TOTEM - CMS
Consolidation and upgrade of Roman Pot system @ LHC ip5

- TOTEM consolidation ->TOTEM-CMS upgrade
- ECR – UPGRADE
- Status of Roman Pot upgrade project
- Schedule of activities during LS1

Overview

Consolidation program : TOTEM

Upgrade program : TOTEM+CMS -> **CMS-TOTEM Precision Proton Spectrometer (CT-PPS)**

-> **Layout of RP stations - combination of consolidation program with upgrade program**

Work packages & ECR related to consolidation & **upgrade during LS1**

-> **Status of work packages and schedule – issues on critical path**

Main goals of TOTEM consolidation project

- Measurement of total cross section

$$\sigma_{TOT}^2 = \frac{16\pi(\hbar c)^2}{1+\rho^2} \cdot \left.\frac{d\sigma_{EL}}{dt}\right|_{t=0}$$

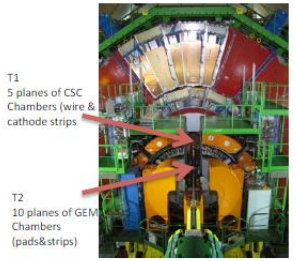
Using luminosity from CMS

$$\frac{d\sigma_{EL}}{dt} = \frac{1}{L} \bullet \frac{dN_{EL}}{dt}$$

ρ parameter from compete fit

$$\sigma_{TOT} = \frac{16\pi(\hbar c)^2}{1+\rho^2} \cdot \frac{\left.\frac{dN_{EL}}{dt}\right|_{t=0}}{N_{EL}+N_{INEL}}$$

Luminosity independent



TOTEM detectors integrated in CMS (T1, T2)

TOTEM detectors integrated in LHC (RP)

- Forward multiplicity
- Diffractive physics (soft & hard diffraction, jets)

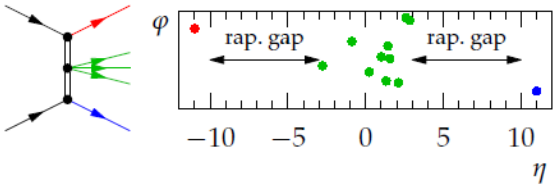
TOTEM (stand alone)
TOTEM&CMS at low / highβ*, special runs

consolidation

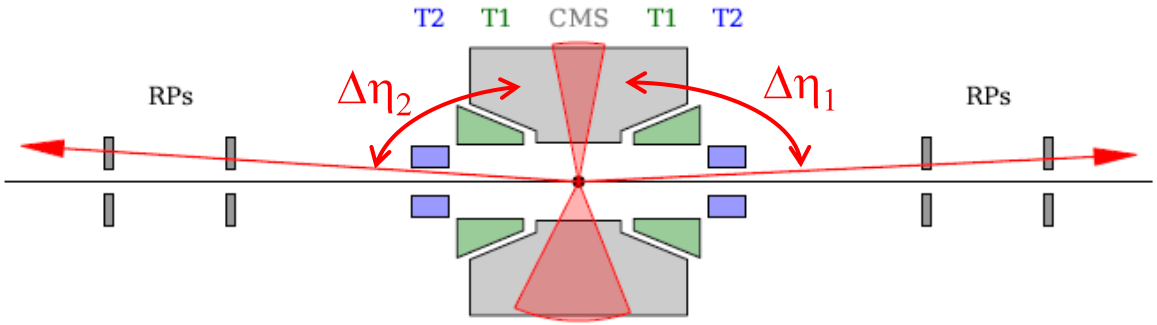
TOTEM&CMS at low β* and high luminosity ->

consolidation & upgrade

Main goals of CMS-TOTEM upgrade project

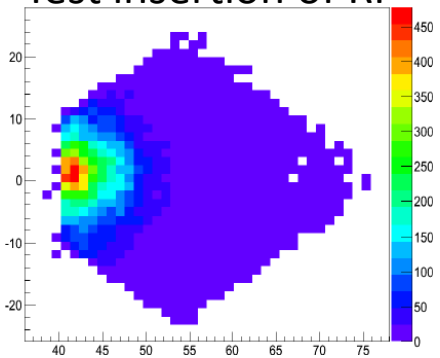


- both protons survive with momentum losses ξ_1, ξ_2 ($\xi_i = \Delta p_i/p$)
- diffractive mass M in the center
- 2 rapidity gaps $\Delta\eta_1$, $\Delta\eta_2$



RP 220 m –> ß* = 0.6 m

Test insertion of RP



Rapidity gaps due to exchange of colour singlets with vacuum quantum numbers
⇒ Selection rules for system X: $J^{PC} = 0^{++}$ ➔ X = χ_{c0}, χ_{b0}, … , H, glueballs?

kinematic redundancy between protons and central diffractive system:
→Joint data taking CMS + TOTEM
To reach low-cross-section processes: operate in standard runs with high pileup

consolidation & upgrade

Roman Pot
consolidation & upgrade strategy

CONSOLIDATION -> LS1

- Remove RP147 m stations & patch panel (allows installation of TCL4)
- Relocation of RP147 m stations (including Si strip detectors) in +/- 210 m region
- Exchange of ferrites of all RPs, Integration of ferrite support spring, integration of RF fingers

Consolidation RP147&RP220 -> during LS1

UPGRADE - Roman Pot station –> LS1

- Installation of additional new RP stations (horizontal) in +/-220 m region (1 or 2 new RP stations in each sector (4/5), (5/6))
- Integration of RF optimized horizontal Roman Pots in relocated horizontal stations in +/- 210 m region

Upgrade Roman Pot station -> during LS1 or In end of year technical stops after LS1 (break of vacuum)

UPGRADE – new movable beam devices –> after LS1

- Development of new movable beam devices

Upgrade movable beam devices -> after LS1 (break of vacuum)

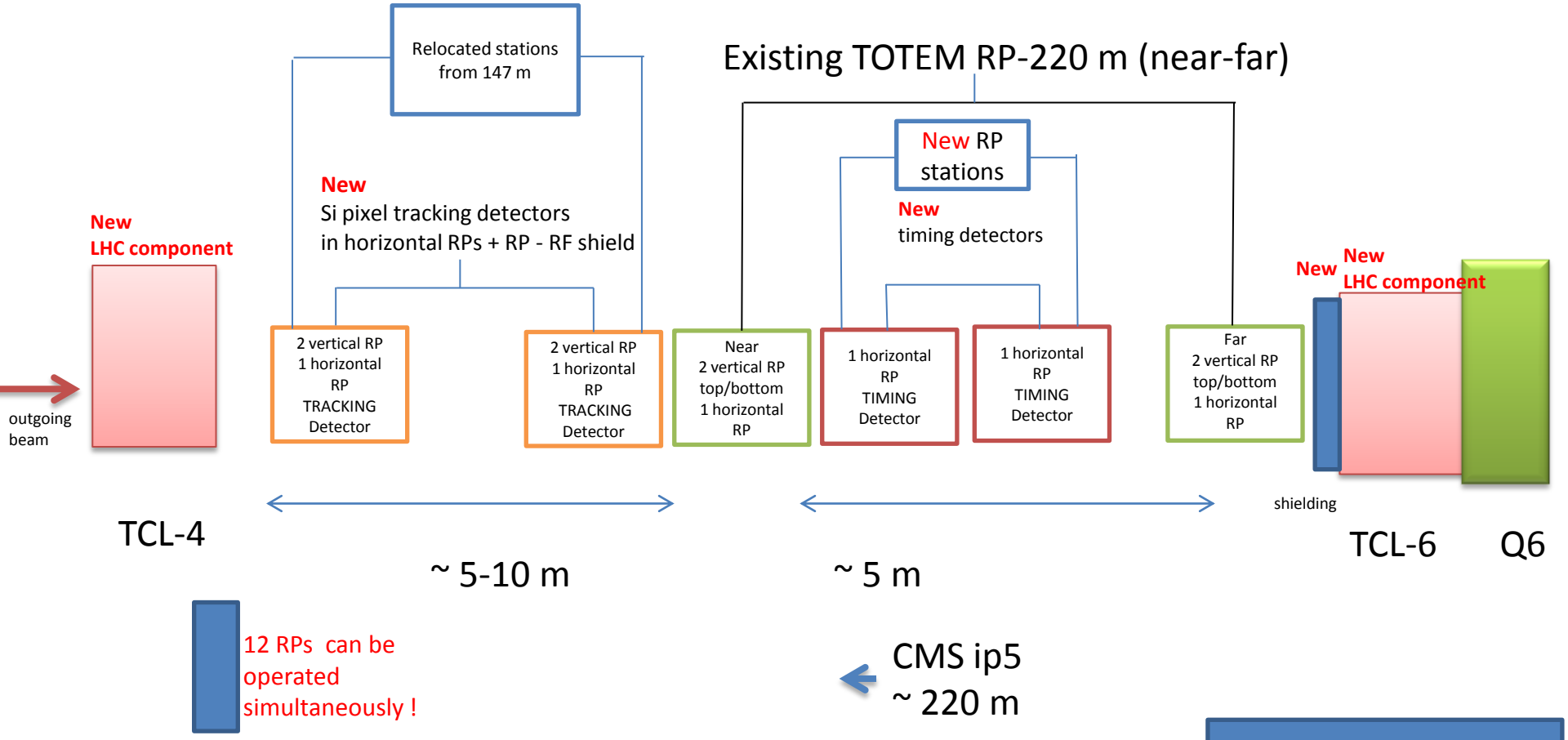
UPGRADE detector -> LS1 and beyond

- Integration of new pixel detectors in the (relocated RP147m) RPs in 210 m region
- Integration of new timing detectors in the new horizontal RPs

Upgrade Roman Pot detector -> during LS1 or in short technical stops after LS1

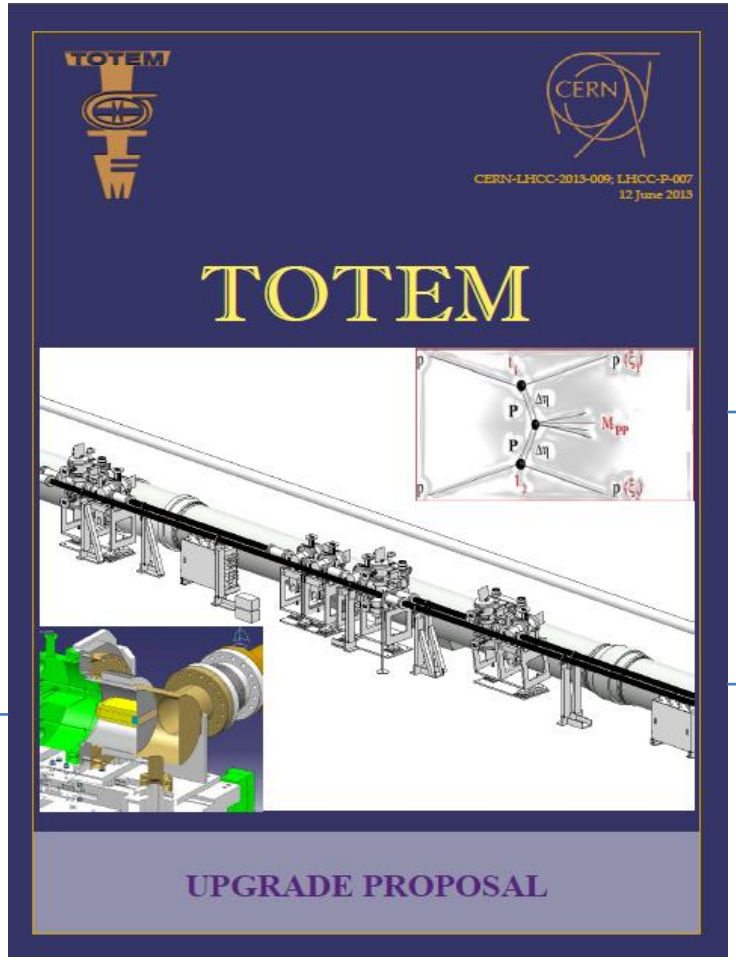
Roman Pot consolidation & upgrade - LS1

overview (schematic)



TOTEM upgrade proposal

(June 2013)

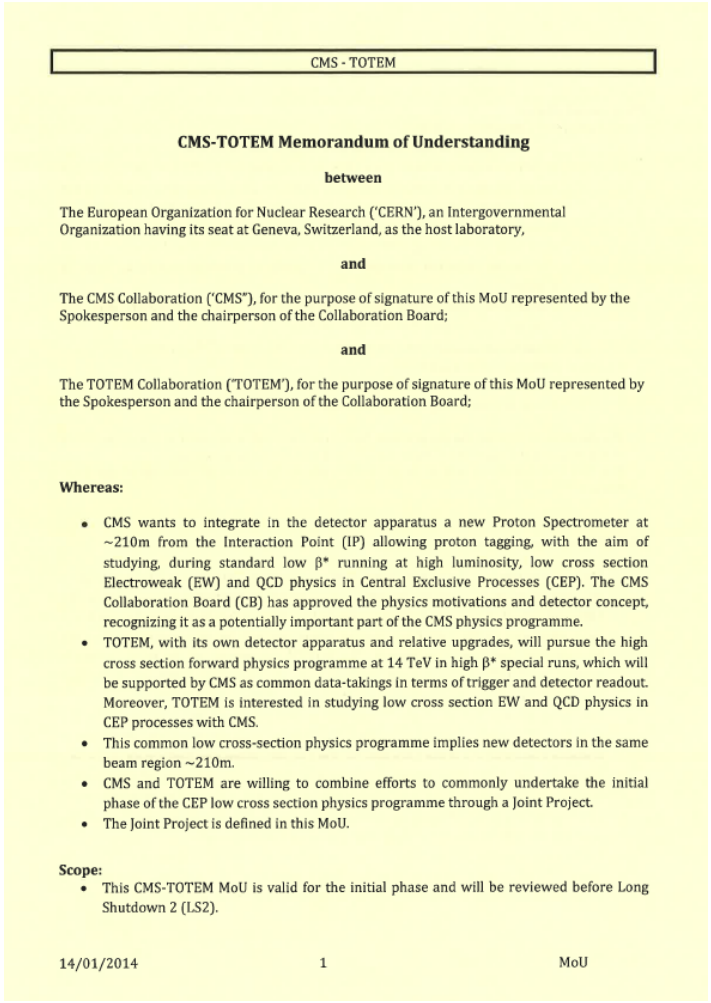


physics – running scenarios

LHC beam line layout

RF study - optimization
new Roman Pot design

Memorandum of Understanding CMS- TOTEM



CMS - TOTEM

CMS-TOTEM Memorandum of Understanding

between

The European Organization for Nuclear Research ('CERN'), an Intergovernmental Organization having its seat at Geneva, Switzerland, as the host laboratory,

and

The CMS Collaboration ('CMS"), for the purpose of signature of this MoU represented by the Spokesperson and the chairperson of the Collaboration Board;

and

The TOTEM Collaboration ('TOTEM'), for the purpose of signature of this MoU represented by the Spokesperson and the chairperson of the Collaboration Board;

Whereas:

- CMS wants to integrate in the detector apparatus a new Proton Spectrometer at ~210m from the Interaction Point (IP) allowing proton tagging, with the aim of studying, during standard low β* running at high luminosity, low cross section Electroweak (EW) and QCD physics in Central Exclusive Processes (CEP). The CMS Collaboration Board (CB) has approved the physics motivations and detector concept, recognizing it as a potentially important part of the CMS physics programme.
- TOTEM, with its own detector apparatus and relative upgrades, will pursue the high cross section forward physics programme at 14 TeV in high β* special runs, which will be supported by CMS as common data-takings in terms of trigger and detector readout. Moreover, TOTEM is interested in studying low cross section EW and QCD physics in CEP processes with CMS.
- This common low cross-section physics programme implies new detectors in the same beam region ~210m.
- CMS and TOTEM are willing to combine efforts to commonly undertake the initial phase of the CEP low cross section physics programme through a Joint Project.
- The Joint Project is defined in this MoU.

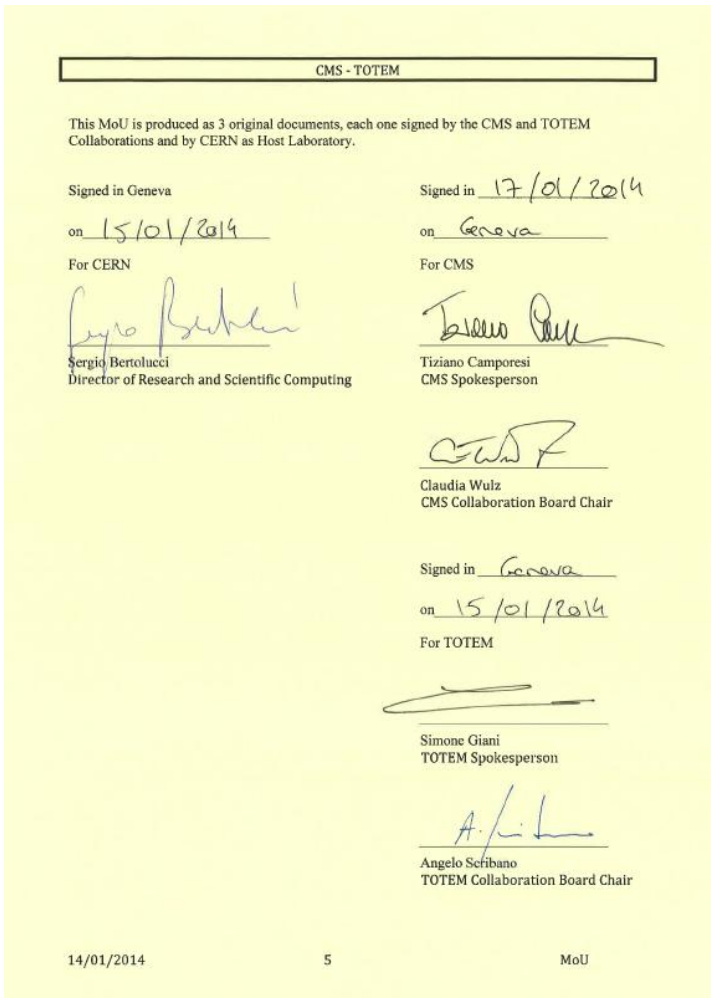
Scope:

- This CMS-TOTEM MoU is valid for the initial phase and will be reviewed before Long Shutdown 2 (LS2).

14/01/2014 1 MoU

Signed in January 2014

→



CMS - TOTEM

This MoU is produced as 3 original documents, each one signed by the CMS and TOTEM Collaborations and by CERN as Host Laboratory.

Signed in Geneva

on 15/01/2014

For CERN

Sergio Bertolucci
Director of Research and Scientific Computing

Signed in 17/01/2014

on Geneva

For CMS

Tiziano Camporesi
CMS Spokesperson

Claudia Wulz
CMS Collaboration Board Chair

Signed in Geneva

on 15/01/2014

For TOTEM

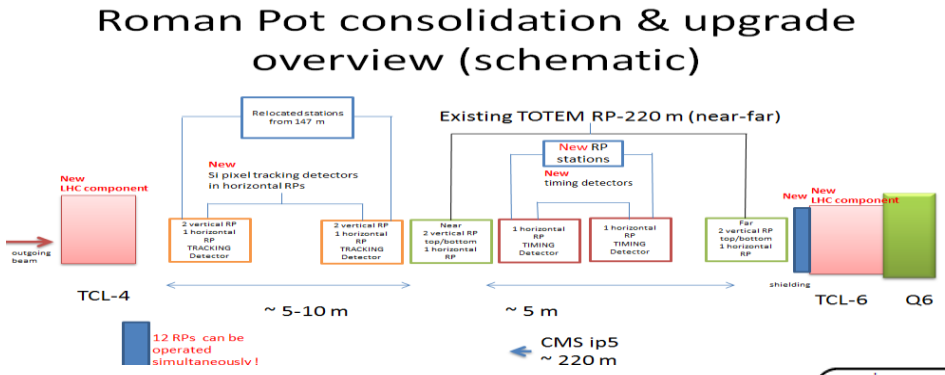
Simone Giani
TOTEM Spokesperson

Angelo Scribano
TOTEM Collaboration Board Chair

14/01/2014 5 MoU

upgrade

ECRs related to consolidation & upgrade @LHC ip5



LHC

EDMS NO.	REV.	VALIDITY
1283826	1.0	RELEASED

ENGINEERING CHANGE REQUEST

Installation and Renaming of Absorbers for Physics Debris (TCL type collimators) on both sides of IP1 and IP5 in front of D2/Q4

BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):

It is proposed to install TCL4 (TCL type) collimators in the forward regions of IR1 and IR5, in front of D2/Q4 cryostats. These collimators were built as part of the present LHC collimation system and their installation was delayed to allow the operation of the "close" TOTEM Roman pot stations in IR5.

LHC

EDMS NO.	REV.	VALIDITY
1357736	0.1	DRAFT

ENGINEERING CHANGE REQUEST

Installation of Physics Debris Absorbers (TCL) on both sides of IP1 and IP5 in front of the Q6 Quadrupole

BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):

It is proposed to install TCL, physics-debris collimators, on both sides of IP1 and IP5 in front of the Q6 Quadrupole (TCL6). This request follows the ECR EDMS Doc. 1283867 where the preparation of the TCL6 infrastructure was proposed and approved. This proposal to install the TCL6 is now brought forward taking into account the latest information on collimator production schedule and results of simulations that were deemed necessary before taking the final decision.

TOTEM

EDMS NO.	REV.	VALIDITY
1314925	1.0	RELEASED

ENGINEERING CHANGE REQUEST

TOTEM Consolidation Project

BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):

The TOTEM Roman Pot (RP) stations that were installed on the outgoing beam at a distance of 147m on both sides of IP5 have been de-installed. TOTEM proposes to move these stations to 210 m (between Q5 and Q6) on both sides of IP5, so that after LS1 the TOTEM setup will contain a new 210 m station with a near and far unit in addition to the existing 220m station. The new 210 m far unit will be rotated by 8° around the axis of the beam. To foresee the later addition of timing detector units, TOTEM proposes to add one piece of dummy beam pipe between the existing near and far units of the 220m station.

CMS-TOTEM

EDMS NO.	REV.	VALIDITY
1361537	0.1	DRAFT

ENGINEERING CHANGE REQUEST

TOTEM Upgrade Project

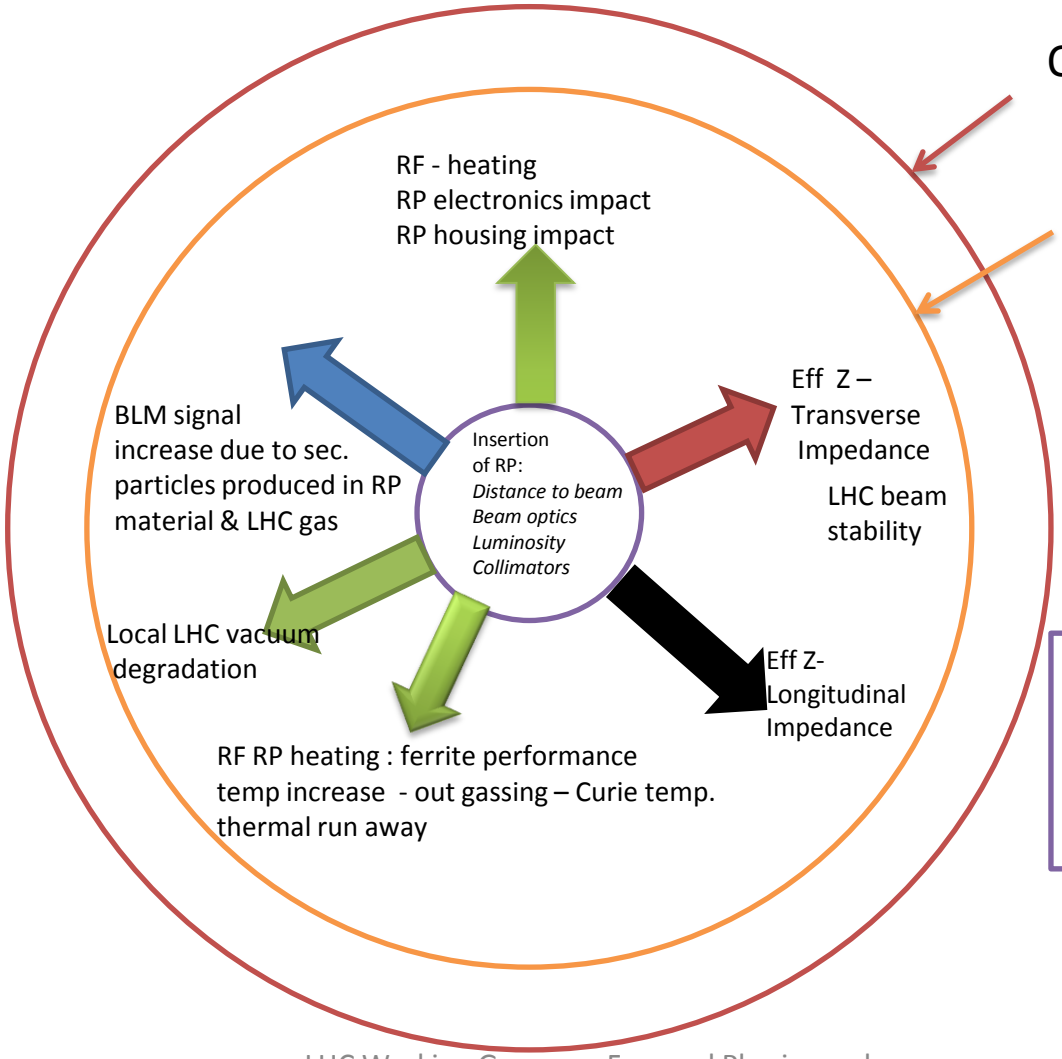
BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):

The TOTEM Upgrade Proposal [1] foresees the installation of additional horizontal Roman Pots (RPs) between the existing RP units at 215 and 220 m from IP5. These new RPs, intended to house time-of-flight detectors for elastically or diffractively scattered protons, have been designed in cylindrical geometry minimising the beam impedance and offering enough space for 12 cm long Cerenkov detectors, one of the technologies being explored for the time measurement.

Furthermore, the existing horizontal RPs of the units at 203 and 213 m will be equipped with Faraday shields to reduce their impedance.

This ECR elaborates on the technical details of the new RP elements and their integration in the LHC. It thus complements the already approved consolidation ECR [2].

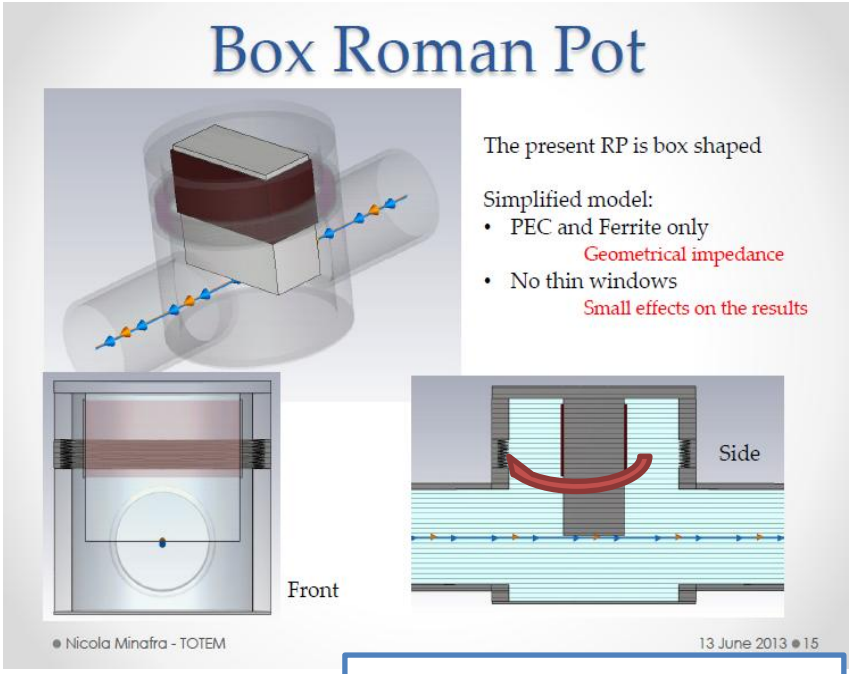
UPGRADE of Roman Pots -> RP operation at high luminosity and low β*
performance & operation limitation -> LHC **and** Roman Pot



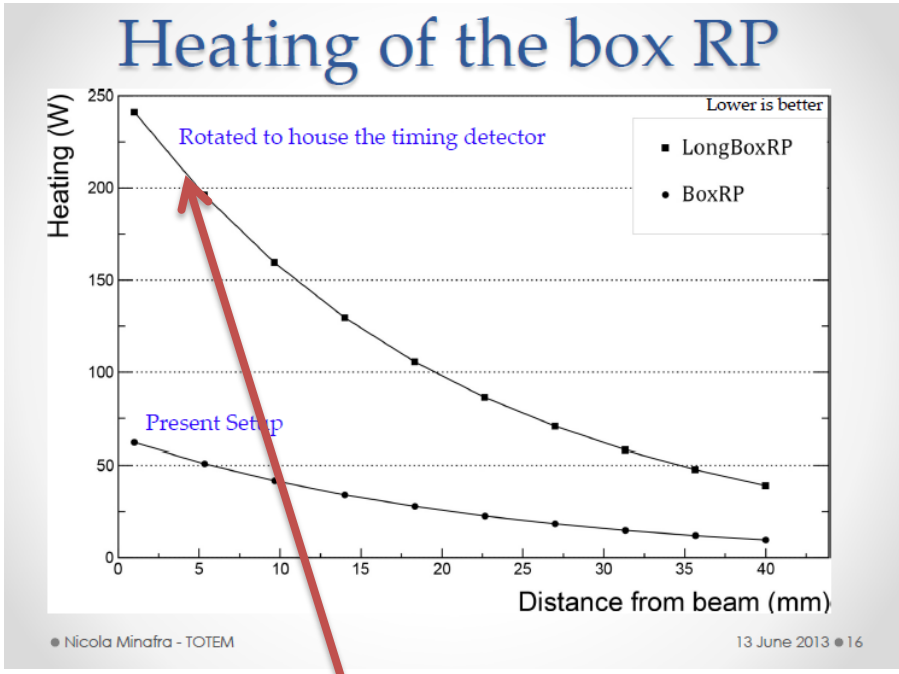
Roman Pot development:
multi parameter optimization

TOTEM development:

From box shaped to cylindrical RP with new ferrite location:
RF study of RP box (normal & rotated)

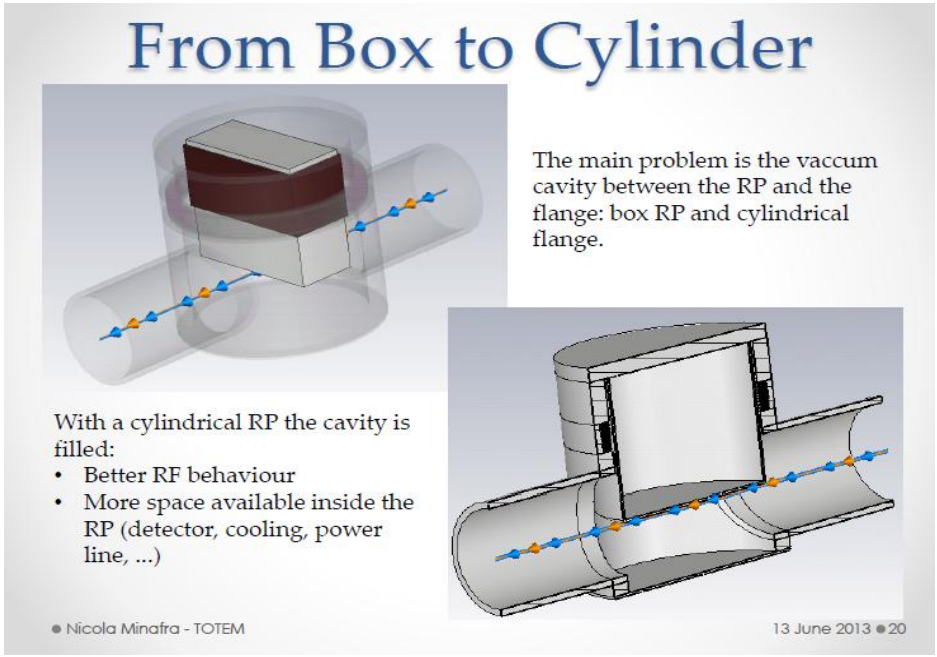


Rotation by 90 ° to house timing detector

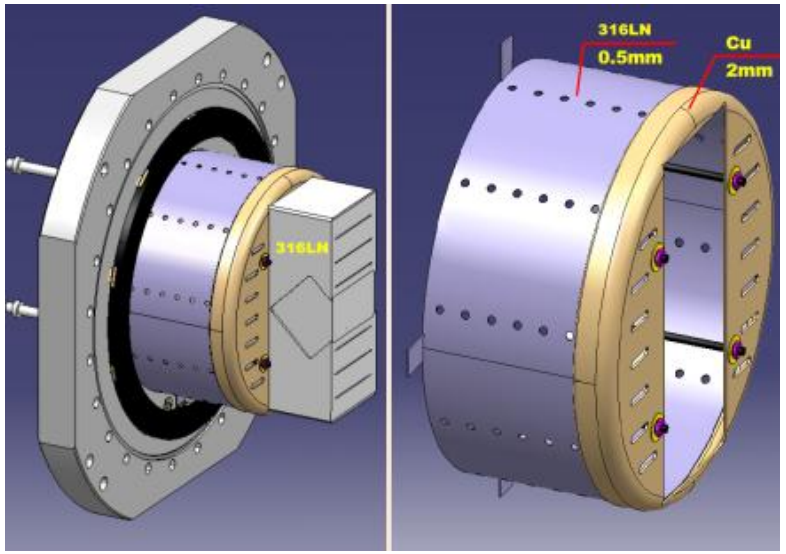


Unacceptable heating

Advantage of cylindrical geometry RF & space for detector & components



RF shield for existing box



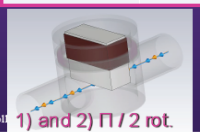
Impedance comparison of different RP designs & conclusion
TOTEM collaboration meeting on June 2013 (E. Metral)

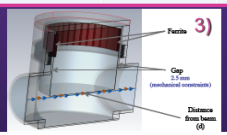
IMPEDANCES OF THE TOTEM RPs (2/3)

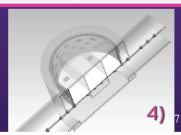
Nicola Minafra

Results for 1 RP with the beam at 1 mm

	$Z_{\parallel}^{eff}/n$ (mΩ)	% to total LHC current impedance (90 mΩ)	$\bar{Z}_{\perp}^{eff}$ (KΩ/m)	% to total LHC current impedance (25 MΩ/m)	Heating (W)
	Imaginary part		Imaginary part		
Present RP [1]	1.7	1.9%	80	< 0.3%	62
Rotated RP [2]	2.6	2.9%	20	< 0.1 %	241
	35% better				~ × 5 better
Cylindrical RP [3]	1.1	1.1%	50	< 0.2 %	13
	30% better				~ × 6 better
Cu shielded RP [4]	1.2	1.3%	70	< 0.3 %	10







Elias Métral, TOTEM coll 7/19

CONCLUSION

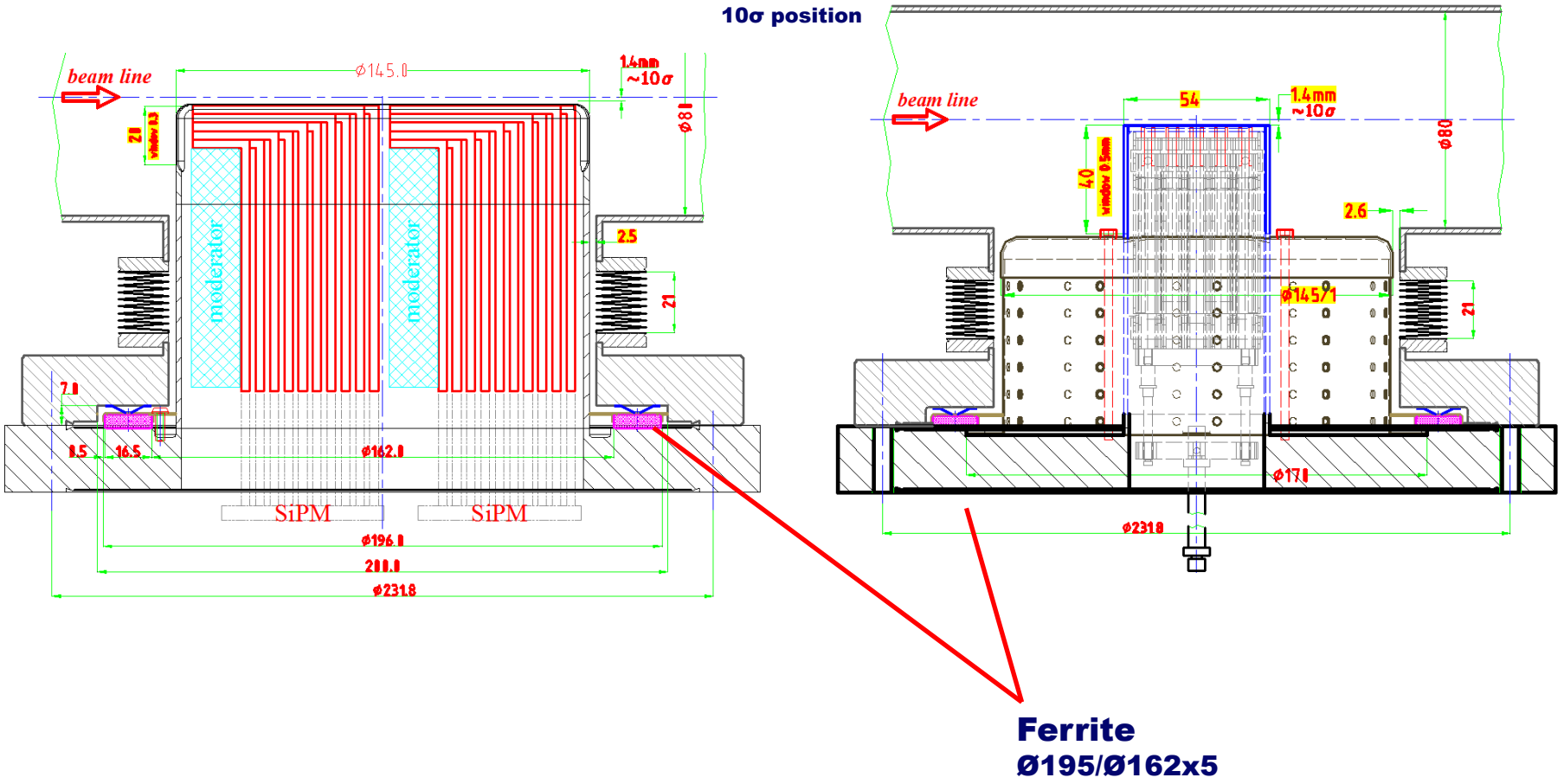
- 3 or max 4 H RPs for high-intensity runs => Should be OK but depends also on all the other impedance contributors => Imagine 10 impedance contributors each increasing by 5%... The other equipments linked to the RPs need to be also considered (collimators, etc.)
- Detailed heat transfer studies to be done with the ferrite
- Recommended Cu coating for the Resistive-Wall impedance: > ~ 5 μm is OK (10 μm if possible)
- EM simulations based on several assumptions => Measurements on a prototype should be performed as a final check / validation!

proto type production started with this design for cylindrical RP and RF shield

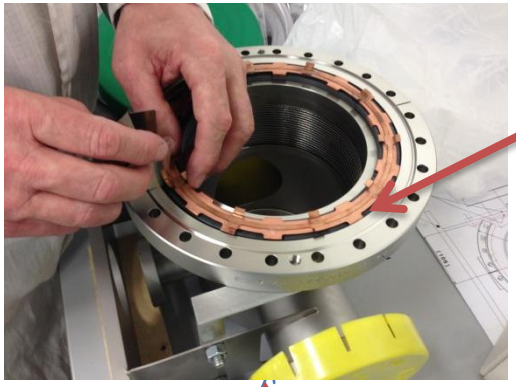
RP prototype development

RP cylinder

RF shield RP box



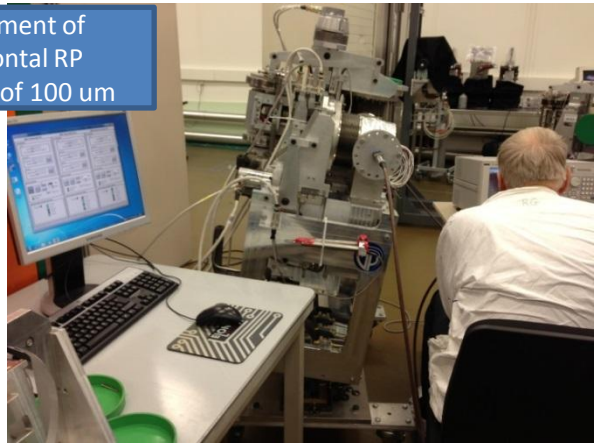
RF test of new Roman Pot design
combination of new bellow & beam pipe & circular ferrite with new cylindrical RP or RF shield

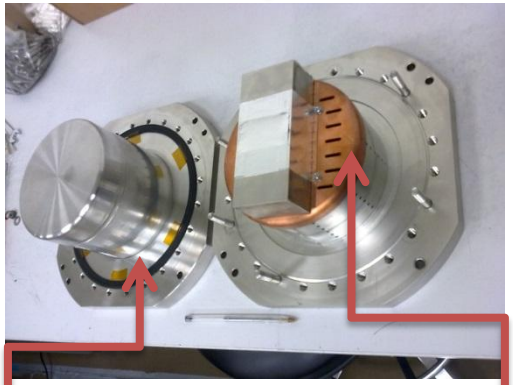


New bellow & beam pipe with circular ferrites &
ferrite support ring –> integrated in horizontal RP test station

Horizontal RP test station

Movement of horizontal RP in steps of 100 um

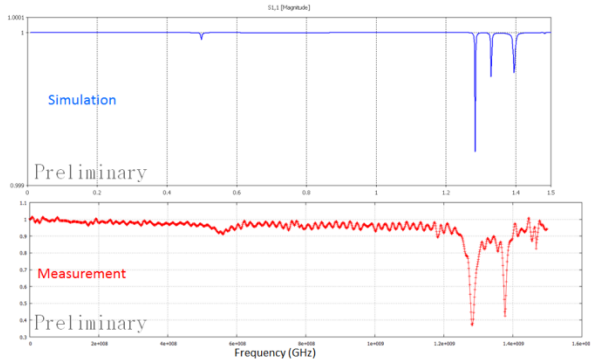




New cylindrical Roman Pot &
RF shield for box Roman Pot

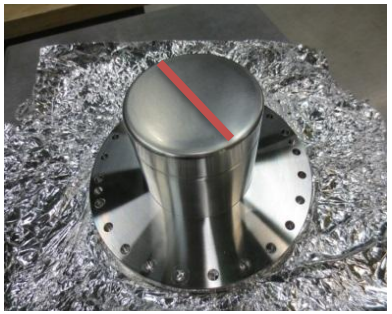
Measurements with and without ferrites
First results show agreement with simulation

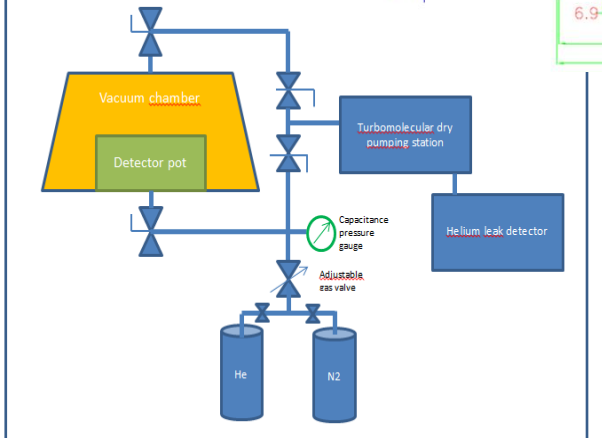
Good agreement between simulation and measurements

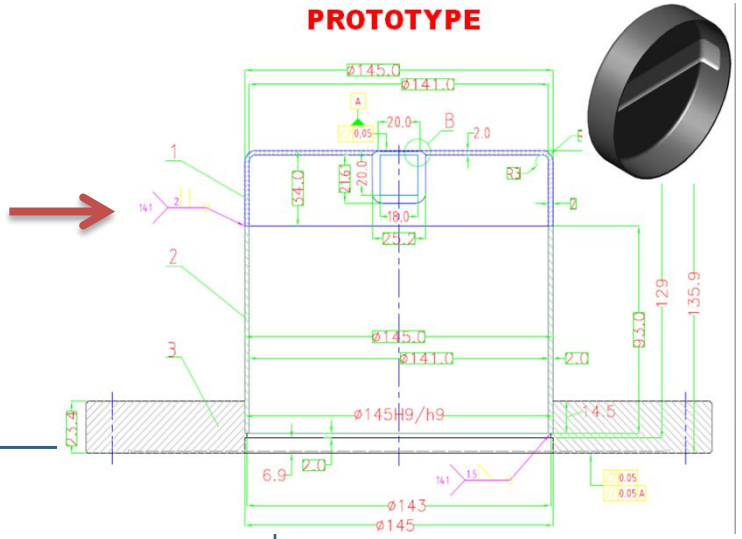


Cylindrical RP without ferrite in garage position, probe 16 cm inside

He leak test of thin window in bat 113







EDMS n°1340920

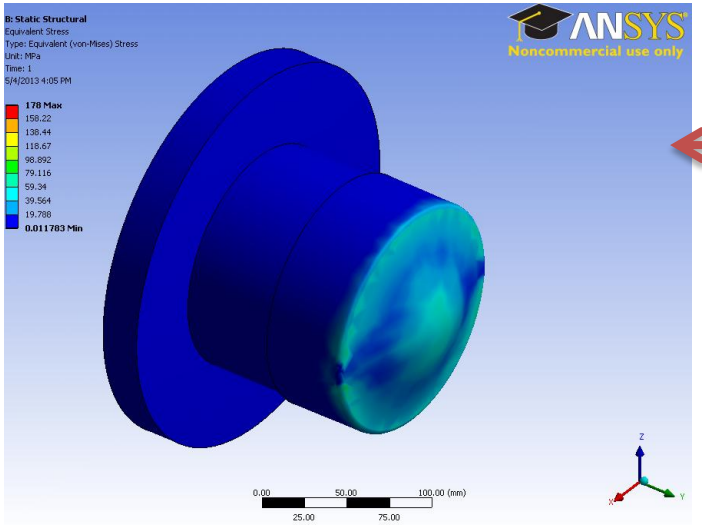
	Residual helium signal before test [mbar.l/s]	Time of helium exposure [min.]	Helium signal at end of exposure period [mbar.l/s]	Results
Initial leak test	1.7E-9	20	2.9E-9	conform
Final leak test	1.3E-9	20	2.7E-9	conform

After 30 pressure cycles

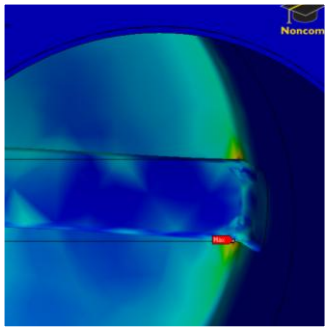
Deformation of thin window (bat 113)

Ongoing measurement

Inner pressure 1 bar



simulation



Assembly of new Roman Pot station at bat 186 (TIF)

- Material arrived for production of 4 RP stations (17.3.2014)

Assembled horizontal units for timing detectors without bellow

Sharing of work overview with CERN groups (not complete)

EN-MEF-LE (coordination, synchronization with LHC planning & scheduling)

PH-DT (RP mechanics, vacuum, motor, services, cable production .. ..)

PH-ESE (electronic issues, fibers, HV cables…)

EN-CV-DC (RP cooling system)

EN-MEF-SI (cables)

EN-MME-DI (new RP production)

EN-ICE-SIC (FESA)

TE-VSC-LBV (ferrite – vacuum measurements, beam pipe)

TE-MPE-PE (LHC machine protection)

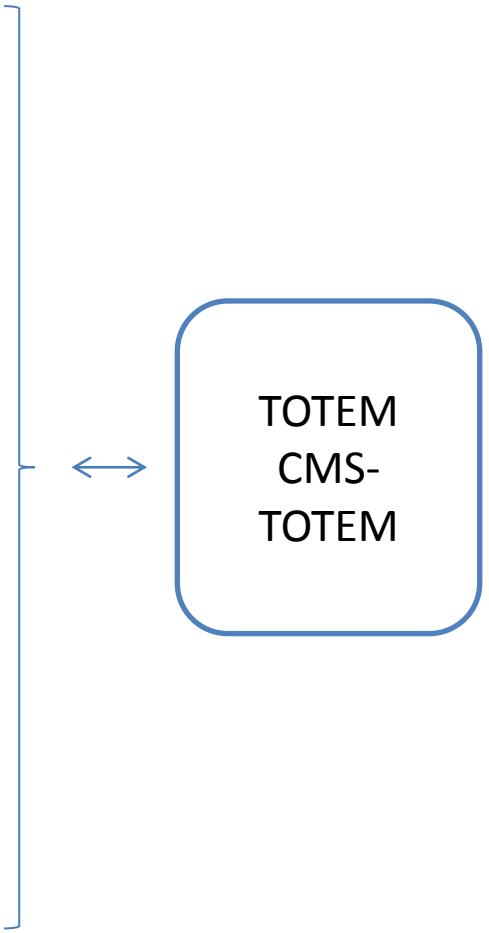
DGS-RP-AS (radiation protection)

PH-UCM (RP engineering, integration,…)

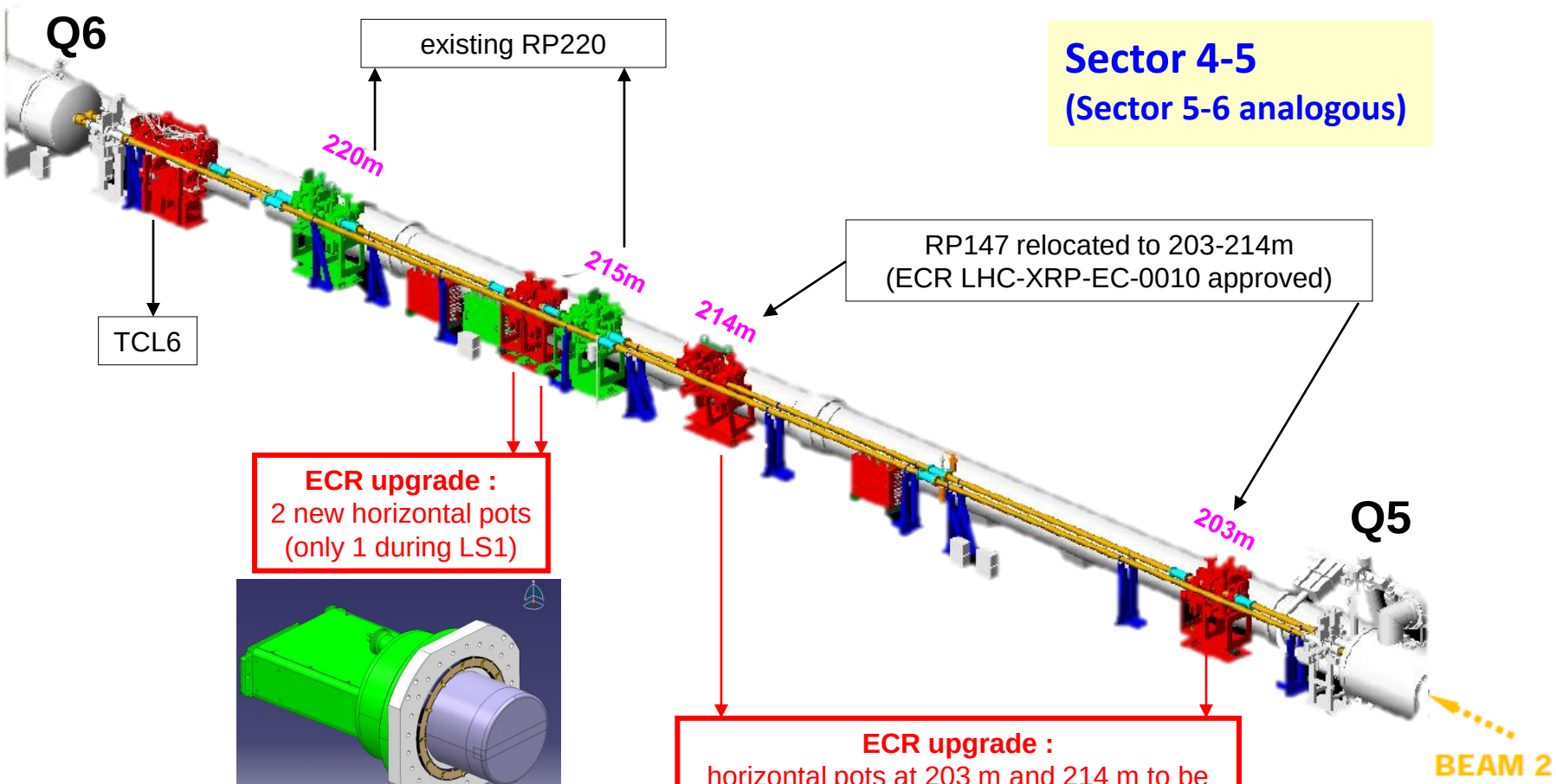
BE-ABP-ICE (RP – RF study & optimization)

BE-OP-LHC (Operation of RP – CCC)

BE-ABP-LCU (collimators)

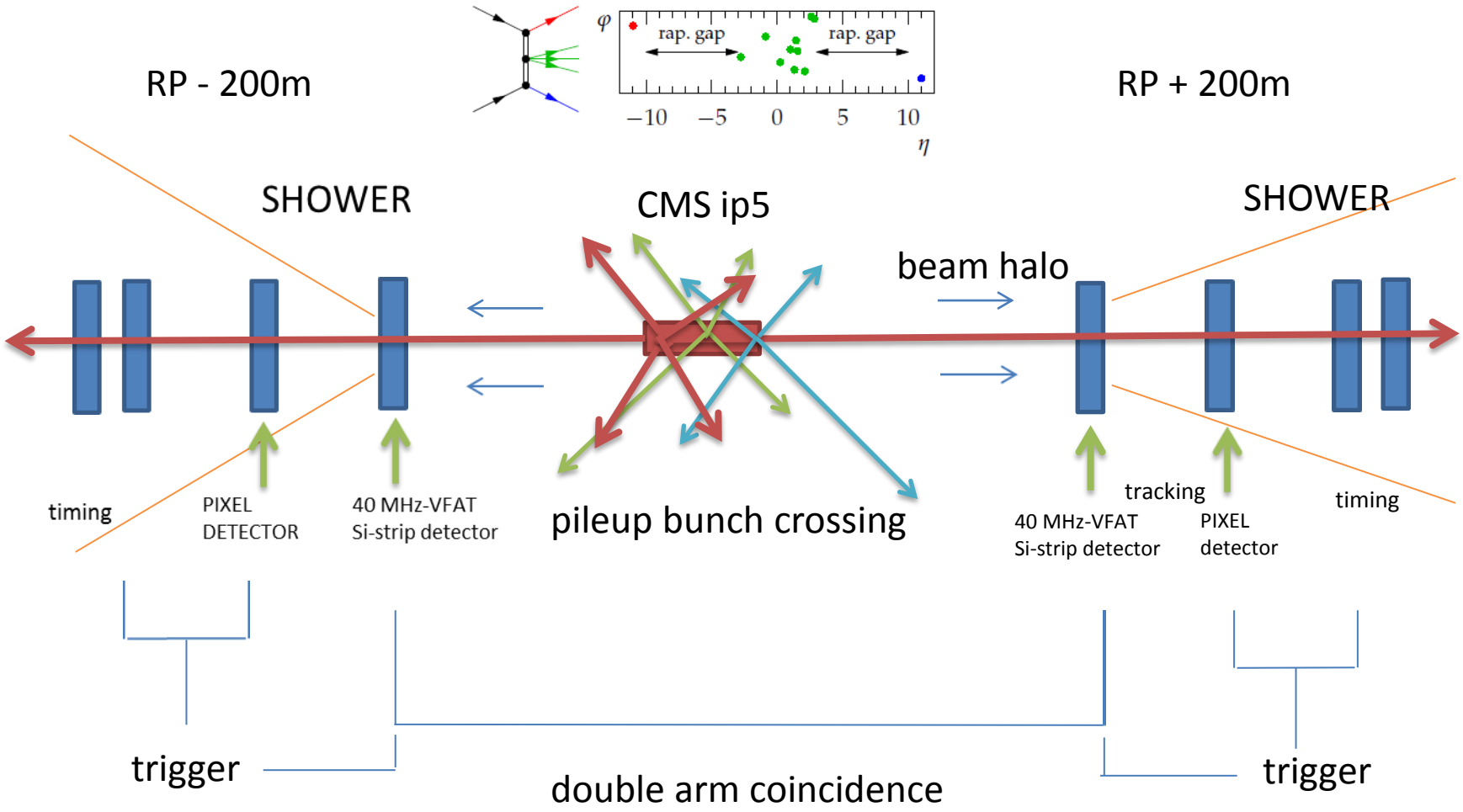


The Upgraded Roman Pot Spectrometer
ECR upgrade



Roman Pot detector system for upgrade project

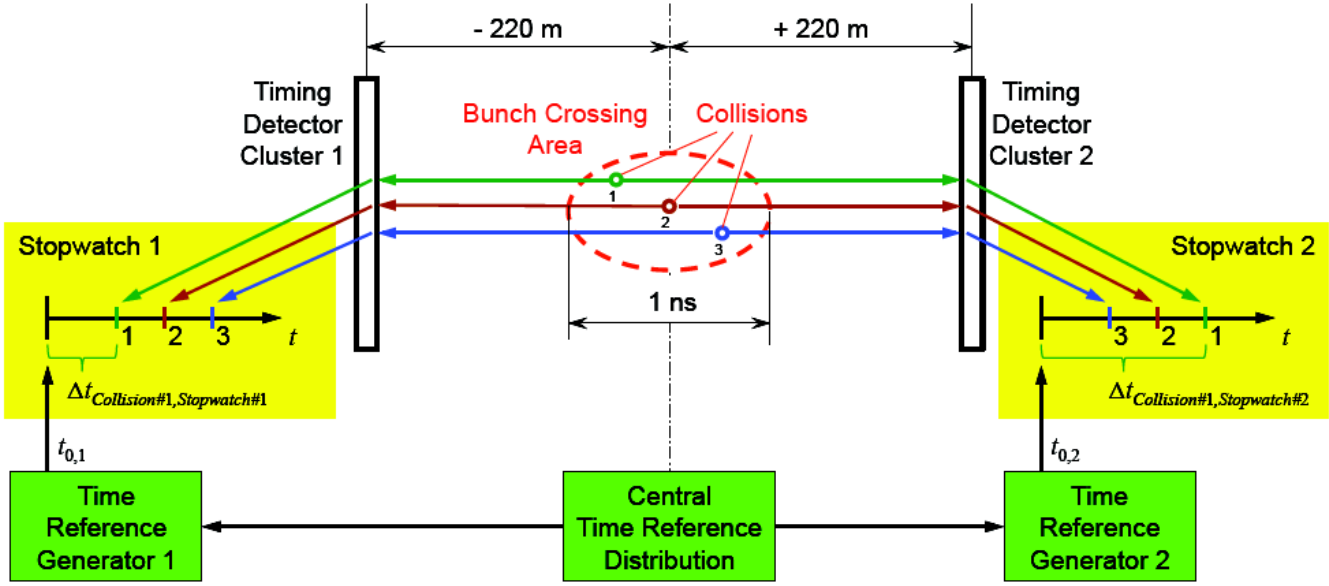
study of combination: Si strip & timing detectors (schematic)



Longitudinal Vertex reconstruction by proton arrival time measurement in Roman Pots

Clock distribution < 10 ps

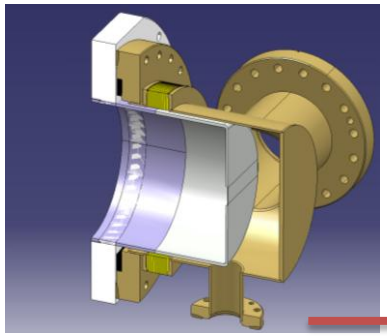
Clock distribution < 10 ps
Timing detector < 10 ps

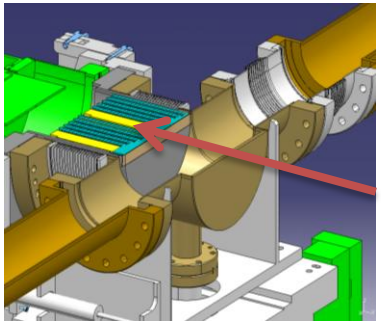


$$\text{Position of Collision 1} = f(\Delta t_{Collision\#1,Stopwatch\#1}, \Delta t_{Collision\#1,Stopwatch\#2})$$

$$\sim \Delta t_{Collision\#1,Stopwatch\#1} - \Delta t_{Collision\#1,Stopwatch\#2}$$

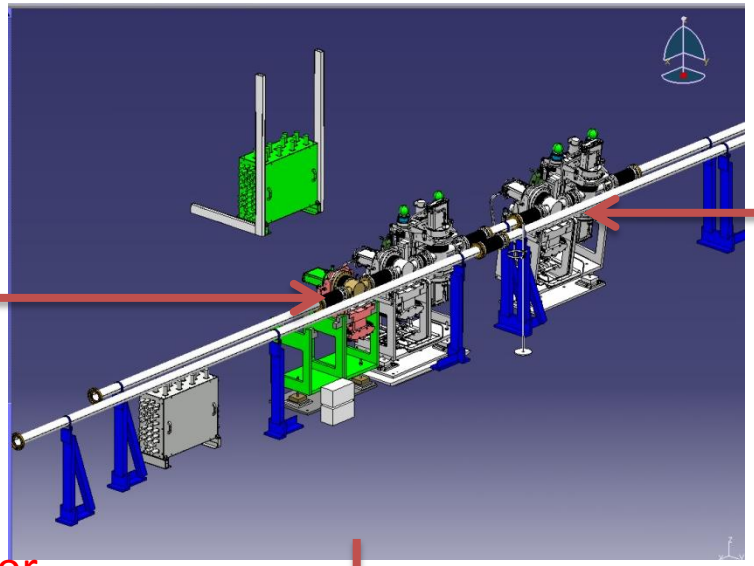
New timing and tracking detectors

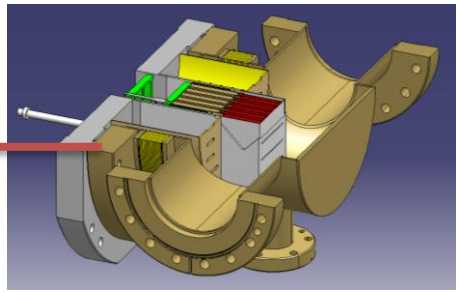




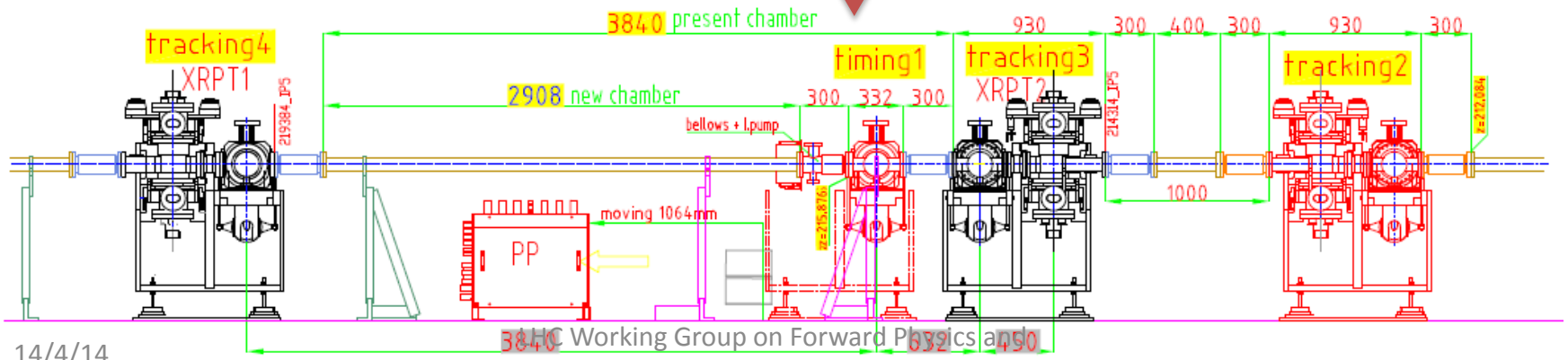
Cylindrical RP and timing detector

Cerenkov timing detector





RP with RF shield and tracking detector



TCL6 Collimators

Proposal for TCL6 collimators in IR1/5

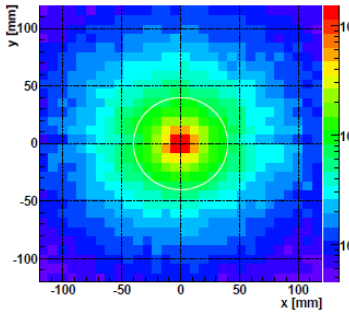
- **Recap.: Why do we decide now?**
  - *New installation considered after proposals of upgraded forward physics programs, but no enough collimators available → idea to re-use the 'old' TCT replaced by TCTP's with BPMs. Agreed to decide after external production status was clarified and impact was evaluated.*
- **Summary of latest simulation results (see details on CWG site)**
  - *Gains if TCL6's installed:*
    - ***Reduce losses in DS by up to a factor 100.***
    - ***Provide flexibility for future upgrades of forward physics program.***
    - ***Reduce losses in Q6/Q7 by a factor 2-3 when Roman pots are inserted.***
  - *Potential drawback:*
    - ***Radiation to RR's increases if used at the tightest settings of 10 sigmas, but in absolute still below dangerous limits.***
    - *Impedance to be evaluated (expected small: metallic jaws)*
- **Taking into account**
  - *More **radiation** to personnel if change done after operation at ~7TeV, high luminosity.*
  - *Uncertainties in simulations. Missing "material budget" from Roman pot upgrades.*
  - *We can always open them and use TCL4/5 upstream in case of problems*

we propose to proceed with the TCL6 installation in IR1/5, if compatible with vacuum team / planning. ECR essentially ready to go out.

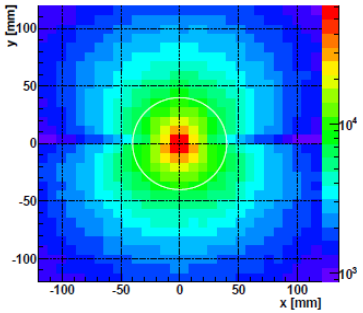
Based on results by L. Esposito, with inputs from Collimation (S.Redaelli) and TOTEM (M Deile).

S. Redaelli, LMC, 19-02-2014 15

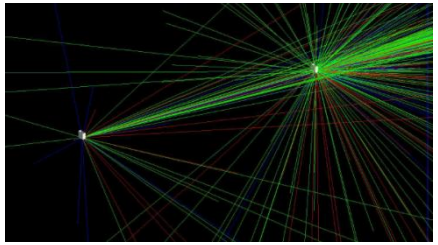
GEANT simulation secondary
CERN-TOTEM-NOTE-2013-002. - 2013



RP box

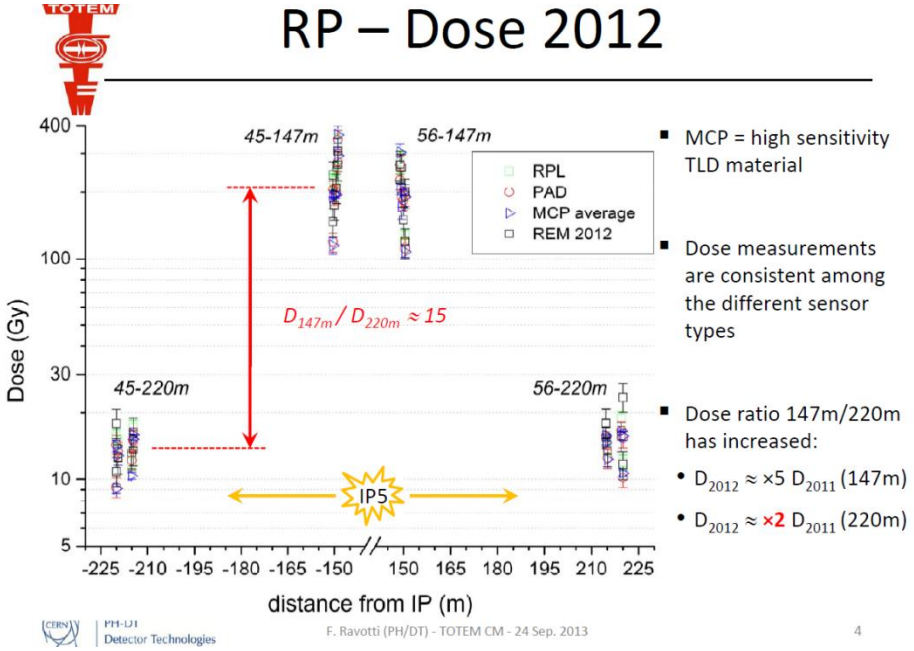


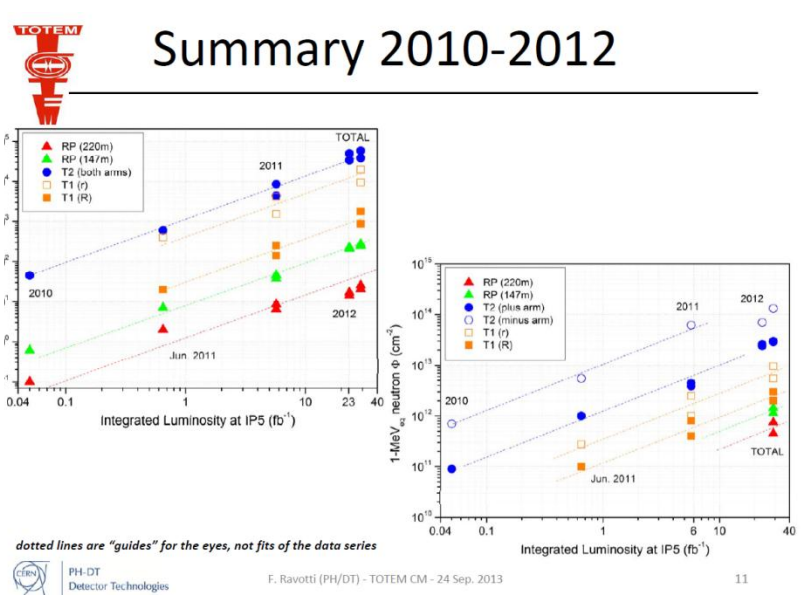
RP cylinder without Cerenkov



Cascade effect of two RPs

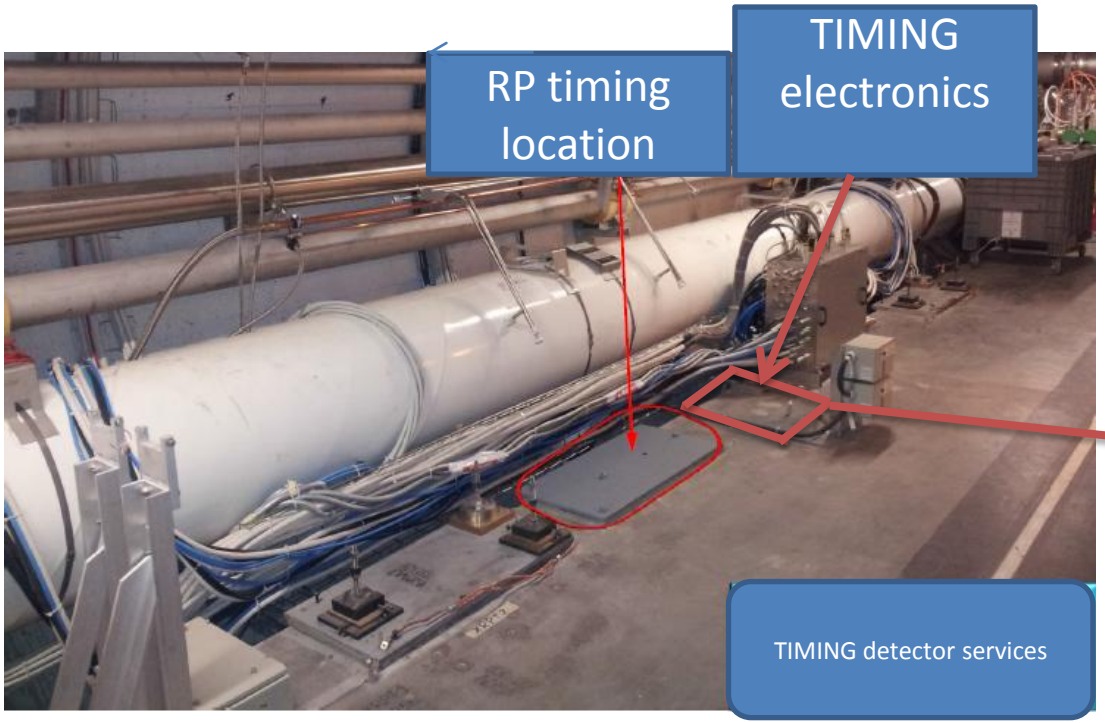
Radiation issues



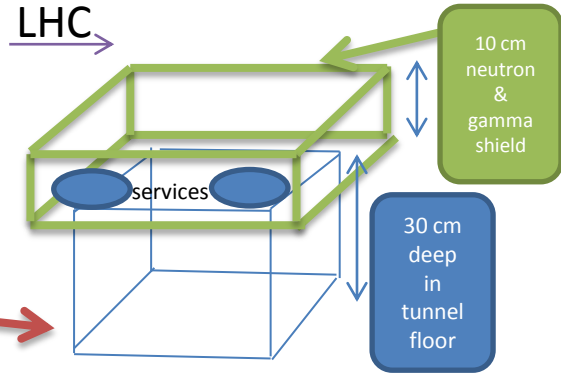


Presentation of F. Ravotti in TOTEM collaboration meeting

Preparation of services for timing detectors



Under study:
Radiation Limiter



$30*40*30\ cm^3$
possible dimensions (tbc)

(not included in ECR upgrade !)

Running scenarios

Exploratory Phase (2015-2016)

After LS1:

- RP insertion tests (end-of-fill tests; as soon in commissioning as possible) with observation of:
  - temperature in RP (temperature sensors will be installed)
  - vacuum
  - BLM response
  - detector rates (Si strip detectors in RP210, perhaps scintillators in new cylindrical RPs)
  - interplay with TCL6 (as soon as installed)

→ **how close can we go ?**

- test data taking with 3 horizontal RPs with existing Si strip detectors (at sustainable irradiation levels)
- replace strip detectors with pixel detectors when available
- install timing detectors when available

→ study timing performance and pileup rejection

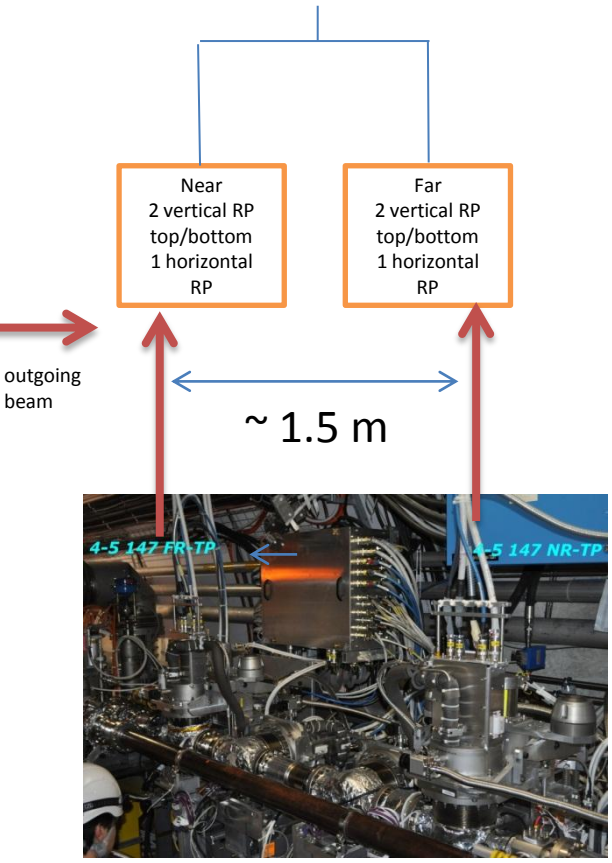
Initial Production Phase (2016-2017)

Aim: ~ 100 fb^{-1} of data

→ continuous running in all physics fills

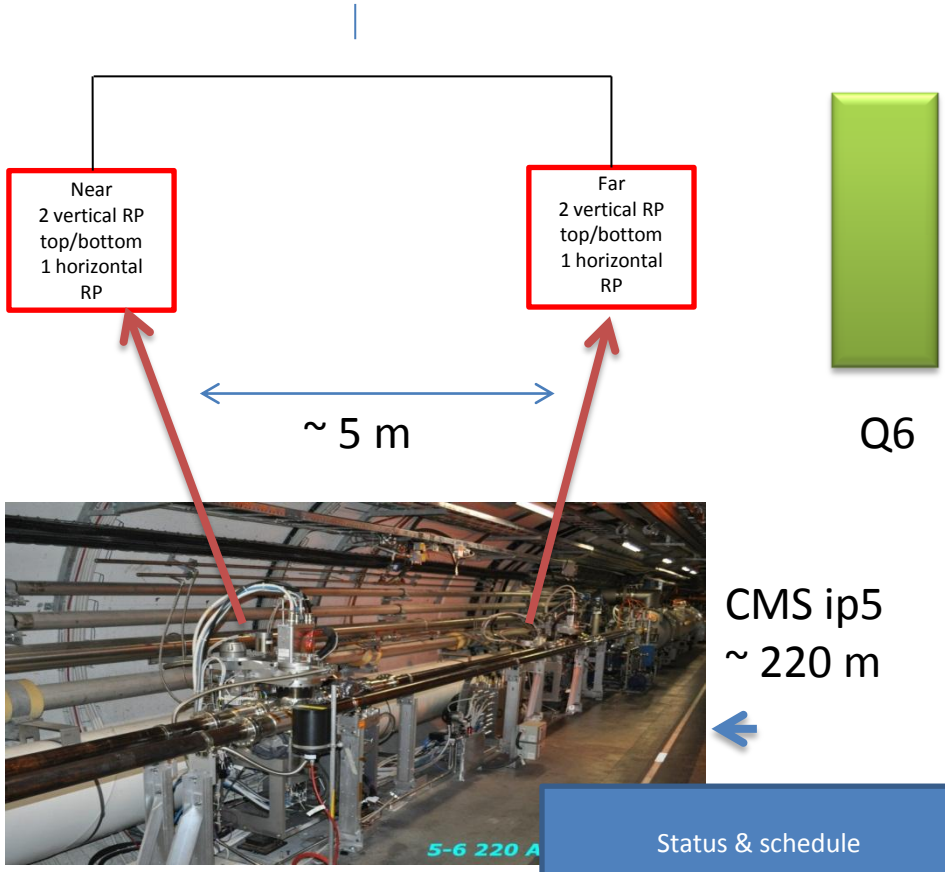
RP installation at IP5 before LS1

TOTEM RP-147 m (near-far)



CMS ip5
~ 147 m

TOTEM RP-220 m (near-far)

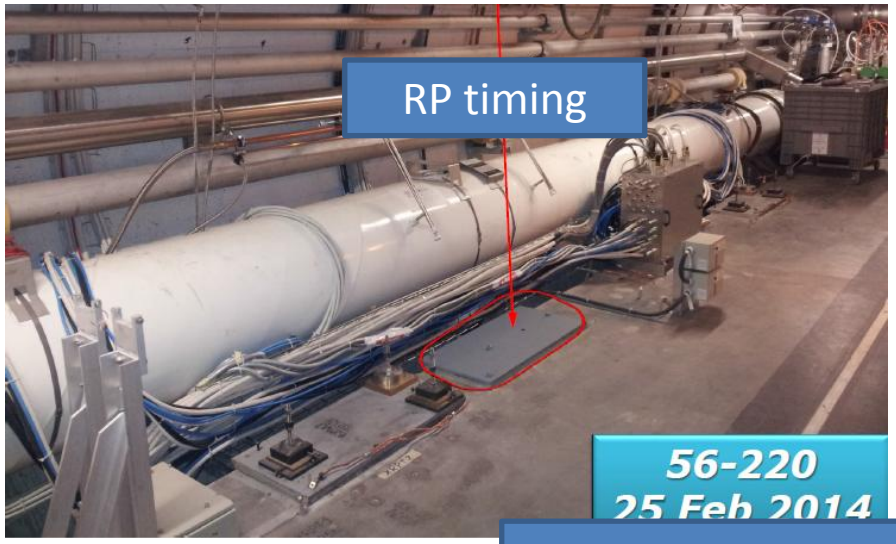


CMS ip5
~ 220 m

Status & schedule

Status sector 5/6-220m & 5/6-210 m February 2014

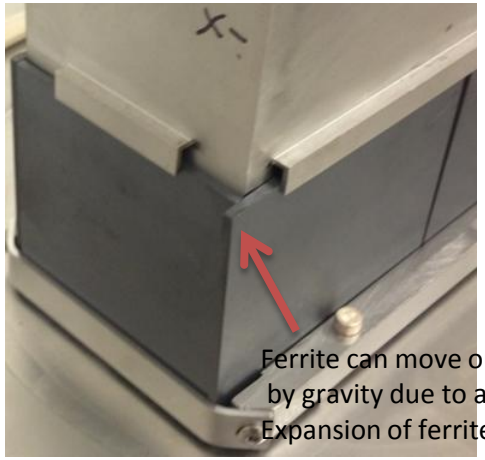
Complete by April 2014



Status & schedule

Broken Ferrite found in units 5-6 220 near (horizontal Roman Pot) XRPH.A6R5.B1

List of Insertions at $\beta^* = 0.6$ m in 2012



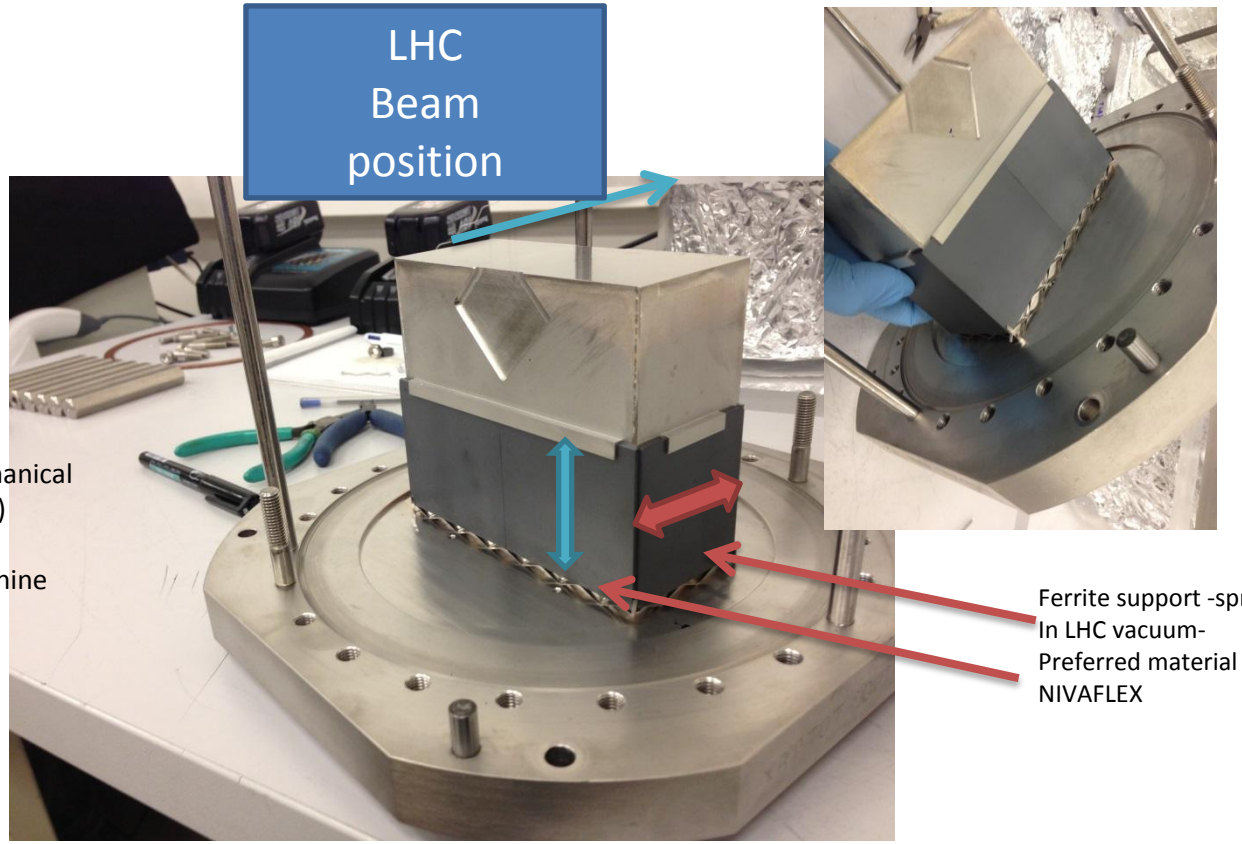
Ferrite can move out of the nominal position by gravity due to a too big gap
Expansion of ferrite due to temperature increase

Date	Pots involved	min. dist.	Observations, Result	Consequence
16.10.	all V all H	12 σ 30 σ	no problem dump on XRPH.A6R5.B1 (slow losses, 5s)	no UFO activity
05.11.	all H	30 σ	dump on XRPH.A6R5.B1 (slow losses, 5s)	no UFO activity
14.11.	all H	32mm ~ 270 σ	dump on XRPH.A6R5.B1 (fast losses)	~~UFO activity in 6L5~~ (*)
16.11.	H, not A6R5.B1	14 σ ~ 2mm	no problem, beams separated by 4σ	slow losses (5s) in each ramp until conditioning (heat up) of beam screen in Q6

(*) The (fast) UFOs in 6L5 were later found to originate from TCL

Roman Pot with NIVAFLEX spring

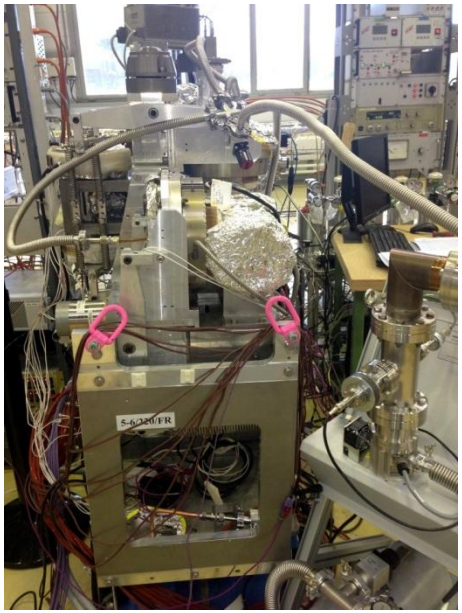
Ferrite stays in nominal position.
The spring like lifter compensates for mechanical tolerances and thermal expansion (vertical)
Due to horizontal expansion
(wrt mech. tolerances) we need to re machine the ferrites

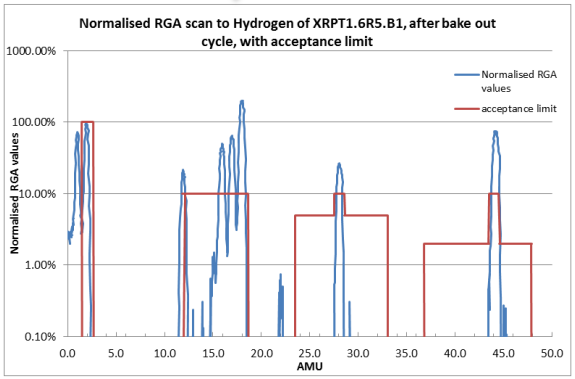


Status & schedule

RP unit
bake out and leak test (bat 113)

XRPH.A6R5.B1 failed vacuum test – after cleaning





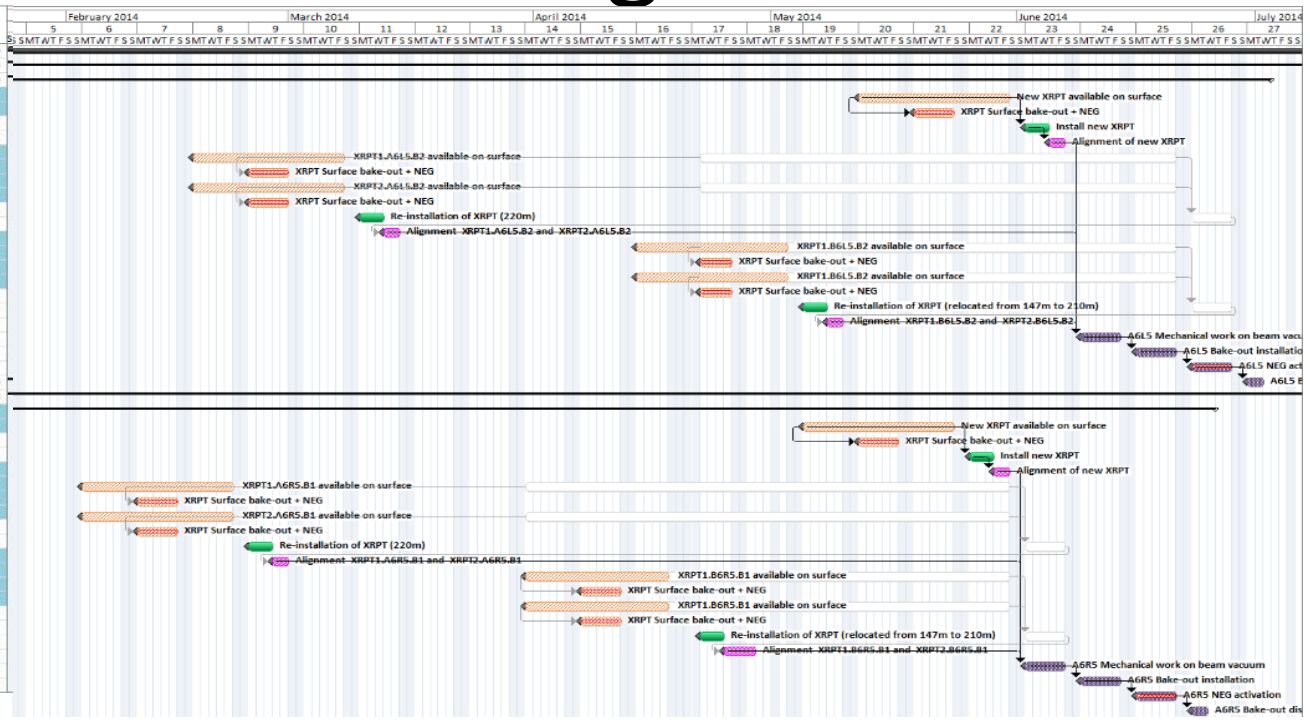
- External leak test performed with helium test as tracer gas: No external leak found.

impact on installation schedule

Status & schedule

LHC Planning

ID	Location	Task Name	Duration	Start	Finish
1061		Point 5	426 days?	01/03/13	14/11/14
1090		Sector 45	387 days?	04/03/13	23/09/14
1120		A6L5	323 days?	12/03/13	02/07/14
1133		New XRPT available on surface	15 days	12/05/14	30/05/14
1134		XRPT Surface bake-out + NEG	5 days	19/05/14	23/05/14
1135	LSS 5L	Install new XRPT	3 days	02/06/14	04/06/14
1136		Alignment of new XRPT	2 days	05/06/14	06/06/14
1137		XRPT1.A6L5.B2 available on surface	15 days	17/02/14	07/03/14
1138		XRPT Surface bake-out + NEG	5 days	24/02/14	28/02/14
1139		XRPT2.A6L5.B2 available on surface	15 days	17/02/14	07/03/14
1140		XRPT Surface bake-out + NEG	1 wk	24/02/14	28/02/14
1141	LSS 5L	Re-installation of XRPT (220m)	3 days	10/03/14	12/03/14
1142	LSS 5L	Alignment XRPT1.A6L5.B2 and XRPT2.A6L5.B2	2 days	13/03/14	14/03/14
1143		XRPT1.B6L5.B2 available on surface	12 days	14/04/14	02/05/14
1144		XRPT Surface bake-out + NEG	4 days	22/04/14	25/04/14
1145		XRPT1.B6L5.B2 available on surface	12 days	14/04/14	02/05/14
1146		XRPT Surface bake-out + NEG	4 days	22/04/14	25/04/14
1147	LSS 5L	Re-installation of XRPT (relocated from 147m to 210m	3 days	05/05/14	07/05/14
1148	LSS 5L	Alignment XRPT1.B6L5.B2 and XRPT2.B6L5.B2	2 days	08/05/14	09/05/14
1149	LSS 5L	A6L5 Mechanical work on beam vacuum	5 days?	09/06/14	13/06/14
1150	LSS 5L	A6L5 Bake-out installation	5 days?	16/06/14	20/06/14
1151	LSS 5L	A6L5 NEG activation	5 days	23/06/14	27/06/14
1152	LSS 5L	A6L5 Bake-out dismounting	2 days?	30/06/14	01/07/14
1242		Sector 56	358.5 days	07/03/13	18/08/14
1336		A6R5	318 days?	12/03/13	25/06/14
1348		New XRPT available on surface	15 days	05/05/14	23/05/14
1349		XRPT Surface bake-out + NEG	5 days	12/05/14	16/05/14
1350	LSS 5L	Install new XRPT	3 days	26/05/14	28/05/14
1351		Alignment of new XRPT	2 days	29/05/14	30/05/14
1352		XRPT1.A6R5.B1 available on surface	15 days	03/02/14	21/02/14
1353		XRPT Surface bake-out + NEG	1 wk	10/02/14	14/02/14
1354		XRPT2.A6R5.B1 available on surface	15 days	03/02/14	21/02/14
1355		XRPT Surface bake-out + NEG	5 days	10/02/14	14/02/14
1356	LSS 5R	Re-installation of XRPT (220m)	3 days	24/02/14	26/02/14
1357	LSS 5R	Alignment XRPT1.A6R5.B1 and XRPT2.A6R5.B1	2 days	27/02/14	28/02/14
1358		XRPT1.B6R5.B1 available on surface	14 days	31/03/14	17/04/14
1359		XRPT Surface bake-out + NEG	1 wk	07/04/14	11/04/14
1360		XRPT1.B6R5.B1 available on surface	14 days	31/03/14	17/04/14
1361		XRPT Surface bake-out + NEG	1 wk	07/04/14	11/04/14
1362	LSS 5R	Re-installation of XRPT (relocated from 147m to 210m	3 days	22/04/14	24/04/14
1363	LSS 5R	Alignment XRPT1.B6R5.B1 and XRPT2.B6R5.B1	2 days	25/04/14	28/04/14
1364	LSS 5R	A6R5 Mechanical work on beam vacuum	5 days?	02/06/14	06/06/14
1365	LSS 5R	A6R5 Bake-out installation	5 days?	09/06/14	13/06/14
1366	LSS 5R	A6R5 NEG activation	5 days	16/06/14	20/06/14
1367	LSS 5R	A6R5 Bake-out dismounting	2 days?	23/06/14	24/06/14



A6R5(5/6)
220m far : 219.384 <-> 220.314 -> XRPT2.A6R5.B1
220m near : 214.3 14 <-> 215.244 -> XRPT1.A6R5.B1
210m far : 212.384 <-> 213.314 -> XRPT2.B6R5.B1 (relocated 147m)
210m near : 203.063 <-> 203.993 -> XRPT1.B6R5.B1 (relocated 147m)
New XRPT : VCDAD.6R5.B - exchange beam pipe

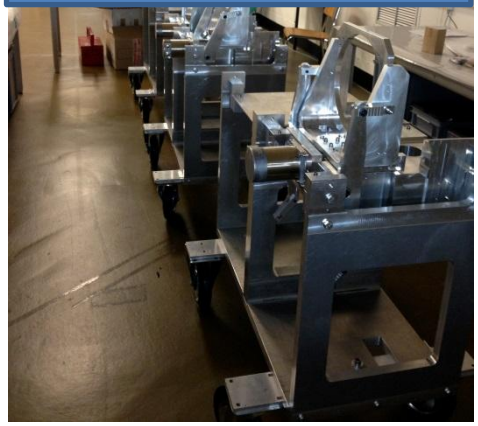
A6L5 (4/5)
220m far : -220.314 <-> -219.384 -> XRPT1.A6L5.B2
220m near : -215.244 <-> - 214.314 -> XRPT2.A6L5.B2
210m far : -213.314 <-> - 212.384 -> XRPT1.B6L5.B2 (relocated 147m)
210m near : -203.999 <-> - 203.063 -> XRPT2.B6L5.B2 (relocated 147m)
New XRPT : VCDAD.6L5.Re xchange beam pipe

Status & schedule

Preparation of timing detector test beam line

- pico-second timing detector development & test
  test beam line @ CERN H8 for forward detectors – TOTEM RP test stand
  integration of timing detector components
  first test with SAMPIC chip & diamond detector at CERN are ongoing
- C-detector beam test scheduled for May 2014 (US)
- TEST BEAM at CERN SPS in fall 2014

high precision carrier



Summary

- CMS – TOTEM upgrade project is officially approved
- New Roman Pot design was developed and prototypes were successfully built & tested
- UPGRADE Proposal & ECRs & work packages

  are approved
- Material reception of RP cylinder has started
- Assembly of new RP units and RF shield has started
- Test of timing detector components has started at CERN

Many thanks for the contributions and supports from all CERN groups involved in this consolidation & upgrade project

TOTEM-CMS Roman Pot @ LHC

new physics + target for applications & development of forefront spin- off technologies