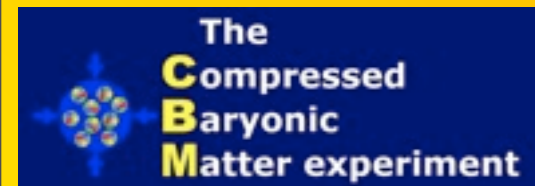




Slow Control System for RICH prototype

Jihye Song for CBM RICH
Pusan National University
Heavy Ion Physics Experiment LAB.
Heavy Ion Meeting
2012.2.22



CBM collaboration

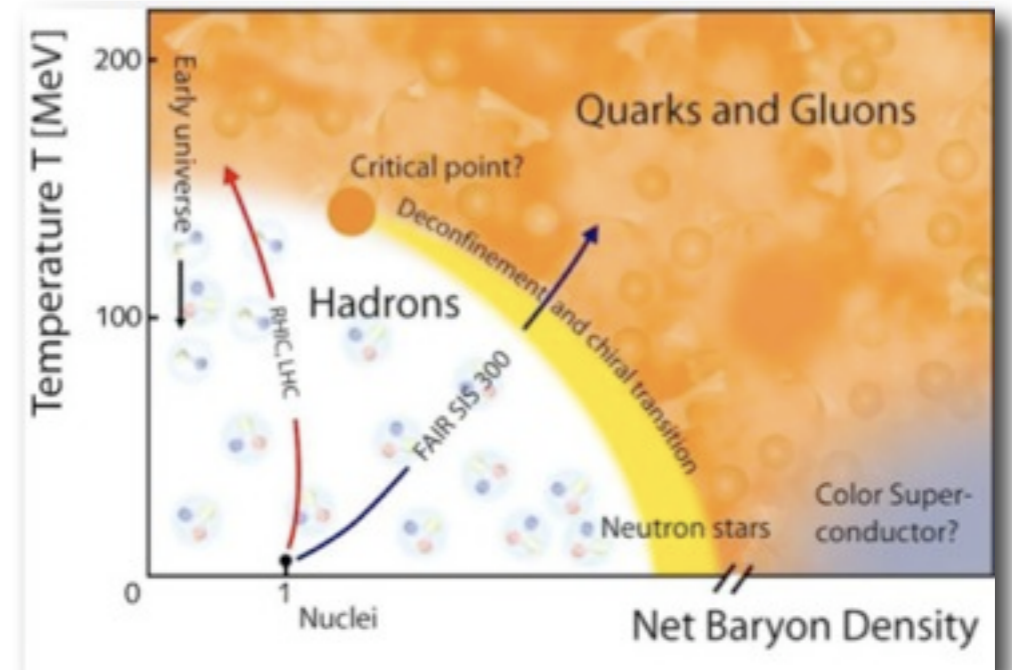
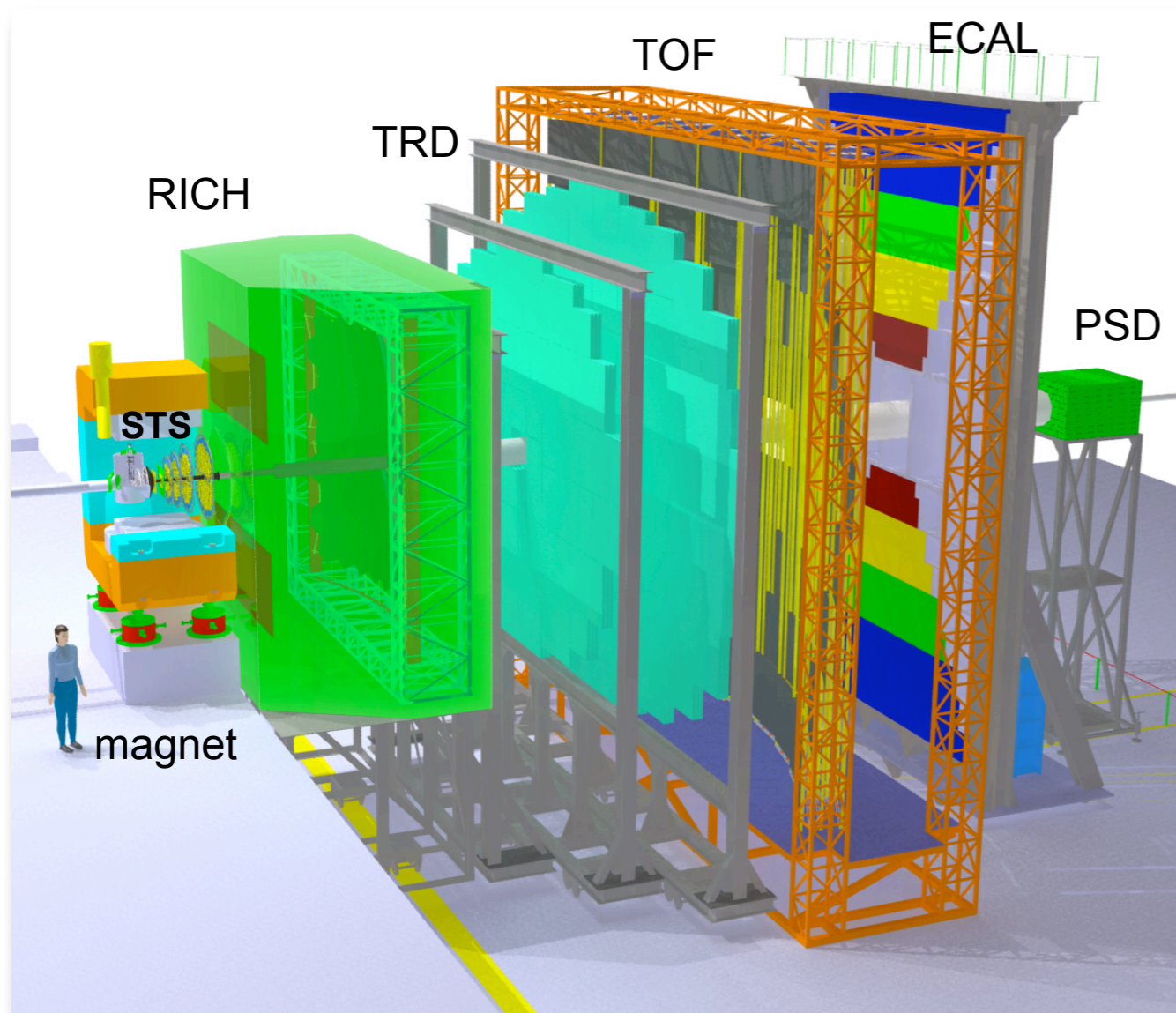


Outline

- 🔊 Compressed **B**aryonic **M**atter
- 🔊 Ring Imaging **C**herenkov detector
- 🔊 Slow **C**ontrol **S**ystem
 - 🔊 Mirror positioning control system
 - 🔊 High Voltage control system
- 🔊 Experiment (Nov.2011.T9 @ cern)
 - Parameter scan & Results
- 🔊 Conclusion

The CBM experiment

Compressed Baryonic Matter



Goal

- ✓ properties of Super-dense nuclear matter
- ✓ rare and penetrating probes(dileptons)

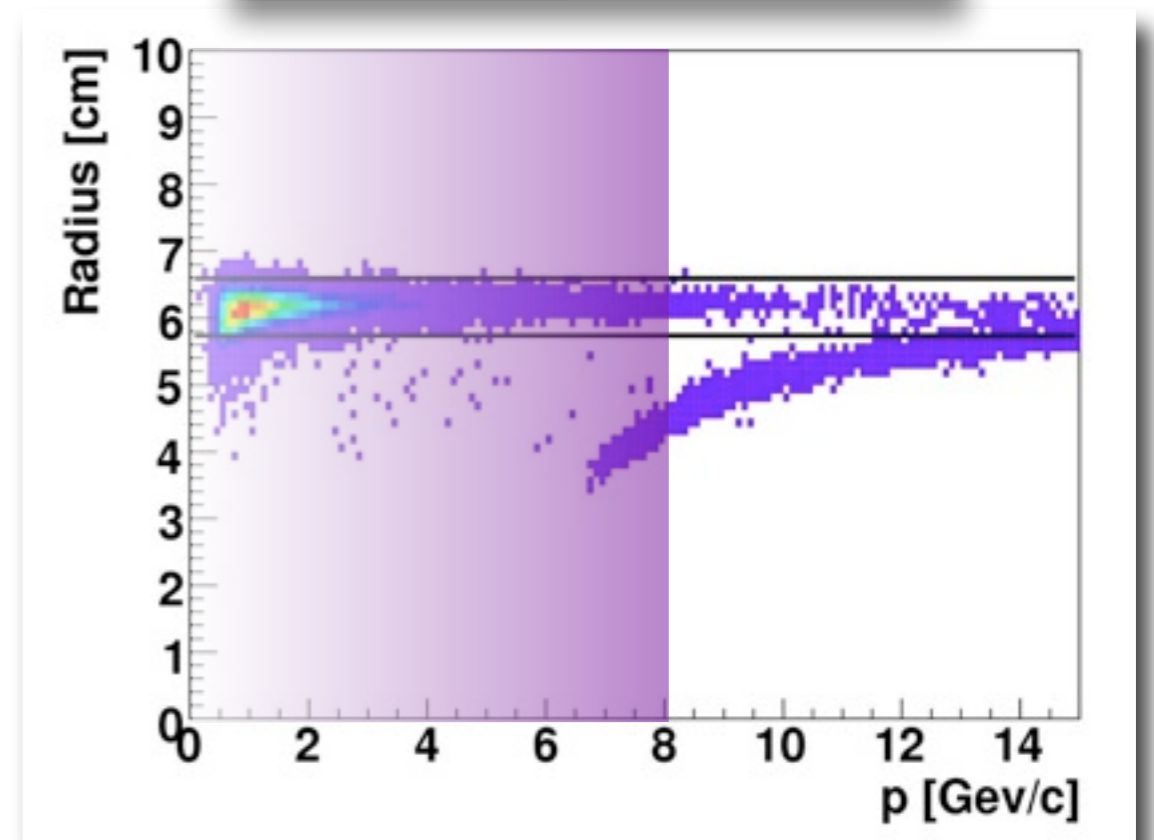
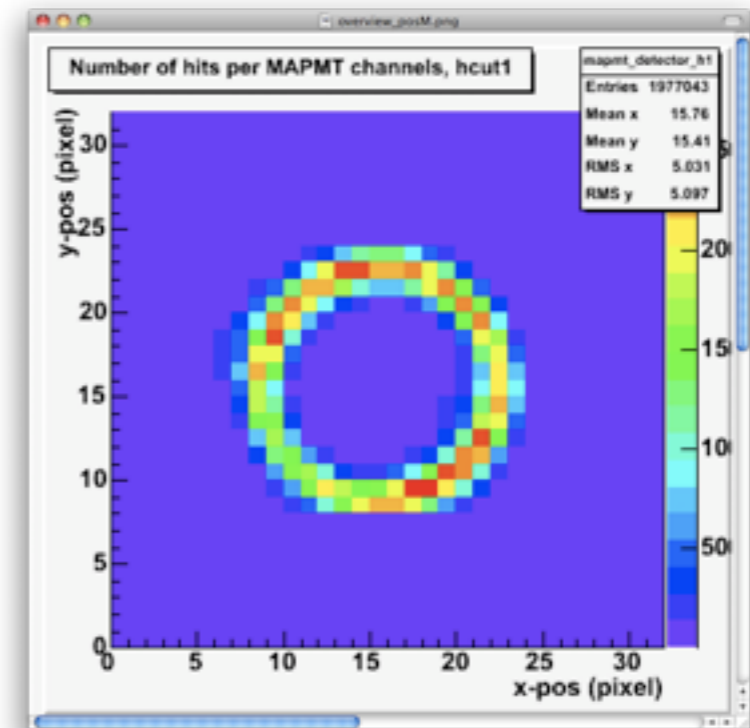
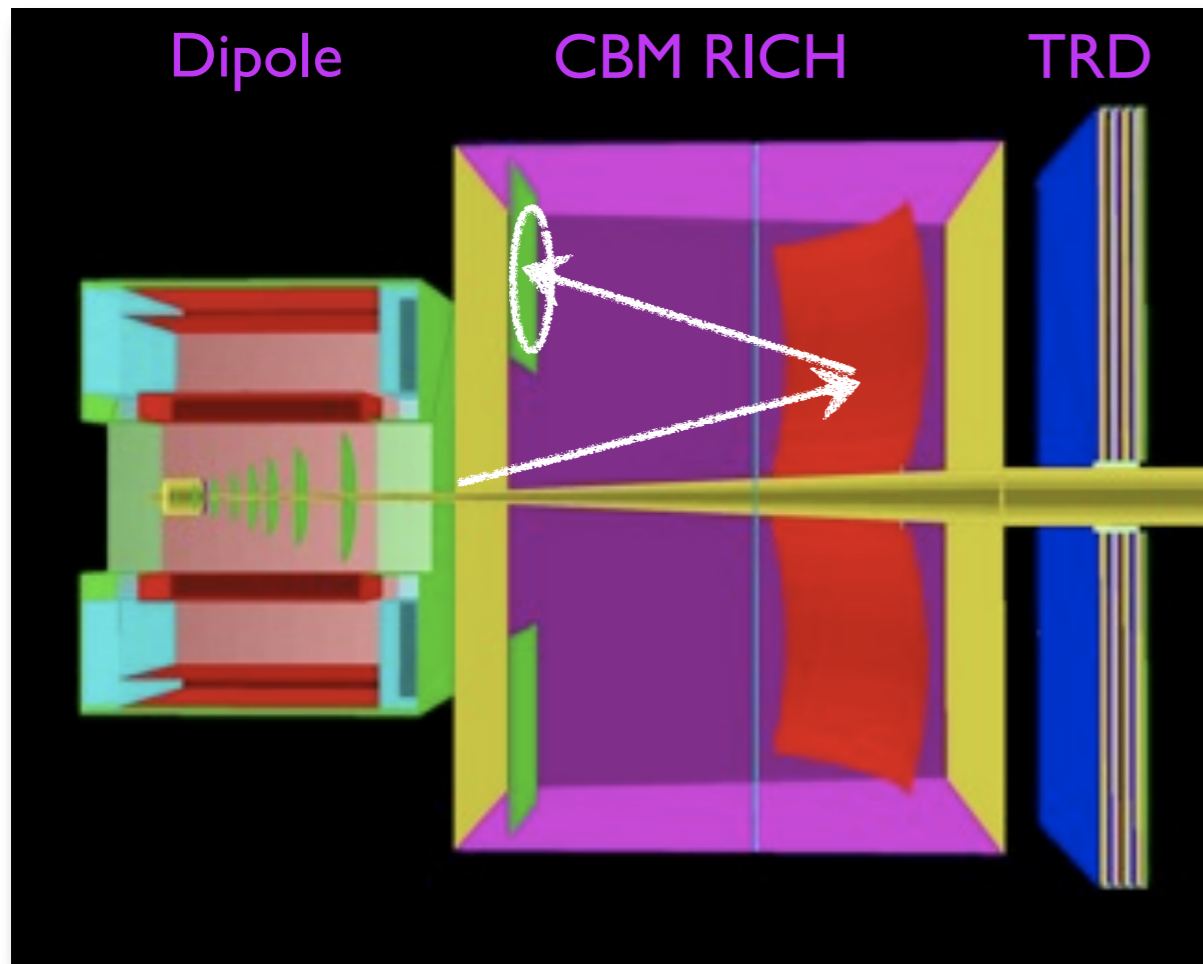
penetrating probes : $\rho, \omega, \varphi \rightarrow e^+e^-$
 : $J/\Psi, \Psi' \rightarrow e^+e^-$

FAIR : Facility for Antiproton and Ion Research

- 10 to 40 GeV/u energy scanned
- it will be installed ~ 2018

The CBM RICH detector

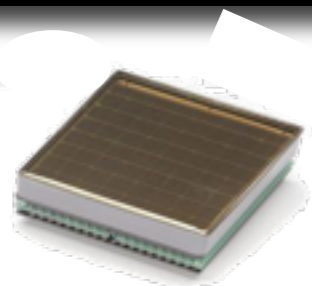
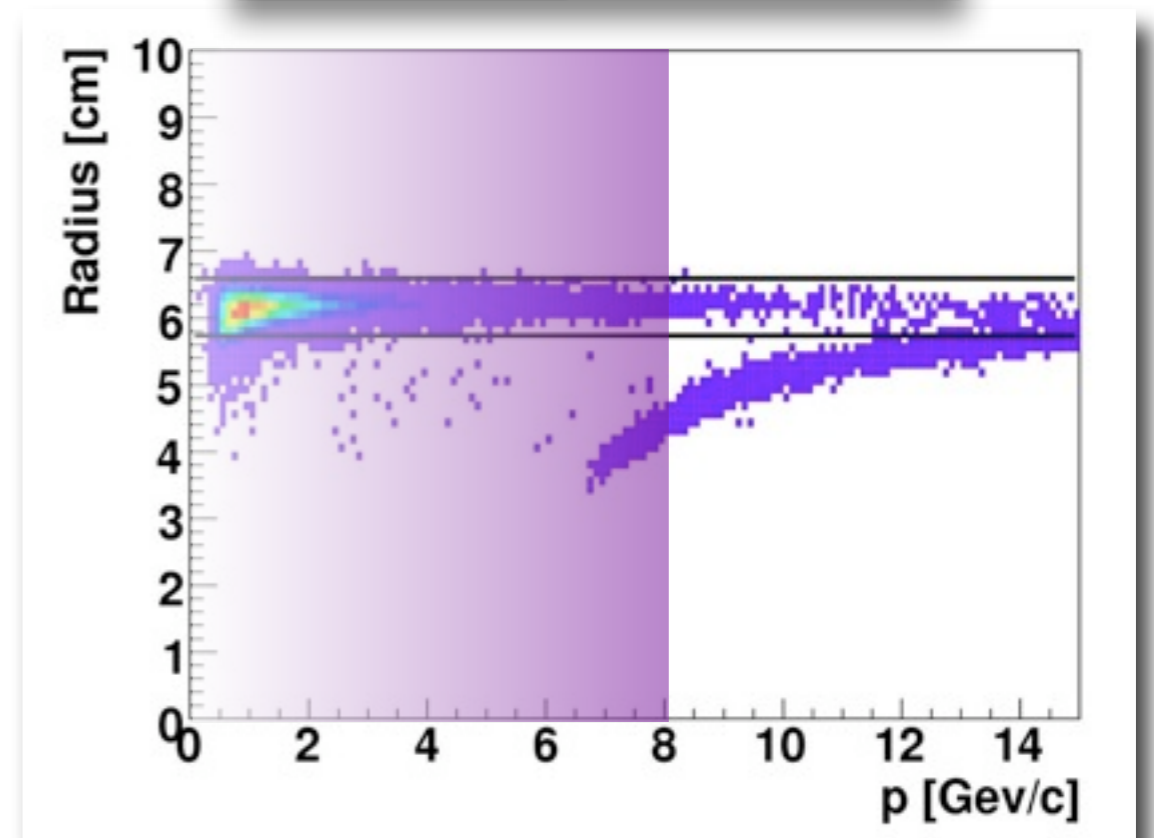
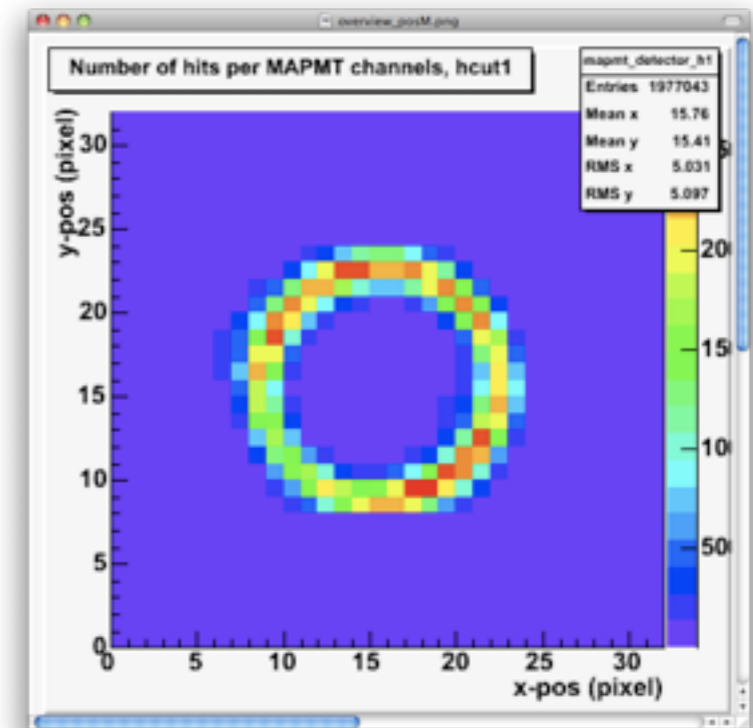
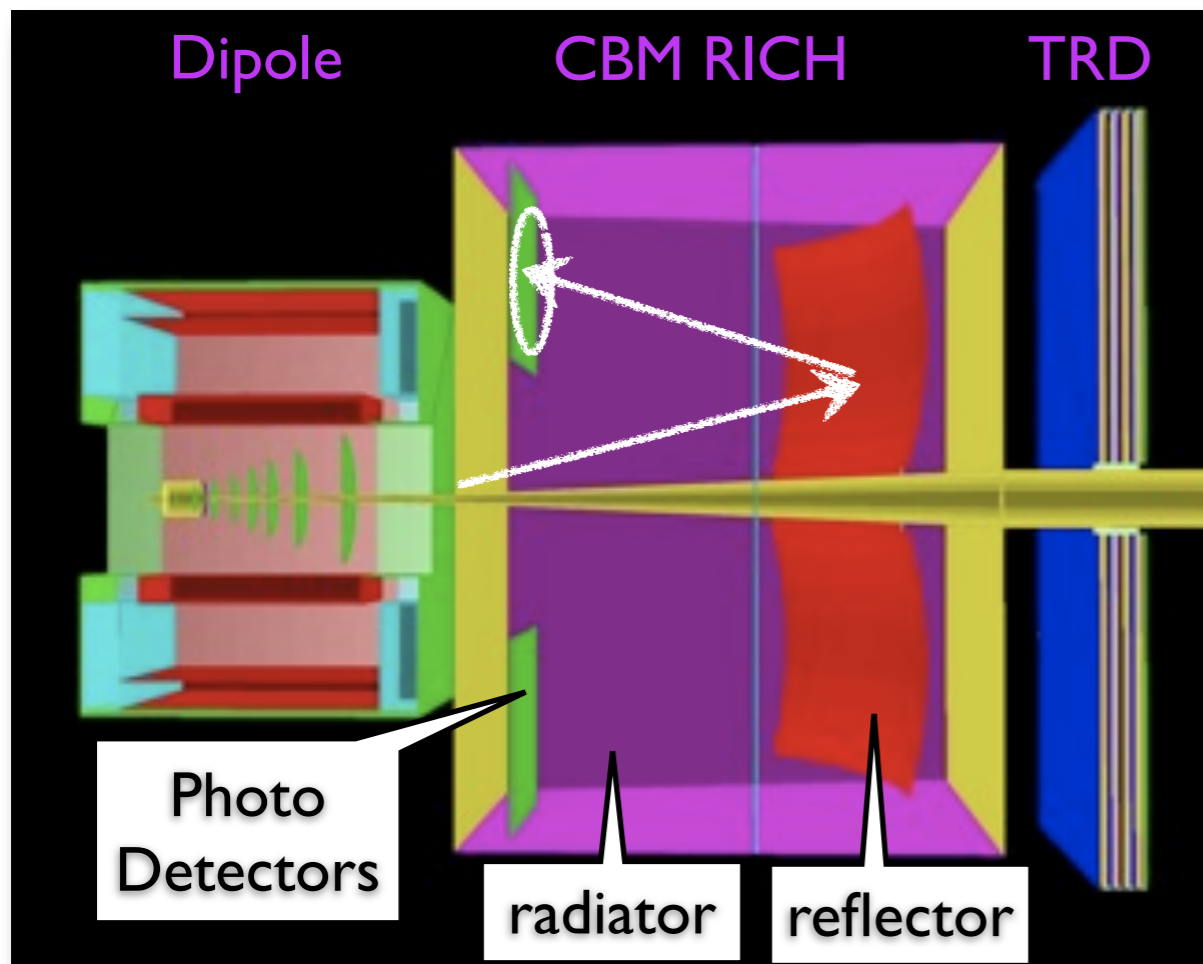
Ring Imaging Cherenkov detector



Aim : **Clean electron identification for momenta below 8 GeV/c**

The CBM RICH detector

Ring Imaging Cherenkov detector

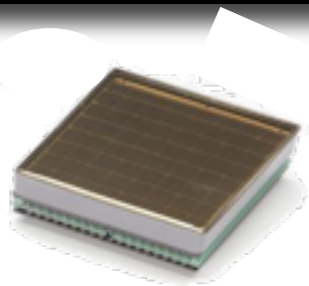
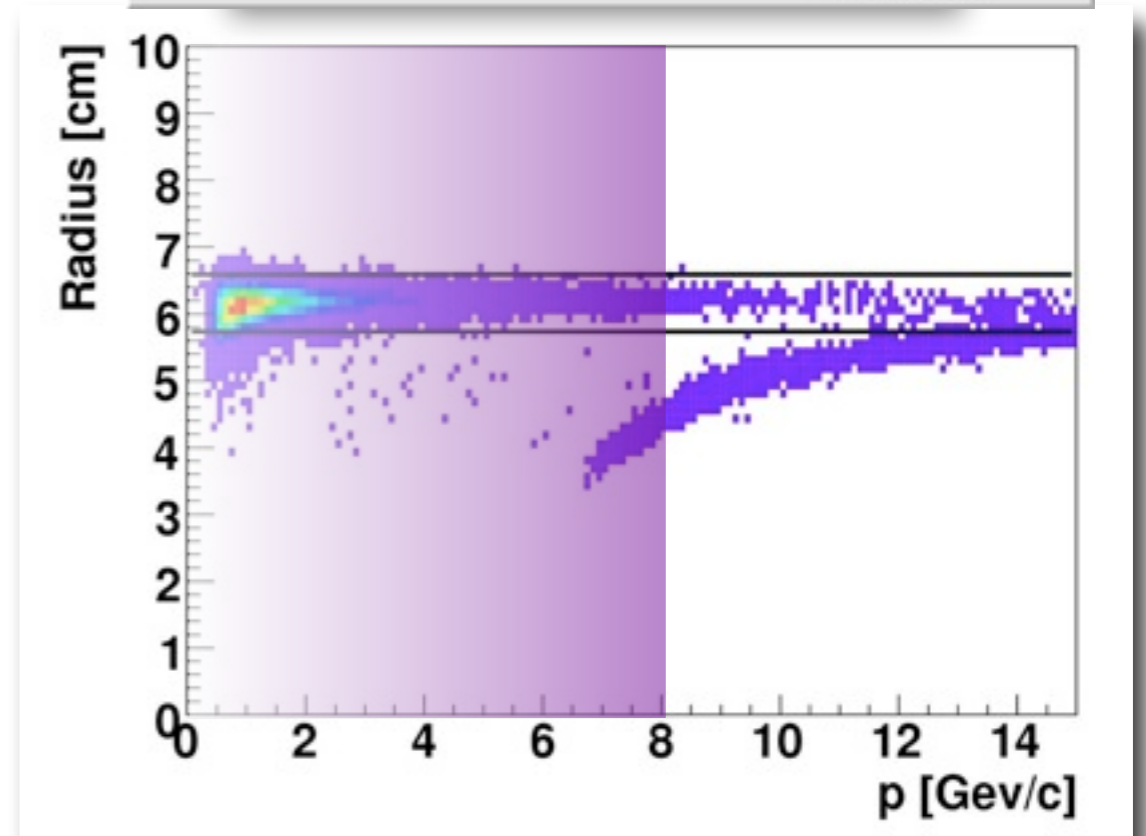
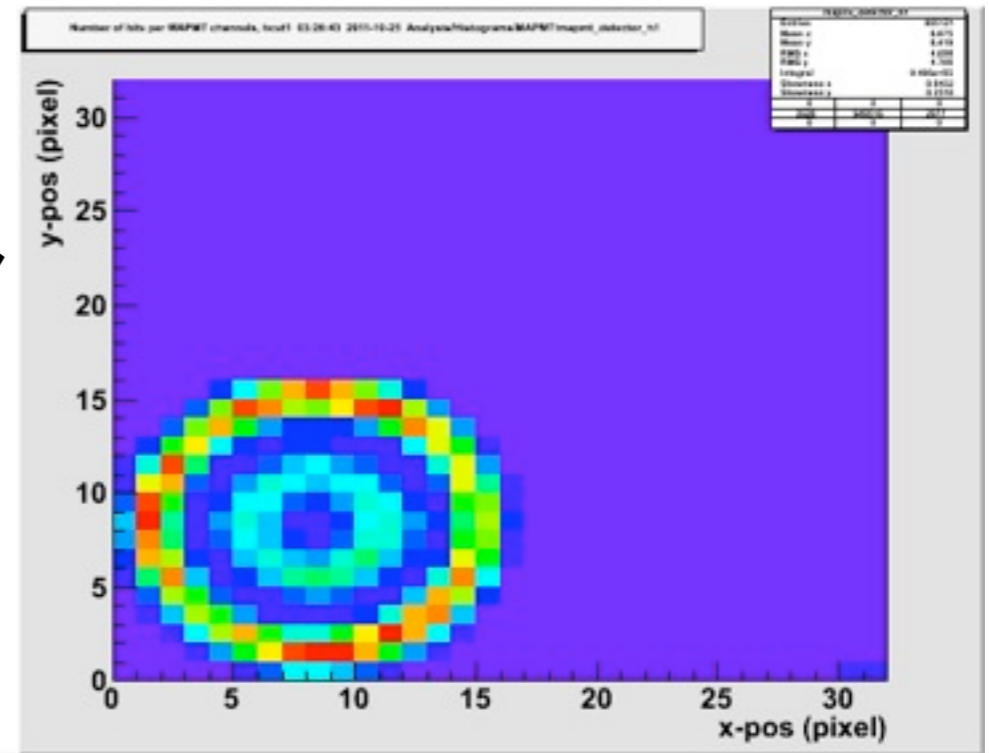
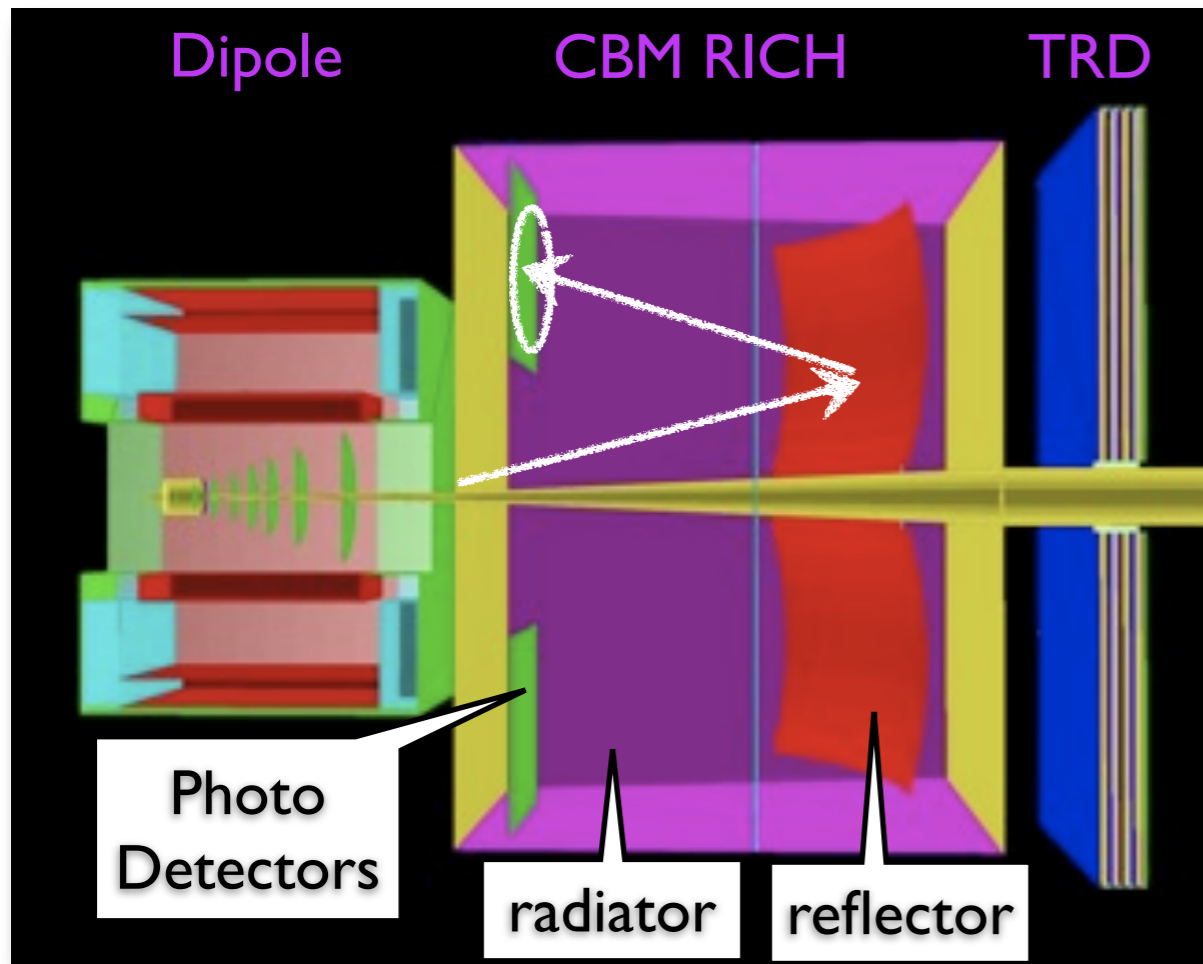


MAPMT : Multi-Anode
Photo Multiplier Tube

Aim : **Clean electron identification
for momenta below 8 GeV/c**

The CBM RICH detector

Ring Imaging Cherenkov detector

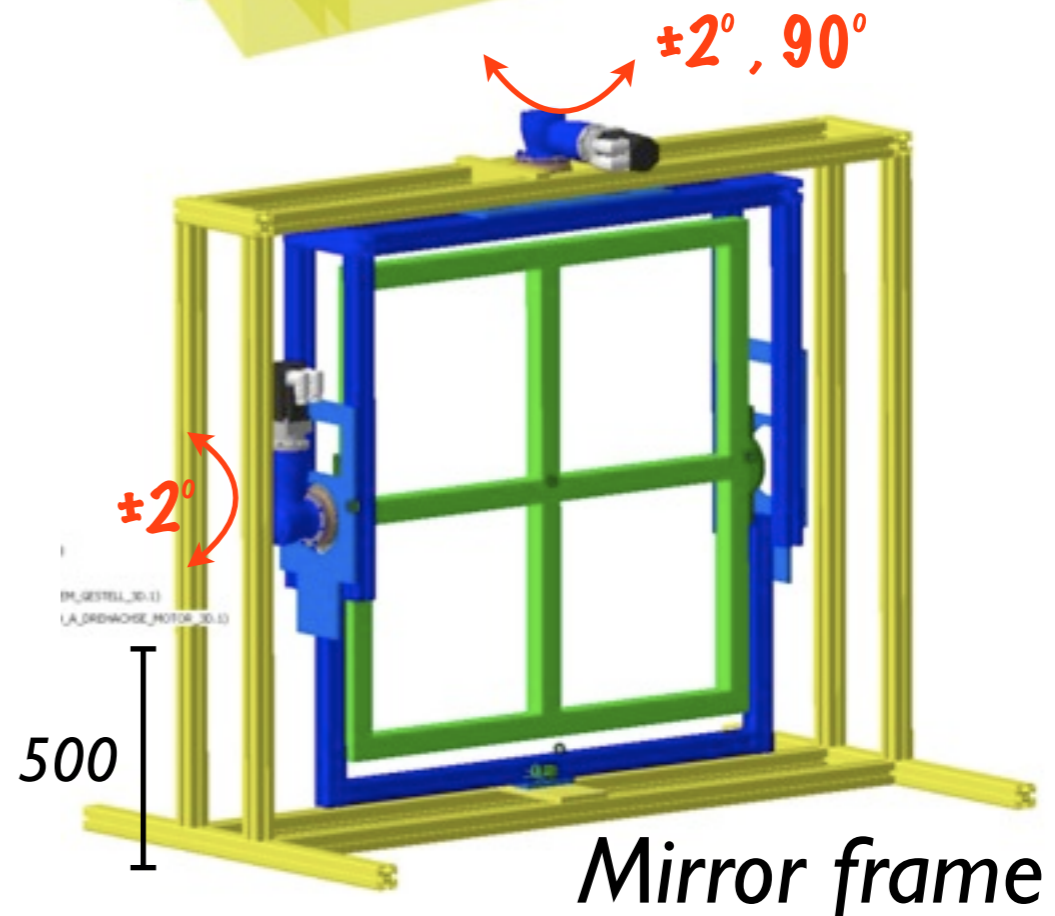
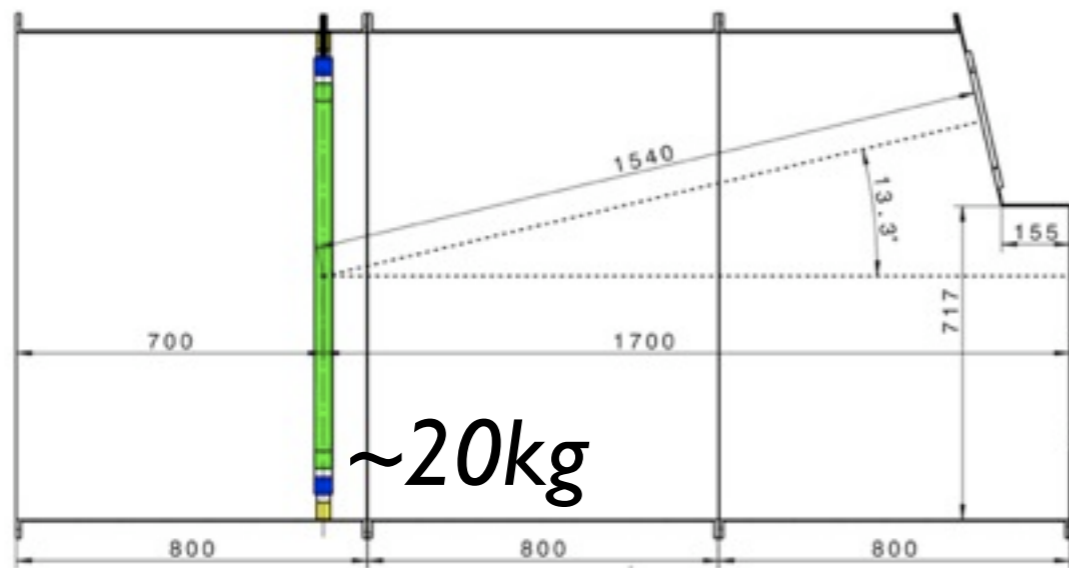
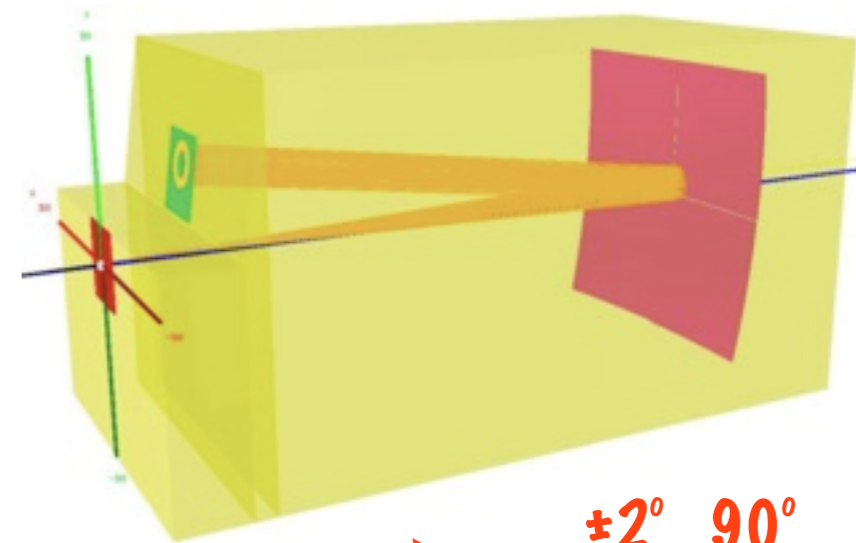
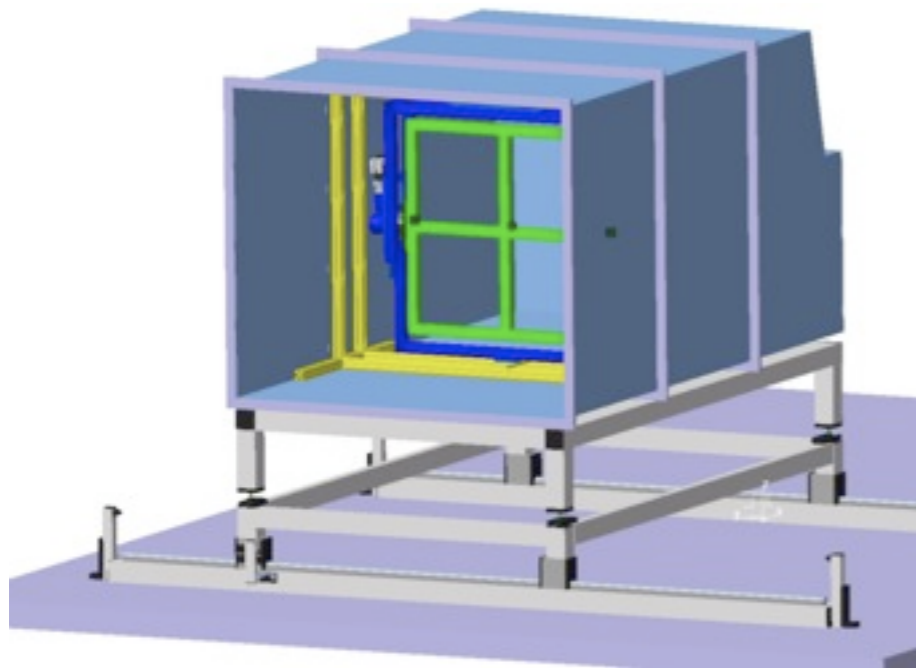


MAPMT : Multi-Anode
Photo Multiplier Tube

Aim : **Clean electron identification
for momenta below 8 GeV/c**

Slow Control System

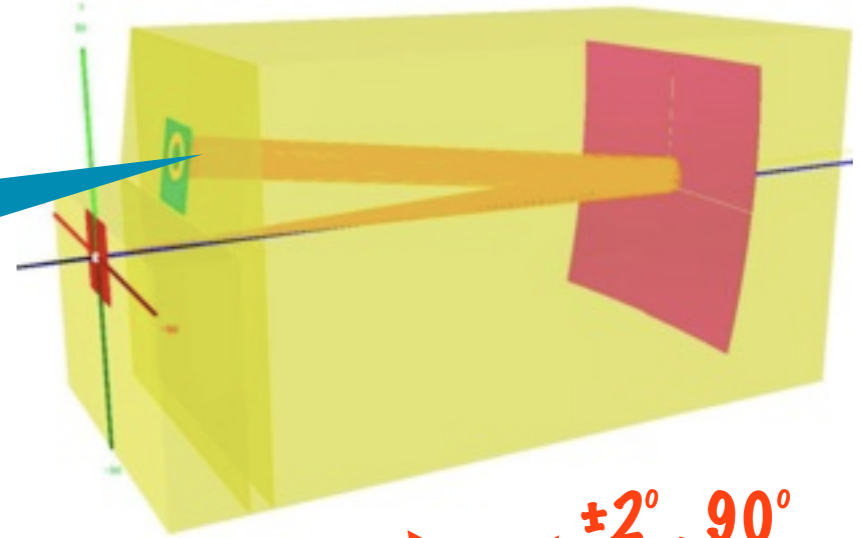
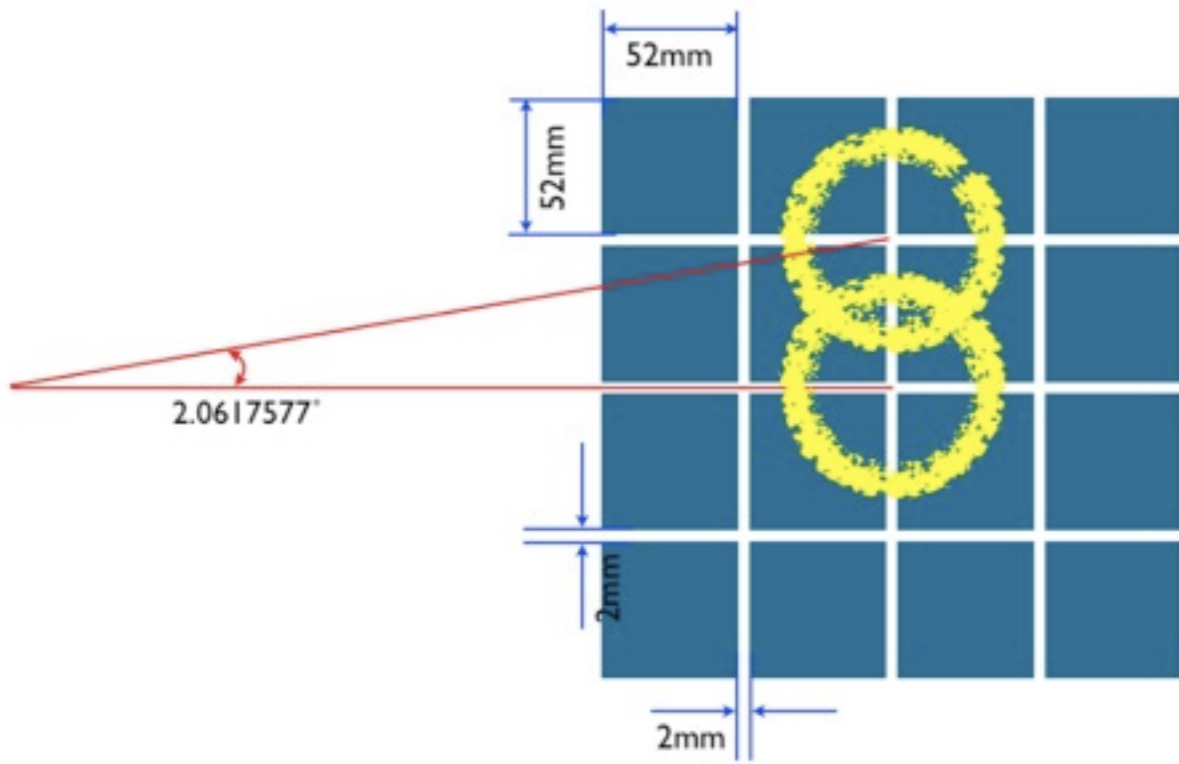
To make HV control system & Mirror Positioning control system *CBM-RICH prototype*
@Giessen University



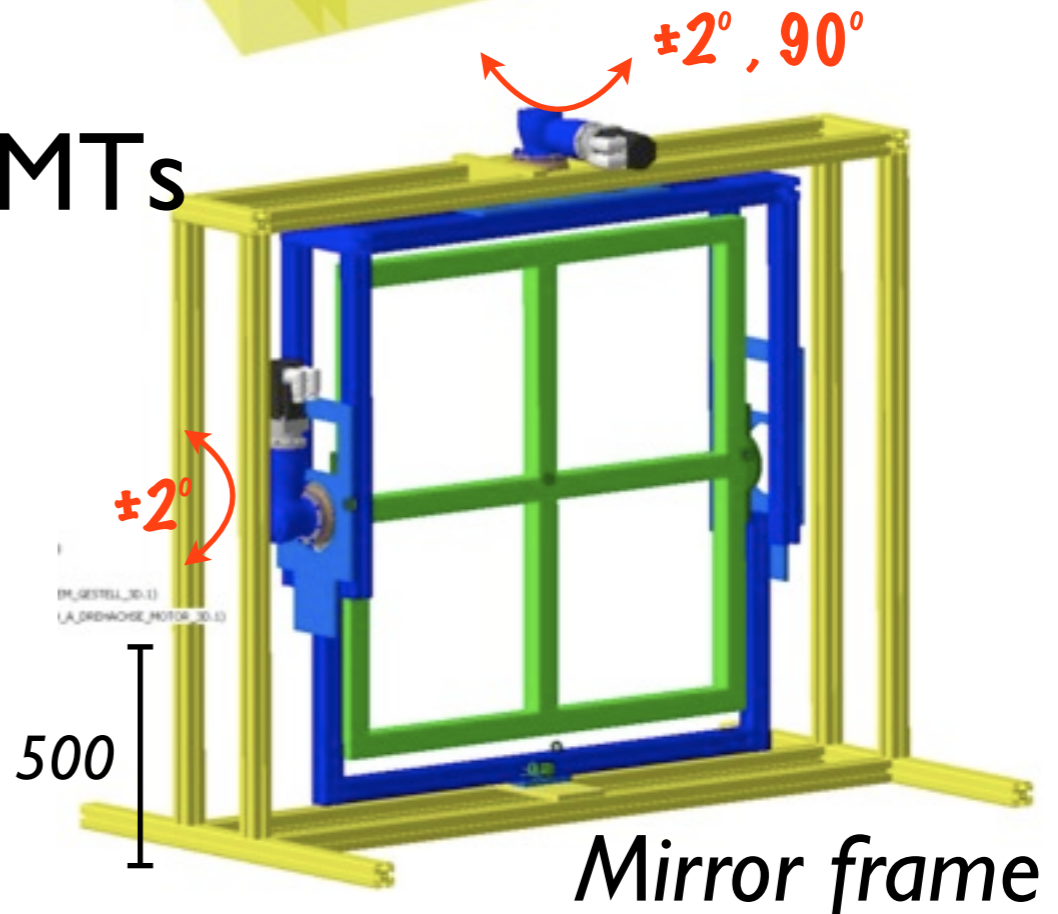
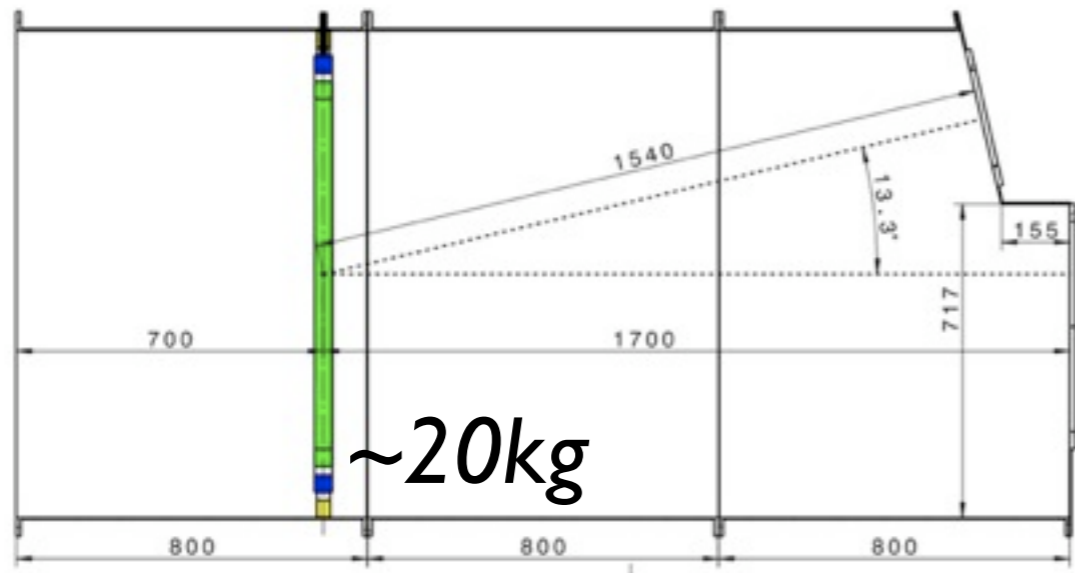
Slow Control System

To make HV control system & Mirror Positioning control system

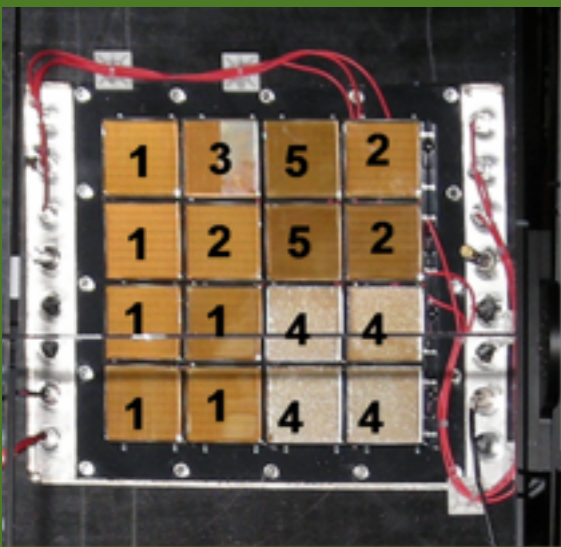
CBM-RICH prototype
@Giessen University



MAPMTs

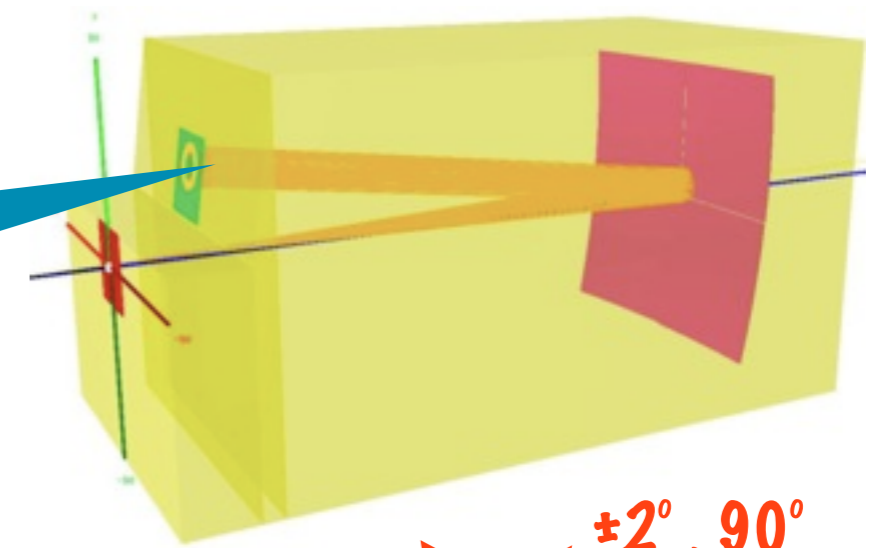
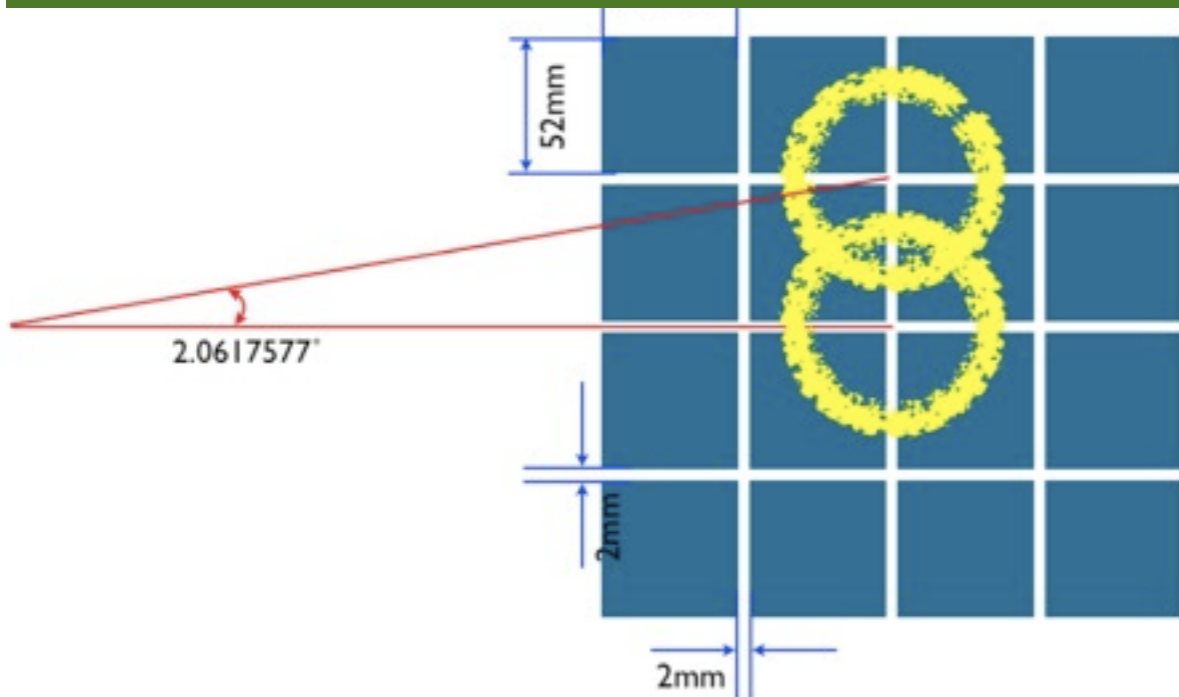


Control System

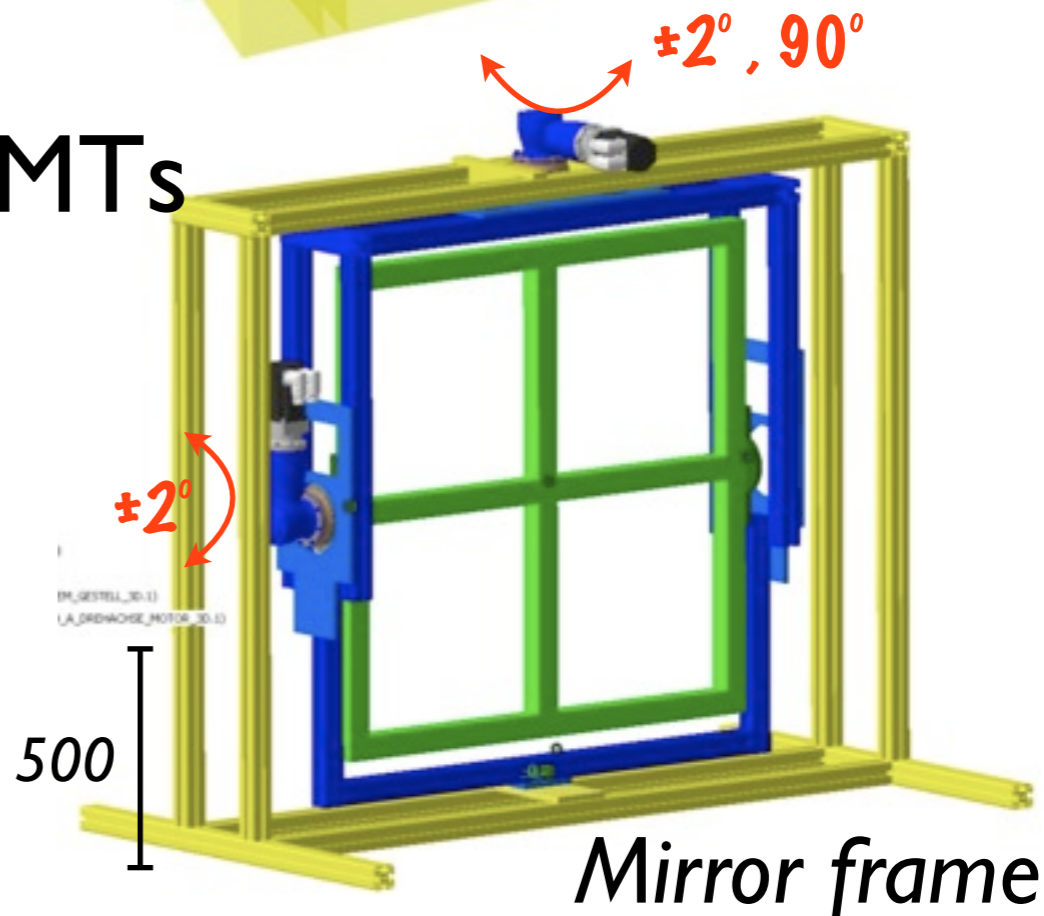
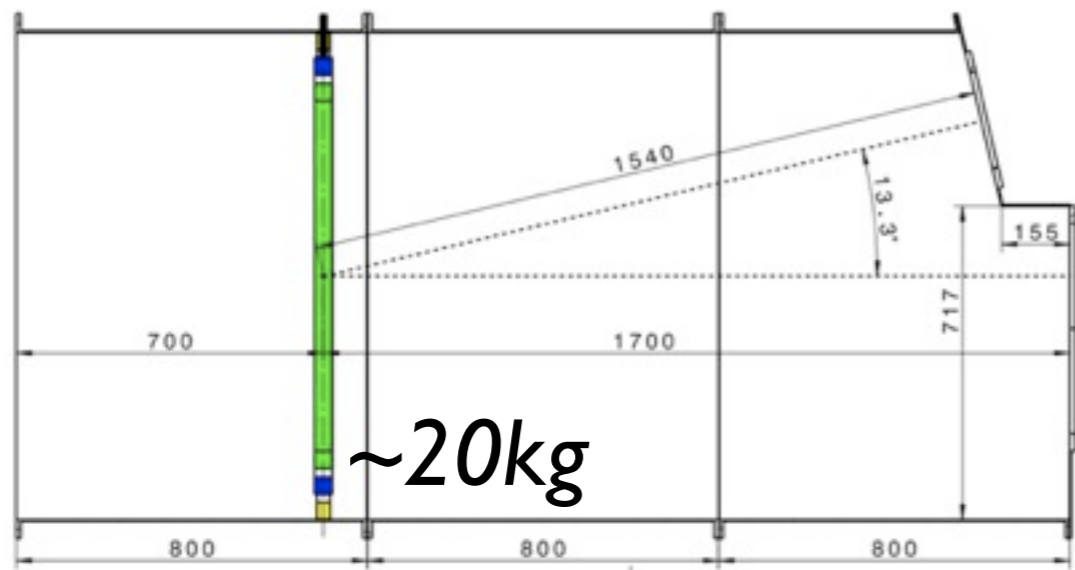


1. H8500-03 D no WLS
2. H8500-03 C no WLS
3. H8500-03 C 1/2 WLS
4. H8500-03 D with WLS
5. HI0966, 8 stage, SBA

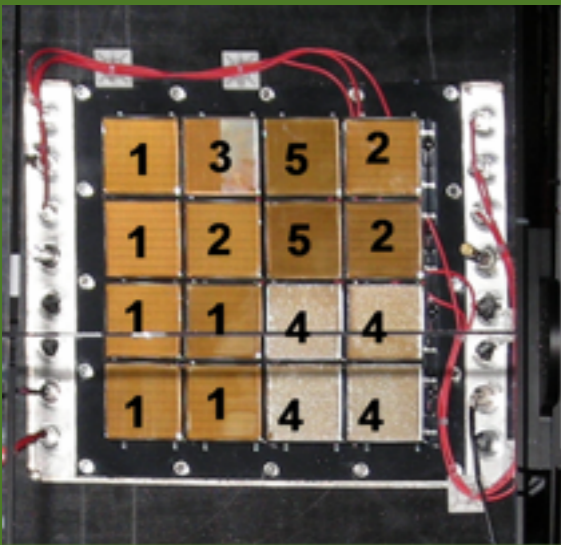
Control system & control system *CBM-RICH prototype*
@Giessen University



MAPMTs



Control System

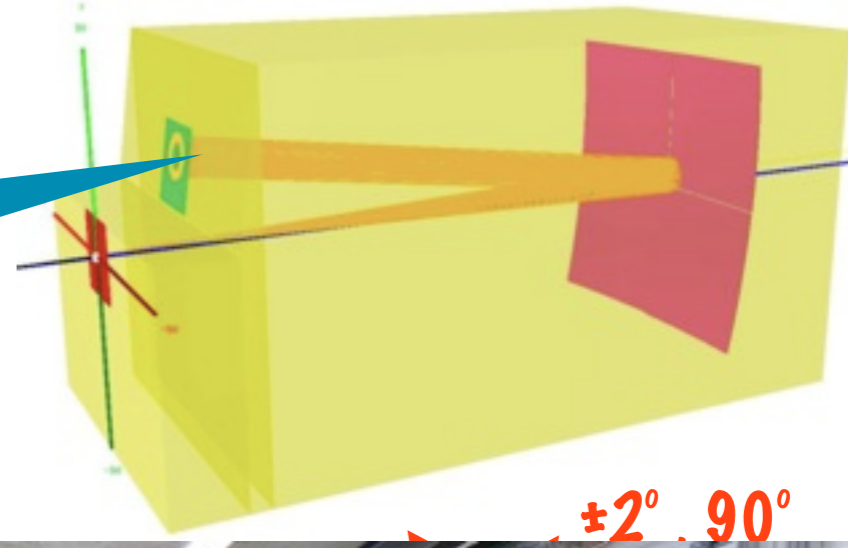
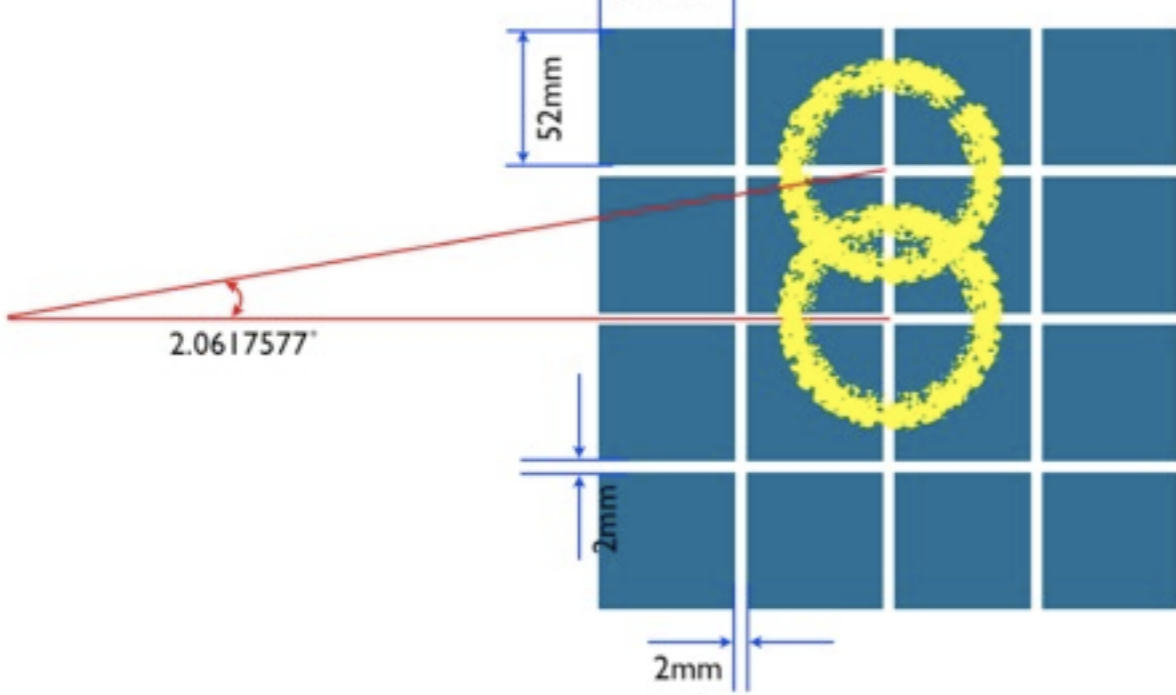


- 1. H8500-03 D no WLS
- 2. H8500-03 C no WLS
- 3. H8500-03 C 1/2 WLS
- 4. H8500-03 D with WLS
- 5. HI0966, 8 stage, SBA

Control system & control system CB

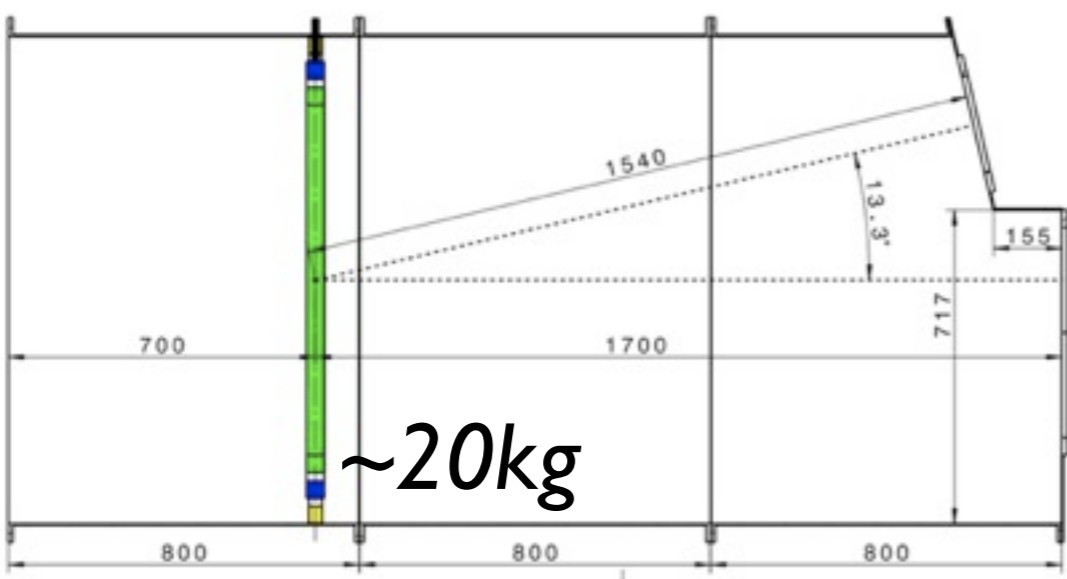


@Giessen University



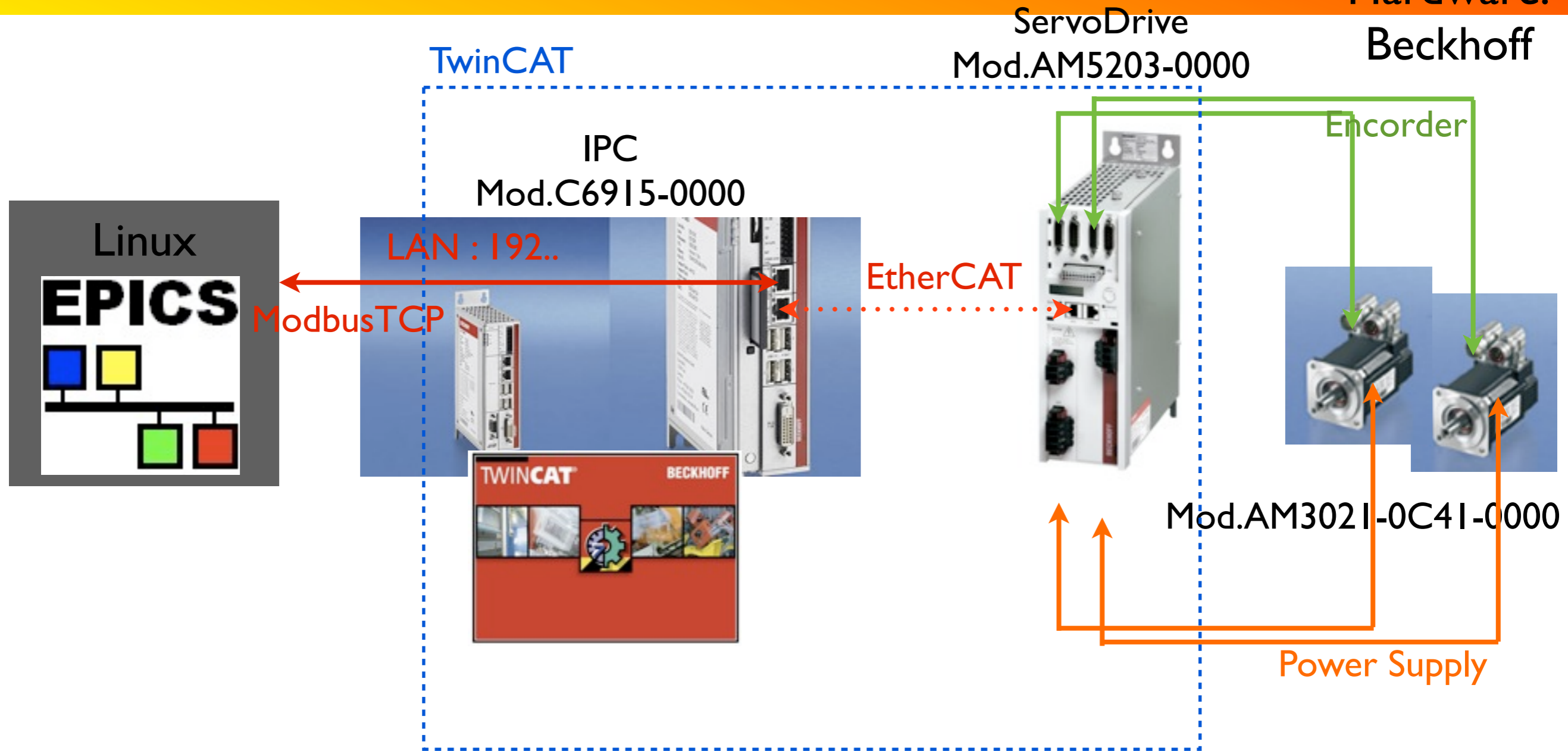
$\pm 2^\circ, 90^\circ$

MAPMTs



Scheme of Positioning control system

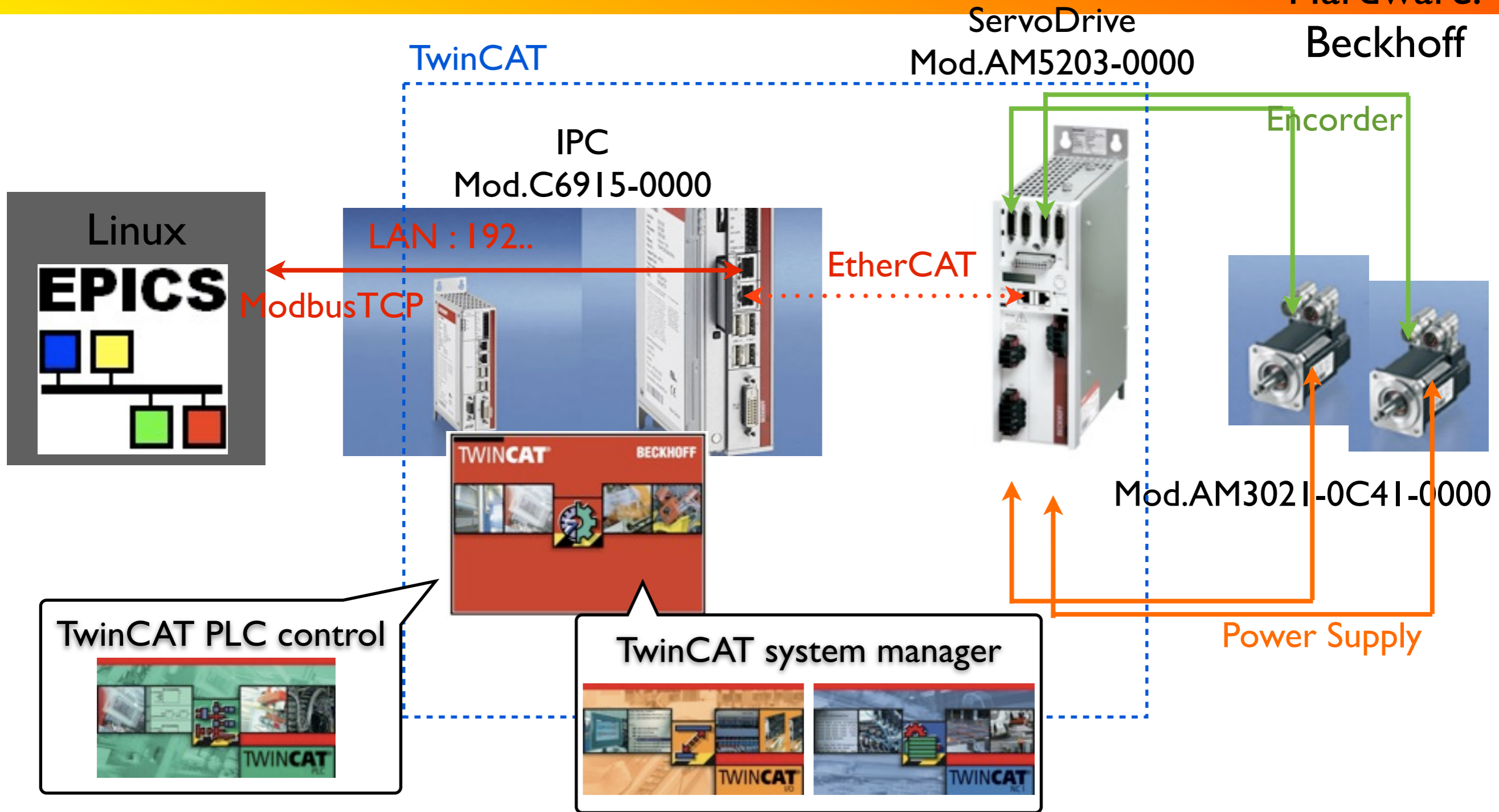
Hardware:
Beckhoff



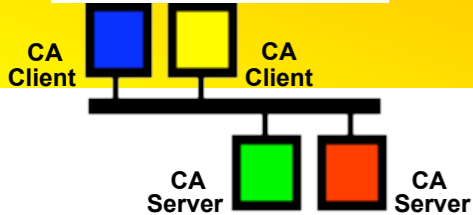
EPICS : Experimental Physics and Industrial Control System.
TwinCAT : The Window Control Automation Technology.

Scheme of Positioning control system

Hardware:
Beckhoff



EPICS : Experimental Physics and Industrial Control System.
TwinCAT : The Window Control Automation Technology.



For Mirror Positioning Control System

EPICS Client

e.g. CSS



Channel Access



EPICS server



IOC (Input Output Controller)

e.g. PC

modbus TCP connection

Server provides information and service
Client uses the service or asks for information

Hardware



EPICS : Experimental Physics and Industrial Control System.

Control Panel(TwinCAT)

1.Start

2.Stop

3.If you click button A, mirror will be moved and you can see the ring image in this position.

Motor 1 Start Stop Motor 2 Start Stop

| Actual Position | |
|-----------------|-----------|
| Horizontal | 340.004 ° |
| Vertical | 20.011 ° |

Numerical control start

| Set Position | |
|--------------|--------|
| Horizontal | 50.0 ° |
| Vertical | 50.0 ° |

| Tilt | |
|------------|-------------|
| Tilt (90°) | NoTilt (0°) |

2° 0° -2°

-2° 0° 2° x

y

Control Panel (TwinCAT)

4. you can check the real position

1. Start

2. Stop

3. If you click button A, mirror will be moved and you can see the ring image in this position.

The screenshot shows a control panel for a mirror system. At the top, there are two motor control sections: "Motor 1" and "Motor 2". Each section has a green "Start" button and a red "Stop" button. Below these is a grid of buttons labeled A through H, arranged in a 3x3 grid. The grid is overlaid on a coordinate system with x and y axes. The x-axis has labels at -2°, 0°, and 2°. The y-axis has labels at -2°, 0°, and 2°. Button A is highlighted in pink. To the right of the grid, there are several readouts and controls: "Actual Position" (Horizontal: 340.004°, Vertical: 20.011°), "Numerical control start" (red button), "Set Position" (Horizontal: 50.0°, Vertical: 50.0°), and "Tilt" (Tilt (90°) and NoTilt (0°) buttons).

Control Panel (TwinCAT)

1. Start

2. Stop

4. you can check the real position

5. If you want to numerical control, Click this

3. If you click button A, mirror will be moved and you can see the ring image in this position.

6. When you click this, Number pad appears.

The screenshot shows the control panel for a mirror system. At the top, there are two motor control sections: 'Motor 1' and 'Motor 2', each with a green 'Start' button and a red 'Stop' button. Below these is a grid of buttons labeled A through H, arranged in a 3x3 grid with 'Zero' in the center. Button A is highlighted in pink. To the right of the grid is a 'Numerical control start' button (red) and a 'Set Position' table. The 'Set Position' table has two rows: 'Horizontal' with a value of 50.0° and 'Vertical' with a value of 50.0°. Below the 'Set Position' table is a 'Tilt' selection panel with two buttons: 'Tilt (90°)' (purple) and 'NoTilt (0°)' (red). At the bottom right, a 'Horizontal' numerical control panel is shown with a text input field containing '50', a 'Misc' section with '0' and 'Max' with '360', and a numeric keypad with buttons for 0-9, '+/-', '.', 'BACK', 'CLEAR', 'ESC', and 'OK'.

| Actual Position | |
|-----------------|-----------|
| Horizontal | 340.004 ° |
| Vertical | 20.011 ° |

| Set Position | |
|--------------|--------|
| Horizontal | 50.0 ° |
| Vertical | 50.0 ° |

| Tilt | |
|------------|-------------|
| Tilt (90°) | NoTilt (0°) |

The 'Horizontal' numerical control panel features a text input field containing the value '50'. Below the input field, there is a 'Misc' section with a '0' button and a 'Max' section with a '360' button. At the bottom, there is a numeric keypad with buttons for digits 0-9, '+/-', '.', 'BACK', 'CLEAR', 'ESC', and 'OK'.

Control Panel (TwinCAT)

1. Start

2. Stop

4. you can check the real position

5. If you want to numerical control, Click this

3. If you click button A, mirror will be moved and you can see the ring image in this position.

6. When you click this, Number pad appears.

The screenshot shows the control panel for a mirror system. At the top, there are two motor control sections: 'Motor 1' and 'Motor 2', each with a green 'Start' button and a red 'Stop' button. Below these is a grid of buttons labeled A through H, arranged in a 3x3 grid with 'Zero' in the center. A coordinate system is overlaid on the grid, with the x-axis ranging from -2° to 2° and the y-axis from -2° to 2°. Button A is highlighted in pink. To the right of the grid is a 'Numerical control start' button. Below that is a 'Set Position' table:

| Set Position | |
|--------------|-------|
| Horizontal | 50.0° |
| Vertical | 50.0° |

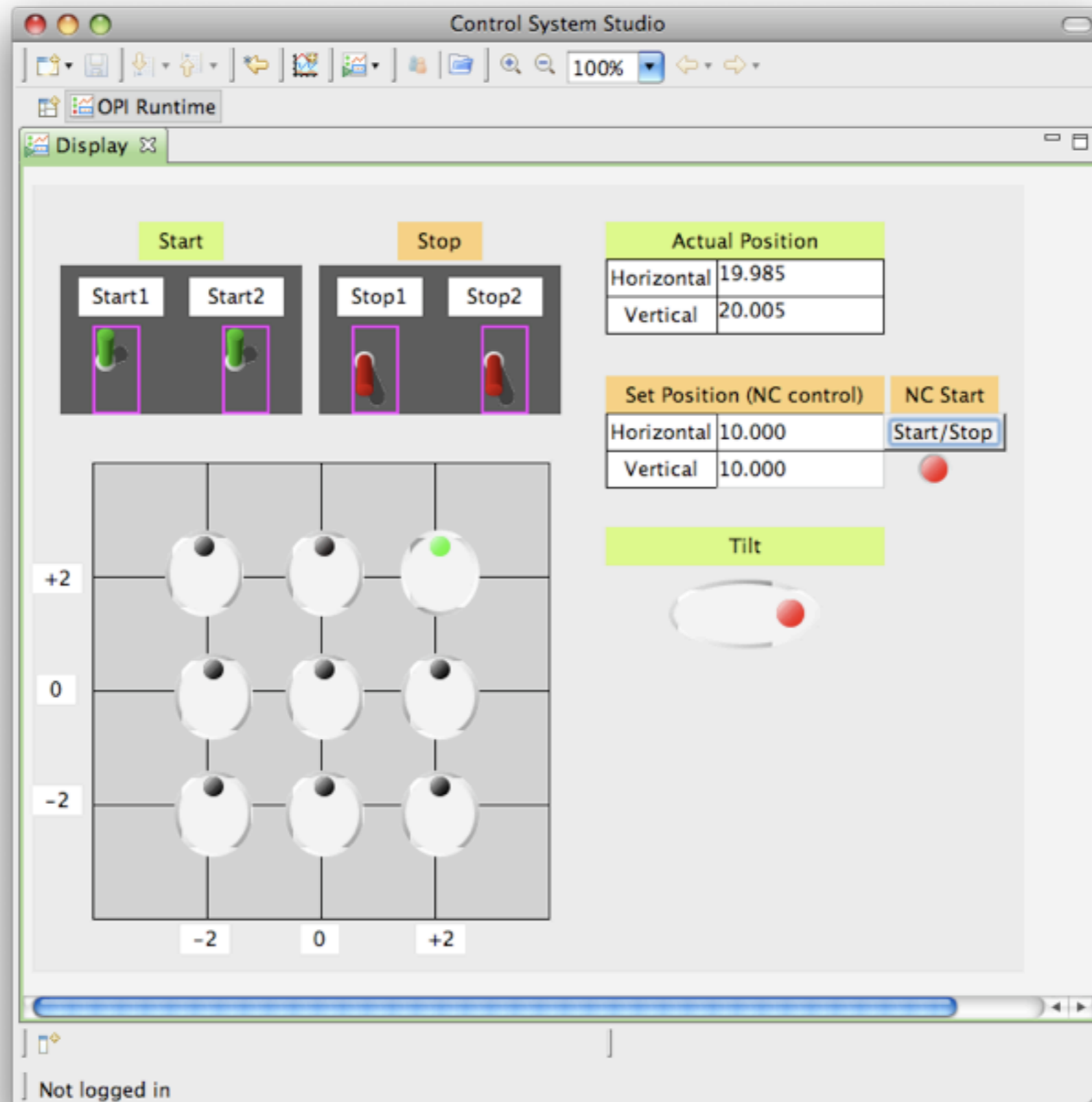
Below the 'Set Position' table is a 'Tilt' control section with two buttons: 'Tilt (90°)' and 'NoTilt (0°)'. To the right of the main panel is an 'Actual Position' table:

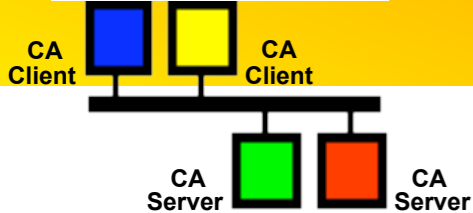
| Actual Position | |
|-----------------|-----------|
| Horizontal | 340.004 ° |
| Vertical | 20.011° |

7. for Tilt(90°,0°)
NoTilt(0°,0°)

The screenshot shows a numerical control input window titled 'Horizontal'. The current value is 50. Below the input field, there are fields for 'Min:' (0) and 'Max:' (360). Below these are several rows of buttons: 7, 8, 9, BACK; 4, 5, 6, CLEAR; 1, 2, 3, ESC; 0, +/-, ., OK.

Control Panel (EPICS)





For ISEG HV module and WIENER crate Control System

EPICS Client

e.g. CSS



Channel Access

LAN



EPICS server



IOC (Input Output Controller)

e.g. PC



create : WIENER
modules : ISEG

SNMP



Hardware

SNMP : Simple Network Management Protocol
MIB : Management Information Base

Control Panel

Slot 1 : for RICH

The screenshot displays the Control System Studio (SNS) interface for the CBM_RICH HV Control. The main window shows the following components:

- Main Switch:** A green indicator light.
- Main Status:** A green indicator light.
- Fan Speed Control [rpm]:** A control panel with 'Get' and 'Set' buttons, both showing a value of 3200.
- Channel Parameters Table:** A table with columns for Channel, Set Voltage [V], Set Current [A], Measured Voltage [V], Measured Current [A], Ramp up [V/s], Ramp down [V/s], Max Voltage, Max Current, Trip Time [ms], Temp, and ON/OFF. The table lists parameters for channels CH0 through CH15.

| Channel | Set Voltage [V] | Set Current [A] | Measured Voltage [V] | Measured Current [A] | Ramp up [V/s] | Ramp down [V/s] | Max Voltage | Max Current | Trip Time [ms] | Temp | ON/OFF |
|---------|-----------------|-----------------|----------------------|----------------------|---------------|-----------------|-------------|-------------|----------------|------|-------------------------------------|
| CH0 | 1,000.000 | 0.000 | 1,000.013 | 1.000E3 | 20.0 | 20.0 | 2,000.000 | 0.004 | 504.0 | 25 | <input checked="" type="checkbox"/> |
| CH1 | 1,000.000 | 0.000 | 1,000.004 | 1.560E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| CH2 | 1,000.000 | 0.000 | 999.984 | 1.640E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 504.0 | 25 | <input checked="" type="checkbox"/> |
| CH3 | 1,000.000 | 0.000 | 1,000.014 | 1.570E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| CH4 | 1,000.000 | 0.000 | 999.998 | 2.200E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| CH5 | 1,000.000 | 0.000 | 999.972 | 2.210E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| CH6 | 1,000.000 | 0.000 | 1,000.007 | 1.570E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| CH7 | 1,000.000 | 0.000 | 1,000.041 | 1.560E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 504.0 | 25 | <input checked="" type="checkbox"/> |
| CH8 | 1,000.000 | 0.000 | 1,000.025 | 1.550E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 504.0 | 27 | <input checked="" type="checkbox"/> |
| CH9 | 1,000.000 | 0.000 | 999.983 | 1.560E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 27 | <input checked="" type="checkbox"/> |
| CH10 | 1,000.000 | 0.000 | 999.990 | 1.560E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 27 | <input checked="" type="checkbox"/> |
| CH11 | 1,000.000 | 0.000 | 999.990 | 1.570E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 27 | <input checked="" type="checkbox"/> |
| CH12 | 1,000.000 | 0.000 | 1,000.021 | 1.560E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 504.0 | 27 | <input checked="" type="checkbox"/> |
| CH13 | 1,000.000 | 0.000 | 1,000.003 | 1.560E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 27 | <input checked="" type="checkbox"/> |
| CH14 | 1,000.000 | 0.000 | 999.977 | 1.560E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 504.0 | 27 | <input checked="" type="checkbox"/> |
| CH15 | 1,000.000 | 0.000 | 1,000.013 | 1.550E-4 | 20.0 | 20.0 | 2,000.000 | 0.004 | 500.0 | 27 | <input checked="" type="checkbox"/> |

Control Panel

Slot 2: for FFM , DUB,TRD

CBM_RICH HV Control

Main Switch: Main Status:

Fan Speed Control [rpm]
Get: 3200
Set: 3200

| Channel | Set Voltage [V] | Set Current [A] | Measured Voltage [V] | Measured Current [A] | Ramp up [V/s] | Ramp down [V/s] | Max Voltage | Max Current | Trip Time [ms] | Temp | ON/OFF |
|---------|-----------------|-----------------|----------------------|----------------------|---------------|-----------------|-------------|-------------|----------------|------|-------------------------------------|
| FFM1 | 2,220.000 | 0.002 | 2,220.030 | 0.000E0 | 5.0 | 5.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| FFM2 | 1,600.000 | 0.002 | 1,600.016 | 0.000E0 | 5.0 | 5.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| FFM3 | 1,800.000 | 0.002 | 1,800.000 | 0.000E0 | 5.0 | 5.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| FFM4 | 2,500.000 | 0.002 | 2,500.071 | 0.000E0 | 5.0 | 5.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| DUB1 | 2,100.000 | 0.002 | 2,100.047 | 0.000E0 | 5.0 | 5.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| DUB2 | 2,100.000 | 0.002 | 2,100.032 | 0.000E0 | 5.0 | 5.0 | 3,000.000 | 0.002 | 504.0 | 25 | <input checked="" type="checkbox"/> |
| CH6 | 0.000 | 0.002 | 0.276 | 0.000E0 | 5.0 | 5.0 | 3,000.000 | 0.002 | 504.0 | 25 | <input type="checkbox"/> |
| CH7 | 0.000 | 0.002 | 0.273 | 0.000 | 5.0 | 5.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input type="checkbox"/> |
| CH8 | 0.000 | 0.002 | 0.267 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input type="checkbox"/> |
| CH9 | 0.000 | 0.002 | 0.269 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input type="checkbox"/> |
| CH10 | 0.000 | 0.002 | 0.394 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input type="checkbox"/> |
| CH11 | 0.000 | 0.002 | 0.238 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input type="checkbox"/> |
| CH12 | 0.000 | 0.002 | 0.277 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input type="checkbox"/> |
| CH13 | 0.000 | 2.000E-3 | 0.277 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input type="checkbox"/> |
| TRD2-B | 2,100.000 | 2.000E-3 | 2,100.026 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.002 | 504.0 | 25 | <input checked="" type="checkbox"/> |
| TRD1-B | 2,100.000 | 2.000E-3 | 2,100.015 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.002 | 500.0 | 25 | <input checked="" type="checkbox"/> |

Control Panel

Slot 3 : for DUB

The screenshot displays the 'CBM_RICH HV Control' interface in Control System Studio (SNS). The interface includes a 'Main Switch' and 'Main Status' indicator, and a 'Fan Speed Control [rpm]' section with 'Get' and 'Set' buttons. Below these is a table of channel parameters for slots 1 through 15. The 'slot3' tab is selected, and the 'DUB4' and 'DUB5' channels are highlighted in green. The table columns include Channel, Set Voltage [V], Set Current [A], Measured Voltage [V], Measured Current [A], Ramp up [V/s], Ramp down [V/s], Max Voltage, Max Current, Trip Time [ms], Temp, and ON/OFF.

| Channel | Set Voltage [V] | Set Current [A] | Measured Voltage [V] | Measured Current [A] | Ramp up [V/s] | Ramp down [V/s] | Max Voltage | Max Current | Trip Time [ms] | Temp | ON/OFF |
|---------|-----------------|-----------------|----------------------|----------------------|---------------|-----------------|-------------|-------------|----------------|------|-------------------------------------|
| CH0 | 0.000 | 3.000E-3 | 0.263 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 24 | <input type="checkbox"/> |
| CH1 | 0.000 | 3.000E-3 | 0.261 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 24 | <input type="checkbox"/> |
| CH2 | 0.000 | 3.000E-3 | 0.246 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 24 | <input type="checkbox"/> |
| CH3 | 0.000 | 3.000E-3 | 0.240 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 24 | <input type="checkbox"/> |
| DUB4 | 800.000 | 0.003 | 800.030 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 24 | <input checked="" type="checkbox"/> |
| DUB5 | 800.000 | 0.000 | 800.042 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 24 | <input checked="" type="checkbox"/> |
| CH6 | 0.000 | 3.000E-3 | 0.248 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 24 | <input type="checkbox"/> |
| CH7 | 0.000 | 3.000E-3 | 0.251 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 24 | <input type="checkbox"/> |
| CH8 | 999.990 | 0.000 | 0.000 | 999.985 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH9 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH10 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH11 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH12 | 0.000 | 0.000 | 3,000.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH13 | 0.000 | 0.000 | 0.000 | 0.240 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH14 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH15 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |

Control Panel

Slot 4 : for TRD

CBM_RICH HV Control

Main Switch: Main Status:

Fan Speed Control [rpm]
Get: 3200
Set: 3200

| Channel | Set Voltage [V] | Set Current [A] | Measured Voltage [V] | Measured Current [A] | Ramp up [V/s] | Ramp down [V/s] | Max Voltage | Max Current | Trip Time [ms] | Temp | ON/OFF |
|---------|-----------------|-----------------|----------------------|----------------------|---------------|-----------------|-------------|-------------|----------------|------|-------------------------------------|
| TRD1-B | 700.000 | 3.000E-3 | 699.996 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 504.0 | 25 | <input checked="" type="checkbox"/> |
| TRD2-B | 700.000 | 3.000E-3 | 700.036 | 0.000E0 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 25 | <input checked="" type="checkbox"/> |
| CH2 | 0.000 | 0.003 | 0.233 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 25 | <input type="checkbox"/> |
| CH3 | 0.000 | 0.003 | 0.244 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 25 | <input type="checkbox"/> |
| CH4 | 0.000 | 0.003 | 0.238 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 25 | <input type="checkbox"/> |
| CH5 | 0.000 | 0.003 | 0.239 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 25 | <input type="checkbox"/> |
| CH6 | 0.000 | 0.003 | 0.253 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 25 | <input type="checkbox"/> |
| CH7 | 0.000 | 0.003 | 0.231 | 0.000 | 30.0 | 30.0 | 3,000.000 | 0.003 | 500.0 | 25 | <input type="checkbox"/> |
| CH8 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH9 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.3 | 0.000 | 3,000.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH10 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH11 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH12 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH13 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |
| CH14 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.002 | 0.0 | 0 | <input type="checkbox"/> |
| CH15 | 0.000 | 0.000 | 0.000 | 0.000 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0 | <input type="checkbox"/> |

Parameter scan



Camera scan

- identify the number of Cherenkov photons per ring
- measure the overall detection efficiency for the different PMTs.



Gas parameter scan

- number of photons per ring was studied as function of the gas purity in terms of O₂ contamination



High voltage and threshold scan

- Threshold : 28, 35, 40, 50, 75, 100
- High voltage : 1000V, 1100V



Momentum scan (2GeV, 4GeV, 6GeV, 8GeV)



Mirror scan

Parameter scan



Camera scan

- identify the number of Cherenkov photons per ring
- measure the overall detection efficiency for the different PMTs.



Gas parameter scan

- number of photons per ring was studied as function of the gas purity in terms of O₂ contamination



High voltage and threshold scan

- Threshold : 28, 35, 40, 50, 75, 100
- High voltage : 1000V, 1100V



Momentum scan (2GeV, 4GeV, 6GeV, 8GeV)



Mirror scan

Results I : HV control

Threshold:

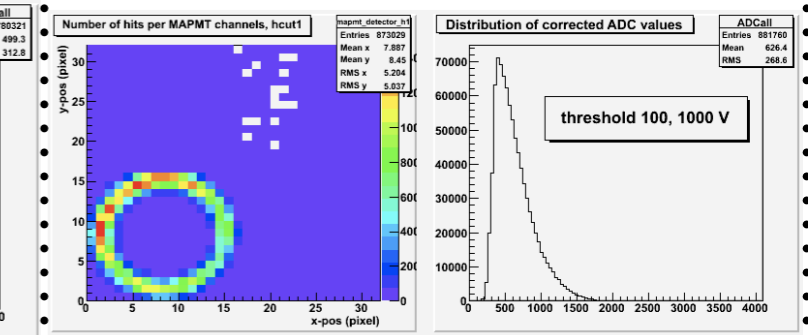
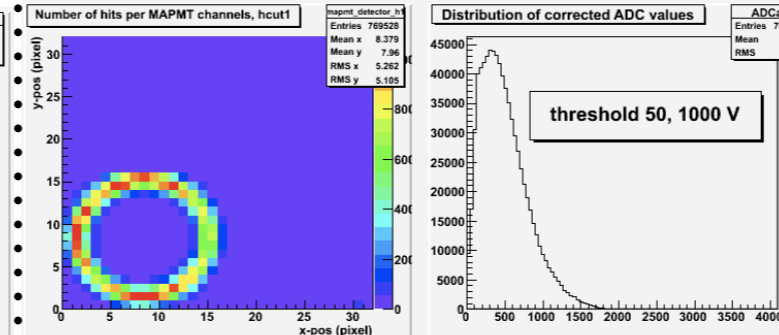
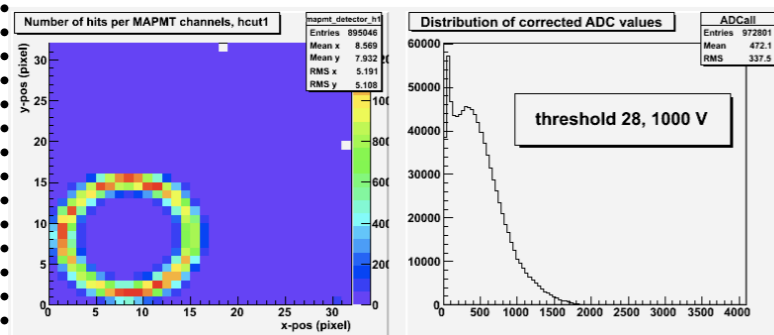
28

50

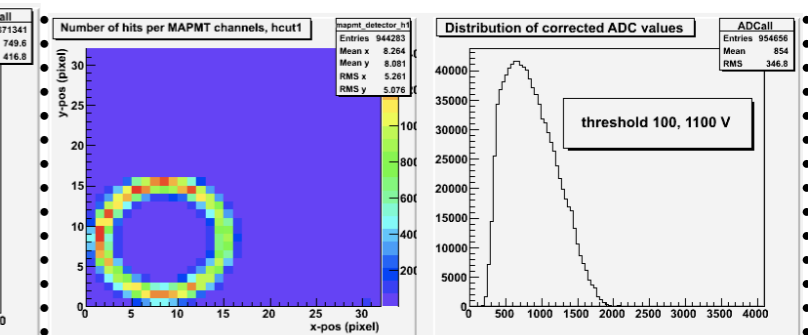
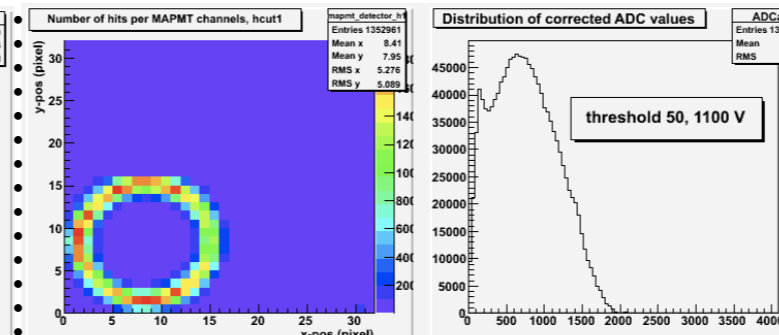
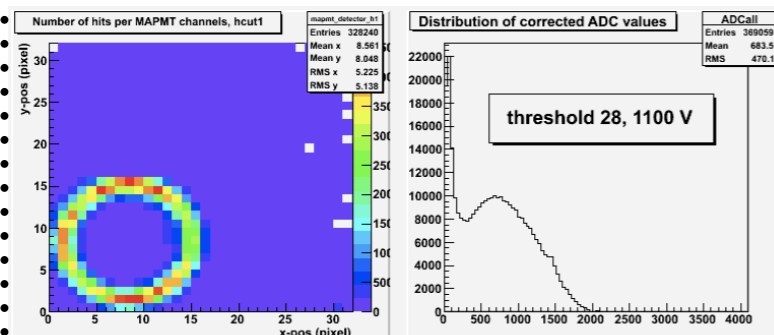
100

HV

1000 V

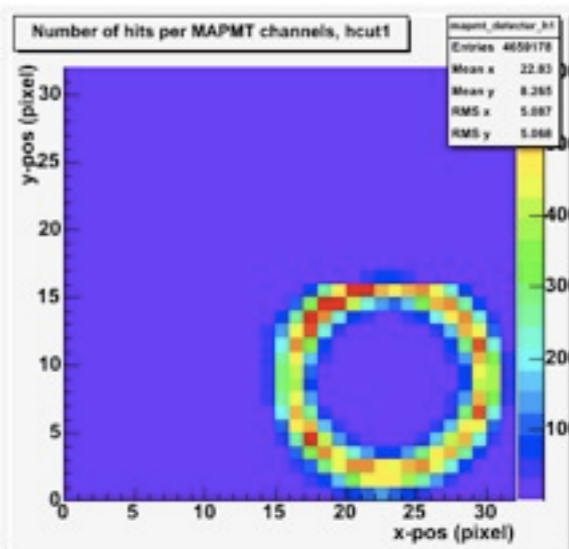
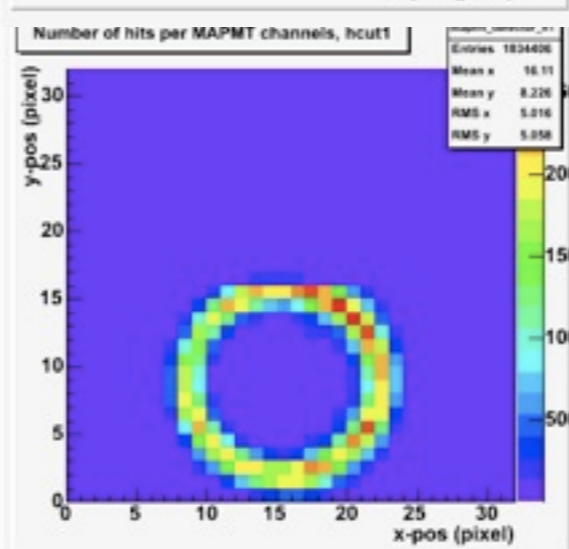
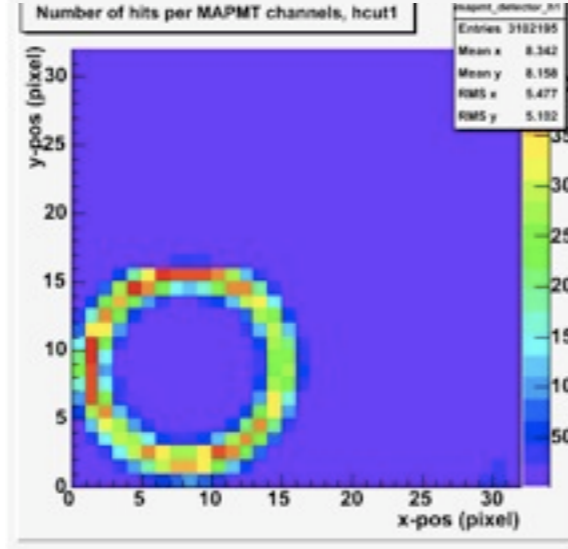
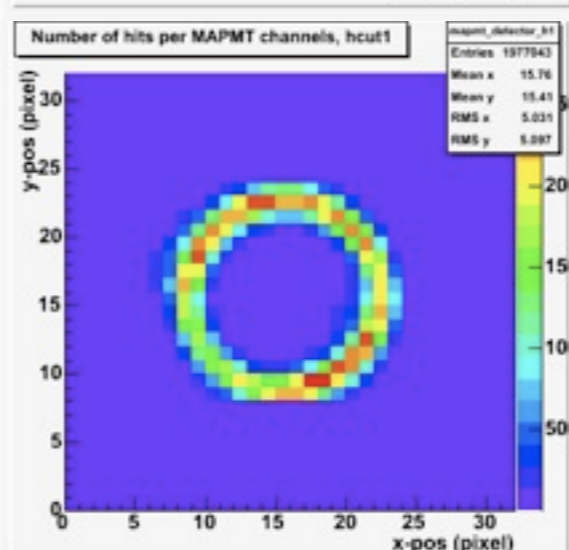
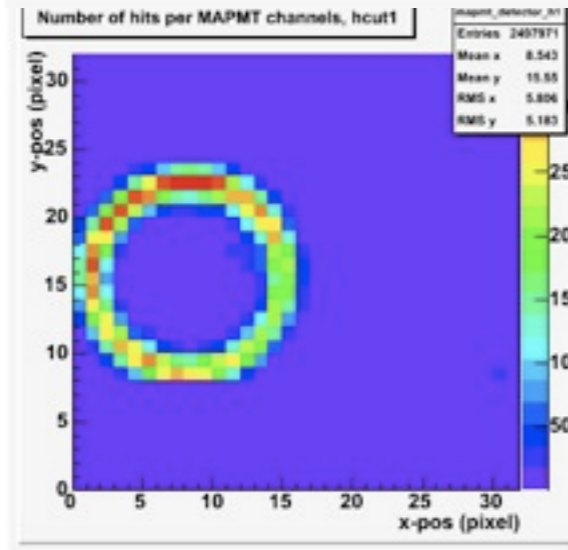
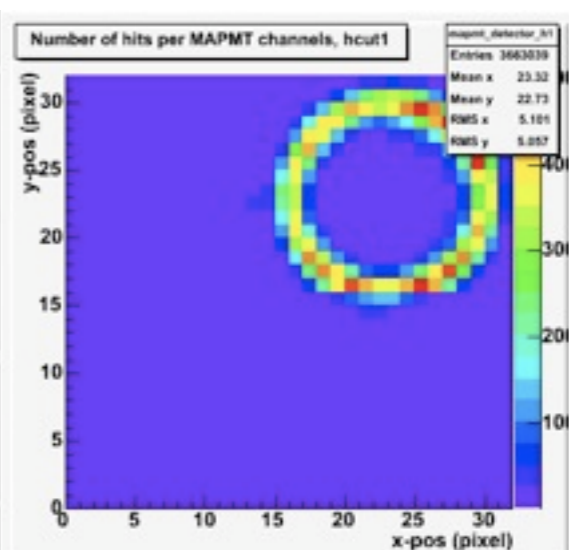
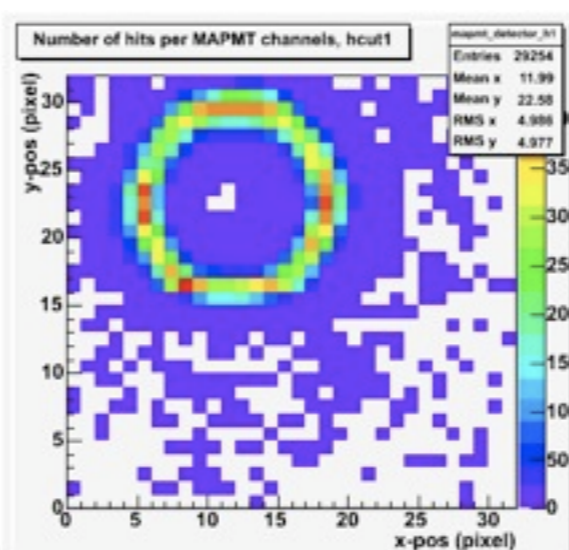
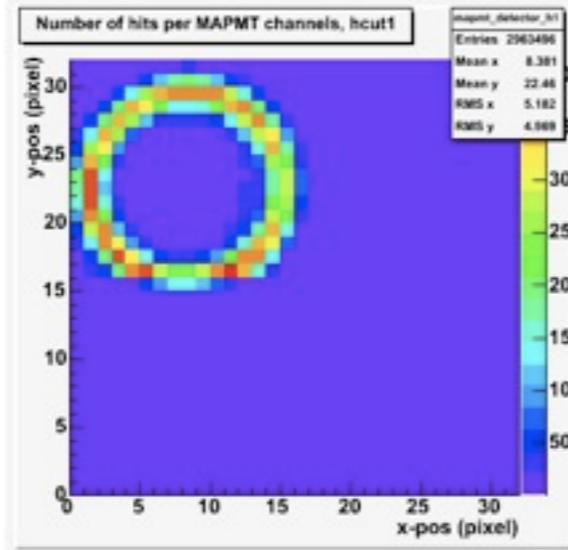
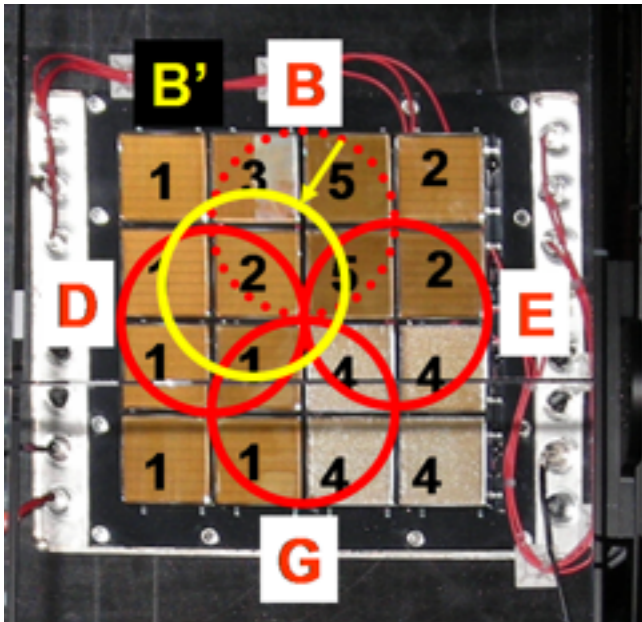
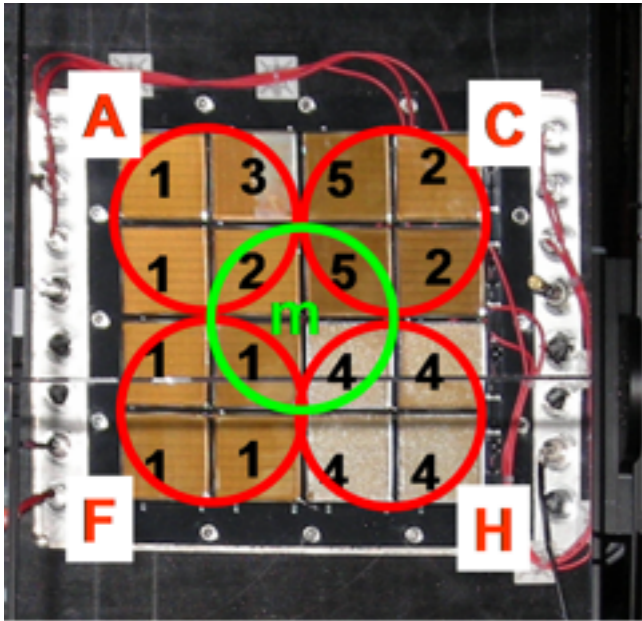


1100 V



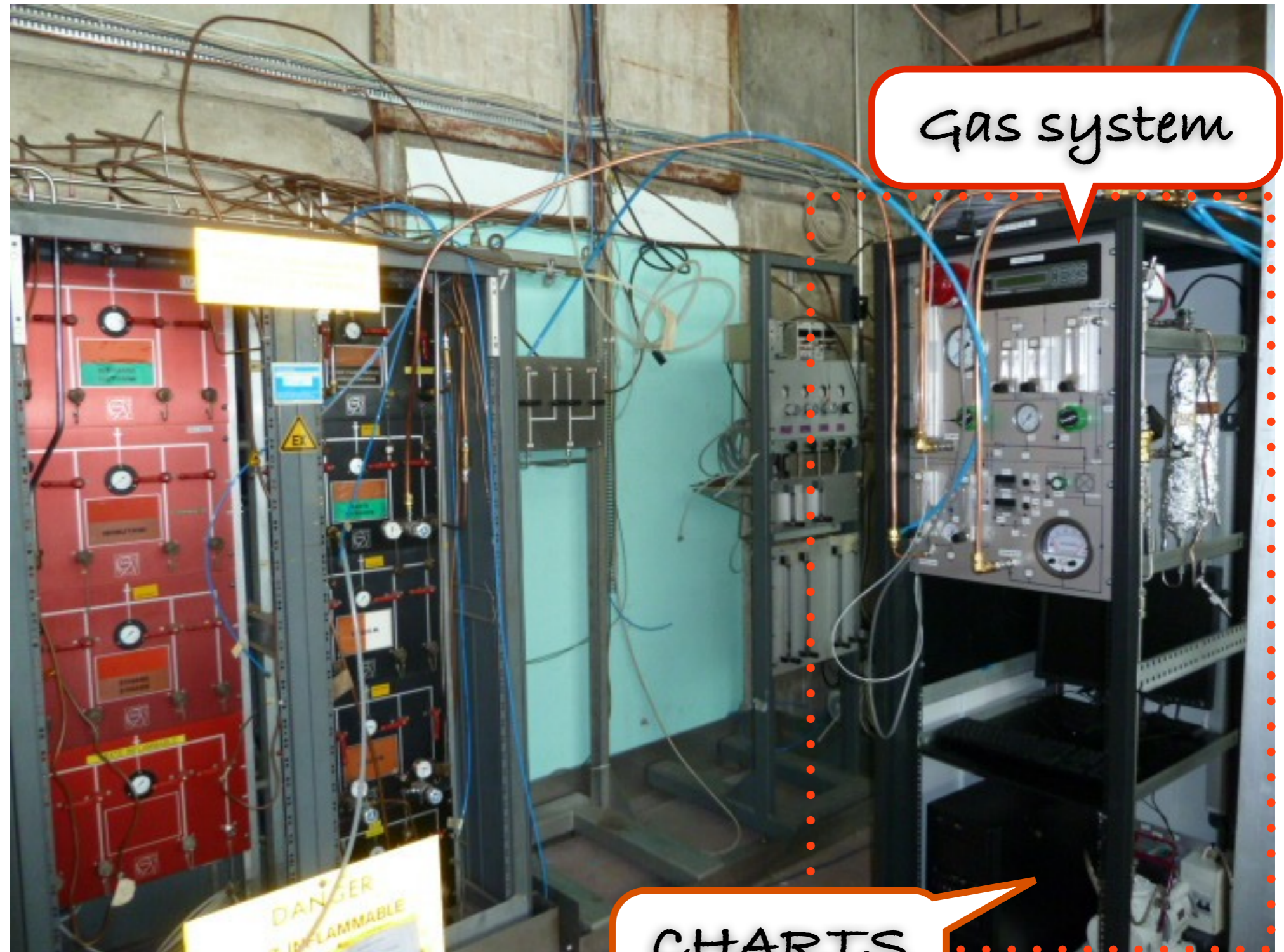
Results II : mirror positioning control

Position

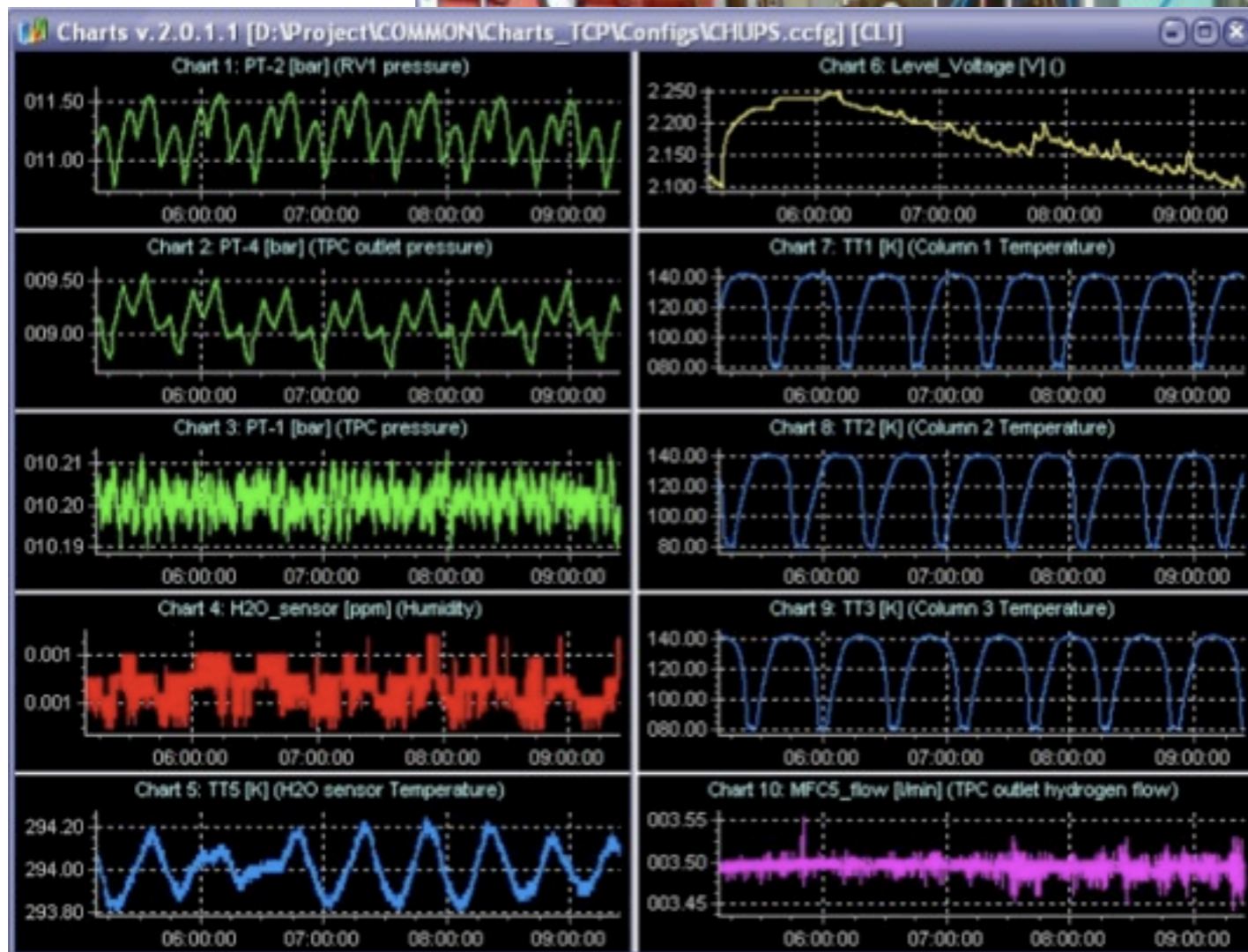
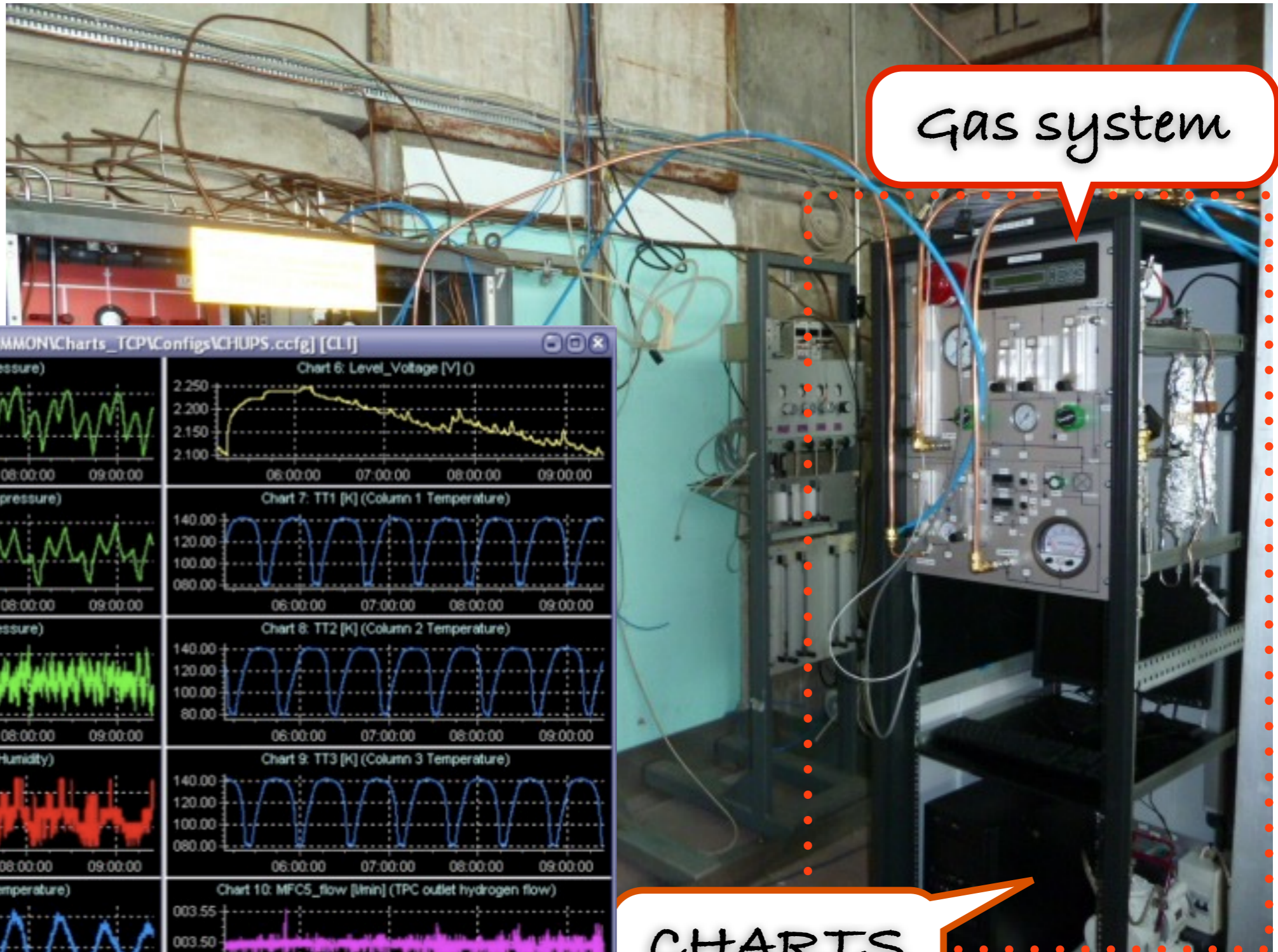


Thank you.

Gas monitoring system



Gas monitoring system



CHARTS

Gas monitoring system

The image displays the CSS (Control System Software) interface for a CBM Gas monitoring system. The main window, titled 'CBM Gas', shows real-time data for various parameters:

- Pressure:** PT 1 [bar] (1.062524557), PT 2 [bar] (146.1354827), PT 3 [mbar] (0.965458929), PT 4 [mbar] (1.999255299), PTB [mbar] (970.4525146), Refr. Index (4.0741160046).
- Contents:** O2 [ppm] (83.061515808), H2O [ppm] (374.96380615), FM-1 (3.4384679794).
- Temperature:** 293.3920898 K.

Below the main window, several charts are visible, including:

- Chart 1: PT-2 [bar] (RV1 pres)
- Chart 2: PT-4 [bar] (TPC outlet p)
- Chart 3: PT-1 [bar] (TPC pres)
- Chart 4: H2O_sensor [ppm] (H)
- Chart 5: TTS [K] (H2O sensor Temperature)
- Chart 10: MFC5_flow [l/min] (TPC outlet hydrogen flow)

The physical gas system hardware is shown on the right, featuring a rack of electronic modules, gas cylinders, and various sensors and valves. A red speech bubble labeled 'Gas system' points to the hardware, and an orange speech bubble labeled 'CHARTS' points to the software interface.