

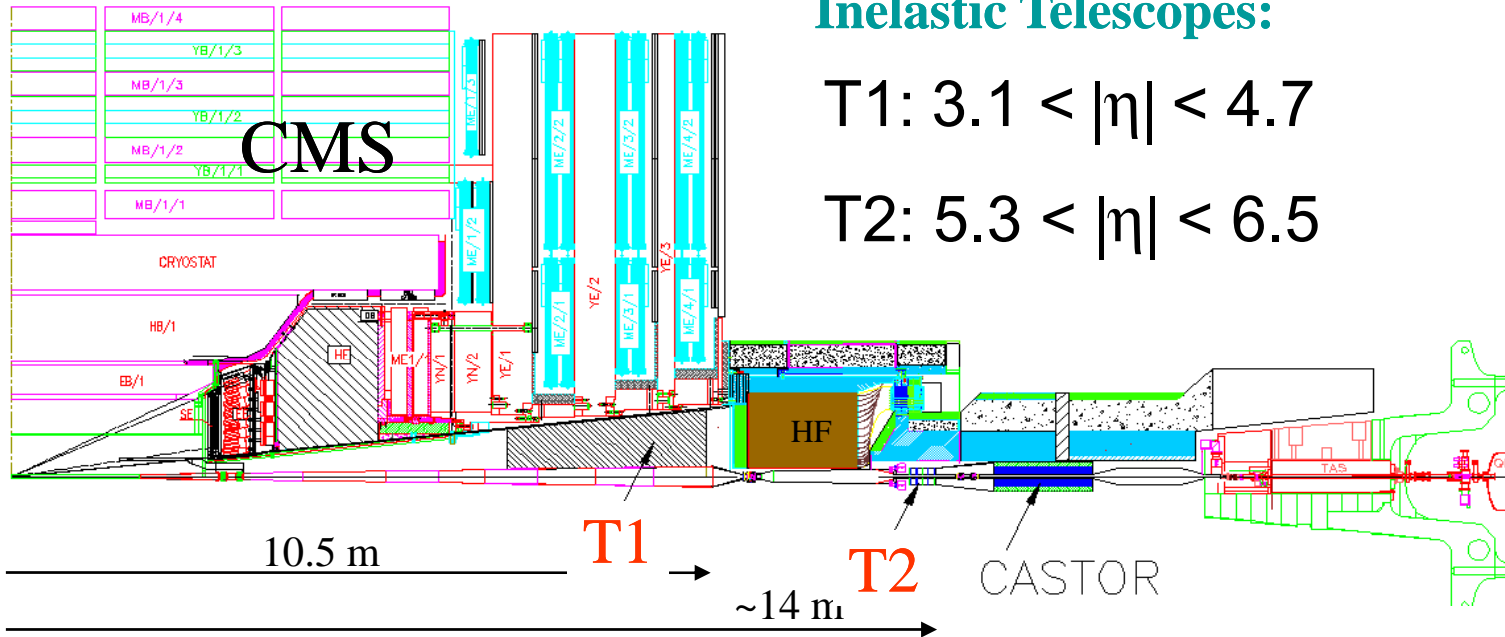


Status of the TOTEM experiment

- The Roman Pots
- The T1 detector
- The T2 detector
- Conclusion and Outlook



The TOTEM experiment

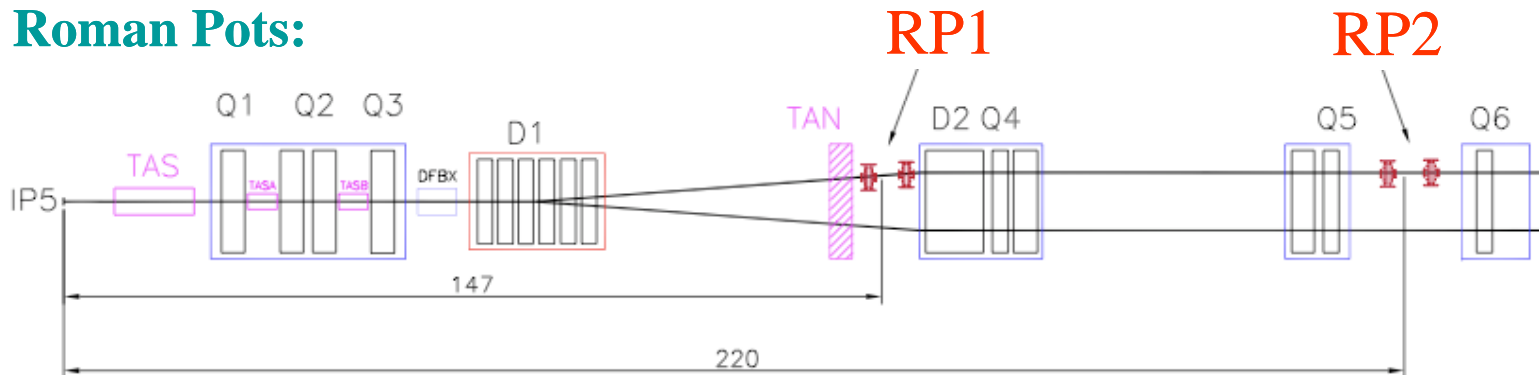


Inelastic Telescopes:

$$T1: 3.1 < |\eta| < 4.7$$

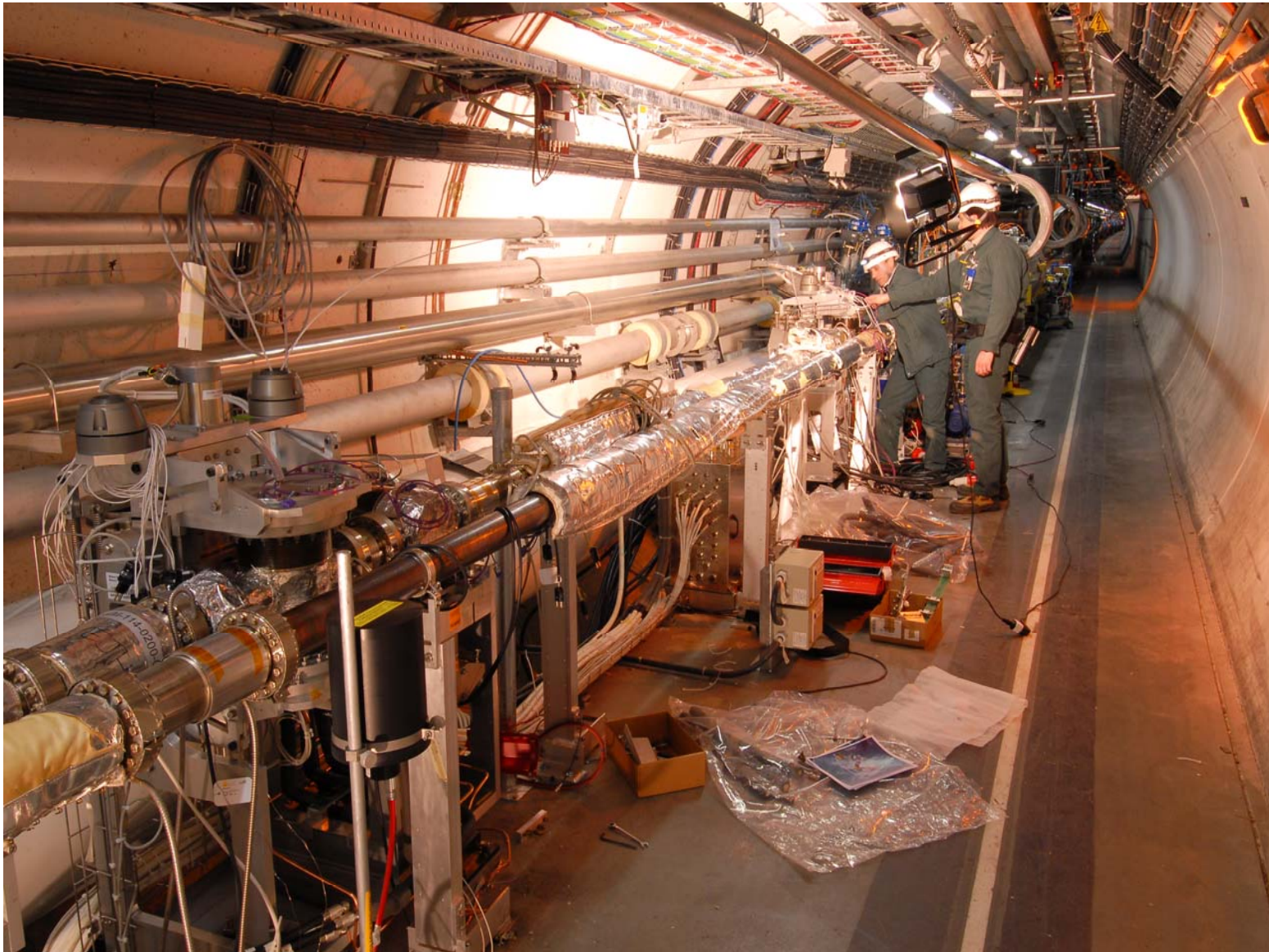
$$T2: 5.3 < |\eta| < 6.5$$

Roman Pots:



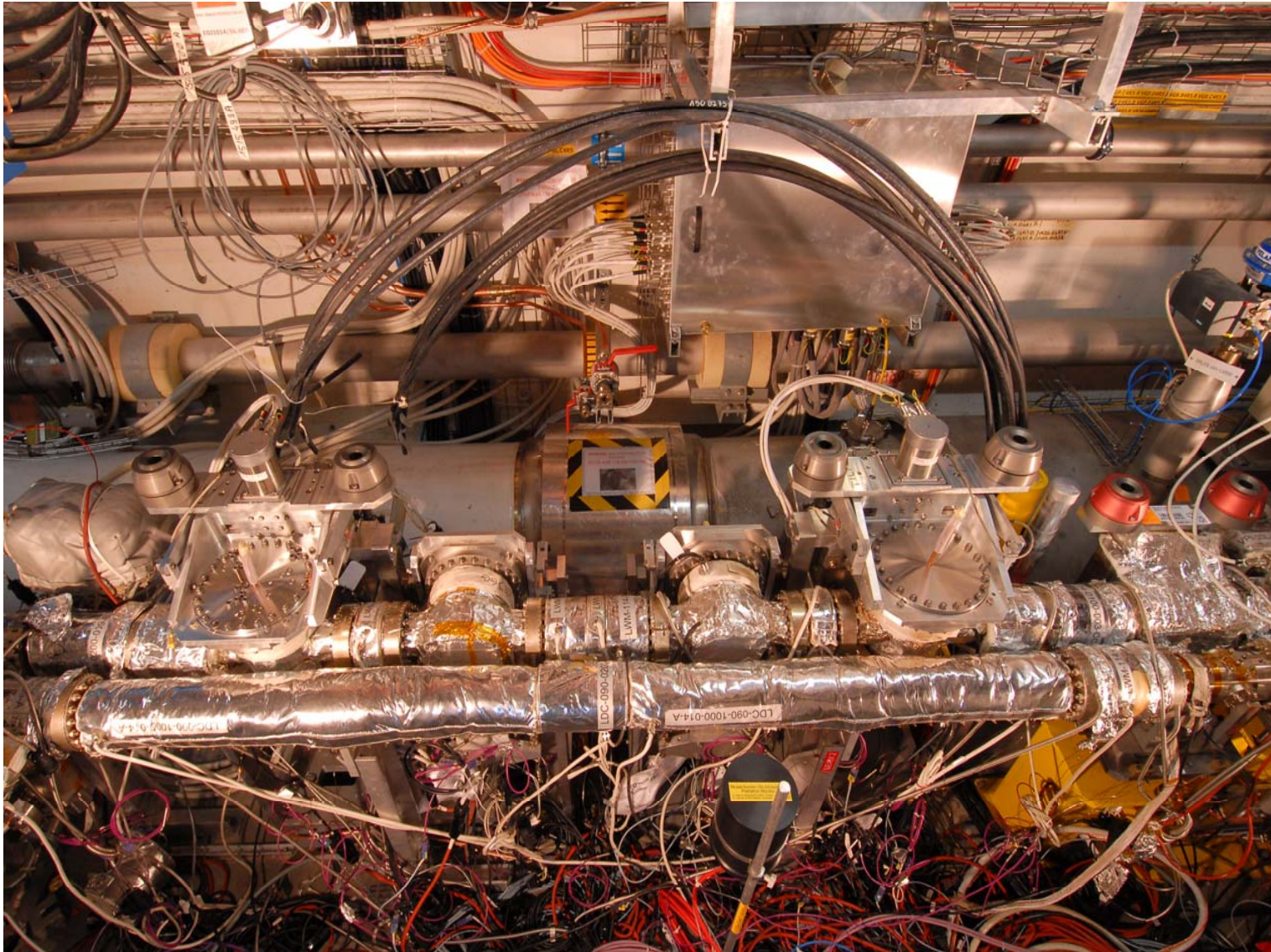


The Roman Pots at 220 m



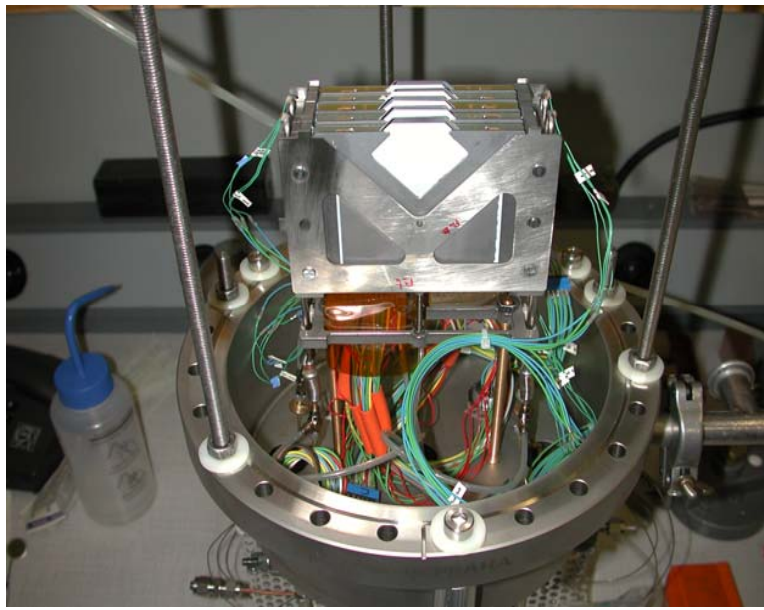
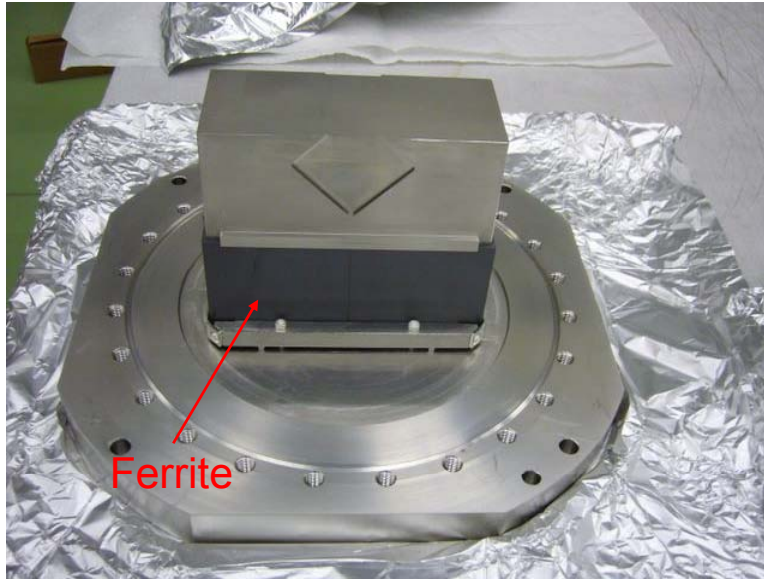


The Roman Pots at 147 m





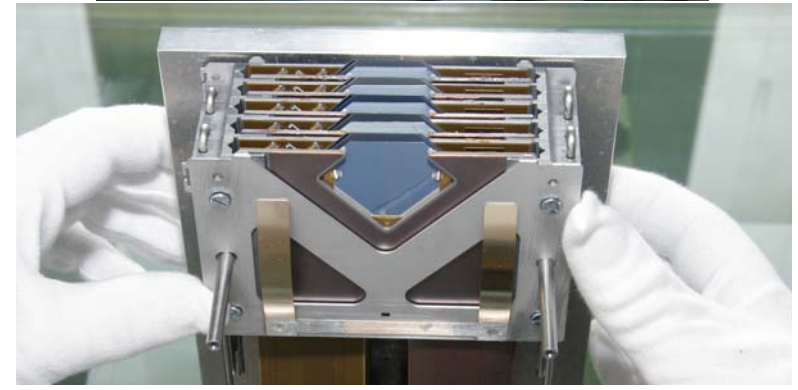
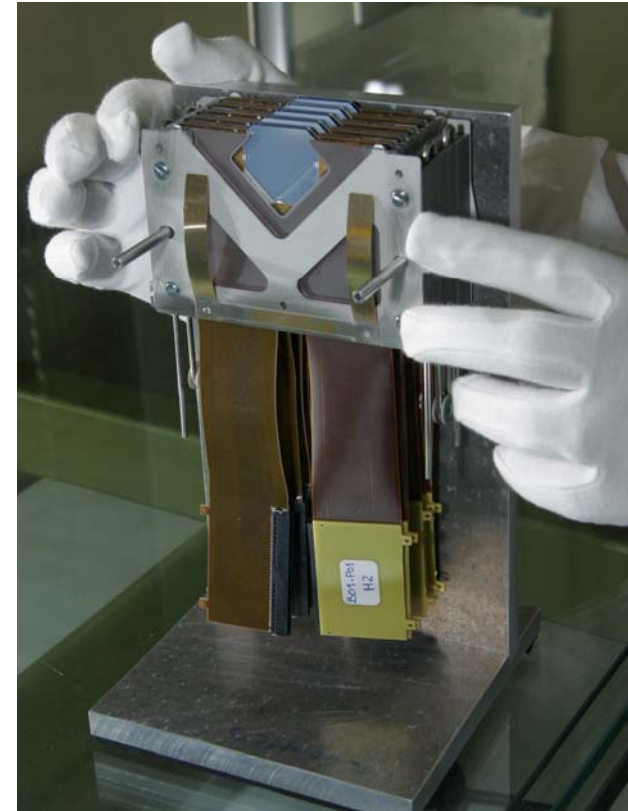
The window and the assembly mock-up





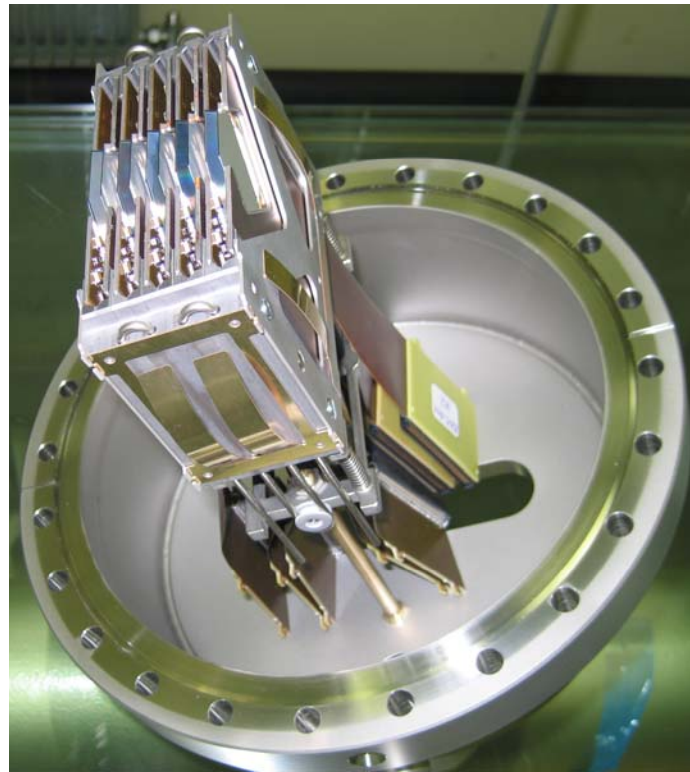
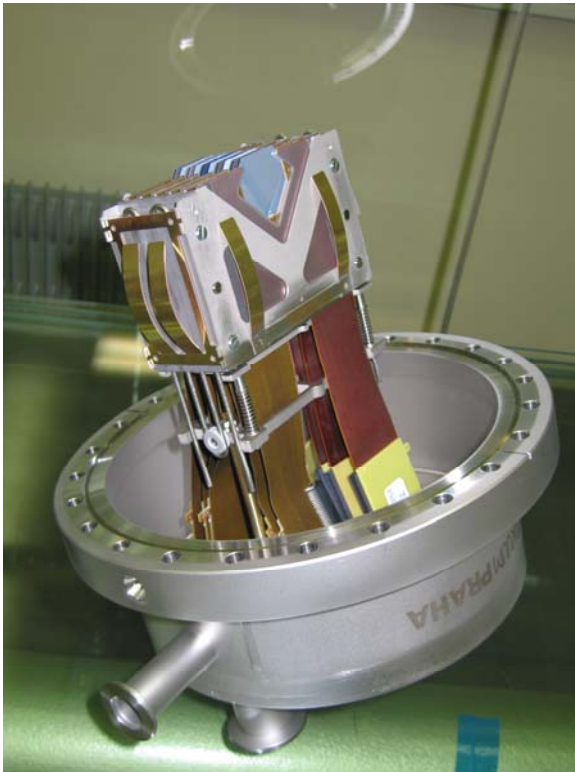
The Roman Pot Silicon detectors

The first mounted stack of 10 Si detectors





First Roman Pot Detector Package assembled



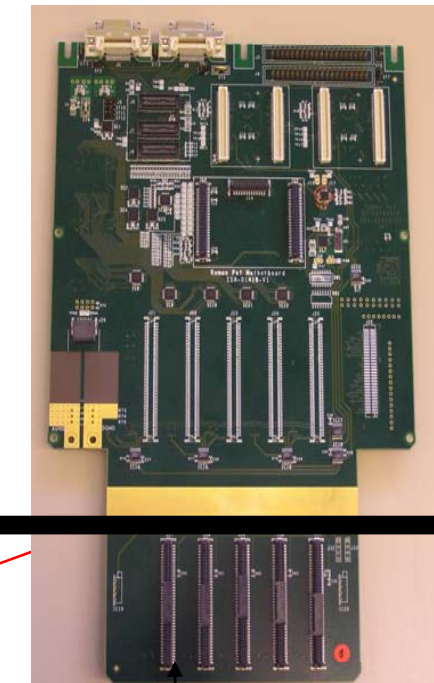
Roman Pot Motherboard connecting the detector packages in the vacuum to the outside world

To be installed in the tunnel by beg. of May.
3 more assemblies to be mounted before LHC start-up.

Roman Pot Motherboard completed and currently under test.

Vacuum flange

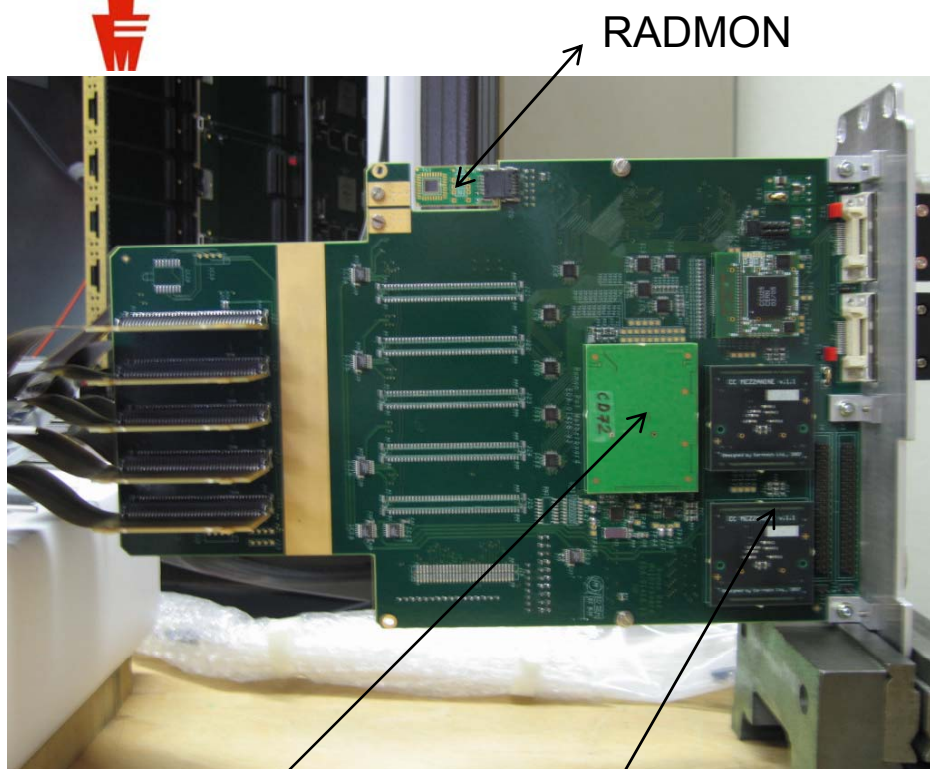
Feed-through



Connectors to detector hybrids

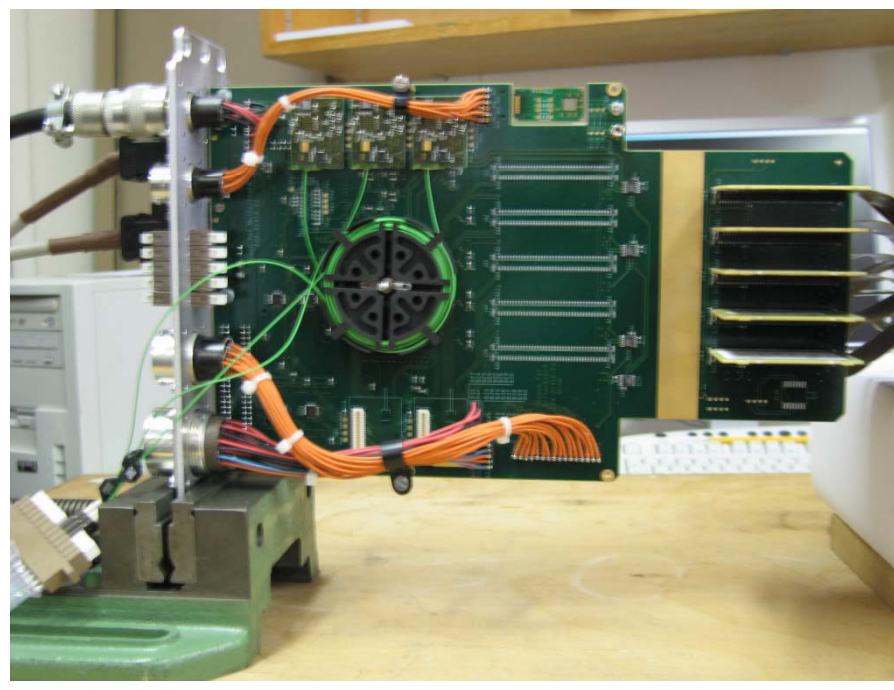


The Roman Pot Mother Board (1)



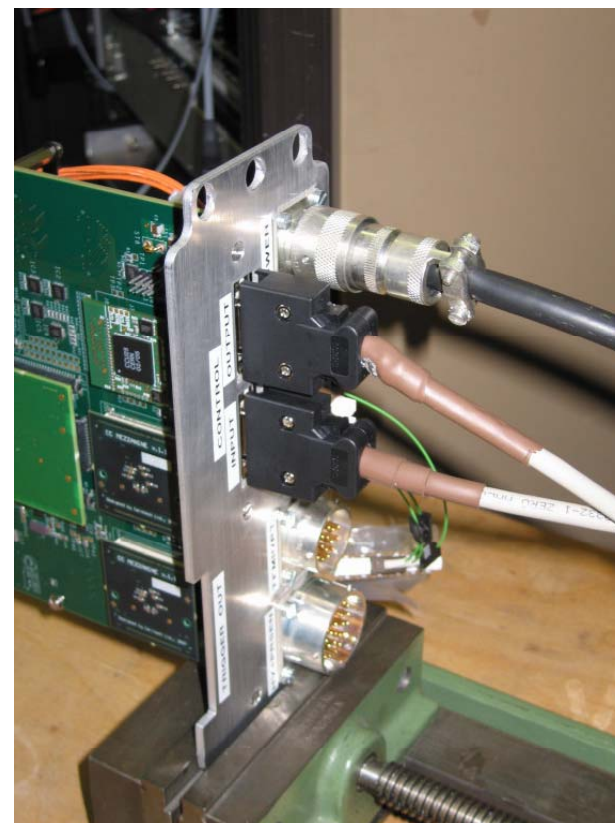
- Board with 16 layers !!
- HV, LV, I2C (slow control), communication with hybrid, Trigger chain (partly) tested.
- Readout still needs to be tested (missing software).

Very good progress





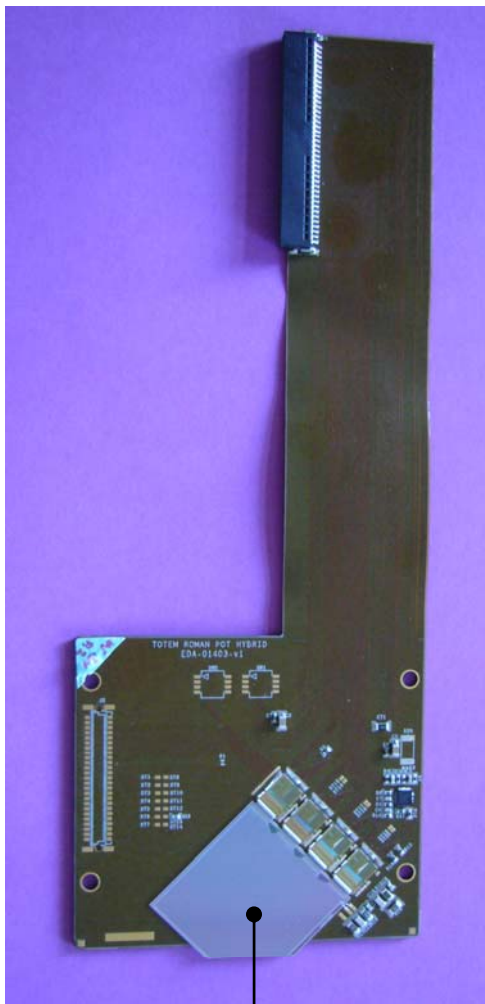
The Roman Pot Mother Board (2)





Radiation tests of Si detectors

Roman Pot Hybrid

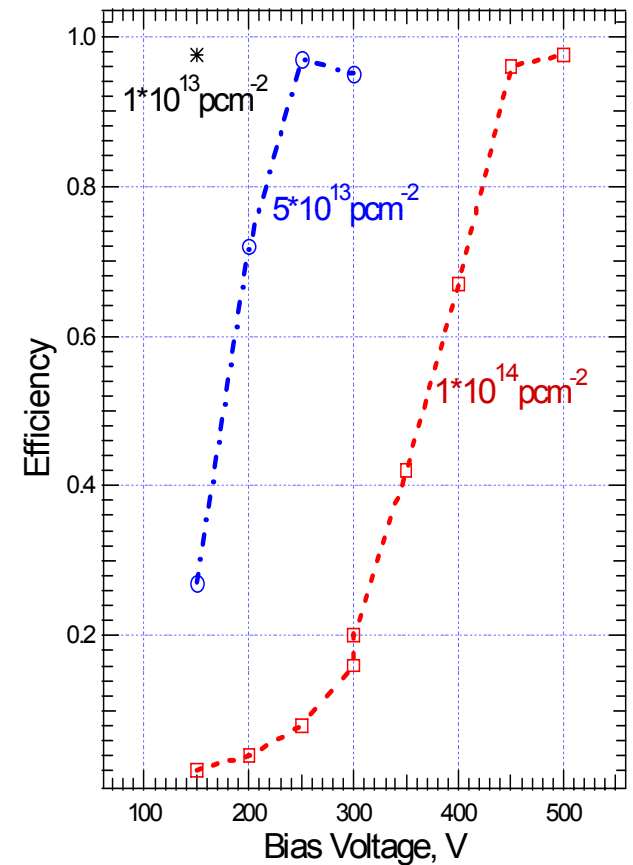


edgeless Si detector

Test of several hybrids with edgeless Si detectors irradiated at different fluences and study of their efficiency.

→ operation after 10^{14} p/cm² is still possible but needs 450 V bias for full efficiency.

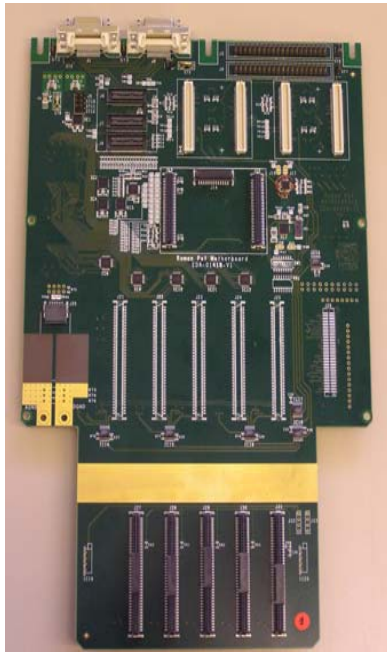
Irradiation Study: Efficiency vs bias voltage



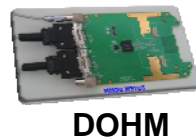
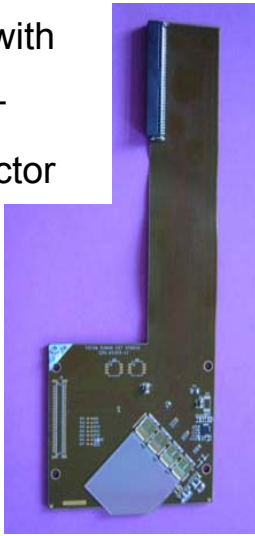


Electronics System for Roman Pots

Motherboard
(with
coincidence chip)



Hybrid with
VFATs +
Si Detector



DOHM

Tracking data

Trigger data

TTC data

Counting room



VME → To Local DAQ
USB → To Local DAQ
FRL → To CMS DAQ



Trigger data



Trigger
and
Timing



Commissioning of the Roman Pots (1)

Before the LHC start:

- Finish cabling and piping at the 220 m stations;
- Commission the motors and calibrate the LVDTs and the resolvers in sector 4-5;
- Test first assembly of 10 Si detectors with cosmics;
- Install this assembly in a horizontal pot in sector 4-5 middle of May;
- Commission the C_3F_8 cooling end of May;
- Test detectors with test pulses, DCS and DAQ;
- Commission motor control with CCC in June;
- Install one assembly in a horizontal pot at 220 m in 5-6 in June;
- Install 2 assemblies in vertical pots at 220 m in 4-5 and 5-6 before LHC start, if possible;
- Install more assemblies if possible in a technical stop.



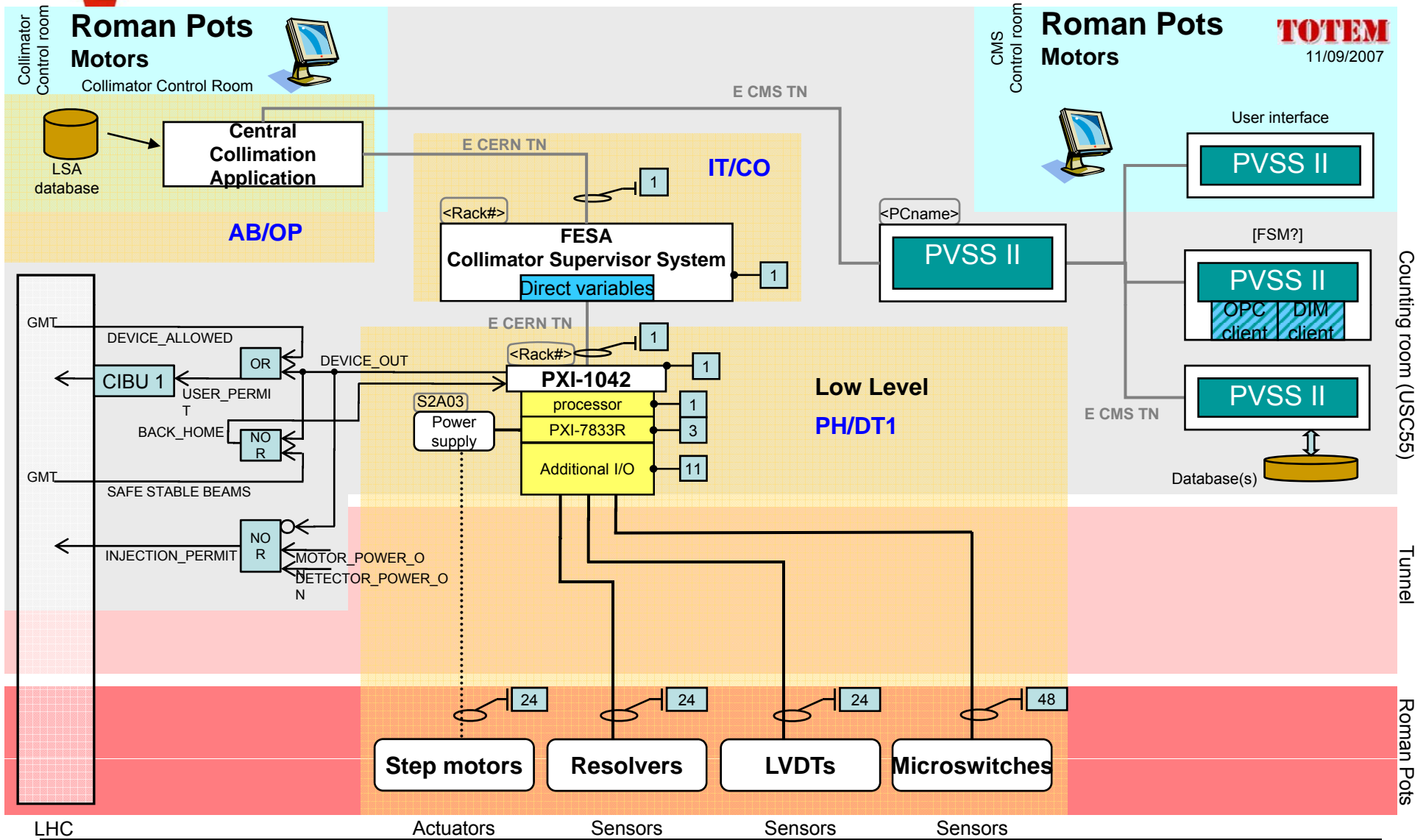
Commissioning of the Roman Pots (2)

After the LHC start:

- Get all assemblies in running condition;
- Start moving process of the pots together with CCC:
 - Read the BPMs and verify with CCC the beam position;
 - Approach the pots by 35 mm (= safe position)
 - Move the horizontal pots nearer to the beam up to the machine limit to see the diffractive peak – verify the rates;
 - Move the vertical pots nearer to the beam such that the rates are equal in both pots. Go to 10-15 σ from the beam center.
 - Calibrate RP rates with BLMs during these processes;
 - Compare beam position from pot positions with BPMs;
 - For an interlock test (to be agreed with the machine) need to move pot nearer to beam center;
 - First movement and interlock tests can be done with a single beam.
- Verify efficiency, trigger, DAQ, DCS etc.;
- If satisfactory take data.



Roman Pot Motor Control





The T1 CSC chambers

All CSCs will be verified for dark current, tested with cosmics or test beam and then mounted in structure. are



50 CSCs already at CERN

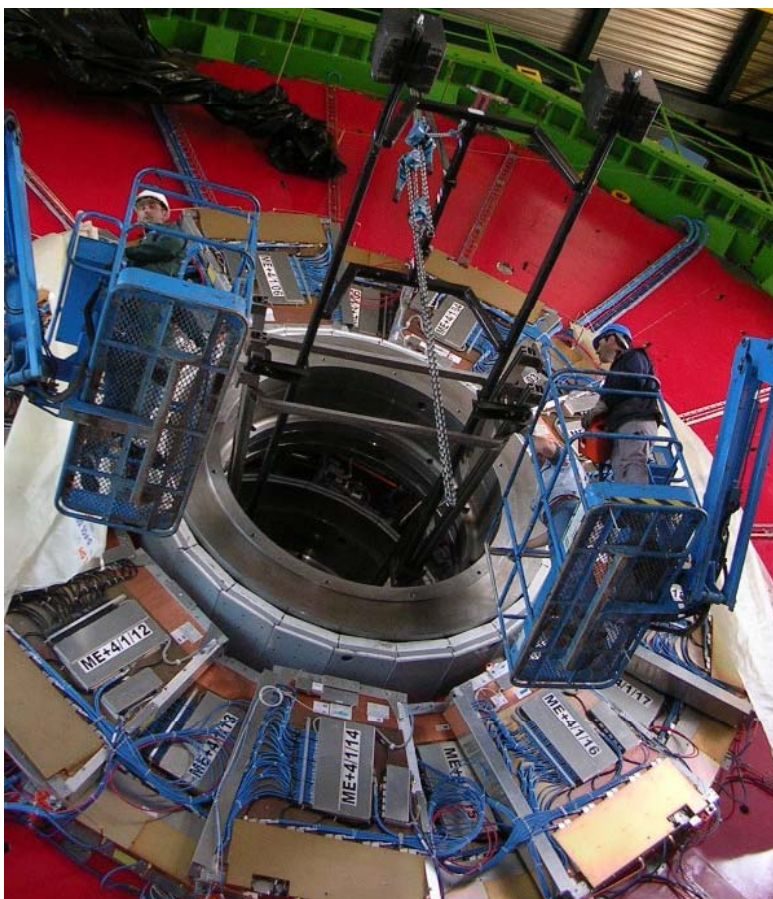


Dummy CSCs in support



Installation of the T1 telescope

Two trusses with rails will be fixed to the internal walls of CMS return yoke
Insertion and fixation test successfully done at IP5

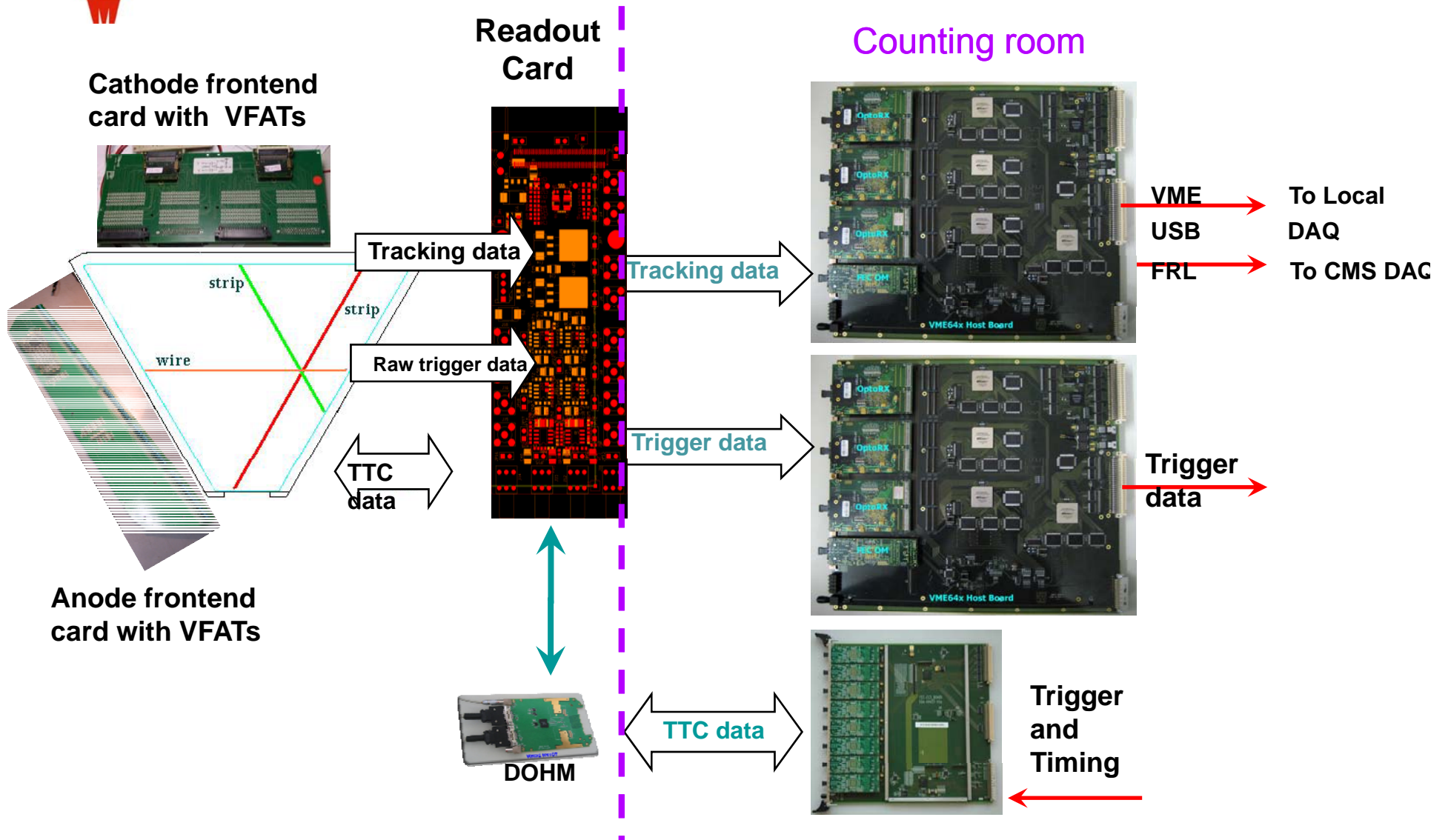


CSC mounted on frames will slide into final position
Mounting and sliding test of “half basket” performed at Genova





Electronics System for T1





Commissioning of the T1 telescope

Before the LHC start:

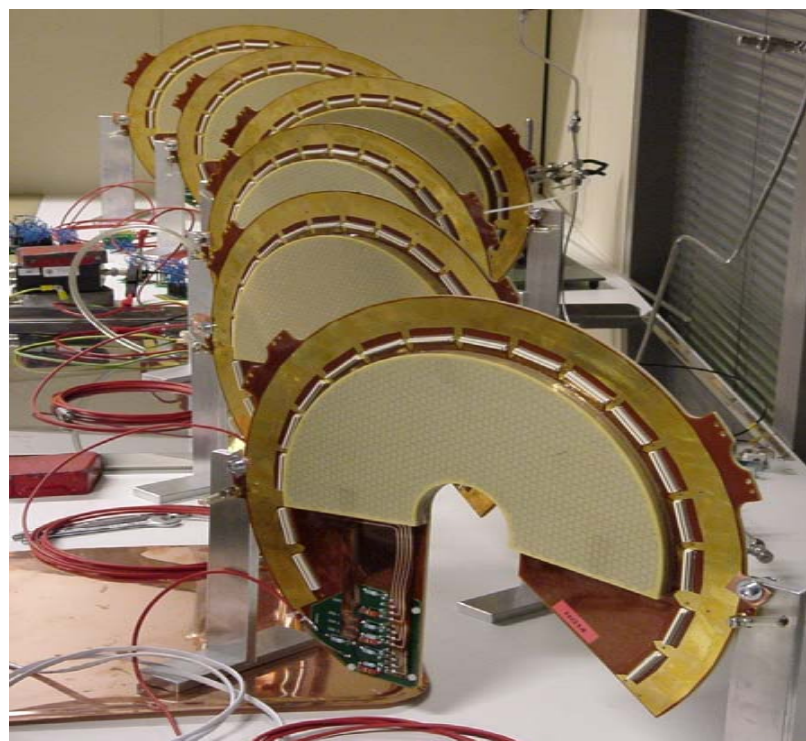
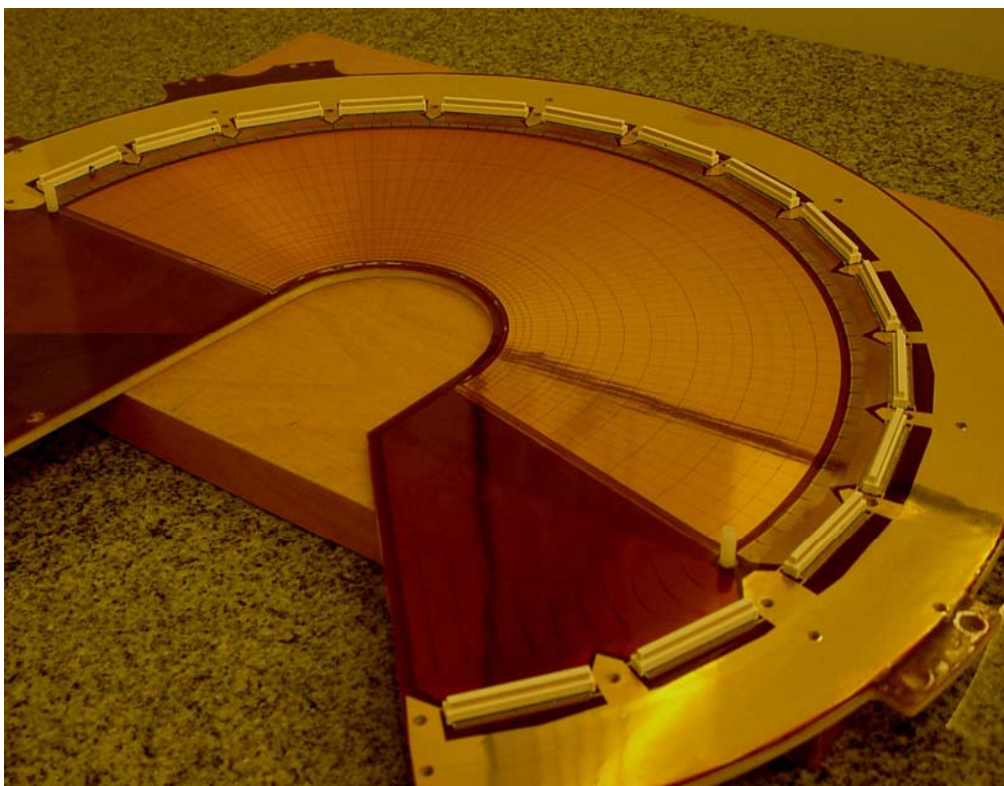
- Review installation and fixation of truss and modify if necessary;
- Finalize the Hybrid, AFEC and CFAC production and install all electronics;
- Test all CSCs with cosmics/test beam;
- Mount CSCs in a $\frac{1}{4}$ telescope support and cable it;
- Install $\frac{1}{4}$ telescope in CMS end cap before end of June (depends on CMS planning) or in a technical stop;
- After survey verify all signals via test pulses, check gas flow and quality, cooling and temperature etc.;
- Commission DCS, DSS and DAQ.

After the LHC start:

- Repeat the commissioning with beam. Measure efficiency, cluster sizes, trigger rates etc;



The T2 GEM chambers

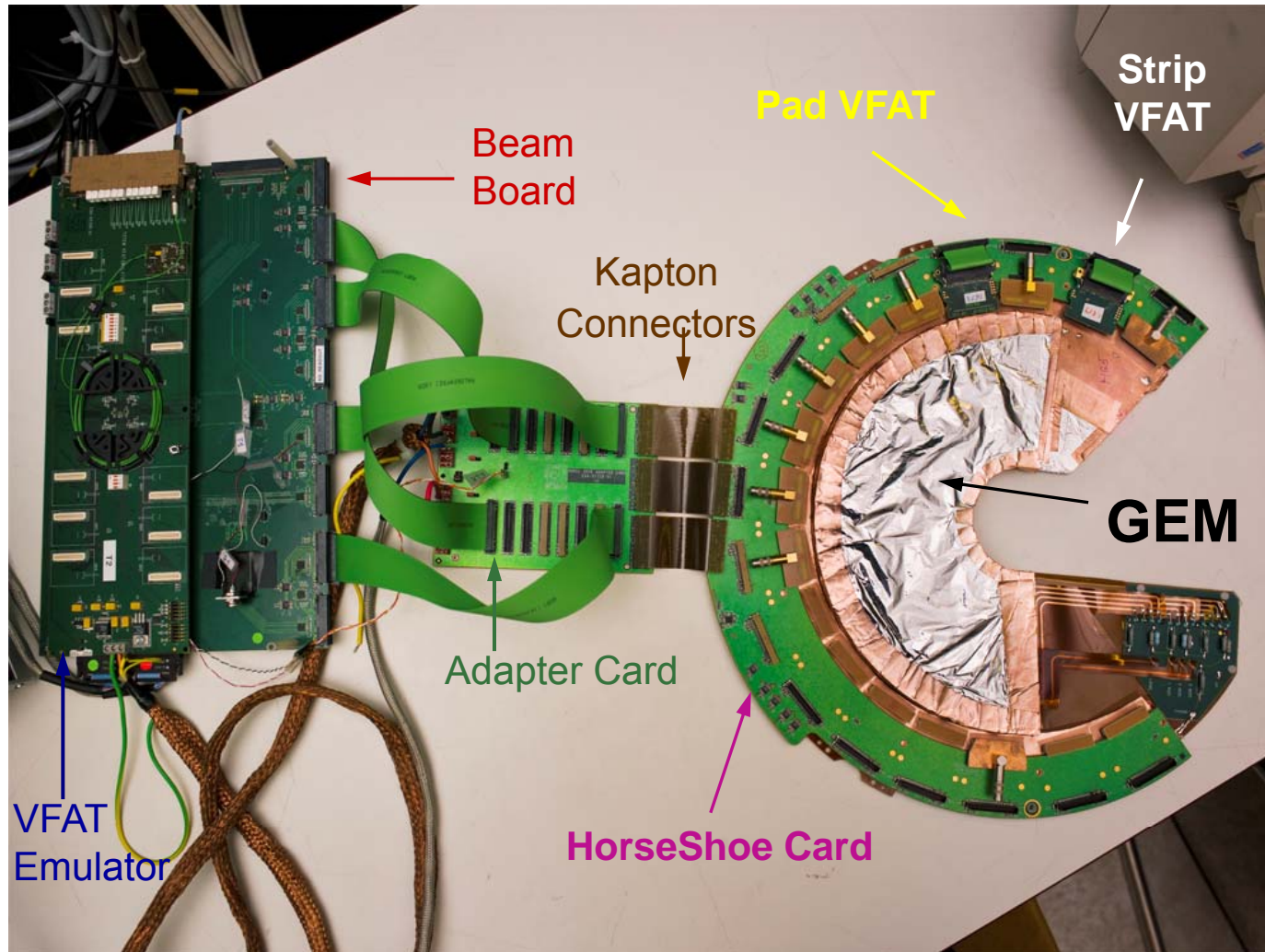


40 + 10 spares produced at Helsinki



The Horseshoe Card

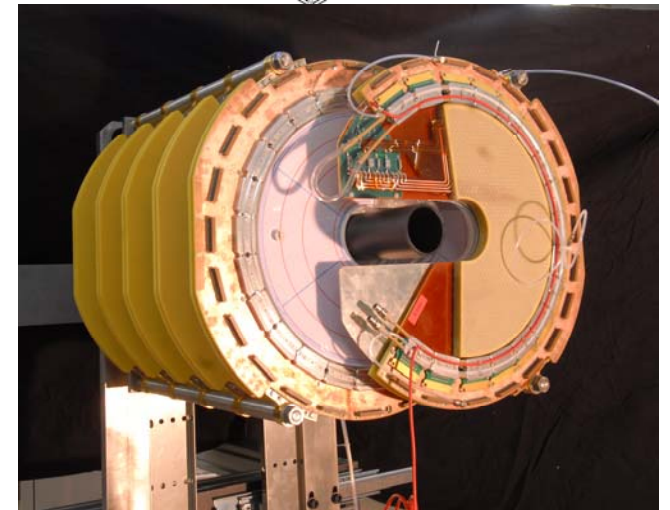
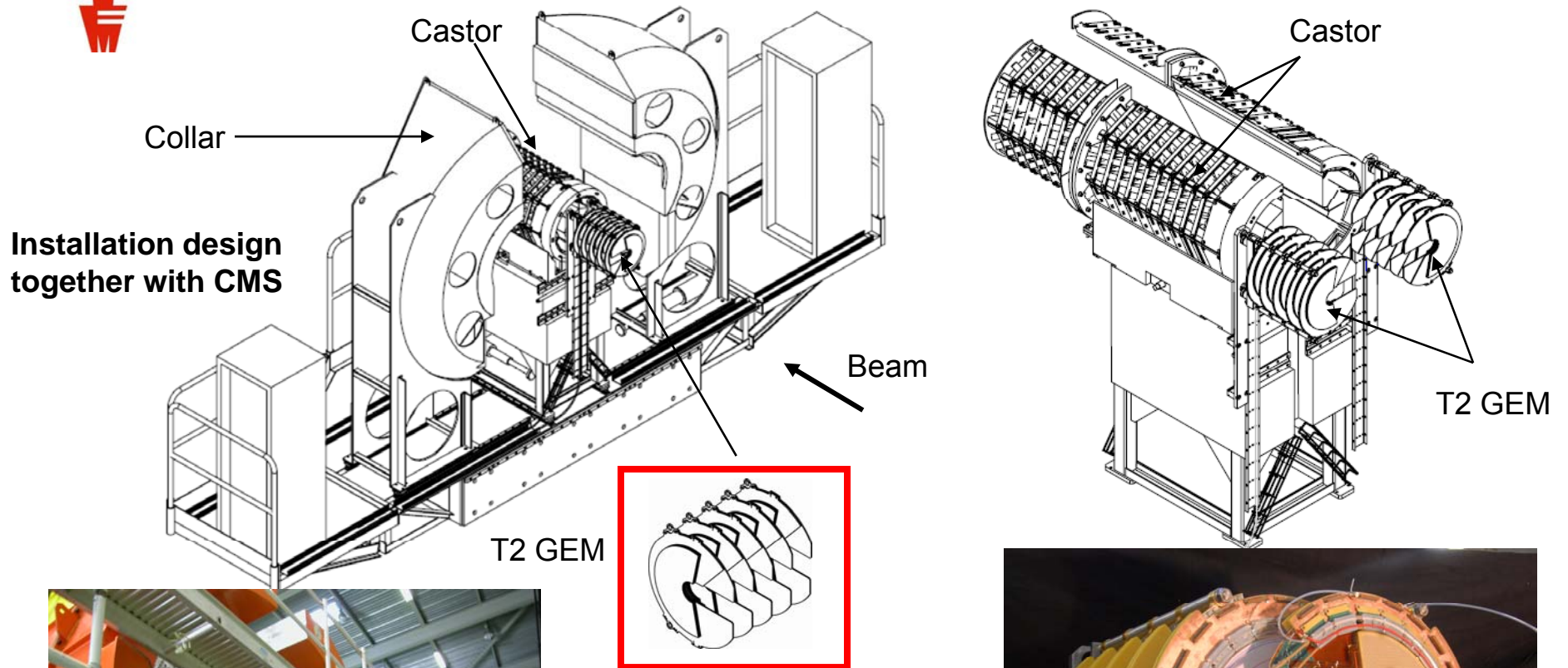
Lab setup:



**Laboratory tests of GEM with horseshoe card successful: good noise level
Successful GEM operation already in the 2007 testbeam.
First arm of the T2 telescope to be installed before LHC start-up.**



Installation of the T2 telescope





Commissioning of the T2 telescope

Before the LHC start:

- Finalize the Hybrid, the horseshoe and 11th card production;
- 11th card layout to be redone → delay !!
- If all electronics is ready mount it and test individual GEMs and complete telescope;
- Install 1 telescope on the platform in the CMS surface hall;
- Install the platform in CMS end of June (depends on CMS planning) or in a technical stop;
- After survey verify all signals via test pulses, check gas flow and quality, cooling and temperature etc.;
- Commission DCS, DSS and DAQ.

After the LHC start:

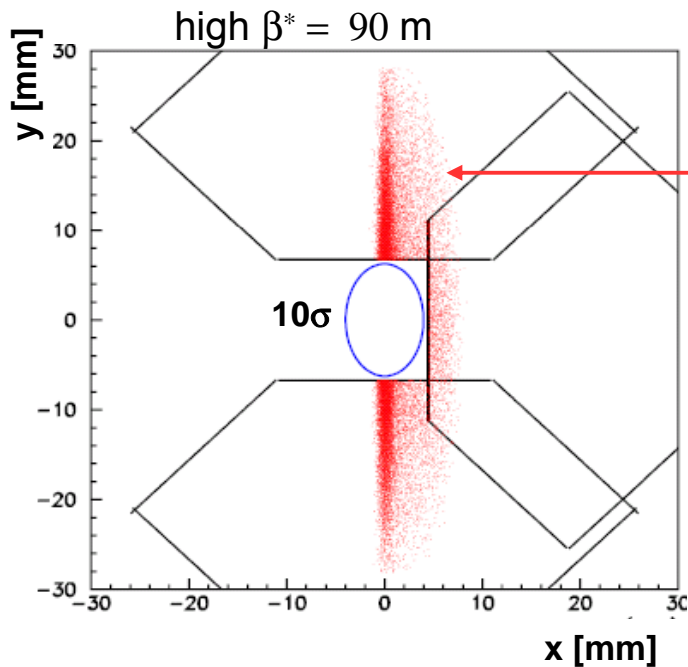
- Repeat the commissioning with beam. Measure efficiency, cluster sizes, trigger rates etc;



Early Physics (1)

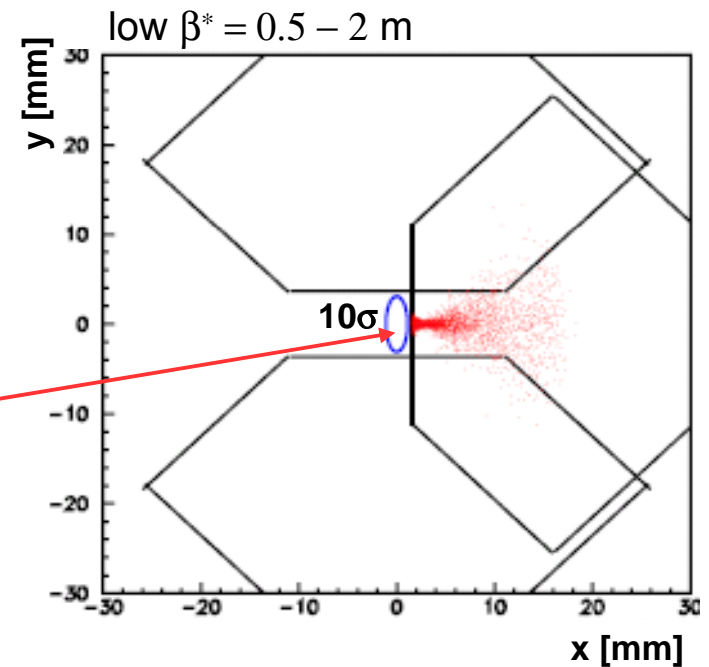
Measurement of elastic and diffractive protons

Hit distributions @ RP220



$$y \sim \Theta_y^{\text{scatt}} \sim |t_y|^{1/2}$$

$$x \sim \xi = \Delta p / p$$



Detect the proton via:

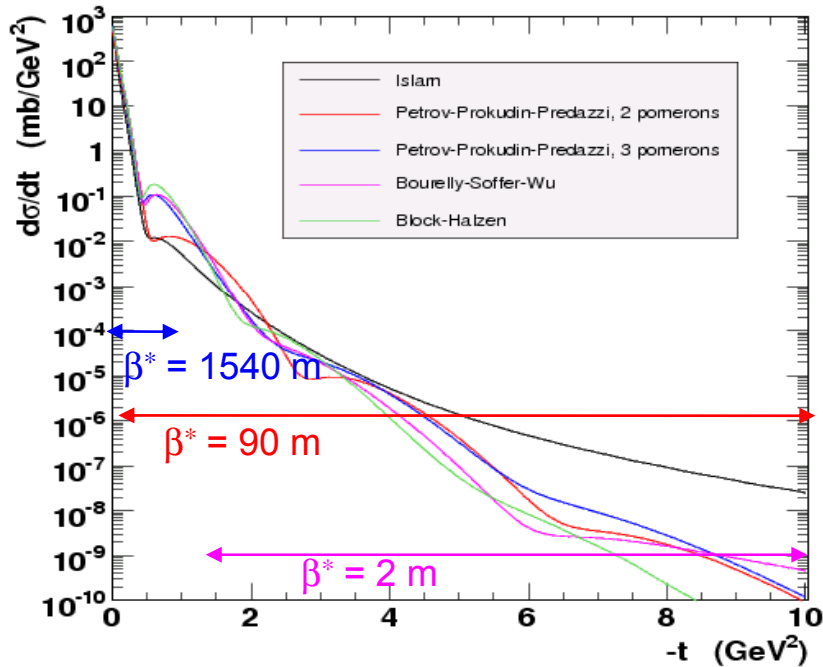
its transverse momentum t_y (high β^*)

its momentum loss ξ (low β^*)



Early Physics (2)

Elastic Scattering

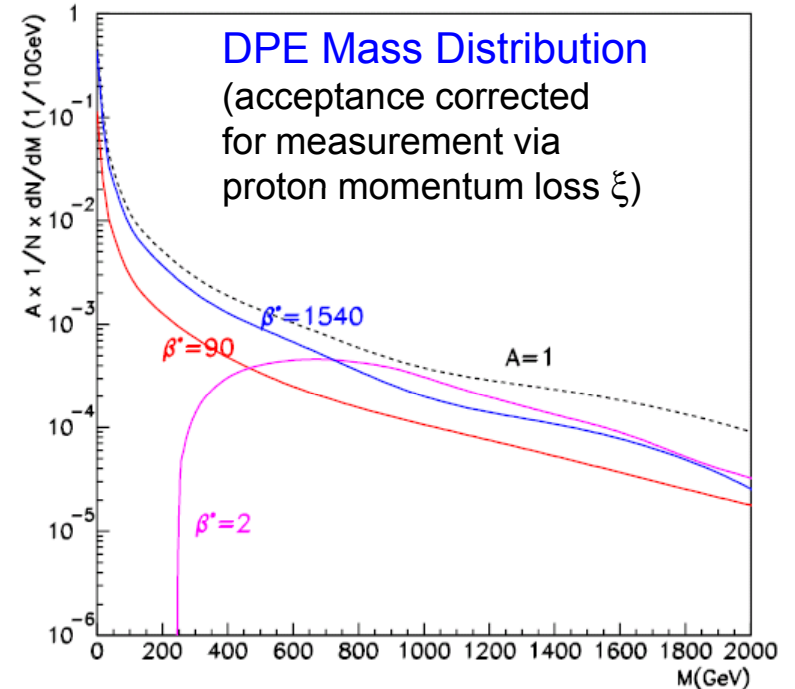
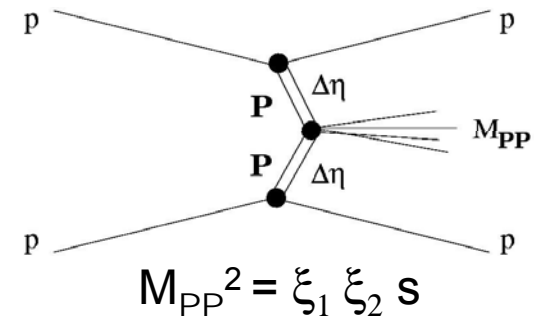


Statistics for 10^5 s of running with
 $\beta^* = 2$ m at $L = 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$ ($\int L dt = 10 \text{ pb}^{-1}$):

- 10^6 Events
- 60×10^7 DPE events

within acceptance

Central Diffraction (DPE)





Conclusion and Outlook

- TOTEM proposes a modest but nevertheless ambitious program.
- TOTEM intends to install at least 2 Roman Pot detectors before end of June. Two or more detectors could be installed later depending on the accessibility to the tunnel.
- TOTEM intends to install at least one T2 telescope on the + side of CMS before end of June. This heavily depends on the availability of the electronics and the CMS planning.
- TOTEM intends to install $\frac{1}{4}$ T1 telescope on the + side of CMS before end of June. This heavily depends on the fixation scenario to be adopted and the CMS planning.
- More T1 and T2 telescopes can be installed at a later date.
- With the few Roman Pots some early physics (**elastic scattering and diffraction**) is possible independent of the machine optics.