

# TOTEM RRB

## Status of the Experiment

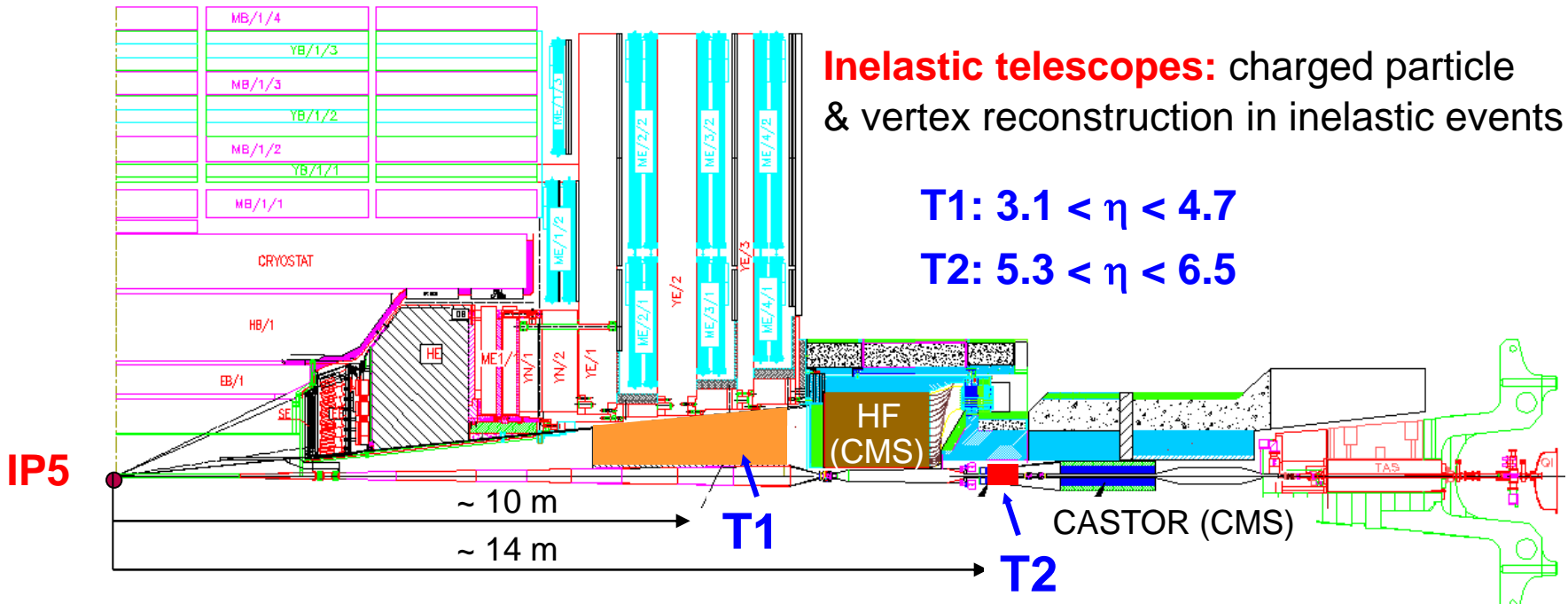
*24 April 2012*

S.Giani

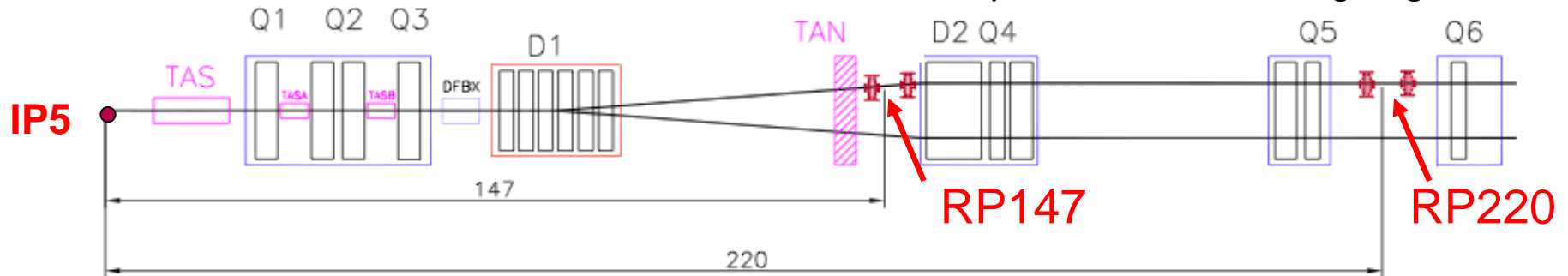
on behalf of the TOTEM collaboration

# Detectors & Trigger

# TOTEM: experimental setup @ IP5



**Roman Pots:** measure elastic & diffractive protons close to outgoing beam



# Activities during winter technical stop 2011/2012

- Service work on Roman Pots, T1, T2 :
  - ✓ all detectors are ready for data taking
- Revision of the RP movement control (requested by MPP)
  - ✓ approved EDMS document

**NEW** : Installation of electrical trigger components on Roman Pots  
=> allows the trigger to be in time for CMS  
=> **bi-directional exchange of triggers with CMS**

# Runs & Data-taking

# Plans for 2012 Runs

**Standard runs at  $\beta^* = 0.6$  m, high luminosity**

*Runs with Roman Pots*

*Data taking with CMS*

**Special run at  $\beta^* = 90$  m, ~156 bunches, medium luminosity**

**CMS + TOTEM = detector with largest acceptance**

*Full physics programme*

*Data Taking with CMS*

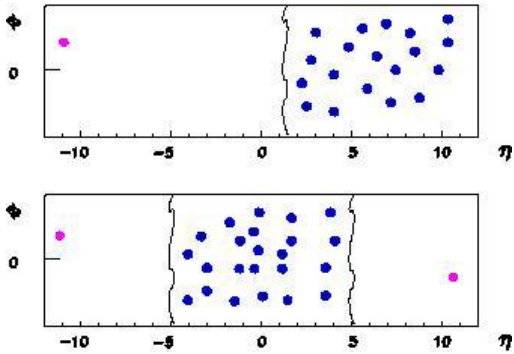
**Special run at  $\beta^* = 500$  m, low luminosity**

*Measurements of low- $t$  elastic scattering*

*Determination of  $\rho$*

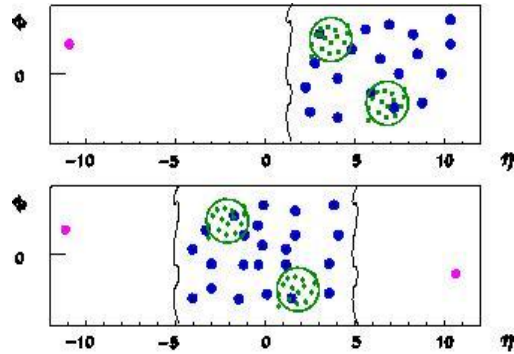


# TOTEM + CMS running scenarios



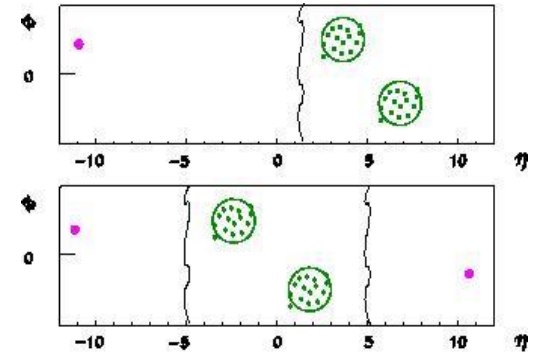
pp->pX  
pp->pXp

soft diffraction



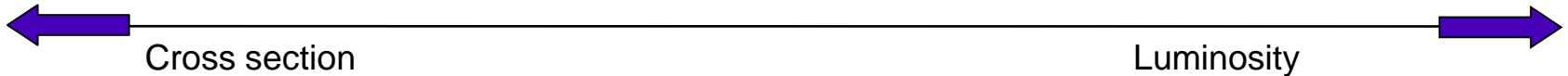
pp->pjjX  
pp->pjjXp

(semi)-hard diffraction



pp->pjj (bosons, heavy quarks, Higgs...)  
pp->pjjp

hard diffraction

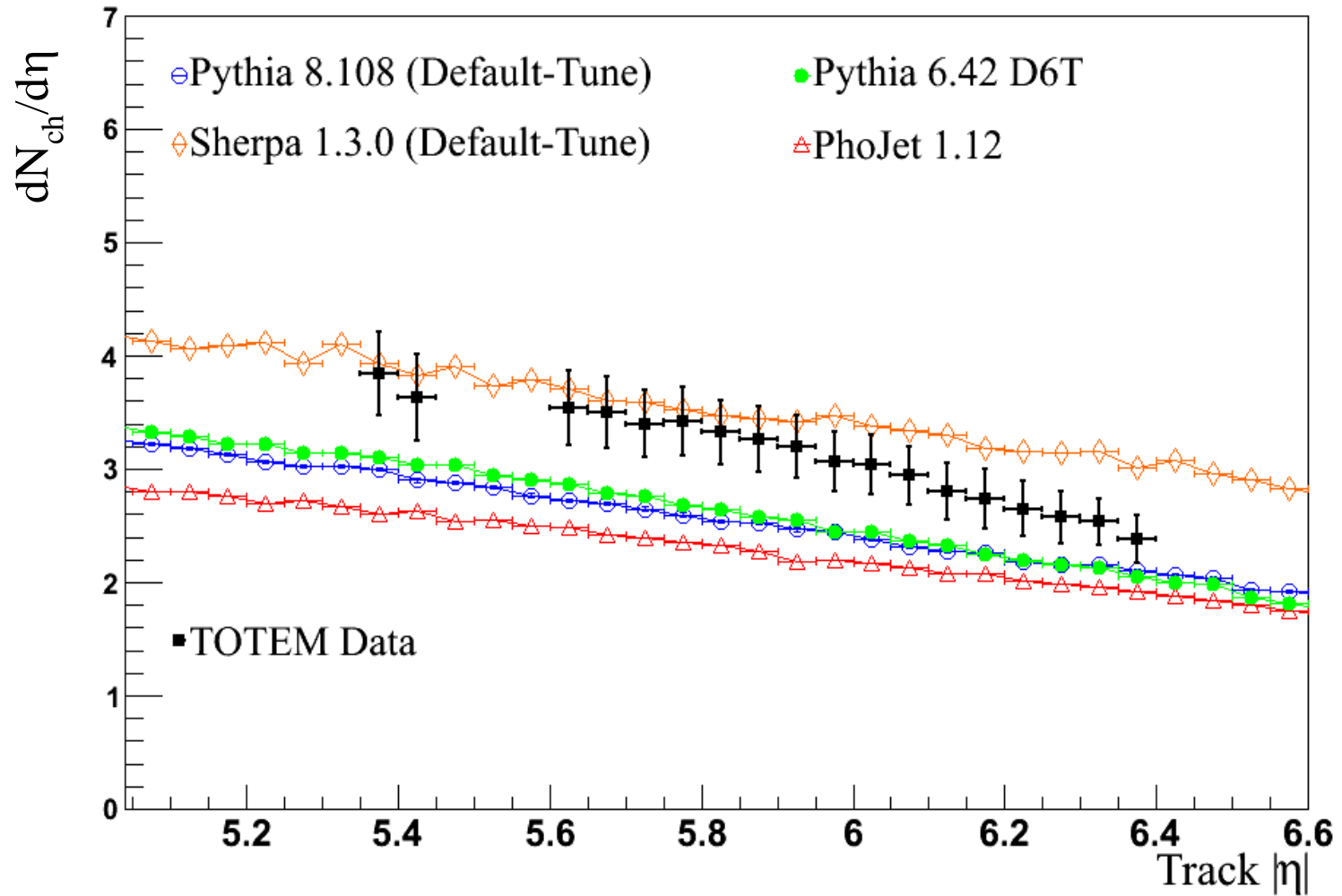


$\beta$ (m)	1540	90	2	0.5
L ( $\text{cm}^{-2} \text{s}^{-1}$ )	$10^{29}$	$10^{30}$	$10^{32}$	$10^{34}$
	TOTEM LHC runs		Standard LHC runs	

# Physics (1) : $dN/d\eta$

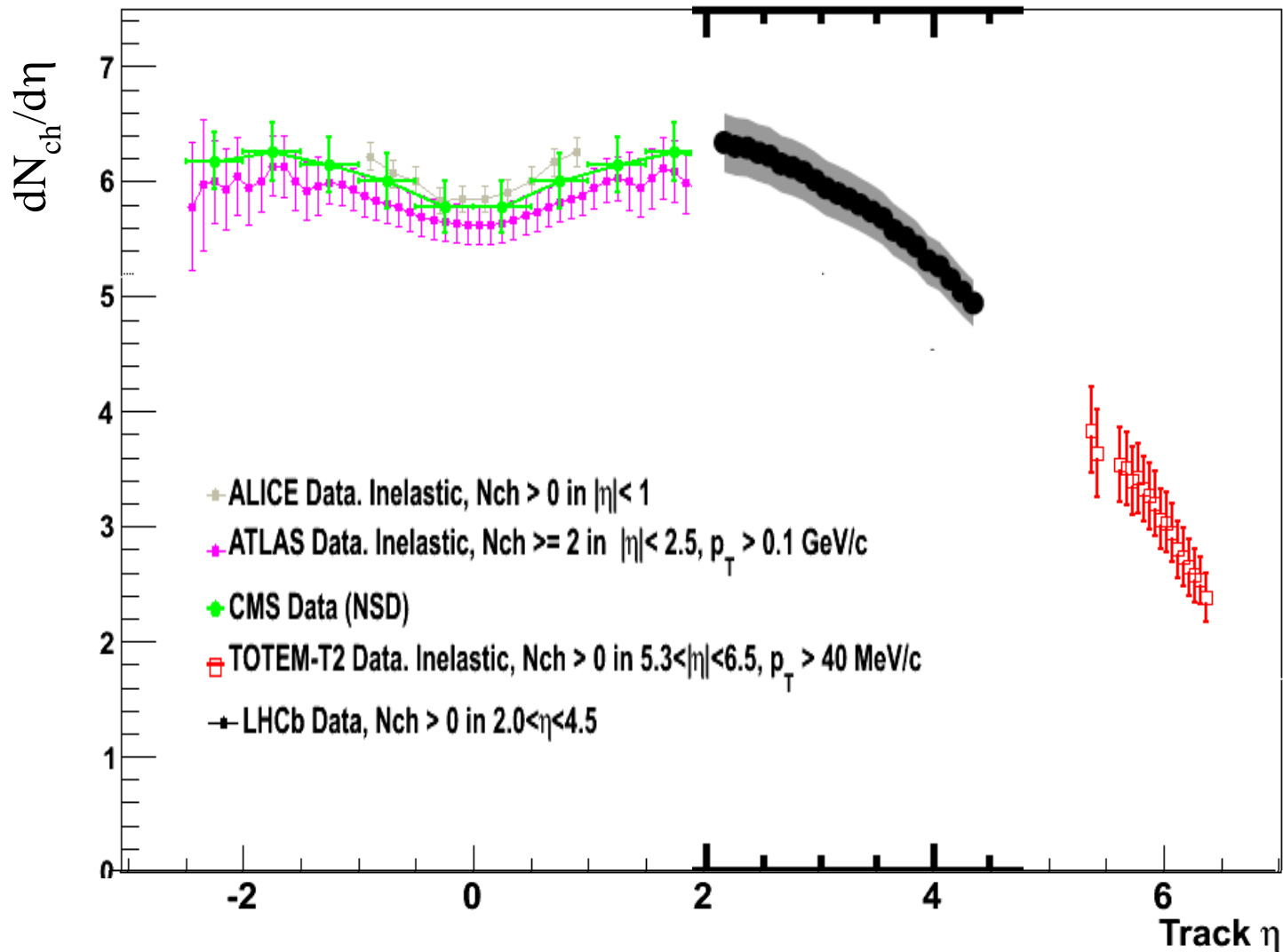


# $dN_{ch}/d\eta$ measured in T2 : results



Approved PH preprint [CERN-PH-EP-2012-106](#) – Submission to journal

# $dN_{ch}/d\eta$ combined with other LHC exp.



Ready to work within *LPCC* framework

# Physics (2) : Total Cross-Section

# pp Cross-Sections @LHC: 4 Methods (& Luminosity calibration)

1. Low\_L(CMS) + Elastic + Optical T.
  - depends on CMS luminosity for low-L bunches & elastic efficiencies &  $\rho$
2. High\_L(CMS) + Elastic + Optical T.
  - checks the CMS luminosity for high-L vs low-L bunches
3. High\_L(CMS) + Elastic + Inelastic
  - minimizes dependence on elastic efficiencies and no dependence on  $\rho$
4. (L-independent) + Elastic + Inelastic + Optical T.
  - eliminates dependence on luminosity

# pp Total Cross-Sections @ $\sqrt{s}=7\text{TeV}$

Published EPL96

1.  $\sigma_{TOT} = 98.3 \text{ mb} \pm \frac{2.2}{2.0} \text{ mb}$

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

Preliminary

2.  $\sigma_{TOT} = 98.5 \text{ mb} \pm \frac{2.4}{2.2} \text{ mb}$

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

Preliminary

3.  $\sigma_{TOT} = 99.4 \text{ mb} \pm 4.4 \text{ mb}$

$$\sigma_{TOT} = \sigma_{EL} + \sigma_{INEL}$$

Preliminary

4.  $\sigma_{TOT} = 97.7 \text{ mb} \pm \frac{2.9}{2.4} \text{ mb}$

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

# Luminosity

# Luminosity calibration run Oct'11

$$\sigma_{\text{tot}} = \frac{16\pi}{1 + \varrho^2} \frac{dN_{\text{el}}/dt|_{t=0}}{N_{\text{el}} + N_{\text{inel}}}, \quad \mathcal{L} = \frac{1 + \varrho^2}{16\pi} \frac{(N_{\text{el}} + N_{\text{inel}})^2}{dN_{\text{el}}/dt|_{t=0}}.$$

$$\mathcal{L}_{\text{CMS}} = 82.8 \mu\text{b}^{-1} \pm \sim 4\% \quad [\text{from HF \& offline corrections}]$$

**Preliminary**

$$\mathcal{L}_{\text{TOTEM}} = 84.3 \mu\text{b}^{-1} \pm \sim 4\% \quad [\text{from Method 4 formulae above}]$$

$\Delta \sim 2\%$  ; consistency within systematics (also with HF vs pix calibration)

Interesting to predict also luminosity for June'11 data >>>

# Luminosity calibration run Jun'11

Method 3 allows computing the ratio  $\sigma_{\text{INEL}} / \sigma_{\text{EL}}$   $\mathcal{L}$ -independent and  $\rho$ -independent

Combined with the result of Method 4 this gives  $\sigma_{\text{INEL}}$  and  $\sigma_{\text{EL}}$   $\mathcal{L}$ -independent

$\sigma_{\text{EL}}$   $\mathcal{L}$ -independent and physics rates $_{\text{EL}}$  measured in June give  $\mathcal{L}$

$$\mathcal{L}_{\text{CMS}} = 1.65 \mu\text{b}^{-1} \pm \sim 4\% \quad [\text{used in published EPL96}]$$

**Preliminary**

$$\mathcal{L}_{\text{TOTEM}} = 1.65 \mu\text{b}^{-1} \pm \sim 4.6\%$$

Consistency within systematics (in June HF needs less pix recalibration)



# Acknowledgements

The TOTEM experiment is grateful to CMS for the collaboration on the luminosity and on the trigger for realizing joint runs.

The TOTEM collaboration is grateful to the accelerator groups for the development of the dedicated optics and for the system operations.