Test set-up for the CMS Resistive Plate Chambers

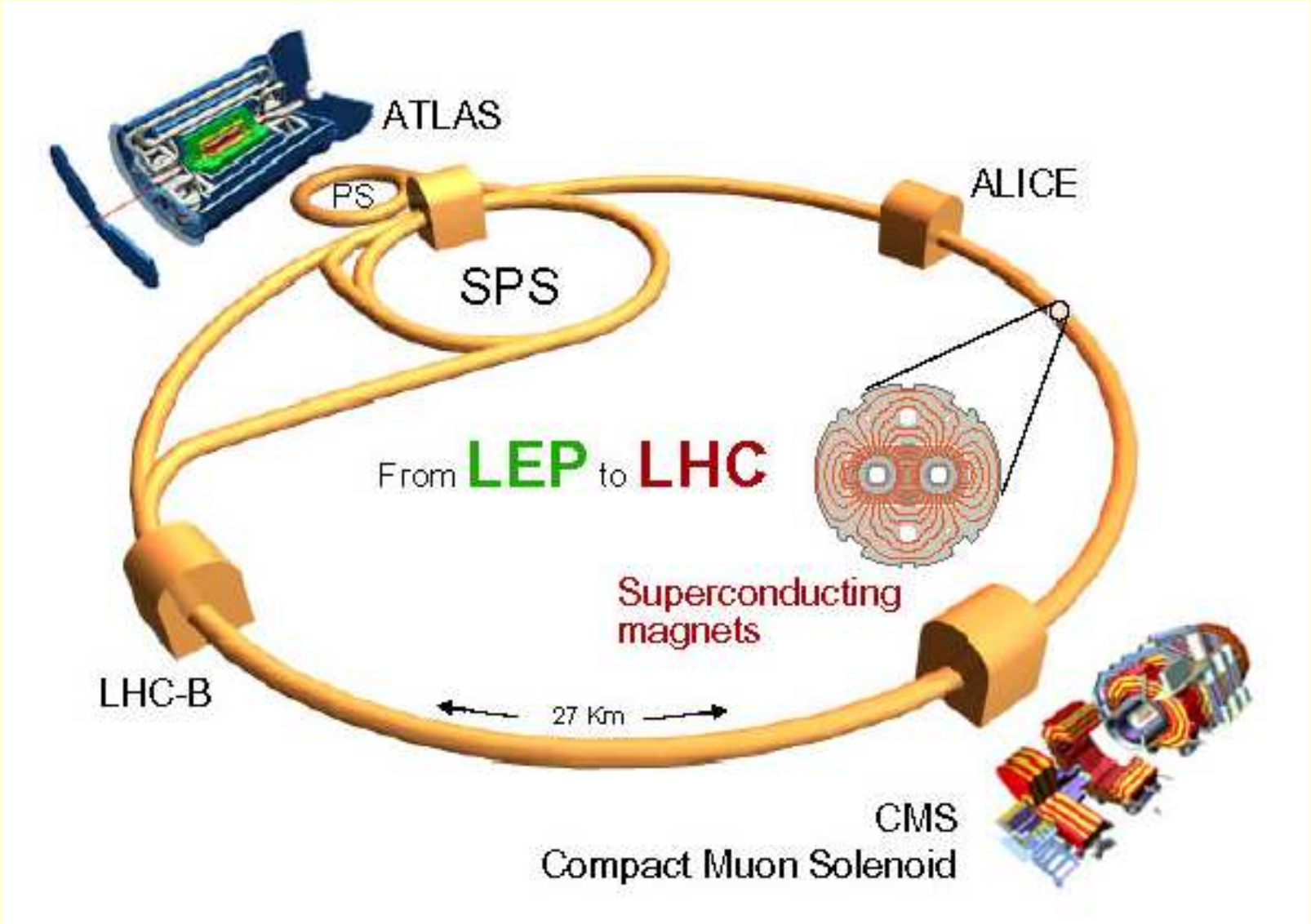
T.Angelov, I. Atanasov, V. Genchev, G. Georgiev, L. Litov,

B. Pavlov, I. Peev, P. Petkov, G. Sultanov

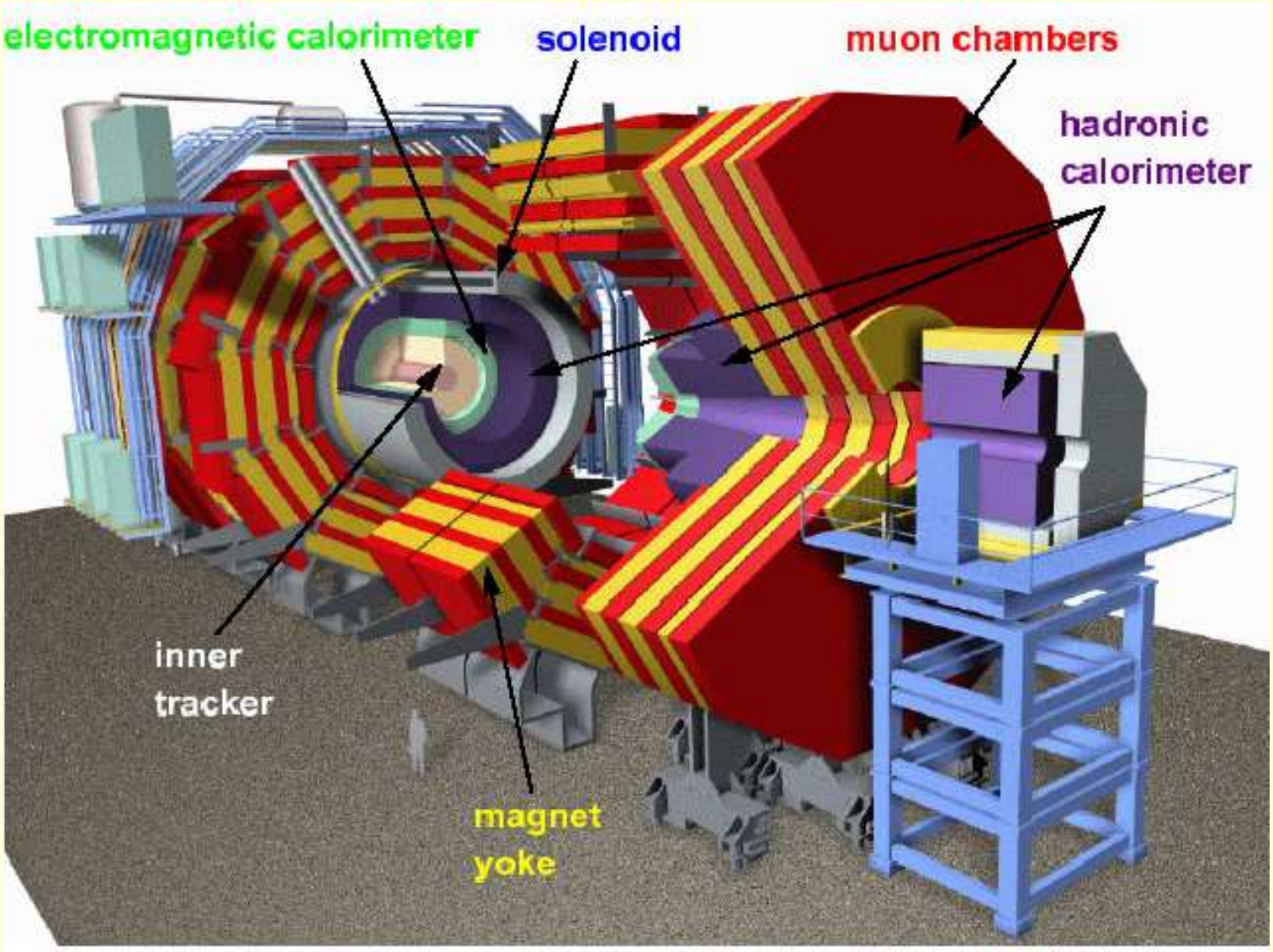
18.01.2002

Meetings in Physics at the University of Sofia

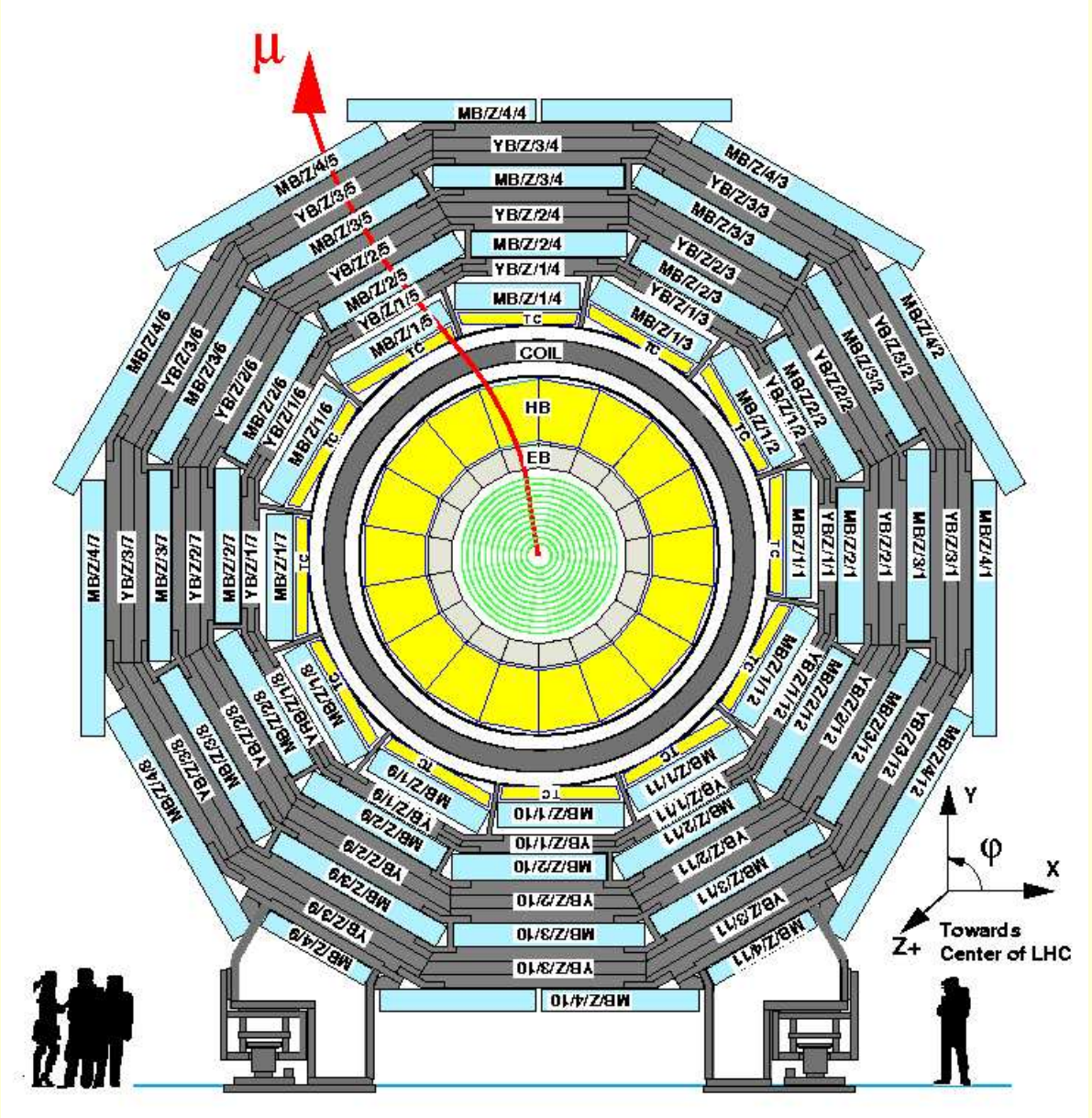
LHC


ATLAS
PS
SPS
ALICE
From LEP to LHC
Superconducting magnets
LHC-B
27 Km
CMS
Compact Muon Solenoid

CMS Experiment



Muon System


μ
MB/Z/4/4
YB/Z/3/4
MB/Z/3/4
YB/Z/2/4
MB/Z/2/4
YB/Z/1/4
MB/Z/1/4
TC
COIL
HB
EB
MB/Z/4/5
YB/Z/3/5
MB/Z/3/5
YB/Z/2/5
MB/Z/2/5
YB/Z/1/5
MB/Z/1/5
MB/Z/4/3
YB/Z/3/3
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YB/Z/3/12
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YB/Z/1/12
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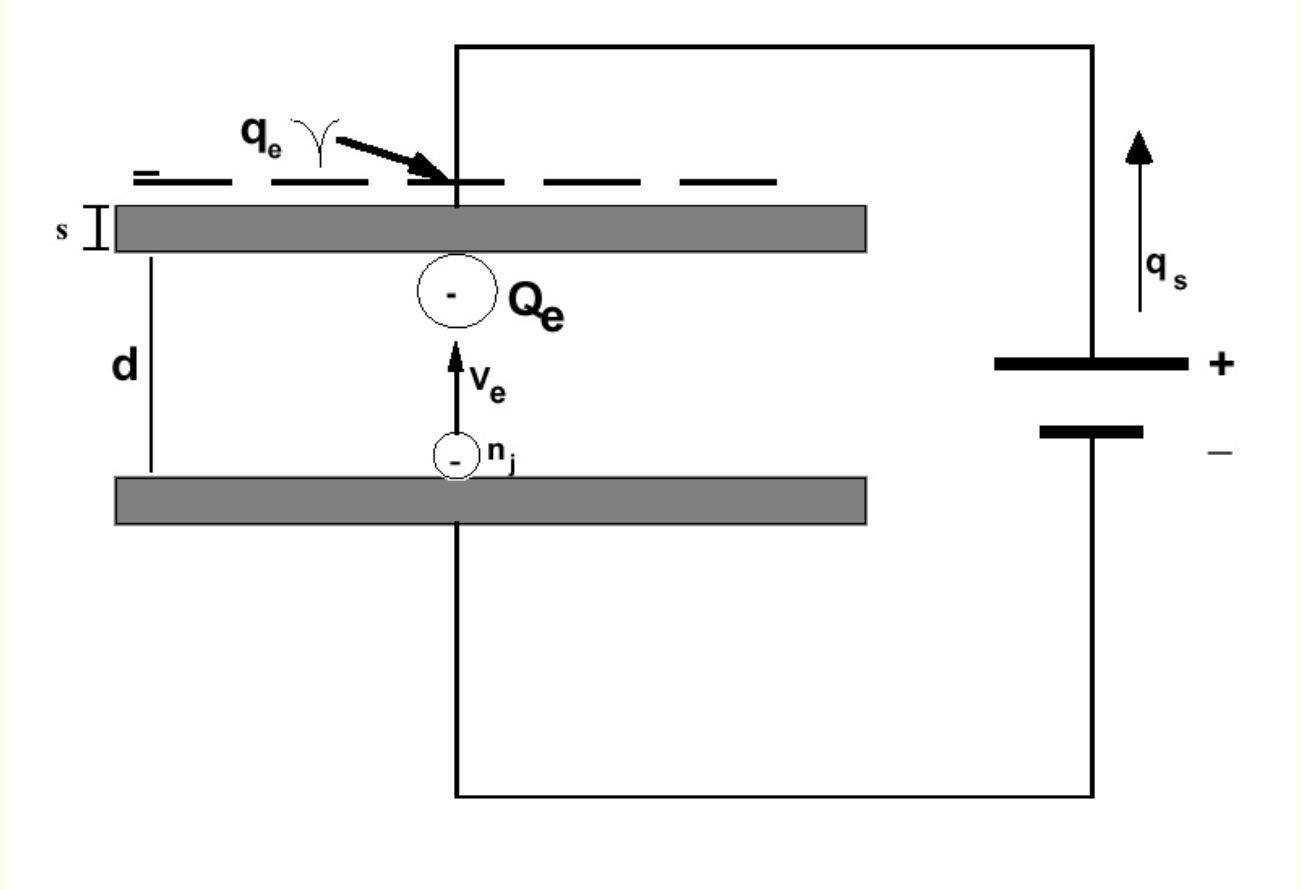
YB/Z/1/11
MB/Z/1/11
MB/Z/4/10
YB/Z/3/10
MB/Z/3/10
YB/Z/2/10
MB/Z/2/10
YB/Z/1/10
MB/Z/1/10
Y
φ
X
Z+
Towards
Center of LHC

CMS SOFIA GROUP

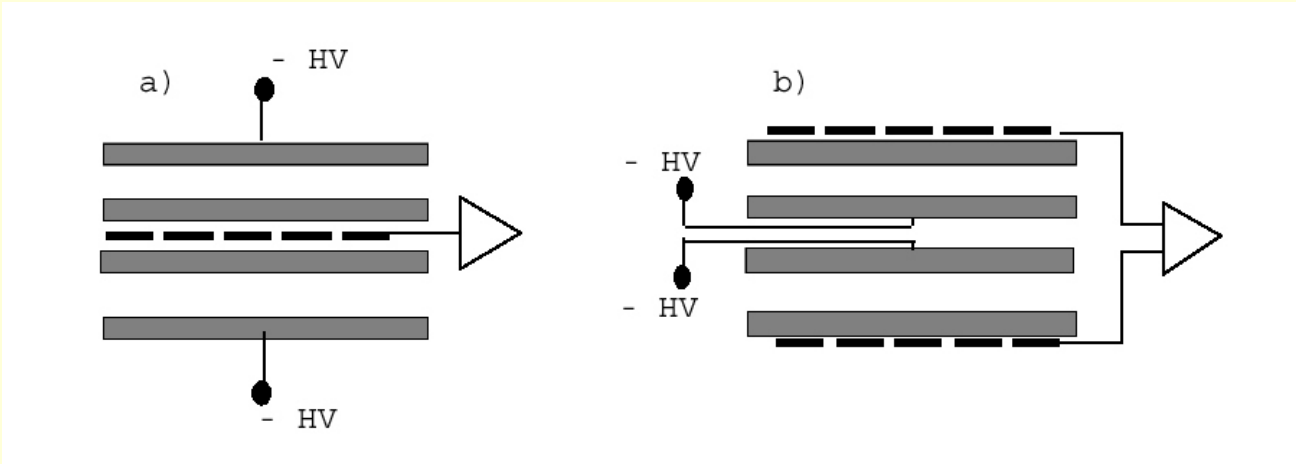
- Bulgaria is participating in barrel RPC design, production and assembly. In particular we are involved in:
  - Production of all mechanical parts for RB2, RB3, RB4 (375 chambers)
  - Production and full assembly of all RB3 (125 chambers)
  - Parameters measurement and testing of all RB3 chambers
  - Integration of RPC chambers in the CMS detector



Principle of action

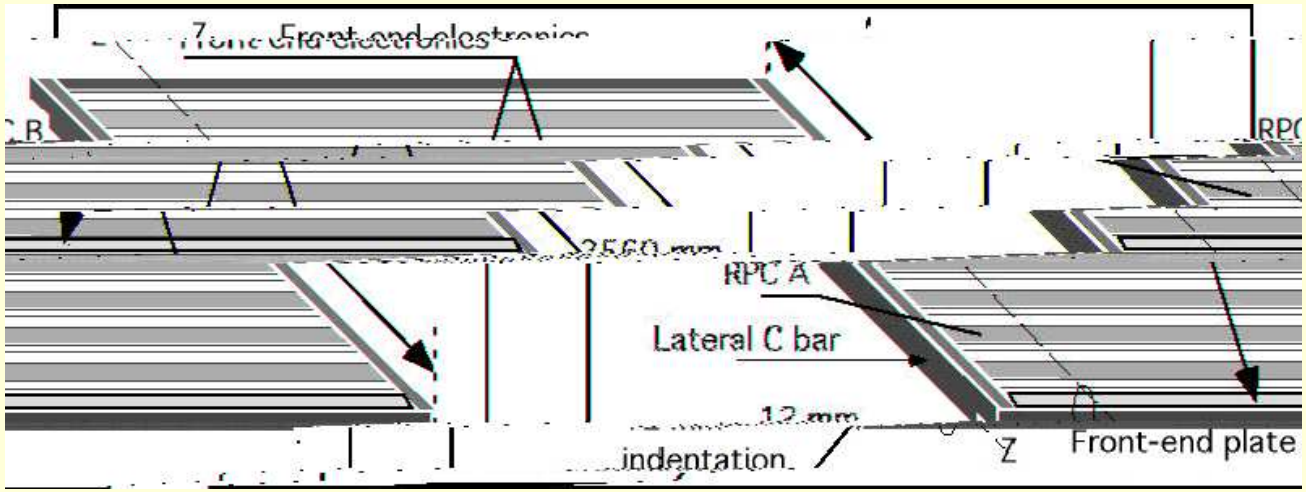
Design

Double-Gap

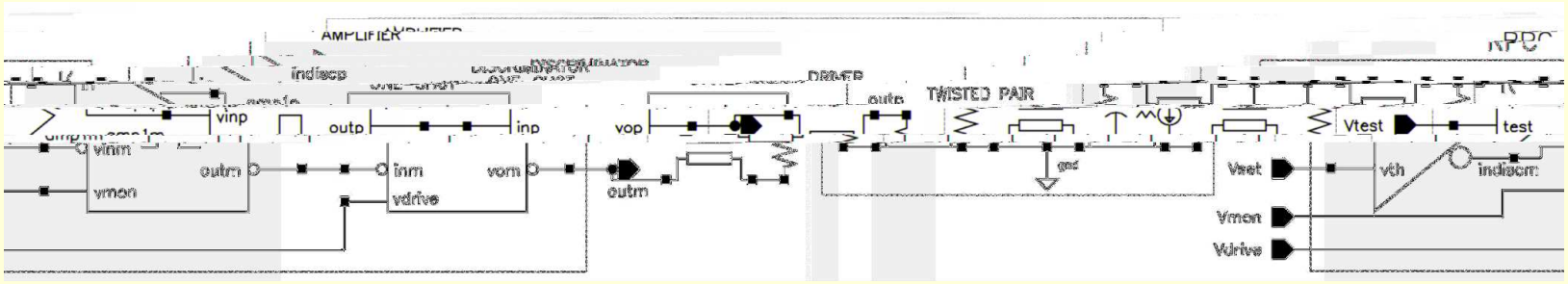


RPC Design and FE bord

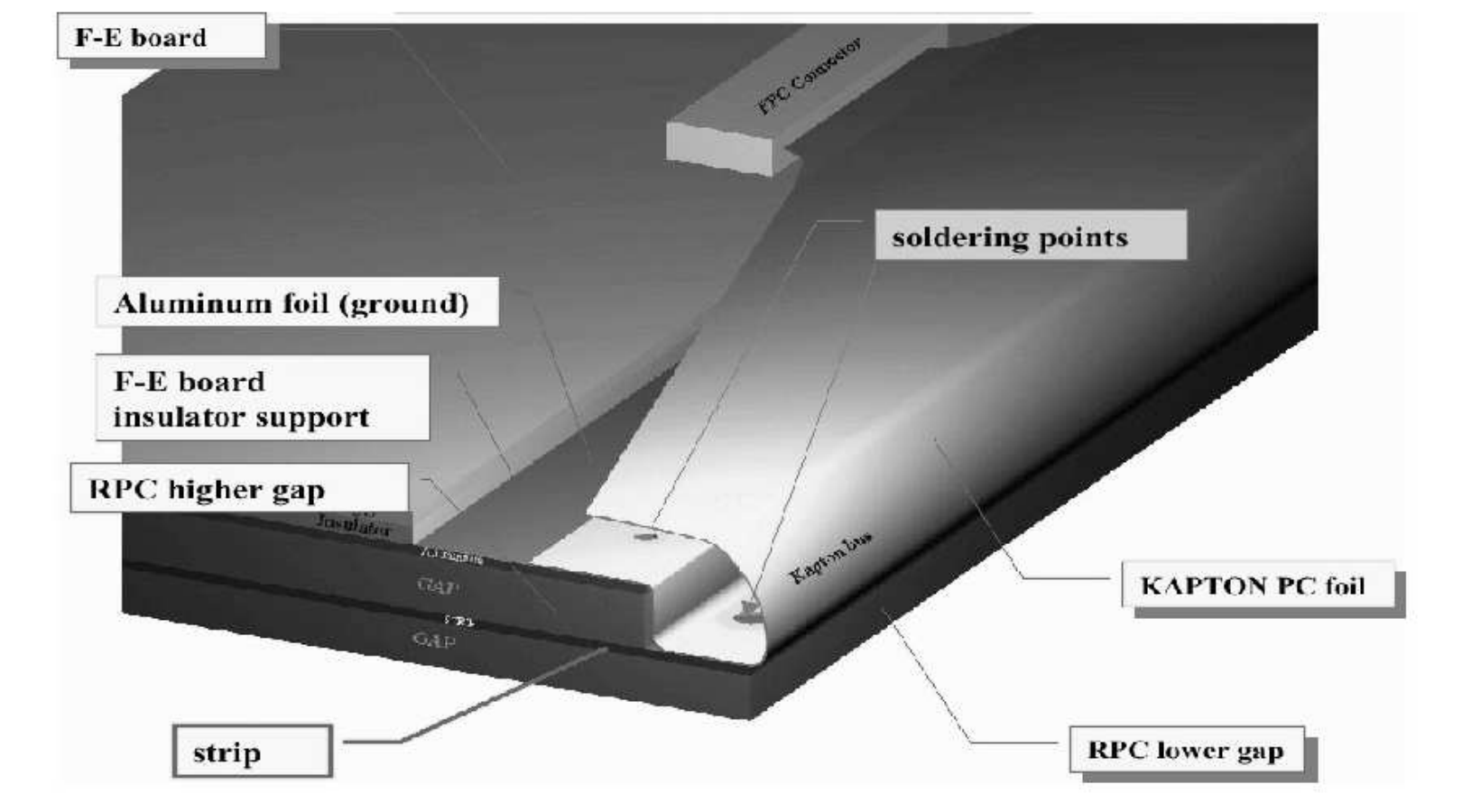
RPC Chamber



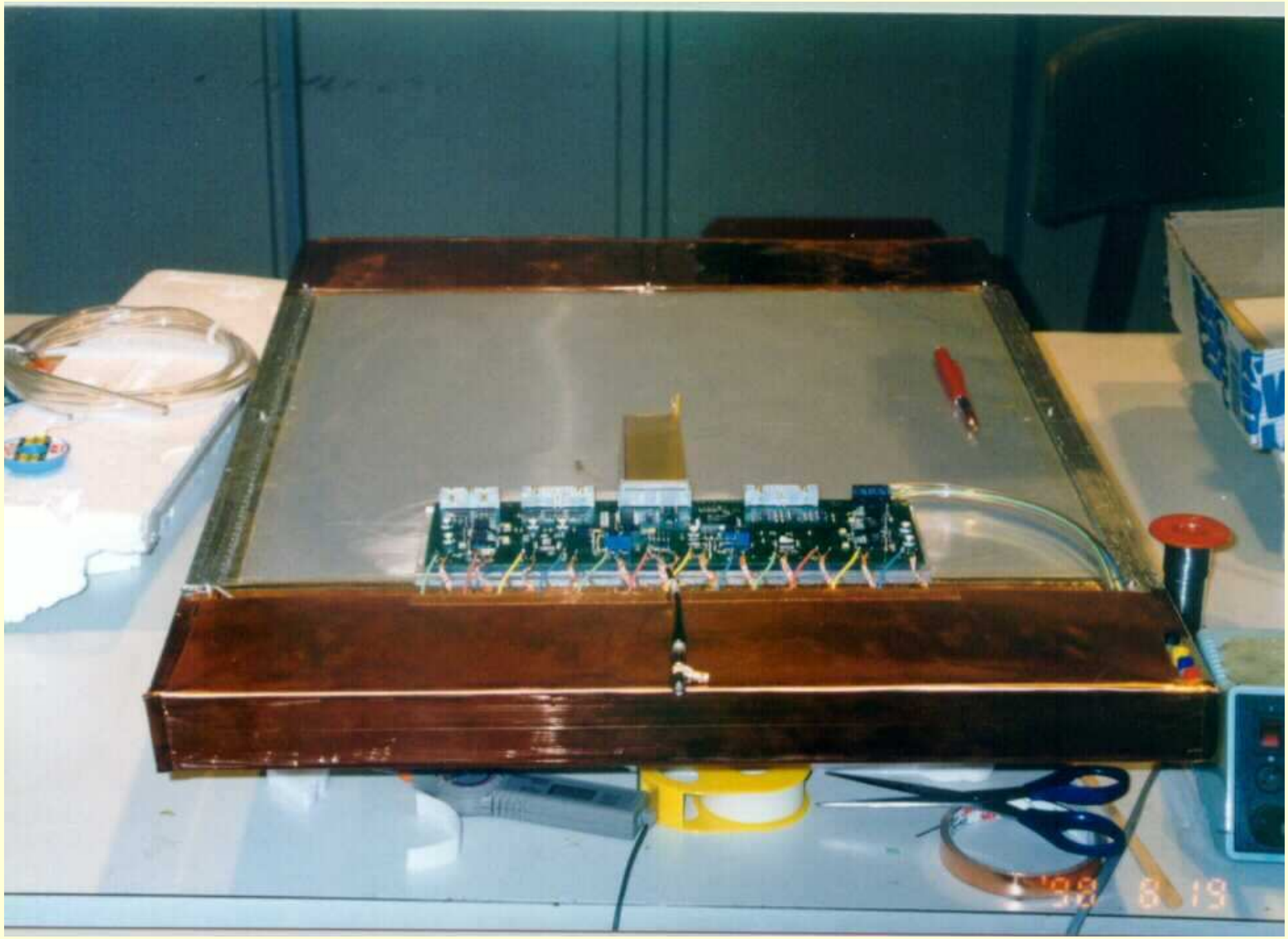
Front-End Board



RPC


F-E board
FPC Connector
soldering points
Aluminum foil (ground)
F-E board
insulator support
RPC higher gap
KAPTON PC foil
strip
RPC lower gap

RPC Prototype



Parameters and Requirements

Bakelite thickness	2mm
Bakelite bulk resistivity	1-2$\times 10^{10}\Omega$cm
Gap width	2mm
Gas mixtures	95% $C_2H_2F_4$, 5% i-C_4H_{10}
Operating High Voltage	8.5 - 10.0 kV
Numper of Gaps	2

Efficiency	>95%
Time resolution	$\leq$ 1.8 ns (98% within 20 ns)
Average cluster size	$\leq$ 2 strips
Rate capability	$\geq$ 1 kHz/cm^2
Power consumption	<2-3 W/m^2
Operation plateau	>300 V
Number of Streamers	<10%

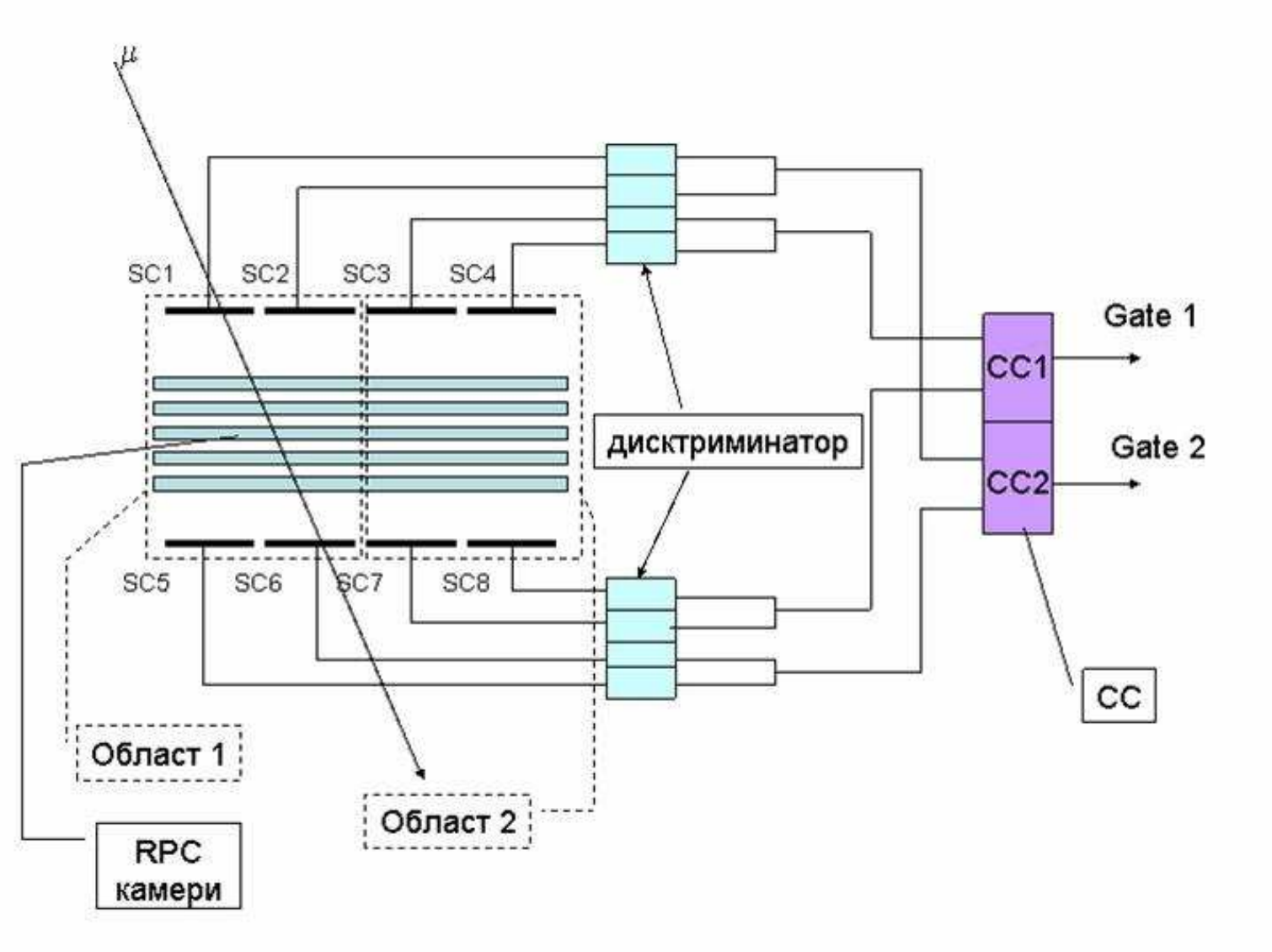
Aim of The Test Set-up

- **Working Voltage**
- **Noise Estimation**
- **Efficiency**

Test Set-up

- **Trigger**
- **High Voltage System**
- **Data Acquisition System (DAQ)**
- **Gas System**
- **Cooling System**
- **Slow Control**

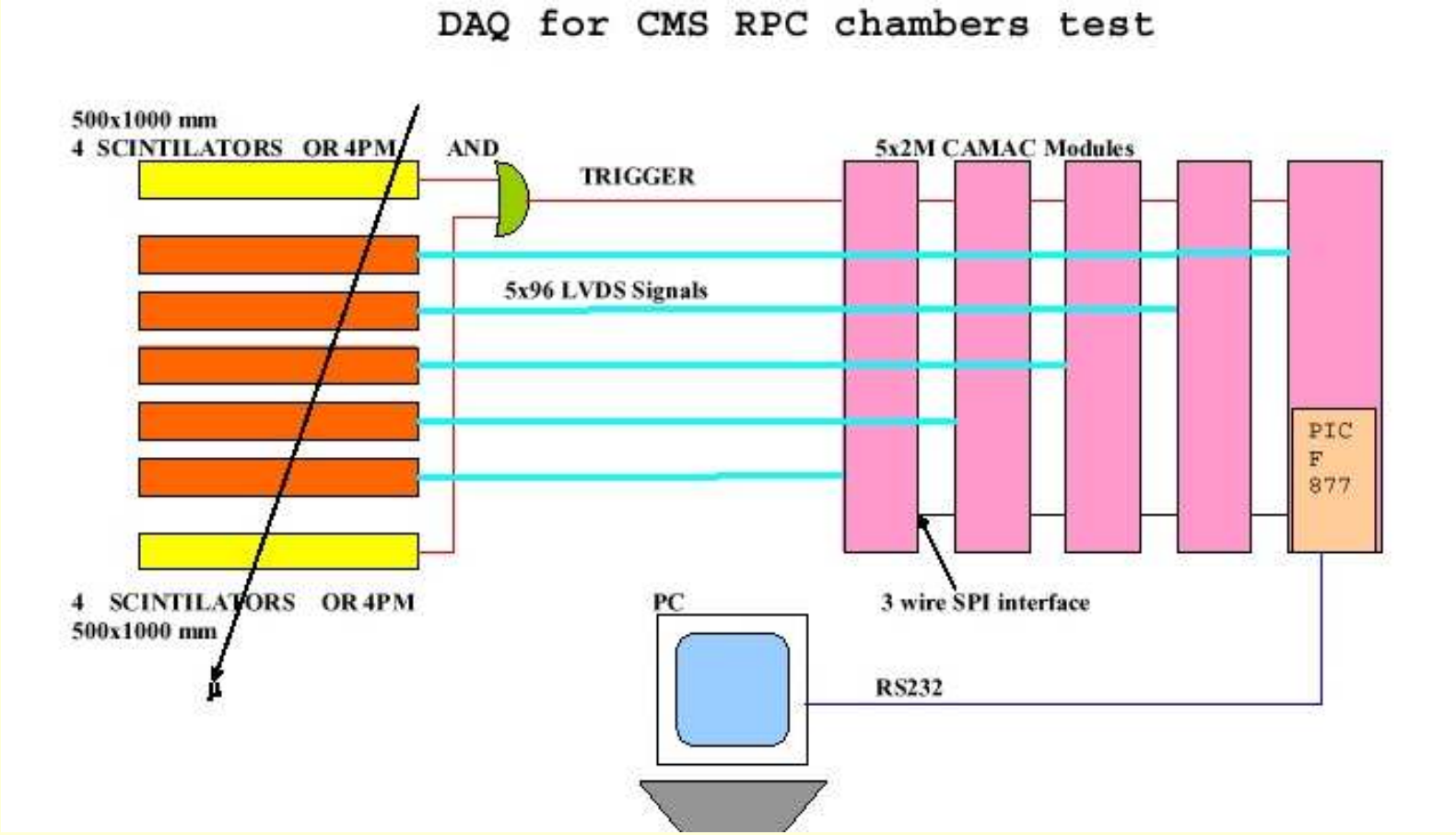
Trigger


μ
SC1
SC2
SC3
SC4
SC5
SC6
SC7
SC8
дисктриминатор
CC1
CC2
Gate 1
Gate 2
CC
Област 1
Област 2
RPC
камери

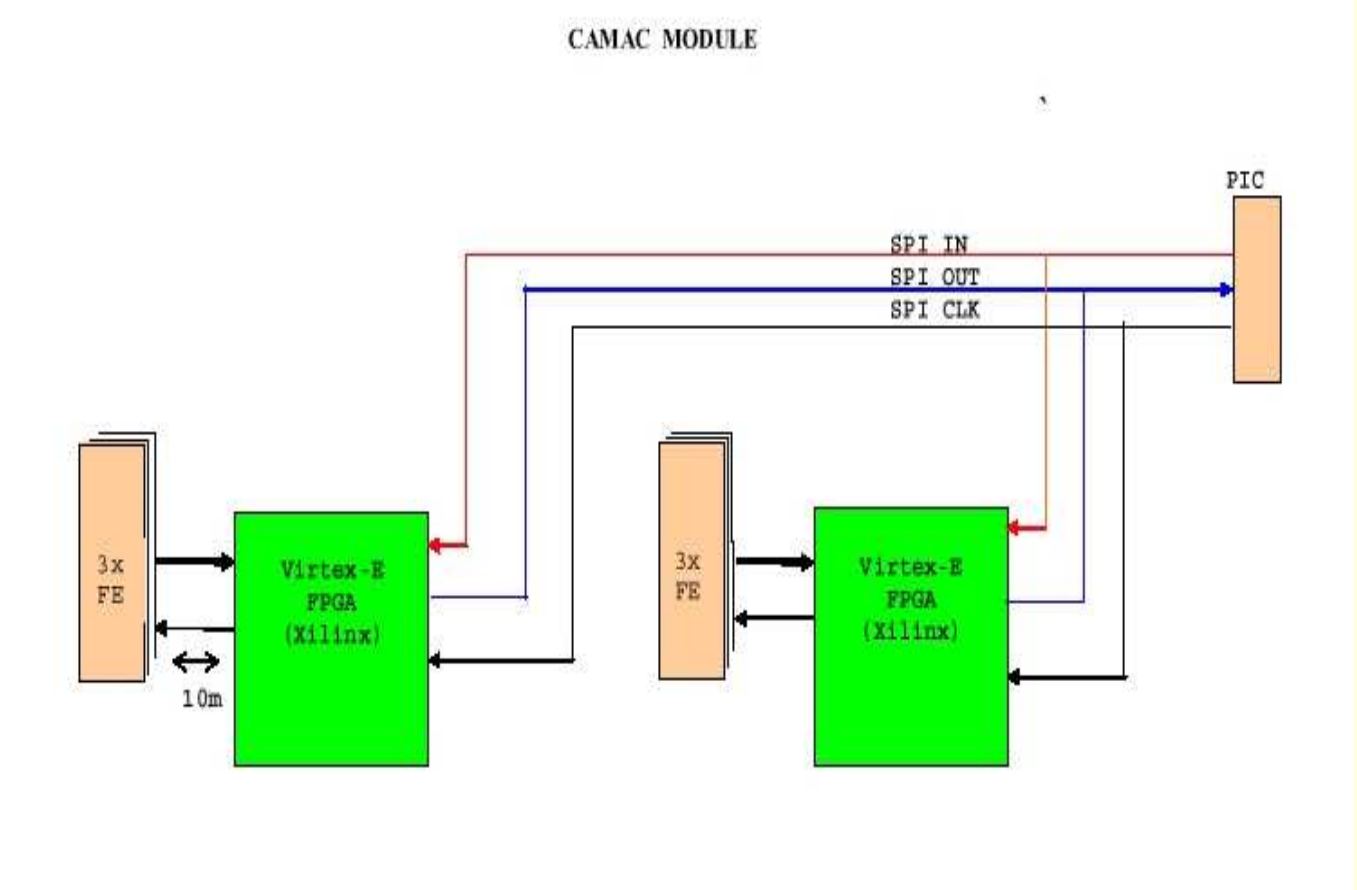
High Voltage System

- **HV10-2N modules (we need 10 of them)**
- **Number of channels in the module : 2**
- **Output voltage : 0 - 10000 V**
- **Maximum output current : 150 μA**
- **Steps of Regulation : 2.5 V**
- **Short-period stability : $<$ 5 V**
- **Long-period stability : $<$ 5 V**
- **Interface : CAMAC**

DAQ


DAQ for CMS RPC chambers test
500x1000 mm
4 SCINTILATORS OR 4PM
AND
TRIGGER
5x2M CAMAC Modules
5x96 LVDS Signals
PIC
F
877
4 SCINTILATORS OR 4PM
500x1000 mm
PC
3 wire SPI interface
RS232

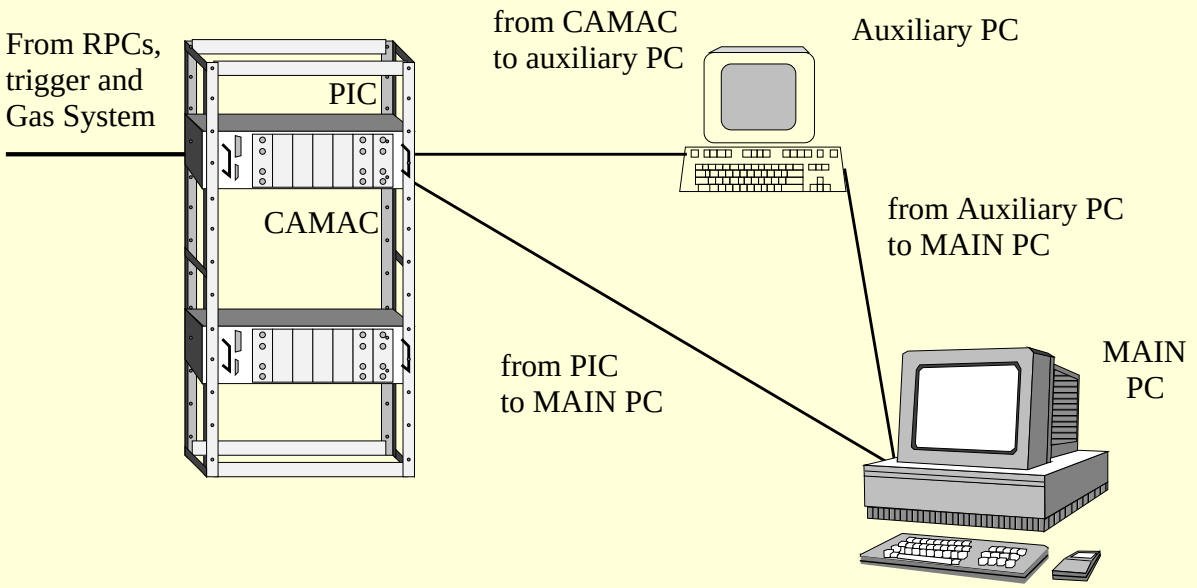
DAQ (FE-PIC)


CAMAC MODULE
PIC
SPI IN
SPI OUT
SPI CLK
3x
FE
Virtex-E
FPGA
(Xilinx)
10m
3x
FE
Virtex-E
FPGA
(Xilinx)

DAQ Main Features

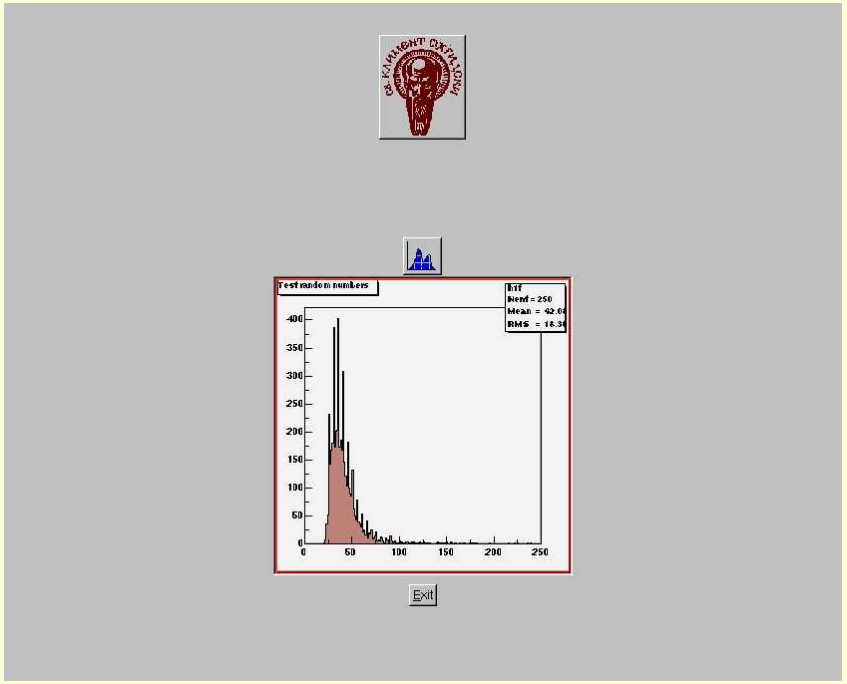
- 480 digital and 2 analogue channels
- Resolution 1 channel
- Noise resolution granularity 8 channels
- FPGA read out clock 1 to 4 MHz
- Trigger rate 240 Hz
- Expandable - up to 720 digital and 5 analogue channels
- Re-configurable, additional logic functions, various input level
- Output interface RS232C @ 115200 baud/sec.

DAQ and Slow Control



- One auxiliary PC (monitoring and cantrol of CAMAC crate via KK-009 crate controller)
- The DAQ PIC processor - responsible for DAQ and monitoring of Gas System
- Main PC

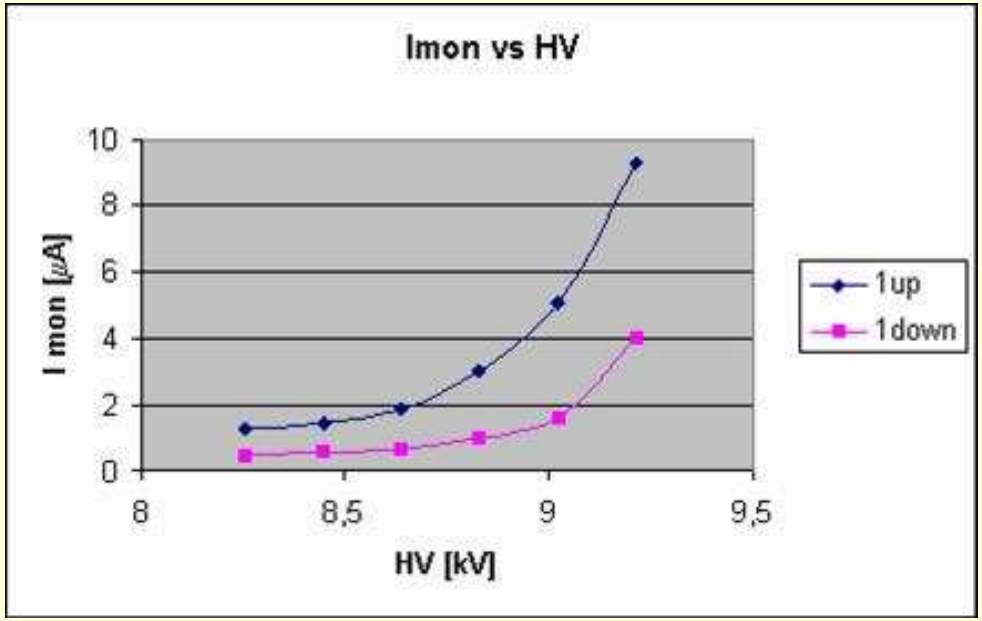
Software

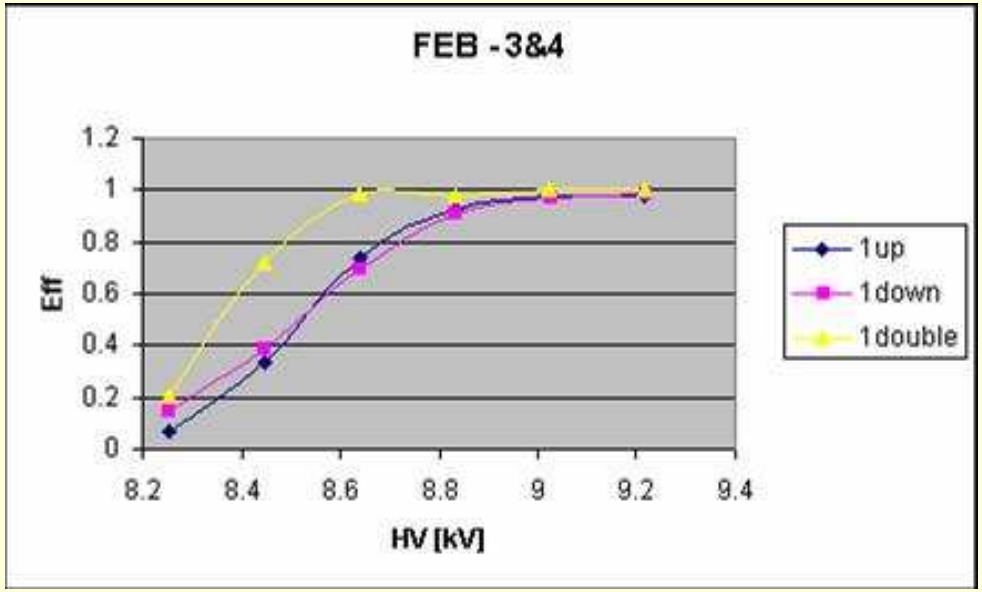


- Software for XILINX Virtex-E FPGA (Field Programmable Gate Arrays)
- C Software for PIC16F877 microcontroller
- C and C++ Software for Auxiliary and Main PC
- C++ Software for Visualisation using ROOT
- Possibility for remote monitoring via Internet

Conclusions

- **Trigger is well studied**
- **High Voltage System is tested**
- **500 channels flexible DAQ is developed**
- **DAQ and Visualisation are on-line**
- **Ready for production ...**


Imon vs HV
I mon [μA]
10
8
6
4
2
0
8
8,5
9
9,5
HV [kV]
1up
1down


FEB -3&4
Eff
1.2
1
0.8
0.6
0.4
0.2
0
8.2
8.4
8.6
8.8
9
9.2
9.4
HV [kV]
1up
1down
1double