



Mirror Positioning Control System

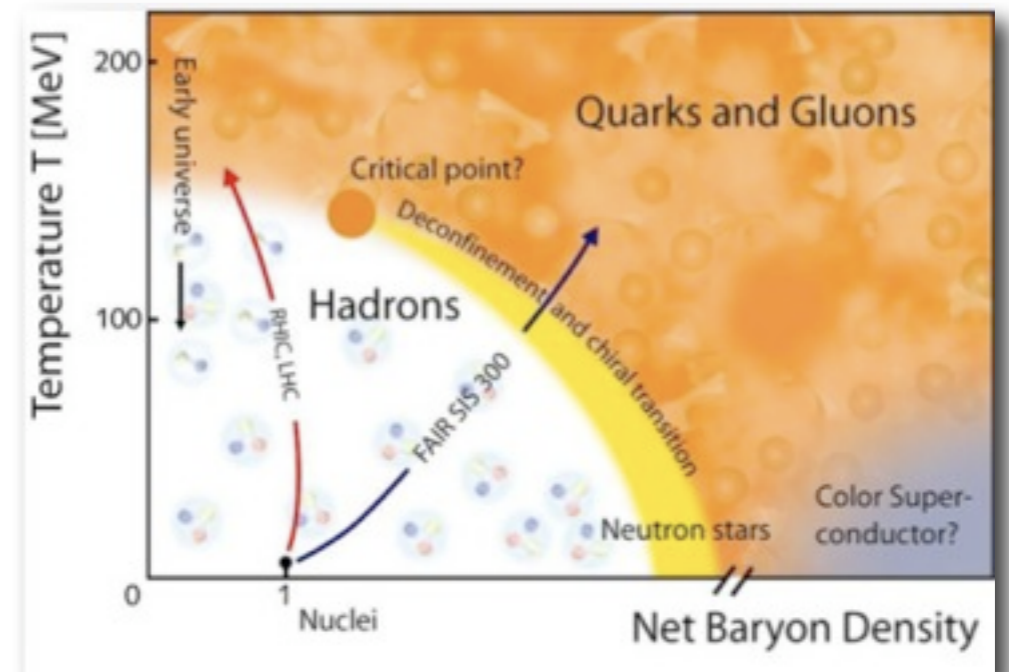
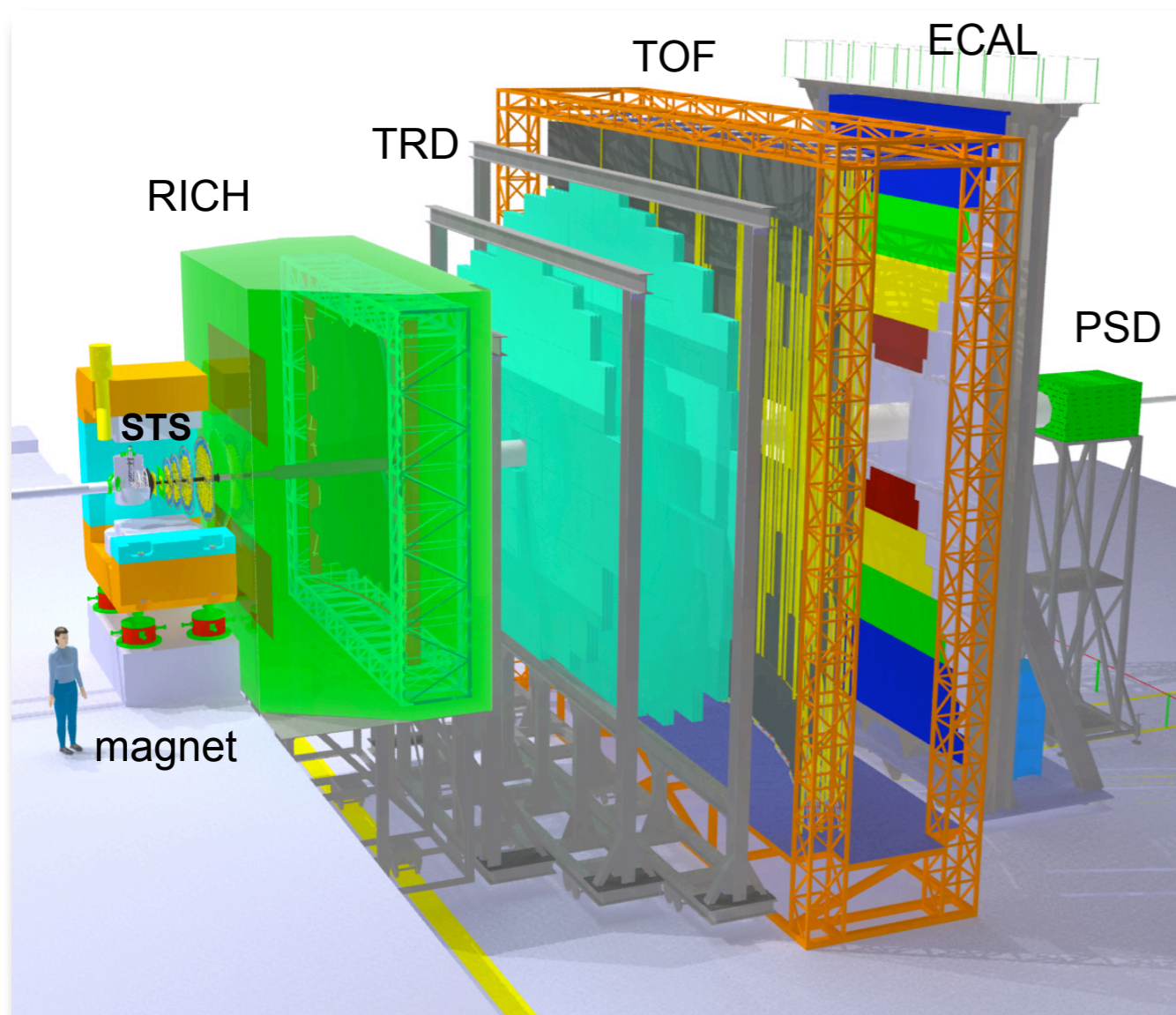
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Heavy Ion Physics Experiment LAB in KOREA

Summer School Project

The CBM experiment

Compressed Baryonic Matter



Goal

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

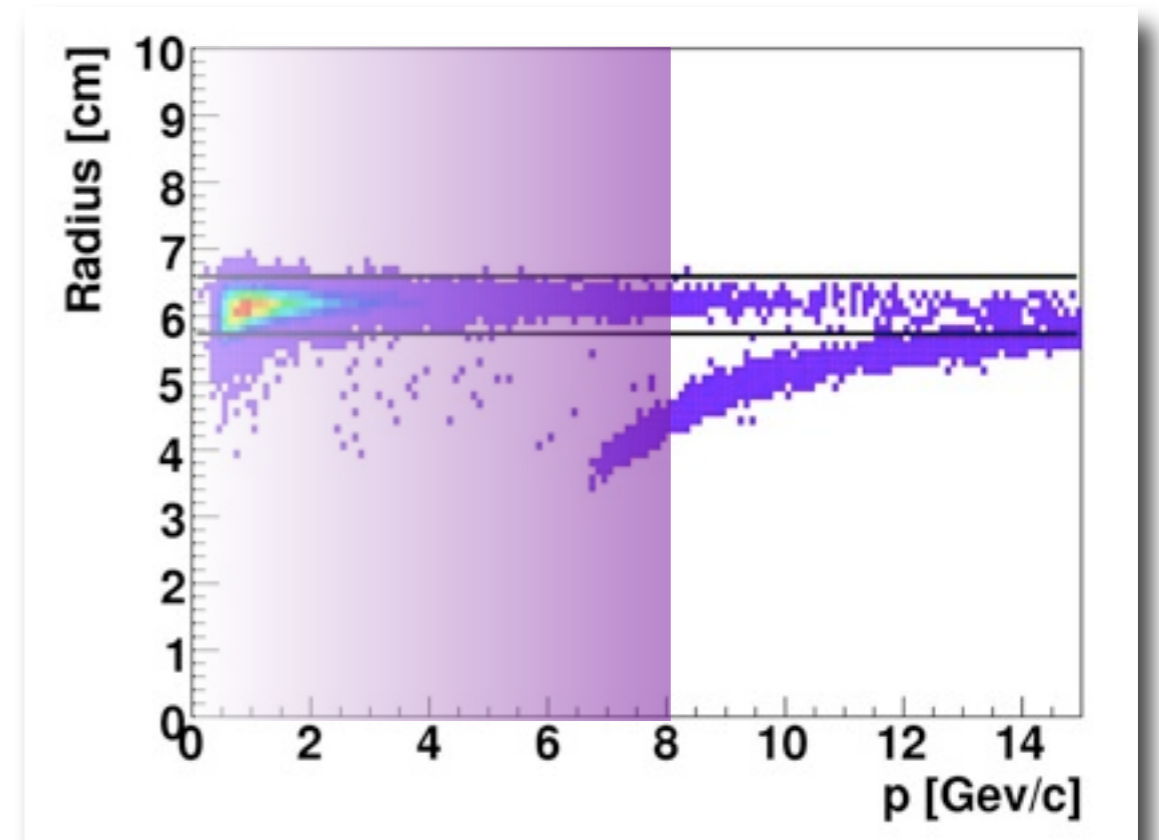
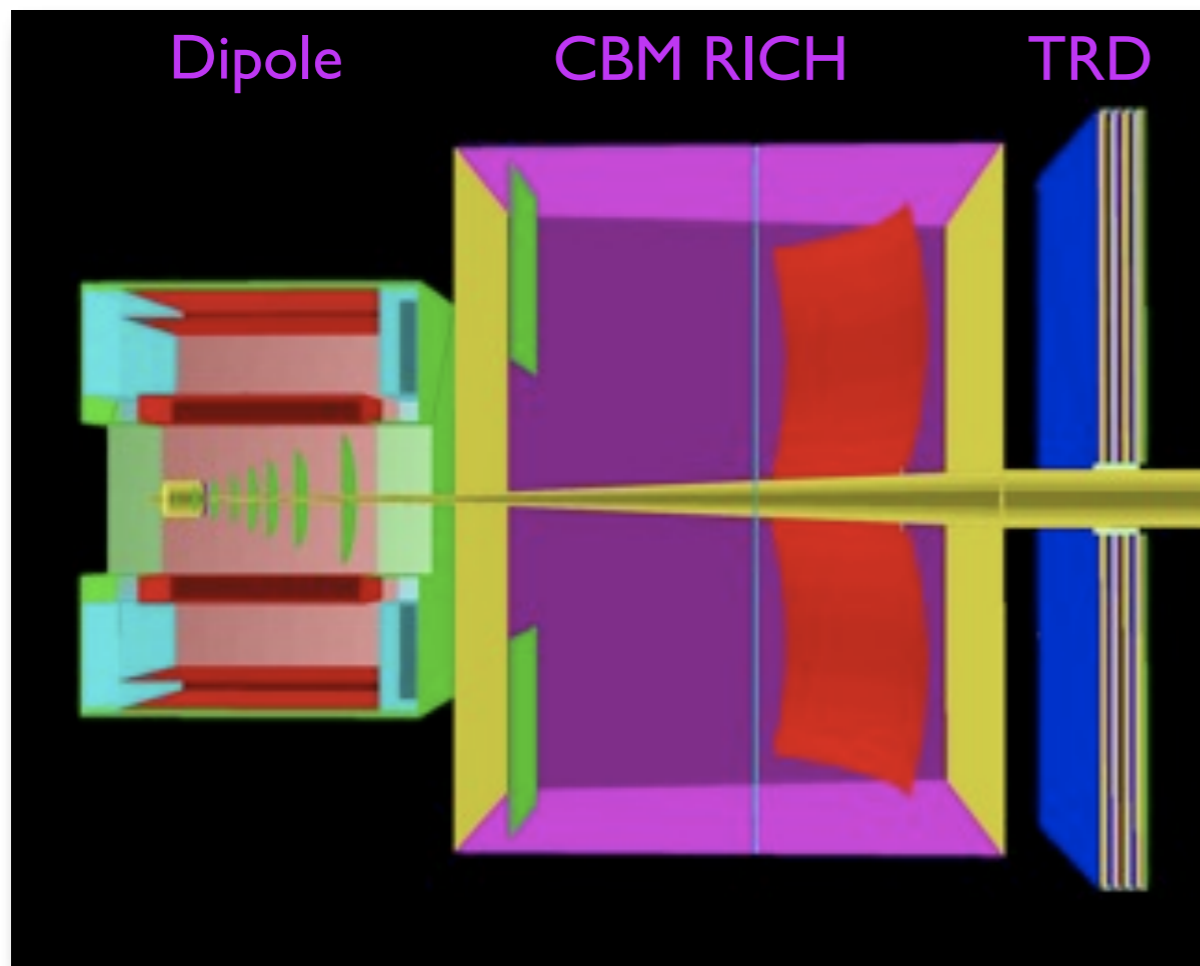
penetrating probes : $\rho, \omega, \varphi \rightarrow e^+e^-$
: $J/\Psi, \Psi' \rightarrow e^+e^-$

FAIR : Facility for Antiproton and Ion Research

- 10 to 40 GeV/u energy scanned

The CBM RICH detector

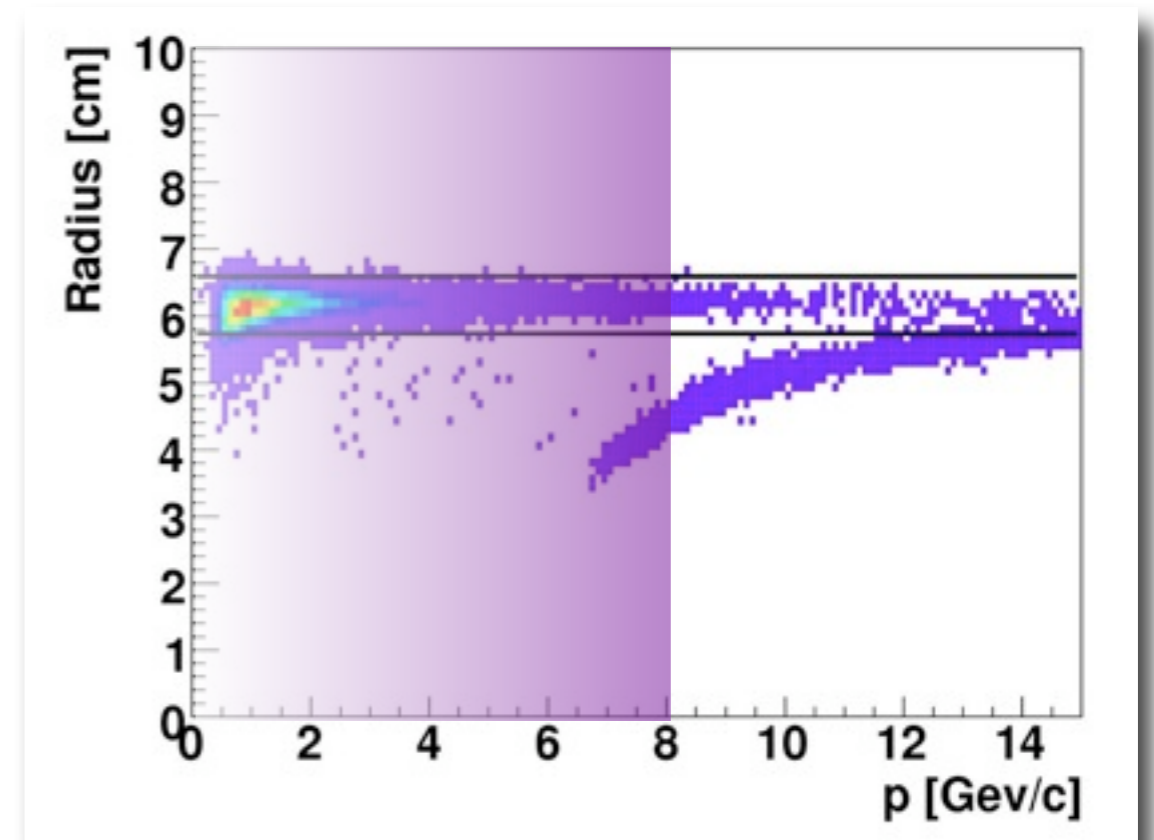
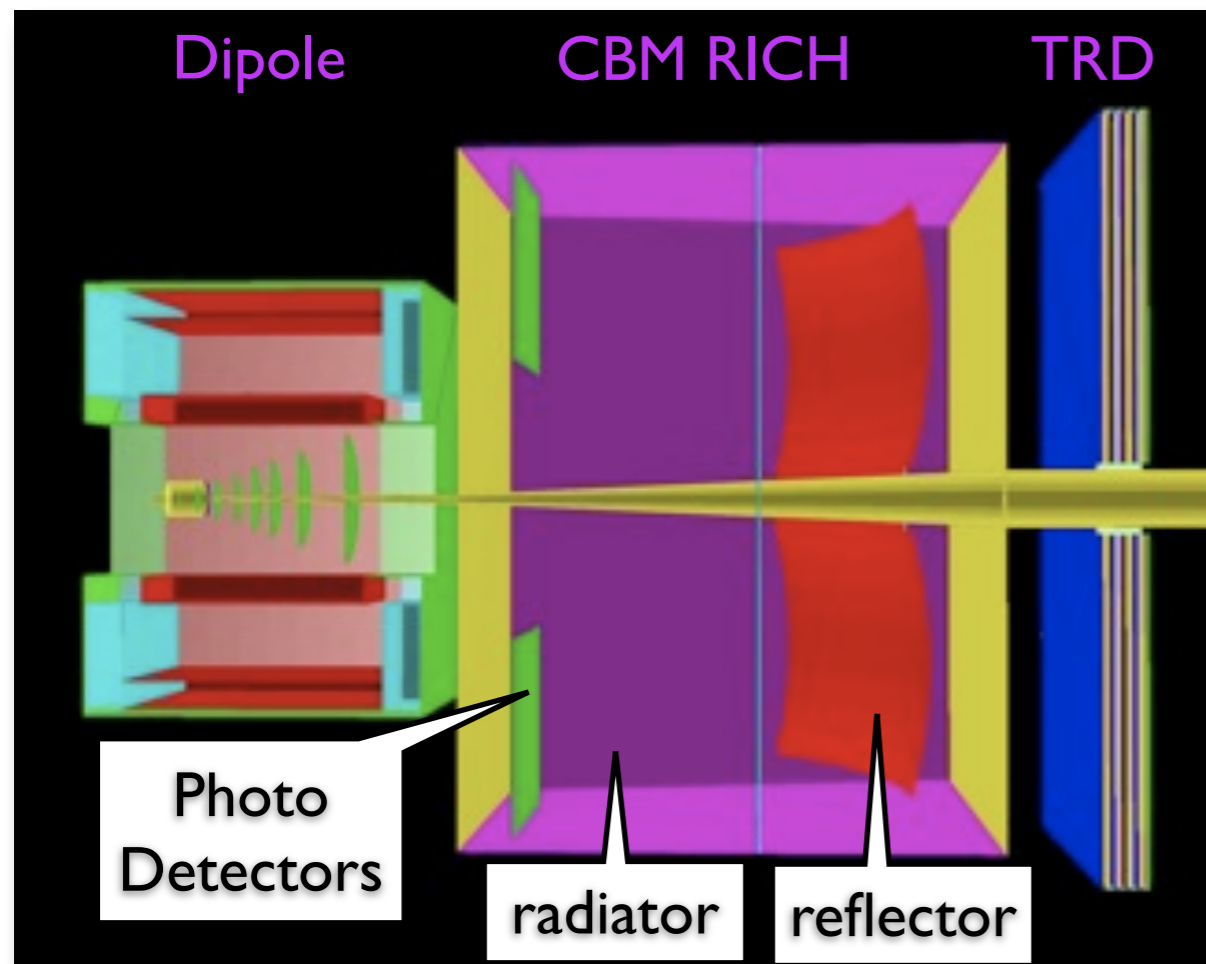
Ring Imaging Cherenkov detector



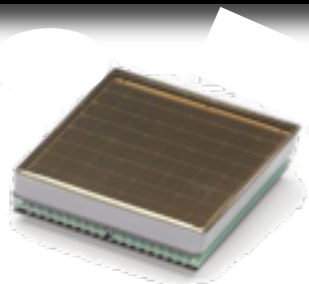
Aim : **Clean electron identification for momenta below 8GeV/c**

The CBM RICH detector

Ring Imaging Cherenkov detector



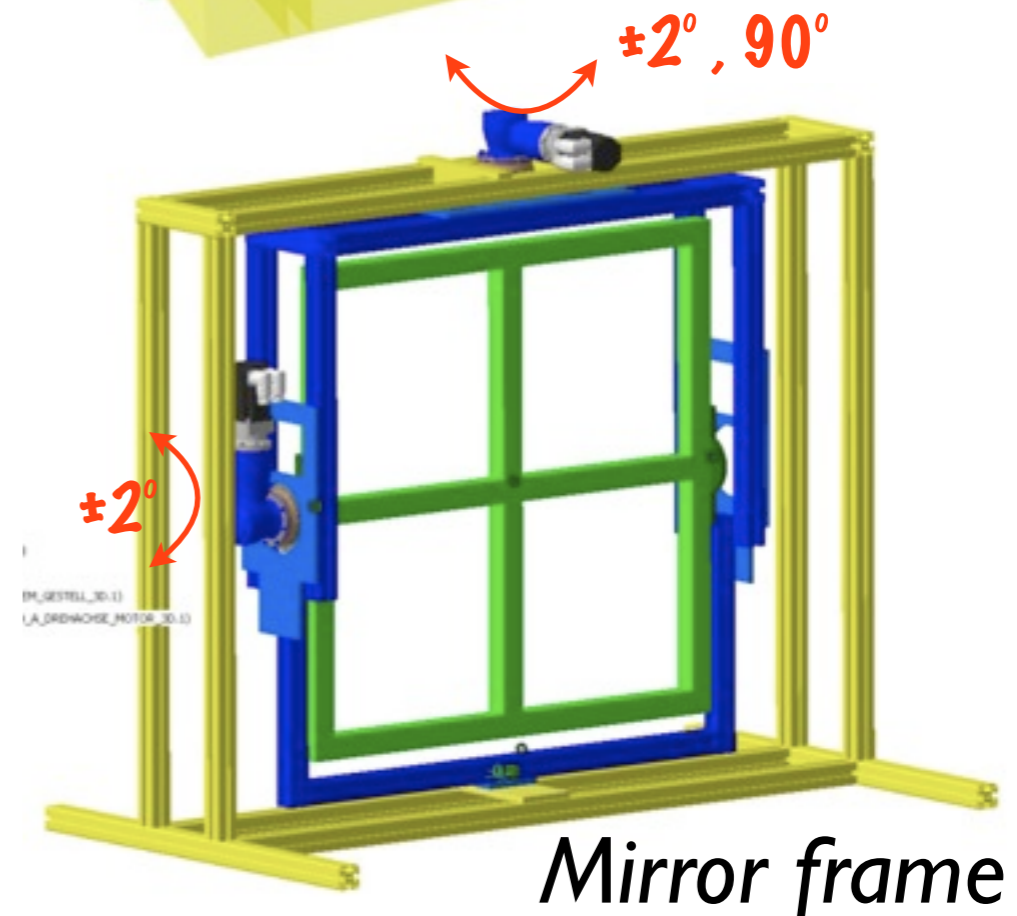
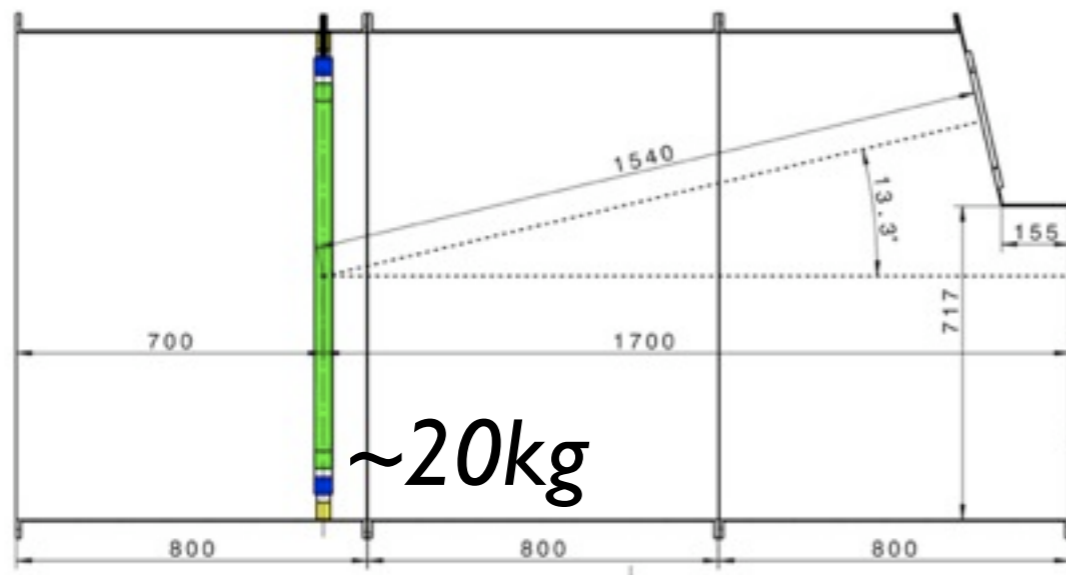
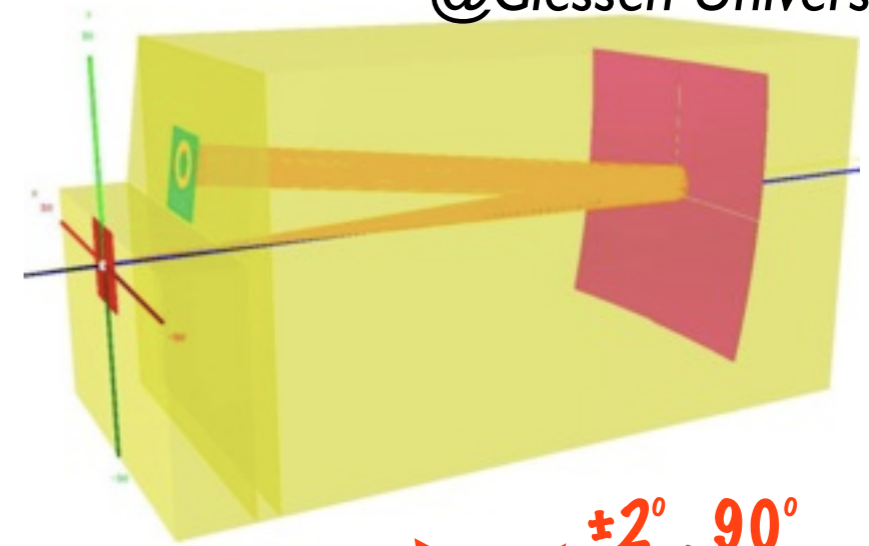
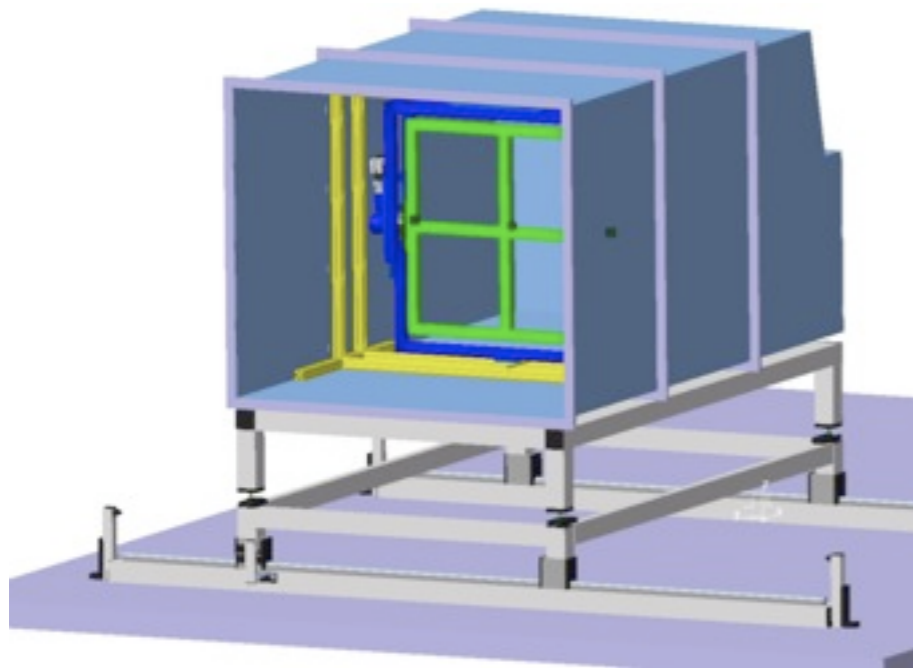
Aim : **Clean electron identification for momenta below 8GeV/c**



MAPMT : Multi-Anode
Photo Multiplier Tube

Project : for Mirror alignment control

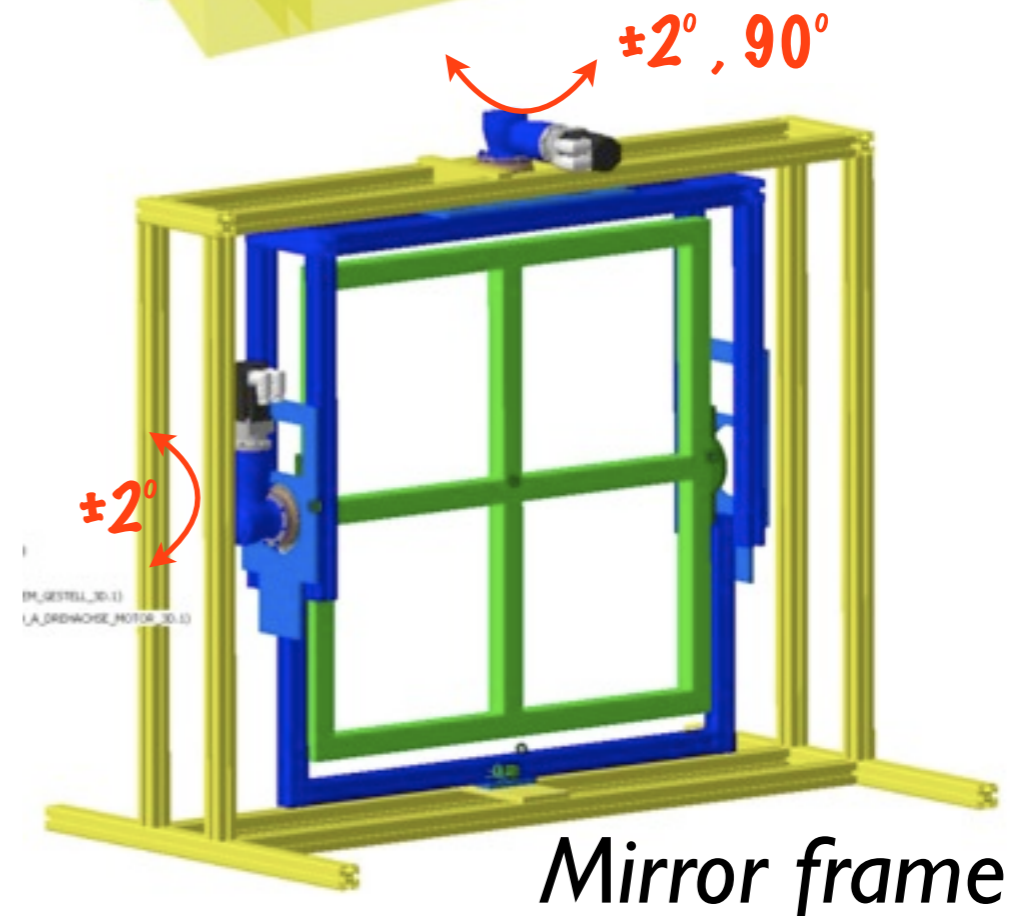
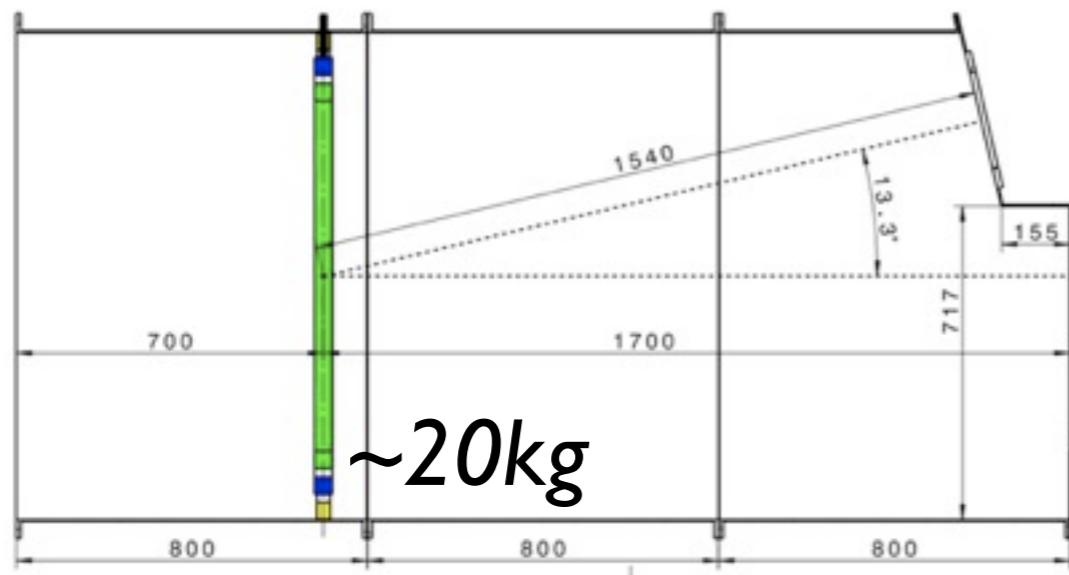
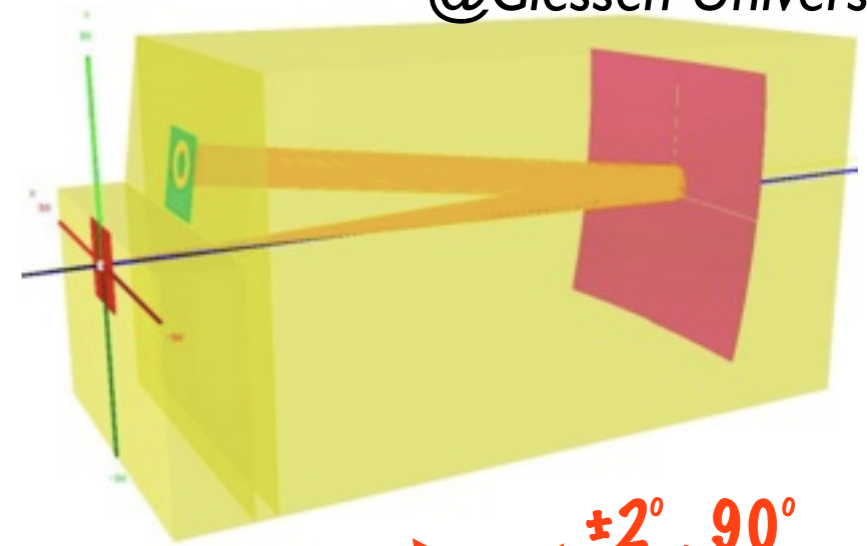
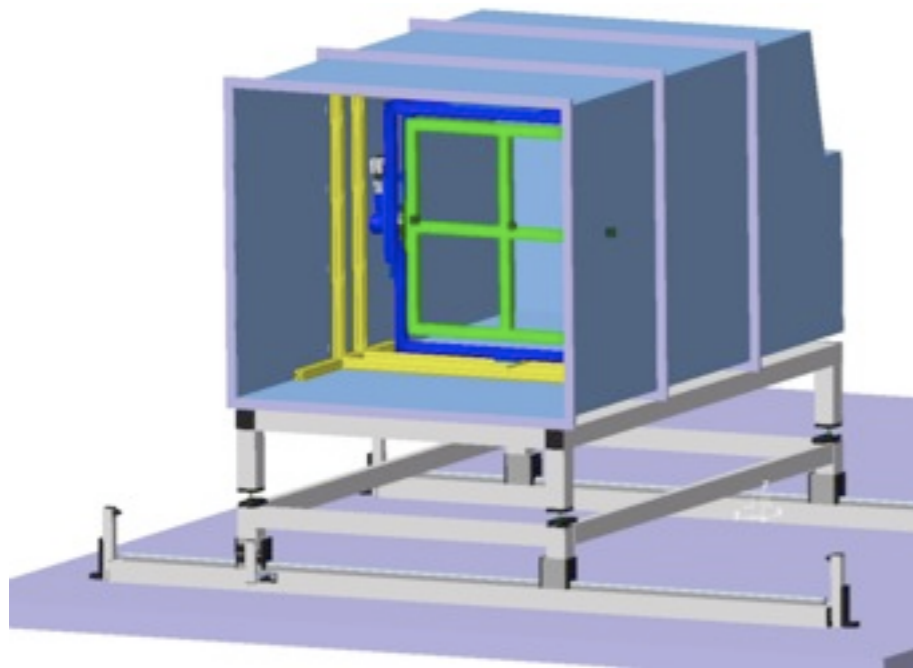
CBM-RICH prototype
@Giessen University



Project : for Mirror alignment contro.



CBM-RICH prototype
@Giessen University

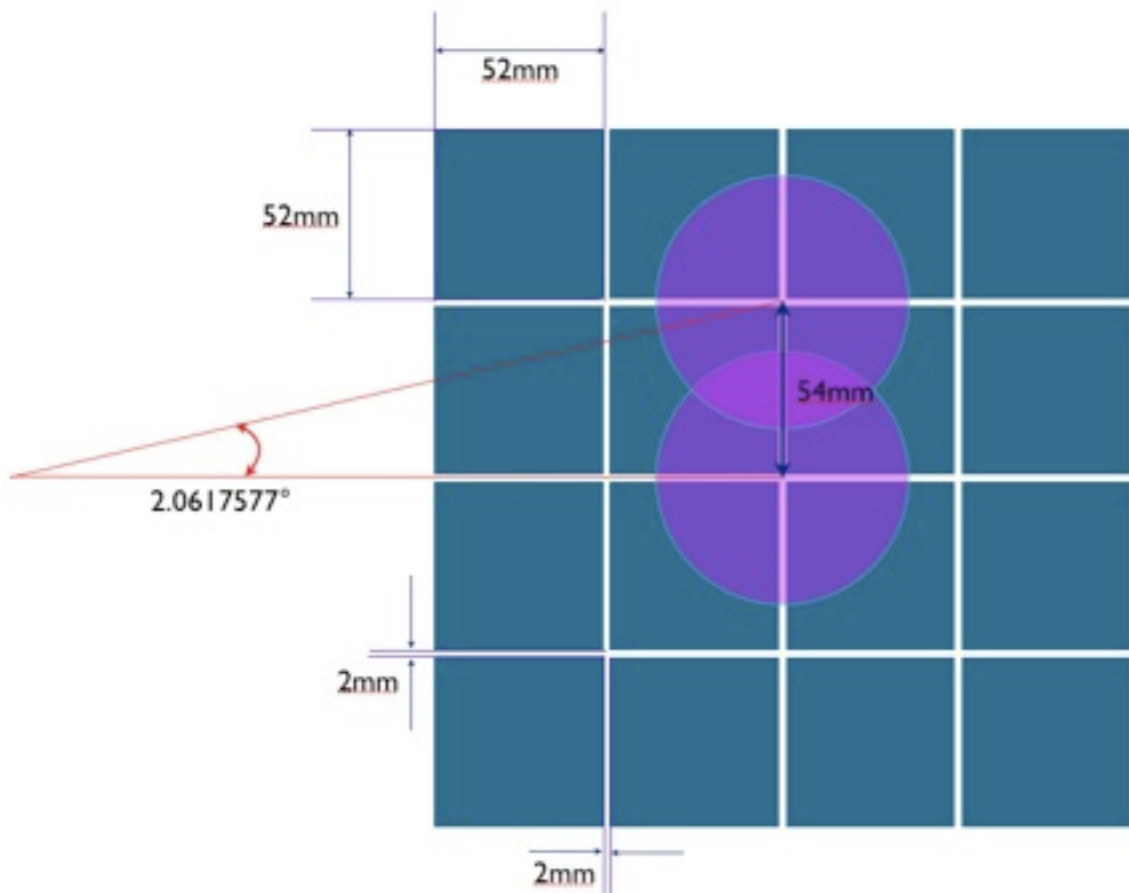




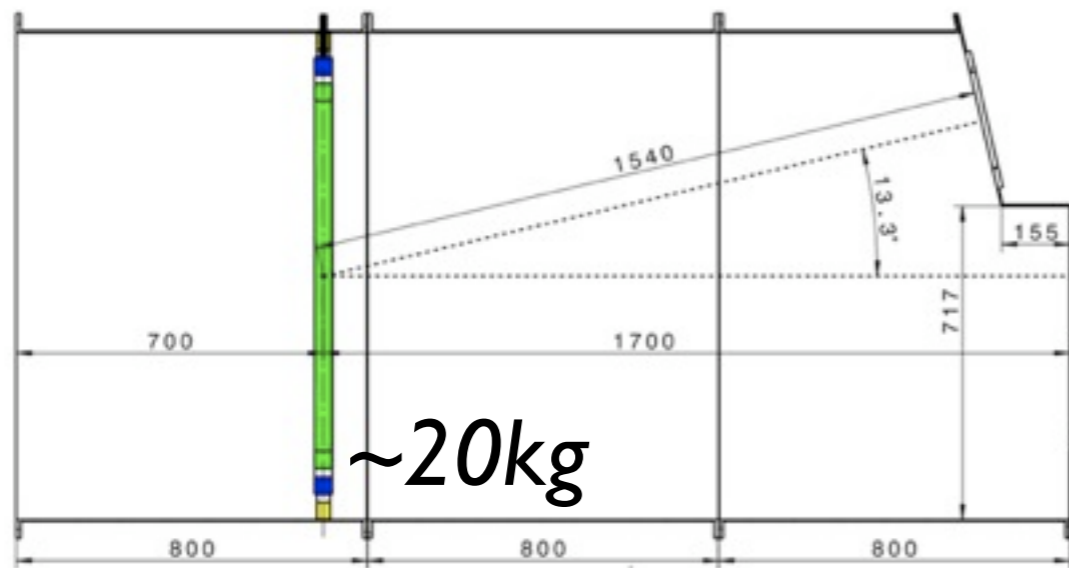
Project : Mirror alignment control.



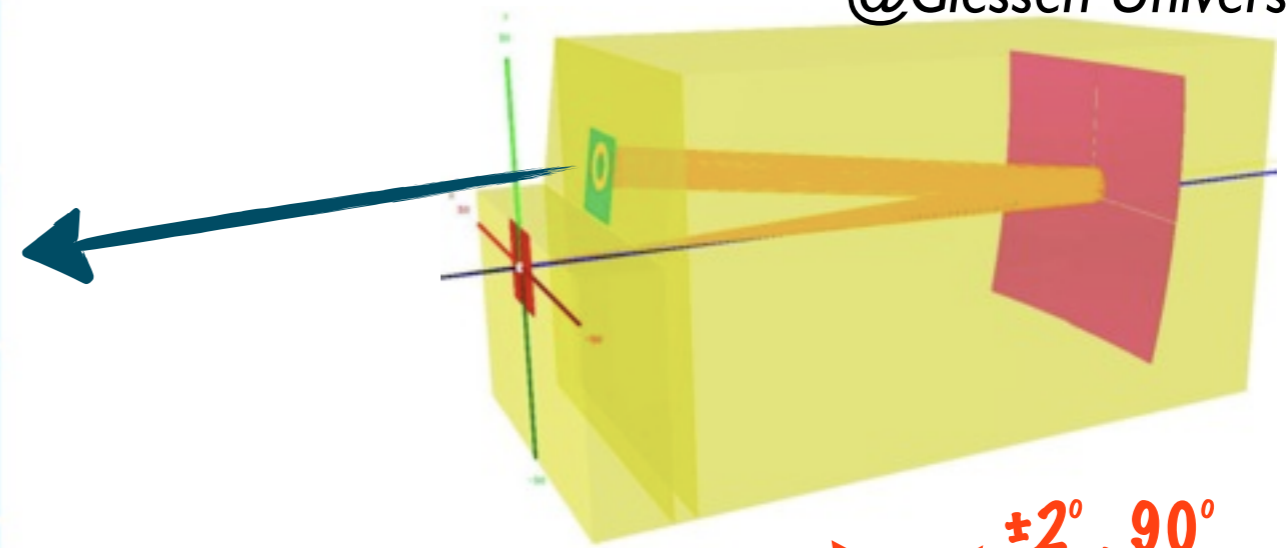
CBM-RICH prototype
@Giessen University



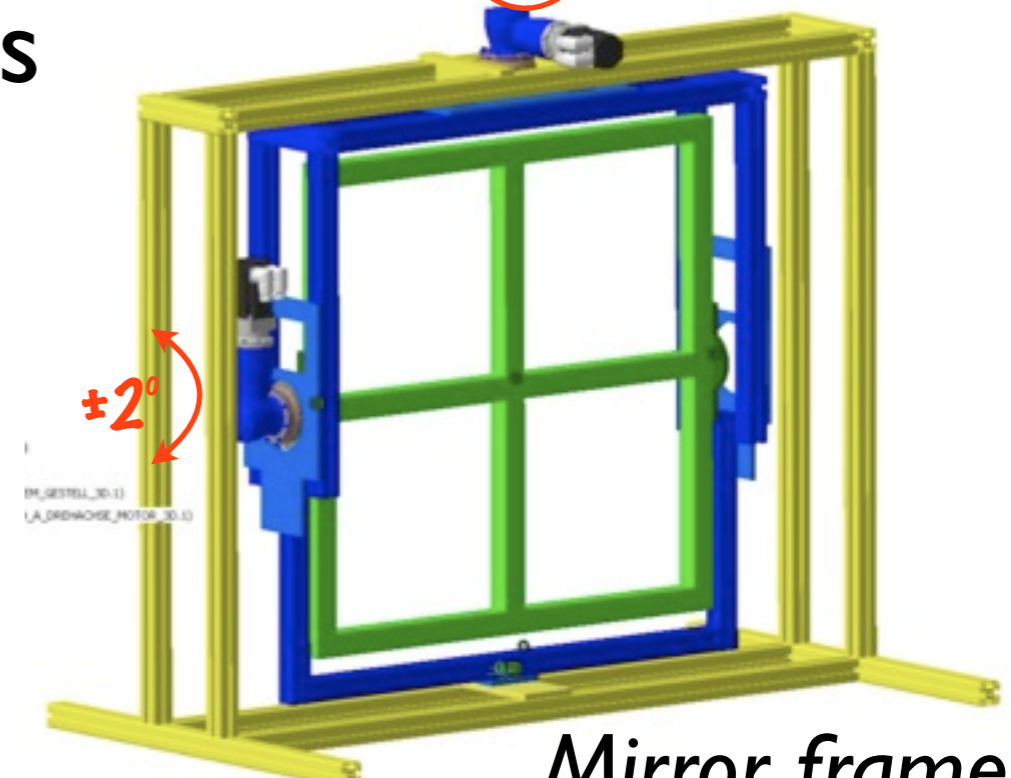
MAPMTs



~20kg

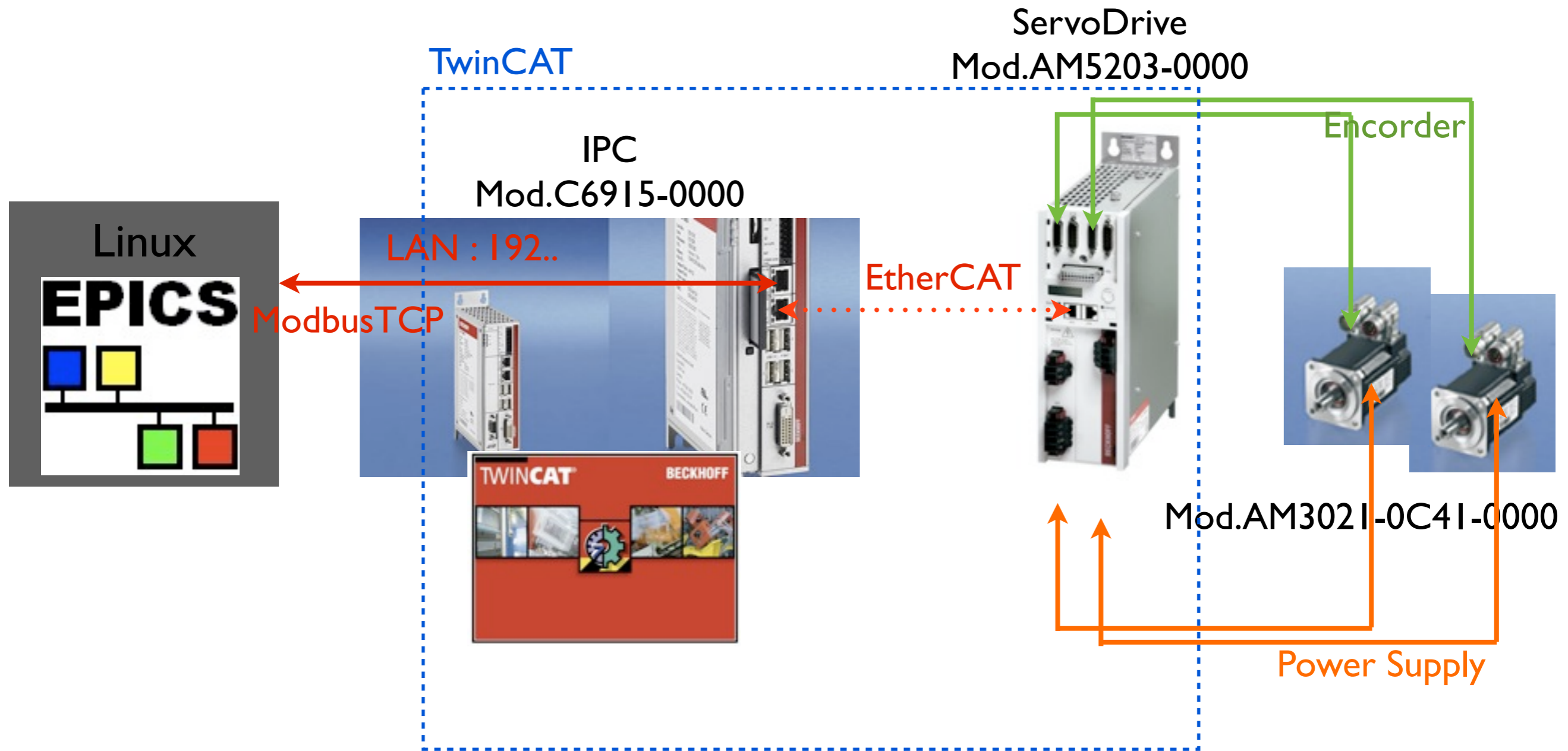


±2°, 90°



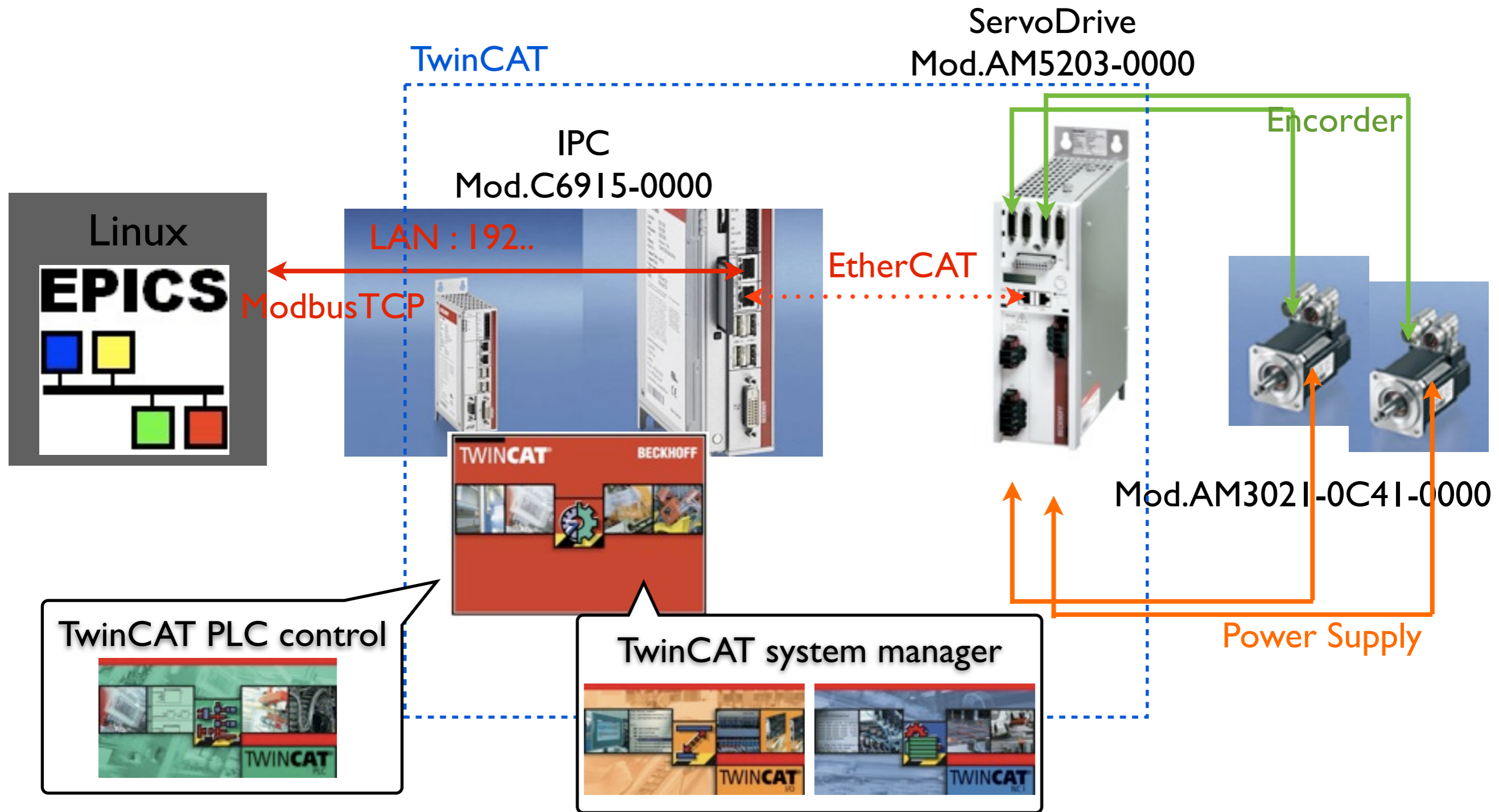
Mirror frame

Scheme



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

Scheme



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TwinCAT system Manager

The screenshot displays the TwinCAT System Manager interface. On the left, a tree view shows the system configuration, including 'SYSTEM - Configuration', 'NC - Configuration', 'PLC - Configuration', and 'I/O - Configuration'. A red box highlights 'NC-Task 1 SAF' in the NC tree, and another red box highlights 'Mirror Control' in the PLC tree. A green arrow points from the top of the tree to the 'I/O Devices' section, and a red arrow points from the 'Mirror Control' section to the 'I/O Devices' section. The main panel on the right shows the 'Functions' tab for 'Numerical Control', displaying a current position of 4.0292 and a setpoint position of 4.0000. Below this, there are controls for 'Extended Start', 'Raw Drive Output', 'Set Actual Position', and 'Set Target Position'. A white box labeled 'Numerical Control' is overlaid on the bottom of this panel. At the bottom of the interface, a message log shows several error messages from TCNC (500) regarding 'Axis 1'.

Numerical Control

Communication with Hardware

Server (Port)	Timestamp	Message
TCNC (500)	17.08.2011 14:27:18 750 ms	AdWrite Function axis 1' (InvokeId: 21104, IndexGroup: 0x00004201, IndexOffset: 0x00000020, Length: 20) is returning error 0x4263 !
TCNC (500)	17.08.2011 14:27:18 750 ms	'Axis 1' (Axis-ID: 1, Grp-ID: 1): Axis is in <SingleStepMode> (single block mode) and does not take further instructions, therefore (error-code: #0x4263) !
TCNC (500)	17.08.2011 13:45:20 222 ms	AdWrite Function axis 1' (InvokeId: 8933, IndexGroup: 0x00004201, IndexOffset: 0x00000020, Length: 20) is returning error 0x4263 !

TwinCAT PLC control

The screenshot displays the TwinCAT PLC Control interface for a project named "MirrorControlV3_CE.js.pro". The main window is divided into several panes:

- 1. Main:** Shows the main program structure with variables for motor power, reset, and halt, and a state machine logic.
- 2. Function Blocks:** Displays four function blocks: PowerMotor1 (MC_Power), ResetMotor1 (MC_Reset), MoveModuloMotor1 (MC_MoveModulo), and HaltMotor1 (MC_Halt).
- 3. States:** Lists the state machine states, including MOVESTATE_INIT, MOVESTATE_ENABLE, MOVESTATE_WAIT, MOVESTATE_A through MOVESTATE_H, MOVESTATE_ZERO, MOVESTATE_NC, MOVESTATE_TILT, MOVESTATE_NOTILT, and MOVESTATE_STOP.
- 4. Variables:** Shows global variables for actual and set positions, and state variables A through H.

Additional elements include a "Run" button, an "Online" button, and a status bar at the bottom showing library loading progress.

Control Panel

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 control panel window displays the following components:

- Motor 1 and Motor 2:** Each has a green 'Start' button and a red 'Stop' button.
- Actual Position:**

Horizontal	340.004 °
Vertical	20.011 °
- Numerical control start:** A red button.
- Set Position:**

Horizontal	50.0 °
Vertical	50.0 °
- Tilt:**

Tilt (90°)	NoTilt (0°)
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- Position Grid:** A 3x3 grid of buttons labeled A through H. The y-axis is labeled from -2° to 2° and the x-axis from -2° to 2°. Button A is highlighted in pink.

Control Panel

1.Start

2.Stop

4.you can check the real position

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 titled "CBM_MIRROR". It features two motor control sections, "Motor 1" and "Motor 2", each with a green "Start" button and a red "Stop" button. A pink callout points to the "Stop" button of Motor 1, and another pink callout points to the "Stop" button of Motor 2. To the right, there are several data and control sections: "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). At the bottom, a 3x3 grid of buttons labeled A through H is shown on a coordinate system. The y-axis ranges from -2° to 2°, and the x-axis ranges from -2° to 2°. Button A is highlighted in pink, and a blue callout points to it, stating that clicking it moves the mirror and shows a ring image. The other buttons (B-H) are cyan.

Actual Position	
Horizontal	340.004 °
Vertical	20.011 °

Set Position	
Horizontal	50.0 °
Vertical	50.0 °

Tilt	
Tilt (90°)	NoTilt (0°)

Grid Buttons		
A	B	C
D	Zero	E
F	G	H

Control Panel

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 a control panel for 'CBM_MIRROR'. It features two motor control sections, 'Motor 1' and 'Motor 2', each with a green 'Start' button and a red 'Stop' button. A central grid displays eight positions labeled A through H, with a vertical axis 'y' ranging from -2° to 2° and a horizontal axis 'x' ranging from -2° to 2°. Position A is highlighted in pink. To the right, there are several data and control sections: 'Actual Position' showing Horizontal at 340.004° and Vertical at 20.011°; a red 'Numerical control start' button; a 'Set Position' section with input fields for Horizontal (50.0°) and Vertical (50.0°); and a 'Tilt' section with 'Tilt (90°)' and 'NoTilt (0°)' options.

The 'Tilt' section contains two buttons: a purple button labeled 'Tilt (90°)' and a red button labeled 'NoTilt (0°)'.

The 'Horizontal' numerical control panel shows a text input field with the value '50'. Below it, a range is indicated as 'Min: 0' and 'Max: 360'. A numeric keypad is displayed with buttons for digits 0-9, '+/-', a decimal point, and function keys: 'BACK', 'CLEAR', 'ESC', and 'OK'.

Control Panel

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.

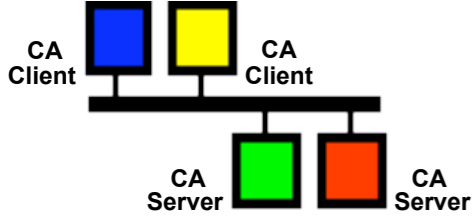
The screenshot shows a control panel for 'CBM_MIRROR'. It includes two motor control sections, 'Motor 1' and 'Motor 2', each with 'Start' and 'Stop' buttons. A central grid shows eight positions labeled A through H, with a vertical axis 'y' ranging from -2° to 2° and a horizontal axis 'x' ranging from -2° to 2°. Position A is highlighted in pink. To the right, there are sections for 'Actual Position' (Horizontal: 340.004°, Vertical: 20.011°), 'Numerical control start', 'Set Position' (Horizontal: 50.0°, Vertical: 50.0°), and 'Tilt' (Tilt (90°) and NoTilt (0°)).

7. for Tilt(90°,0°)
NoTilt(0°,0°)

The screenshot shows a numerical keypad interface for 'Horizontal' control. It features a text input field with the value '50', a 'Min' field with '0' and a 'Max' field with '360'. Below these are several rows of buttons: '7', '8', '9', 'BACK'; '4', '5', '6', 'CLEAR'; '1', '2', '3', 'ESC'; and '0', '+/-', '.', 'OK'.

EPICS

EPICS architecture



Network based Client/Server model

EPICS Client

e.g. CSS



Channel Access

LAN

EPICS server



IOC (Input Output Controller)

e.g. PC

modbus TCP connection

A server provides information and service

A Client uses the service or asks for information

Hardware



Control Panel

Control System Studio

OPI Runtime

Display

Start

Stop

Start1 Start2 Stop1 Stop2

Actual Position

Horizontal	19.985
Vertical	20.005

Set Position (NC control)

Horizontal	10.000
Vertical	10.000

NC Start

Start/Stop

Tilt

+2

0

-2

-2 0 +2

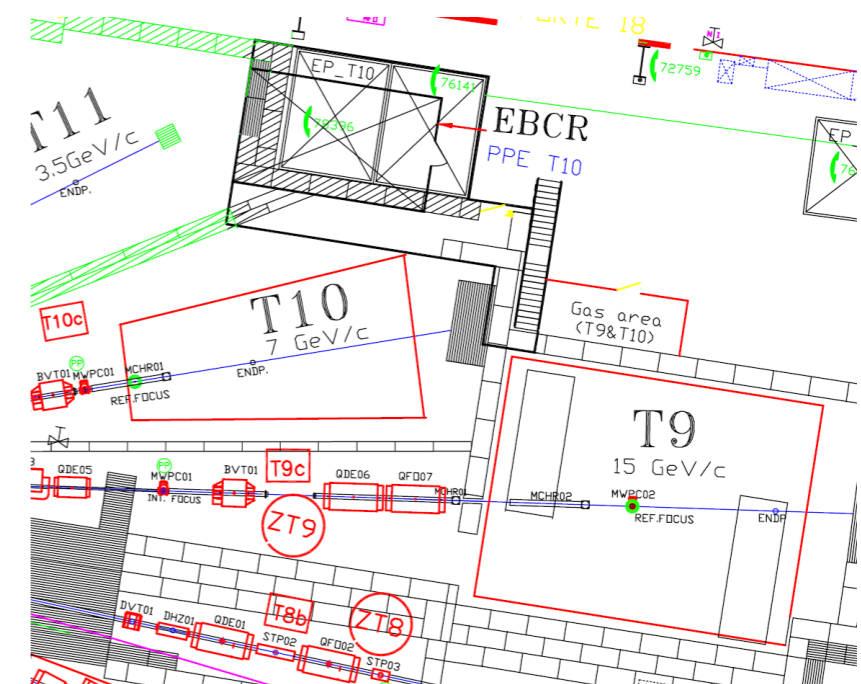
Not logged in

Summary & Outlook

- I programmed mirror positioning control system using TwinCAT and EPICS for CBM-RICH prototype.
- The control system is successfully implemented.
- It will be used for experiment @CERN, T9 in Oct.2011



floor space at T9 for CBM test



Thanks to my advisers.

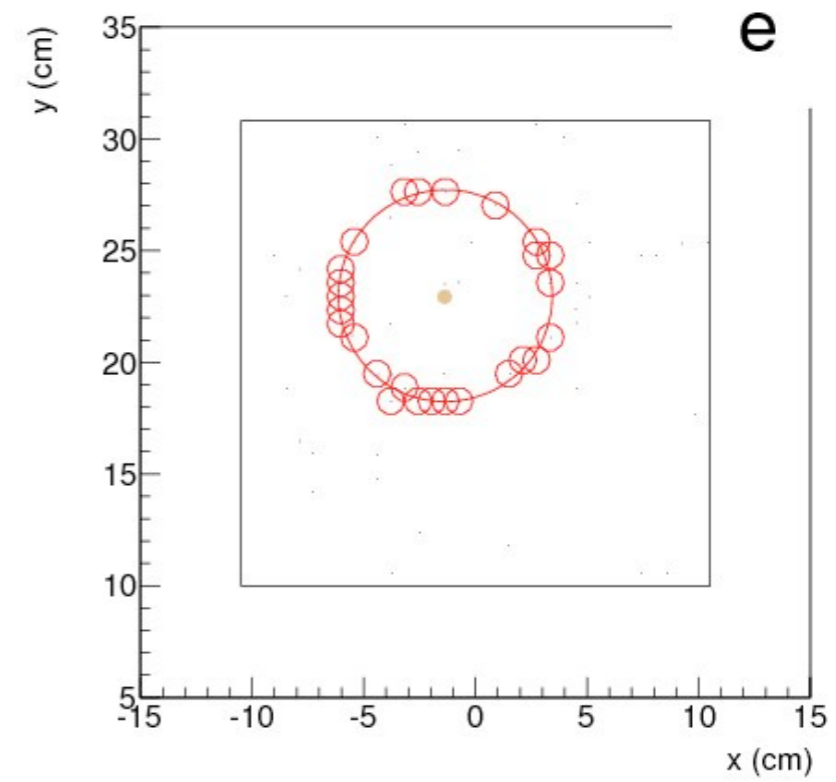
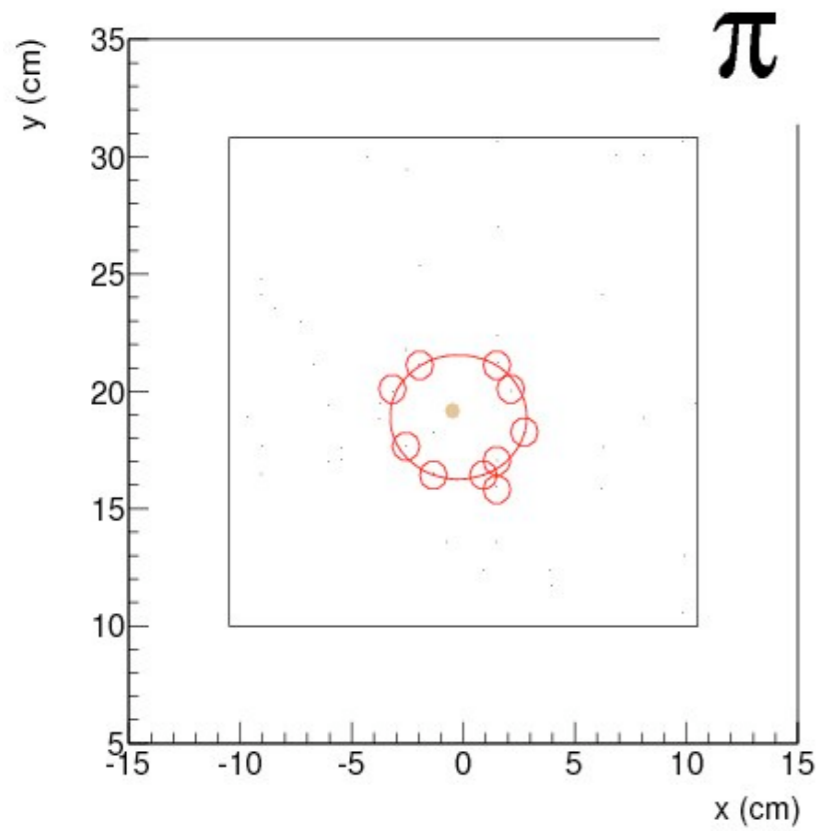
Peter Zumbruch,

Tanya Torres De Heidenreich,

Burkhard Kolb

Back up

Simulation results



single event

