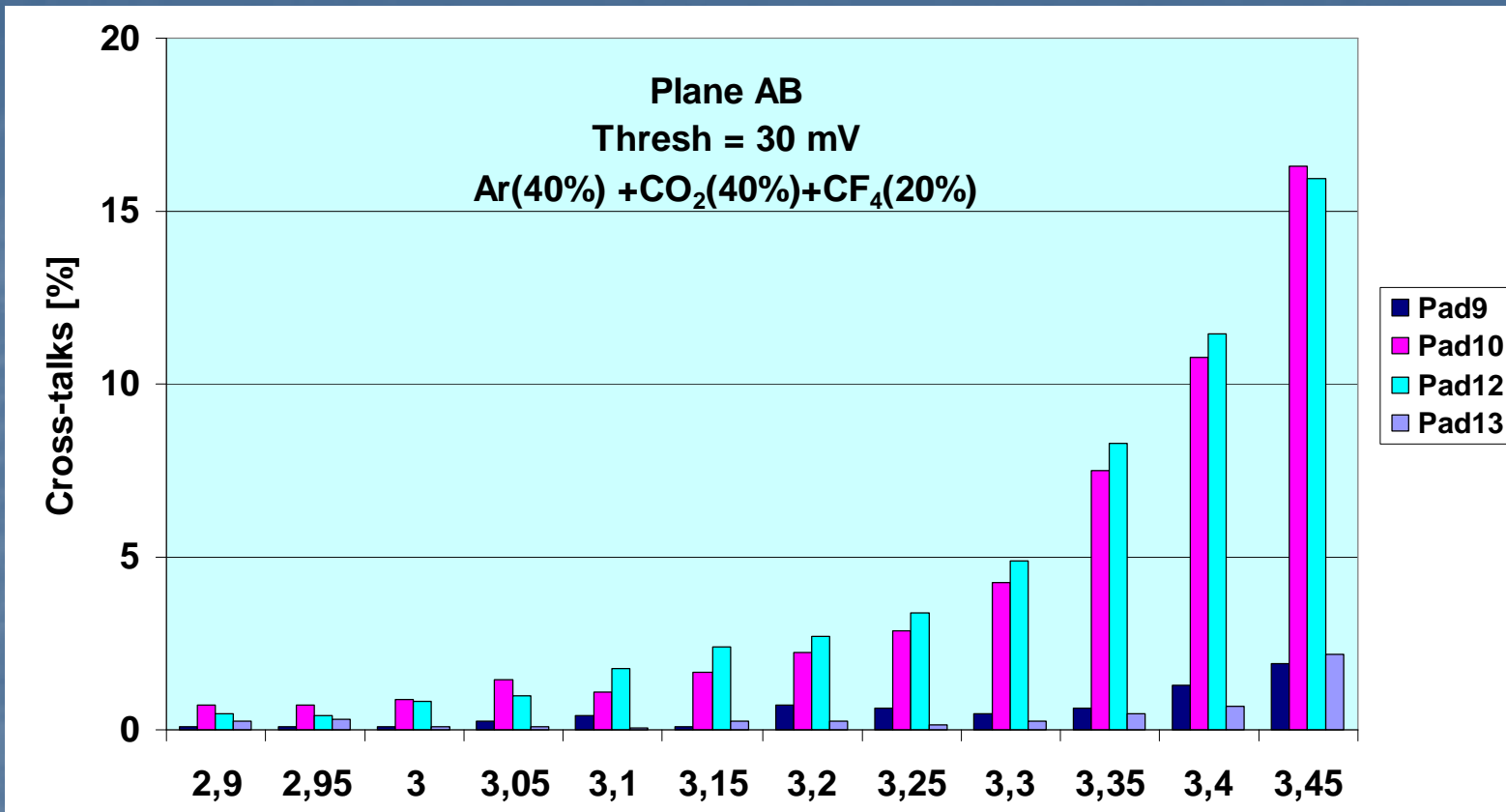
Mean ADC for various pads and beam positions.  
Plane AB.



Mean ADC for various pads and beam positions.  
Plane CD.



Gas gain variation over the surface of M2R4-01



## Cross talk probabilities vs HV.

Beam on pad 11. Presented are the cross-talks to neighbour pads (10 & 12) and to next-to-neighbour pads (9 & 13).

TDC window = 300 ns.

# Mass production of Muon chambers

Total number of chambers in Muon System

**1300 chambers**

To be produced in PNPI-1 factory

**200 chambers M2R4**

**200 chambers M3R4**

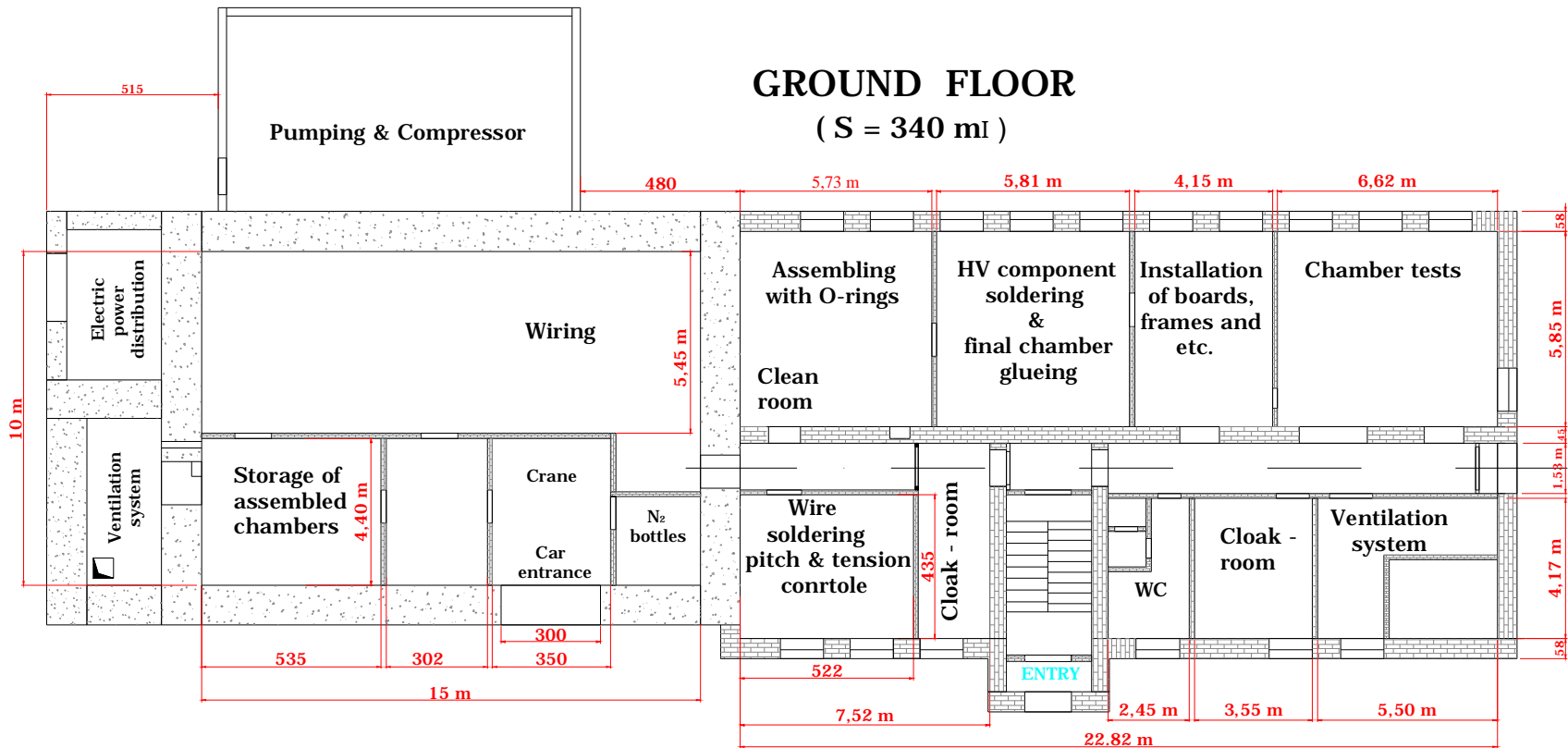
To be produced in PNPI-2 factory

**200 chambers M4R4**

# PNPI-1 Muon Chamber Factory



# PNPI-1 Muon Chamber Factory



# TOOLING

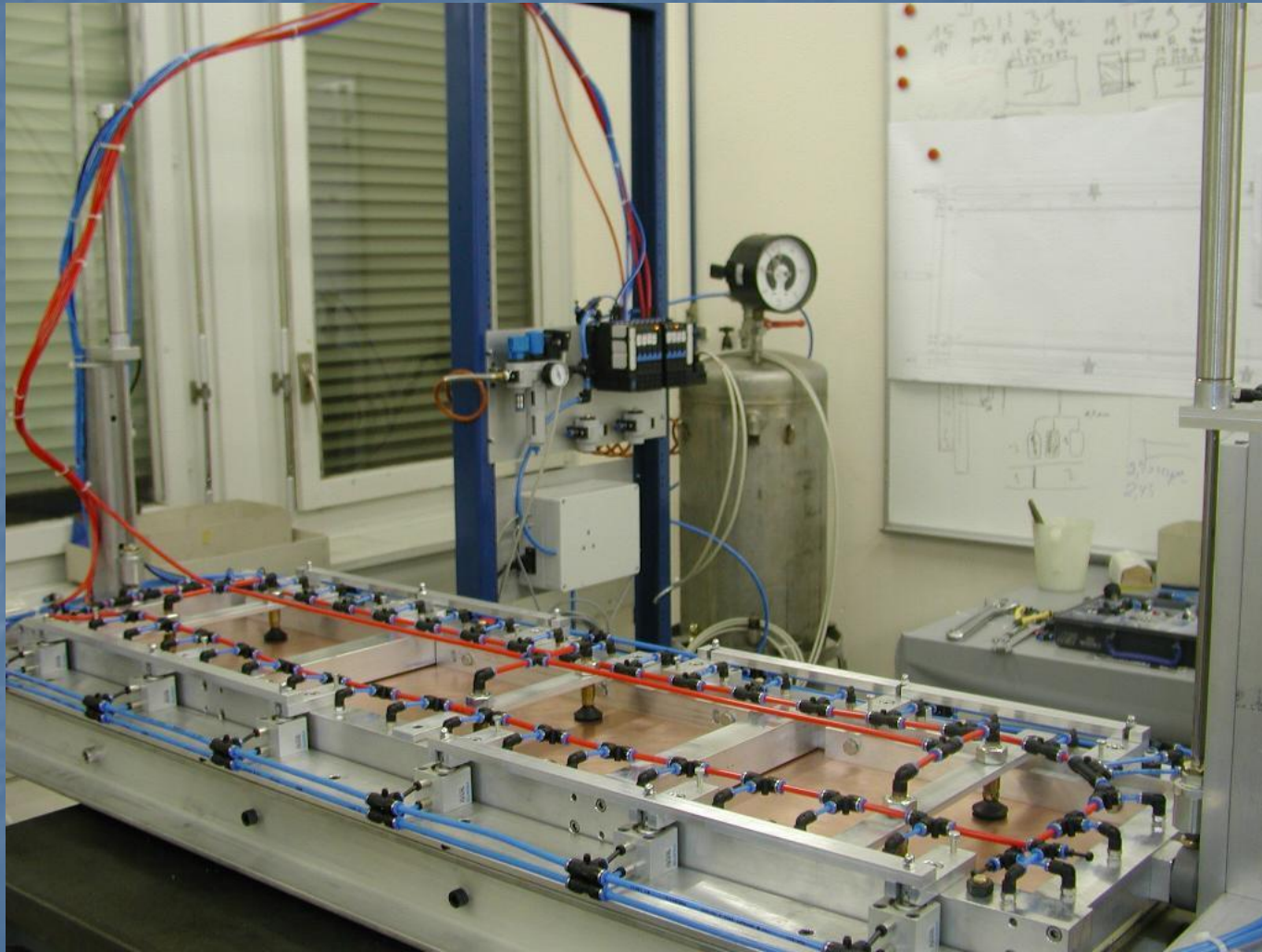
\*Bar glueing machines

\*Wiring machine

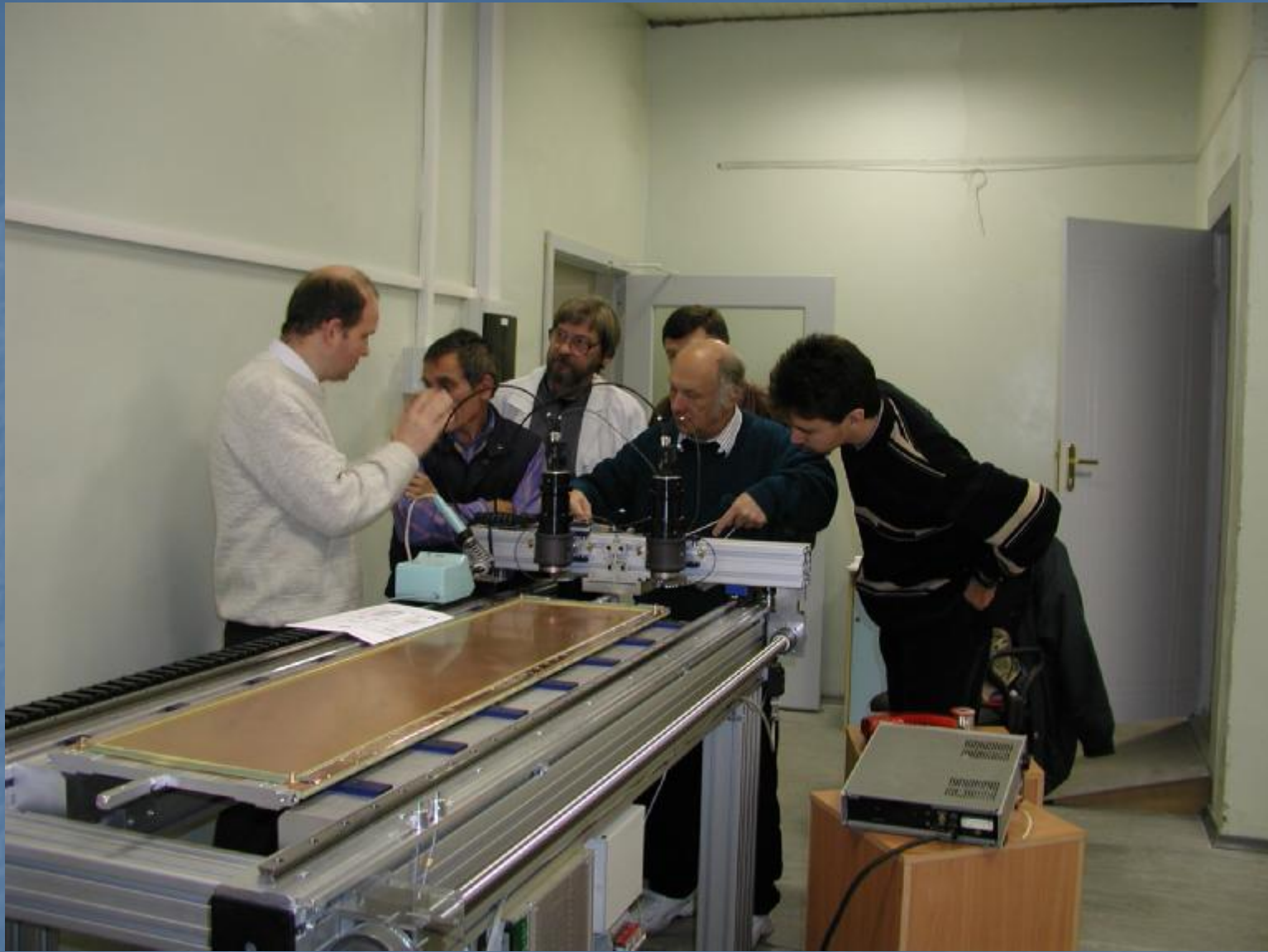
\*Soldering machine

\*Wire pitch&tension measuring machine

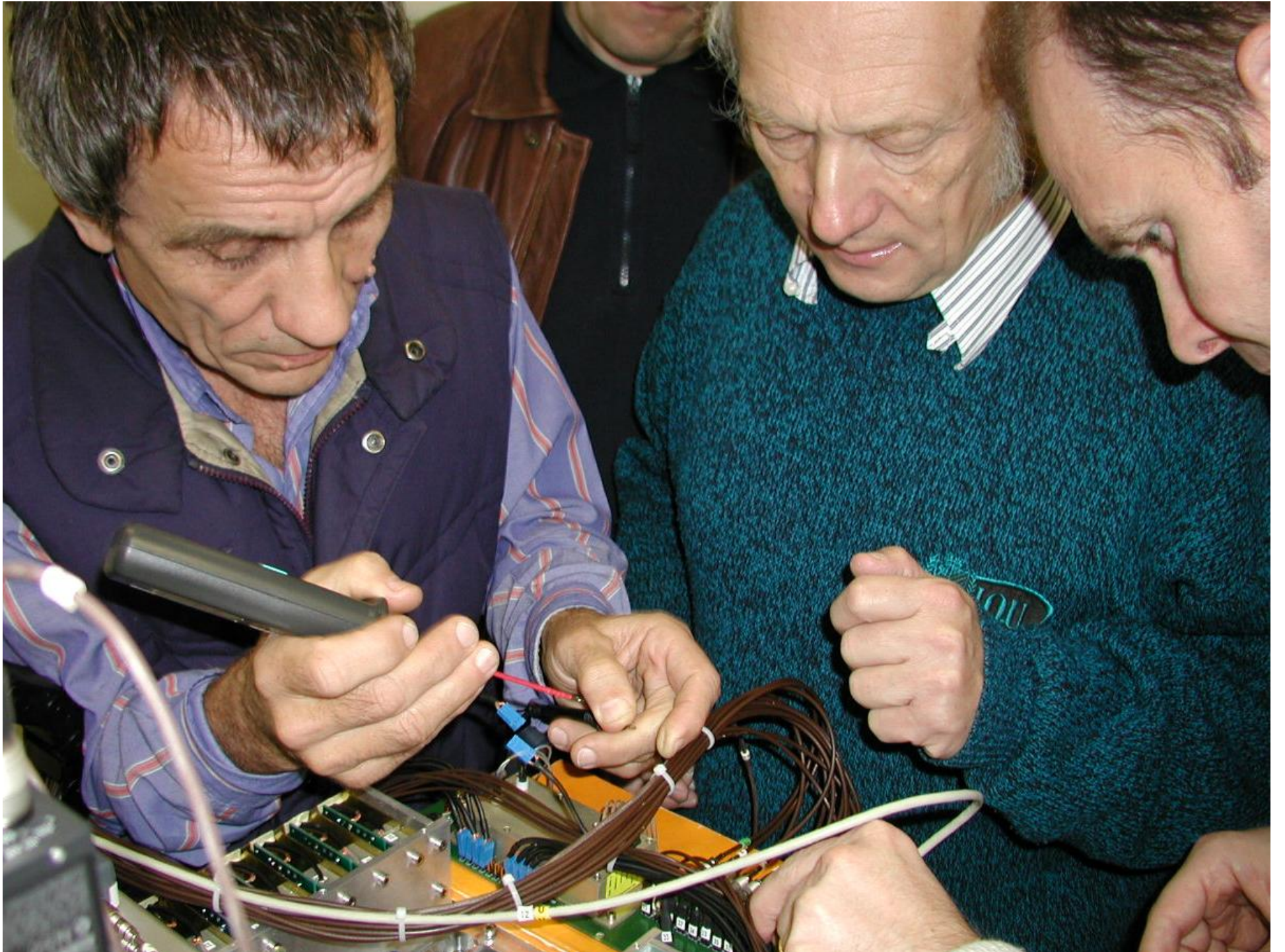
# Bar glueing machine



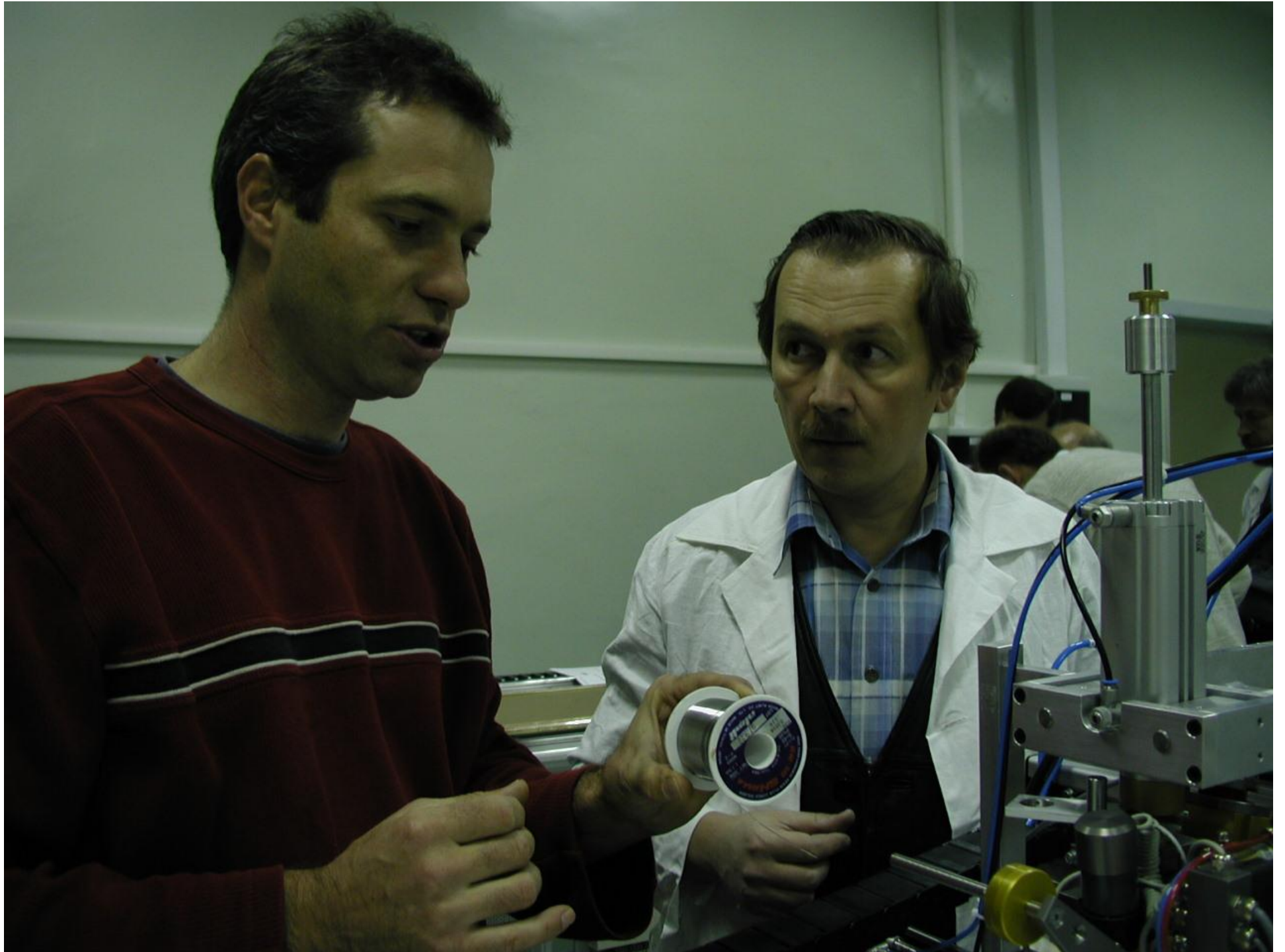






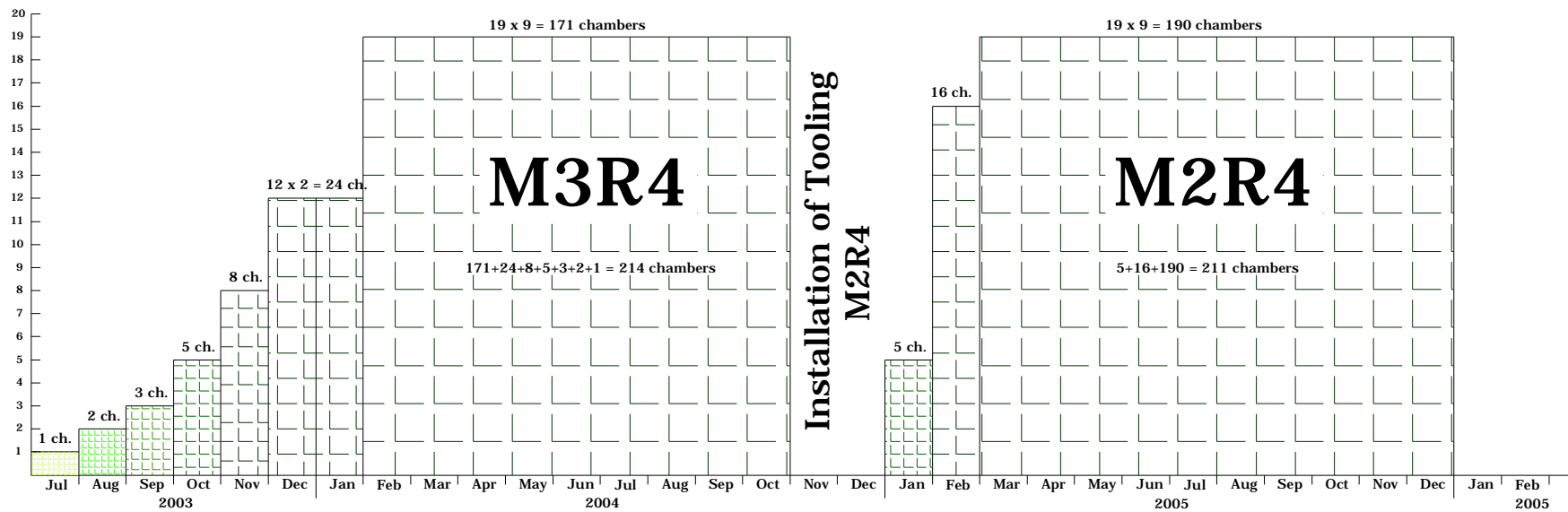








# Muon Chamber Production Plan in PNPI-1



Production rate up to one chamber per day  
400 chambers by the end of 2005

# PNPI-2 factory

By August 2004

CMS Muon ChamberFactory

should be transferred

into PNPI-2 LHCb muon Chamber Factory

All chambers should be constructed

by the end of 2005