

PPS: a CMS - TOTEM forward detector



CMS and TOTEM have decided to work together toward a plan of common data taking. This collaboration is outlined as follow:

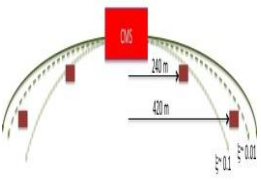
Phase I (after LS1): low luminosity running.

1. common data-taking using the TOTEM hardware in the forward region
2. Use one cylindrical RP for impedance/detector studies
3. Develop the Movable Beam Pipe

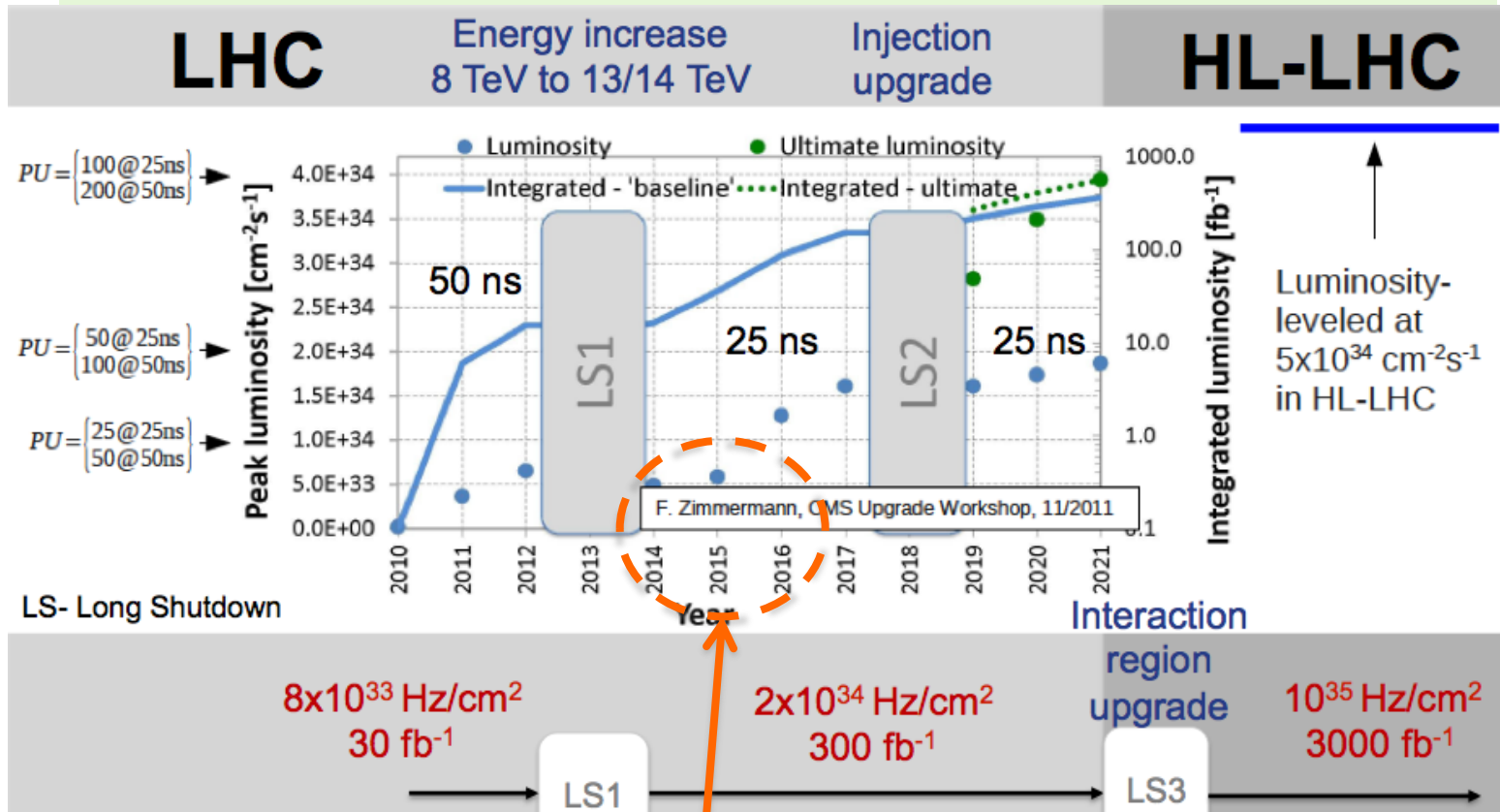
Phase II (after LS1+ 1-2 years): high luminosity running.

1. Replace the TOTEM silicon strips with rad-hard pixel detector
2. Use timing detector

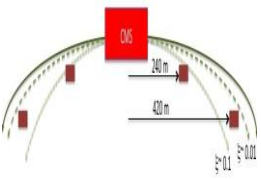
PPS = Precision Proton Spectrometer



PPS Schedule



This is our best period: as LHC increases the luminosity, data taking becomes more difficult for near-the-beam detectors. This fact has been demonstrated by TOTEM



How can we install at the end of LS1?



Important dates for LHC operation in the beam-pipe sectors:

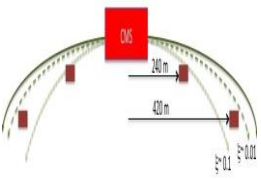
April 2014: beam-pipe is closed.

September 2014: tunnel is closed.

There are only ~ 8 months left to install the “detector carriers”.

After that, we have 6 more additional months to install all “services” needed: cables, crates, cooling...

Detector installation is last, it's actually quite quick and it can be done also after the tunnel is closed.

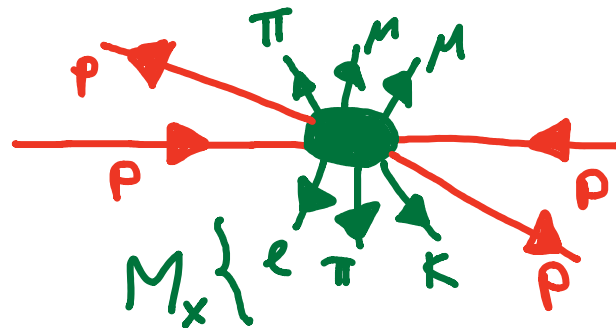


Physics aide-memoires



CENTRAL EXCLUSIVE PRODUCTION

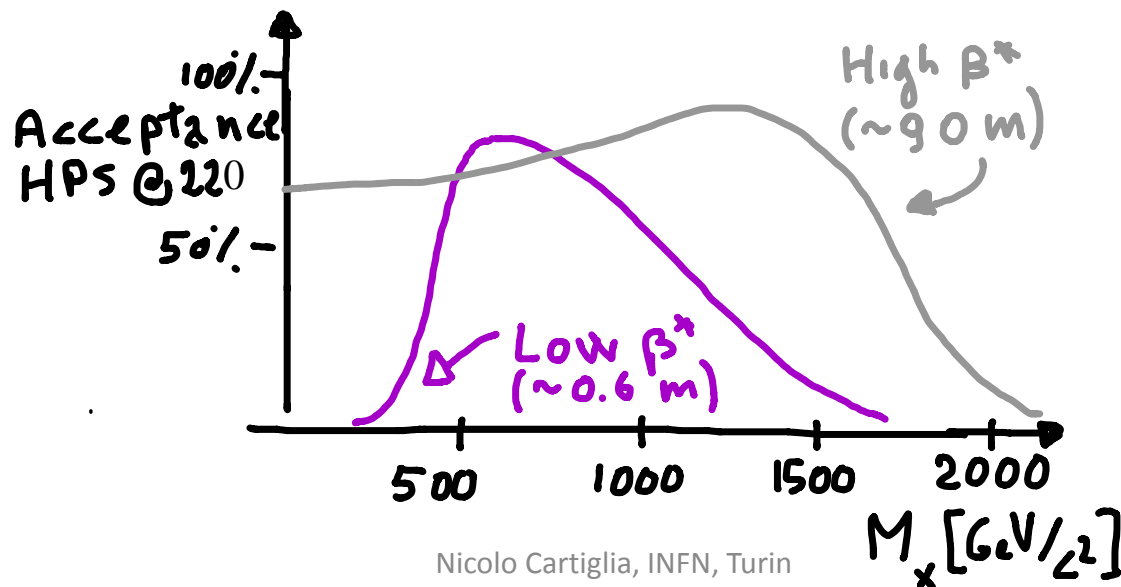
$$PP \rightarrow PPX$$

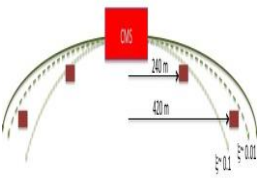


$\xi = P_1$ momentum lost

$$t_1 = -P_{\perp}^2 \text{ of } P_1$$

$$M_x = \sqrt{\xi_1 \xi_2 S}$$





PPS Physics Reach



PPS is the sole detector that can measure Central Exclusive Production processes, both at low and high mass.

PPS @ 220 meter:

Low β^* (~ 0.6 meter)

High mass states ($M_x > 300$ GeV),
high & small cross section processes (standard luminosity optics)

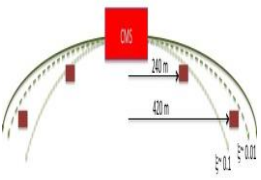
High β^* (~ 90 meter)

Full mass range ($M_x < 2000$ GeV),
Large cross section processes (1-3 day of dedicated optics)

PPS @ 420 meter:

Low β^* (~ 0.6 meter)

Low mass states, large & small cross section processes
(standard luminosity optics)

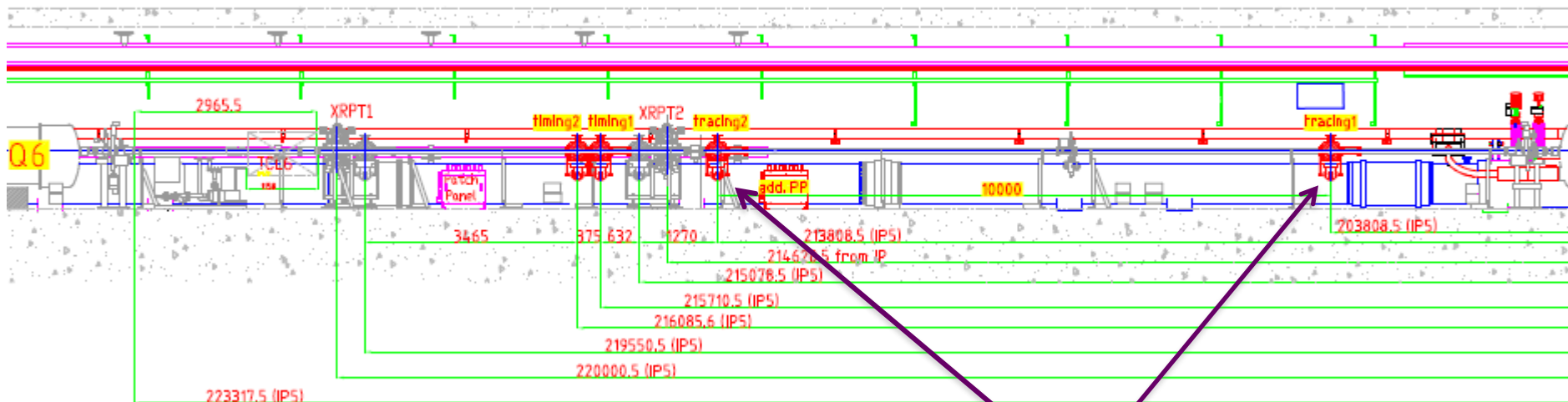


Phase I layout of the PPS -Totem project

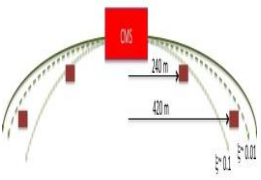


Two Roman-Pots for tracking, 10 meters apart (relocated)
instrumented with Totem silicon detectors

- ➔ No timing
- ➔ Need to run at low luminosity



147 m relocated RP station

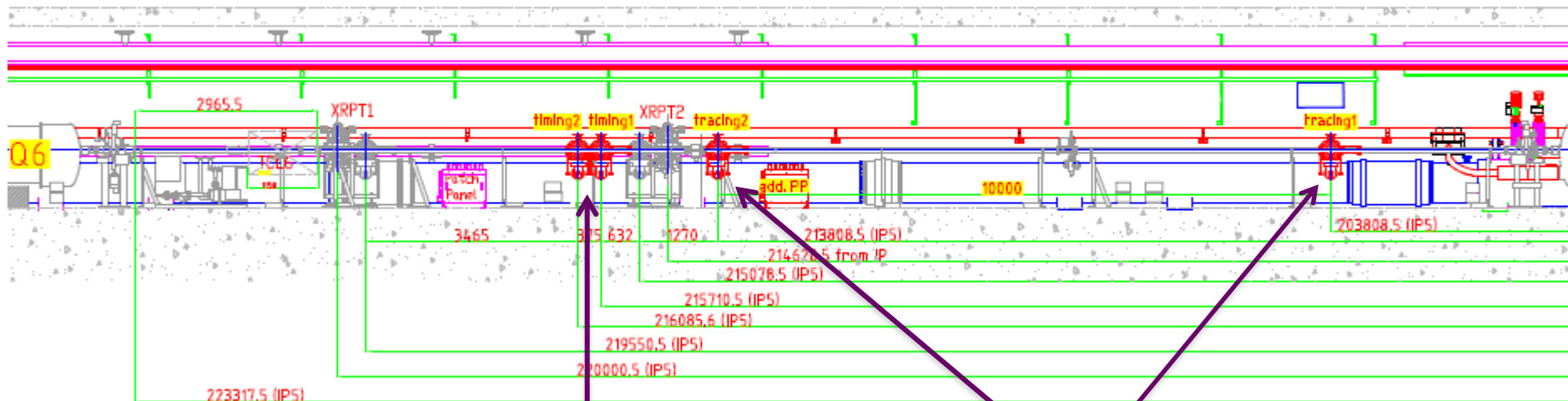


Phase II layout of the PPS-Totem project



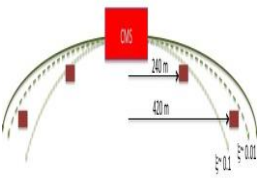
Two Roman-Pots for tracking, 10 meters apart, instrumented with upgraded rad-hard pixel.

Timing detector in RPs and MBP (depending on what we learn)



RP with
timing detector

Rad-hard Si-pixel detectors



Protection against quenches - I

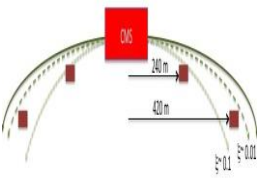


To be allowed to take data at LHC you need to give “no troubles” to the accelerator, or at least to give as few troubles as possible...

The avalanche effect between pots causes showers in the downstream magnets and possibly their quench

→ It's mandatory to have a collimator before the next magnet Q6 (230m)

→ The installation of TCL6, the protection to Q6, is approved for LS1



Protection against quenches - II

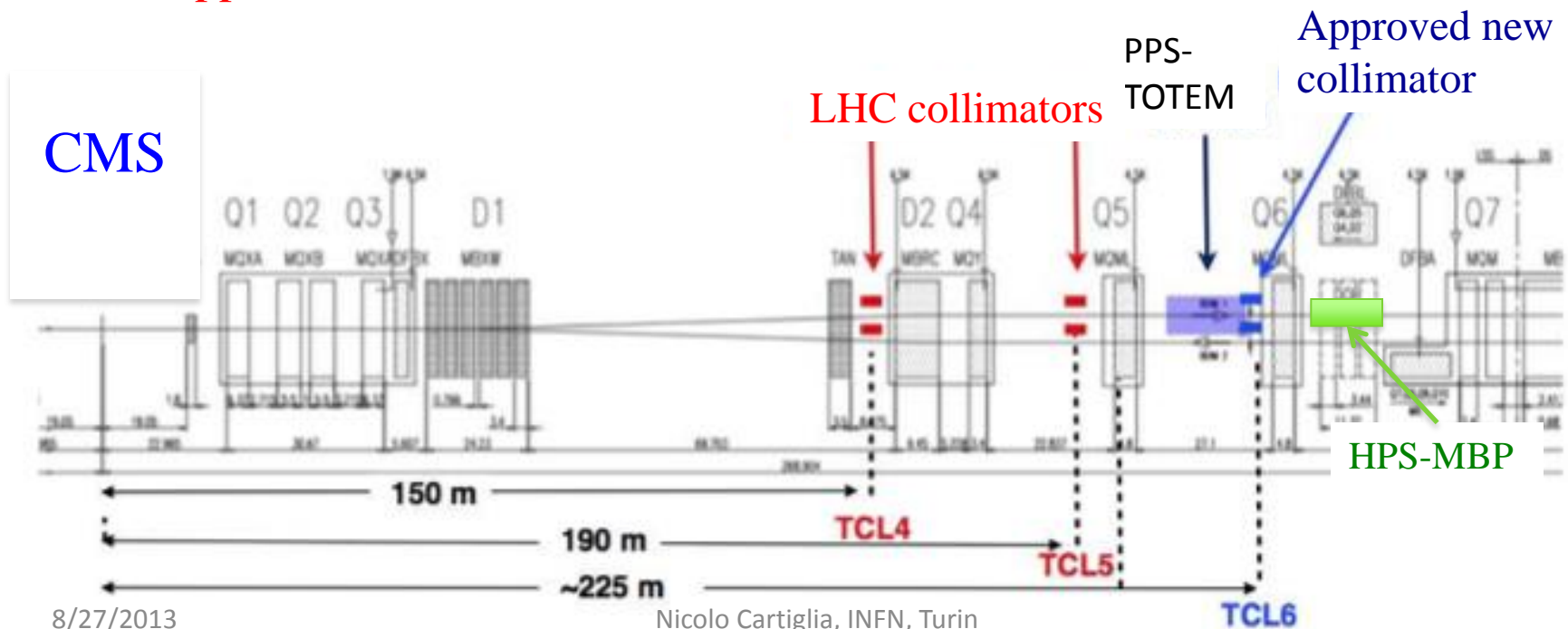


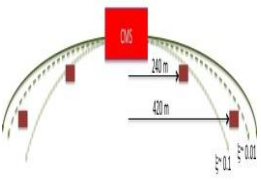
TCL4 has been designed to protect the separation dipole D2 from physics debris and also the first matching section quadrupole Q4.

TCL5 has been designed to protect Q5 and possibly other superconductive elements down to the dispersion suppressor (DS) at about 400 m. If closed, TLC-5 will prevent to perform physics measurements downstream.

TCL6 protects Q6 from the debris from HPS-TOTEM

TCL6 is approved and scheduled for installation.





Summary of PPS HW & Physics Plan



Phase I (LS1 + 1 day): good physics and exploration phase

TOTEM's RP and silicon detector & CMS central detector

- Study of large cross section CEP processes

$\text{Lum} = 1 - 10 \text{ pb}^{-1}$ at $\beta^* = 90 \text{ meters}$

Phase II (LS1+1-2 year): great physics, high luminosity data taking

TOTEM's RP & Timing & New 3D Pixel & CMS central detector & MBP

- Study of small cross section CEP processes

$\text{Lum} = 1 - 10 \text{ fb}^{-1}$ at $\beta^* = 0.5 \text{ meters}$