TOTEM status report

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on behalf of TOTEM
collaboration

- analysis of 2010 data
- shutdown activities
- 2011 data taking
Detector setup at 2010 data taking

$3.1 \leq |\eta| \leq 4.7$

$5.3 \leq |\eta| \leq 6.5$

T1  
T2

RP 147
Near  
Top  
Bottom
Far

BPM  
BLM

RP 220
Near  
Top  
Bottom
Far

BPM  
BLM

Horizontal Pot  
Vertical Pots  
BPM

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Page 2
Elastic pp scattering – event topology

- one single track coincidence on each side of IP5 in a diagonal configuration

- single track coincidence in near-far top or near-far bottom pots on same side of IP5

2 diagonals: top 45 – bottom 56
bottom 45 – top 56
Low $\xi$ requirement

\( x \approx 0 \), compatible with $\xi = 0$
Collinearity requirement

scattering angle $\theta^*$ left = scattering angle $\theta^*$ right
(within spread due to beam divergence)

$\theta_{x,45}^* \text{ vs } \theta_{x,56}^*$

$\theta_{y,45}^* \text{ vs } \theta_{y,56}^*$

minimize optics dependence:
$\theta_y^*$ from $y^{RP}$ (trigger)
$\theta_x^*$ from $\theta_x^{RP}$

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Elastic pp scattering $dN/dt$

Excellent optics understanding: agreement of 2 diagonals with different optics !!

Diagonals:
- Top 45 bottom 56
- Bottom 45 top 56

RPs @ $7\sigma_{beam}$
All requirements

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Elastic pp scattering $dN/dt$

TOTEM preliminary

$\sqrt{s} = 7$ TeV,
$\int L dt = 6.5$ nb$^{-1}$

RPs @ $7\sigma_{\text{beam}}$

62k events

$+ \sim 10k$ elastic candidates in $|t| > 2.2$ GeV$^2$

(good $|t|$ overlap)

$\int L dt = 3.9$ pb$^{-1}$

with RPs @ $18\sigma_{\text{beam}}$

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### 7 sigma, fill 1455

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<th>run time [s]</th>
<th>files</th>
<th>events</th>
<th>IntegL [nb⁻¹]</th>
<th>DAQ eff</th>
<th>Trigger eff 45_bot_56_top</th>
<th>Trigger eff 45_bot_56_top</th>
<th>prescaler</th>
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</table>
Elastic pp scattering $d\sigma/dt$ ...

TOTEM preliminary
\( \sqrt{s} = 7 \text{ TeV} \)
\( \int \mathcal{L} \, dt = 6.5 \text{ nb}^{-1} \)
RPs @ 7\( \sigma_{\text{beam}} \)

Missing: correction due to t acceptance + RP detector & tracking efficiency
T2 data analysis

- review of material & geometry, understanding of simulation
- tuning of detector performance
data-Monte Carlo agreement
- study of trigger and tracking efficiency

...
Reconstructed $dN/d\eta$ (Not unfolded)

$\frac{dN_{ch}}{d\eta}$ analysis with T2

keypoint: primary-secondary separation

unfold for efficiency, bin migration & secondaries

data from collisions with low pileup rate

systematics:
– vary input momentum distribution of primaries & number of neutrals in MC ("green band") – no significant difference Pythia/Phojet
– more conservative also vary analysis cuts ("yellow band")
Detector installation shutdown 2010/11

3.1 \leq \eta \leq 4.7

5.3 \leq \eta \leq 6.5

T1

RP147

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RP147 installation

- All 12 silicon detector packages for RPs at 147 m installed.
- All services connected & tested, all sensors cooled down.

- Sensors & front-end electronics powered up & tested
- Integrated into DAQ, DCS & trigger
- In progress: interlock tests
- To be done: collimator-based alignment
T1 telescope installation

- All 4 T1 quarters installed in CMS endcap.
- All services connected & tested.
- CSC chambers & front-end electronics powered up & tested.
- Integrated in DAQ & DCS.
- First proton proton collision data taken March 13th.

Installation support of CMS much appreciated !!

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First T1 data

pp collisions at $\sqrt{s} = 2.38$ TeV with T2 MB trigger.

data taking settings, reconstruction algorithms & selection to be optimized.

$V(x) = 3 \text{ cm}$

$V(y) = 3 \text{ cm}$

$V(z) = 1.4 \text{ m}$

$\sigma(z) \sim 1.4 \text{ m}$

$\sigma(x) & \sigma(y) \sim 3 \text{ cm}$

T1 acceptance: $3.1 \leq |\eta| \leq 4.7$

CSC inefficiency (solvable via SW)

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T2 shutdown activities

- Change one 11\textsuperscript{th} card
- Addition of HV filters $\Rightarrow$ reduced noise
- Change of 3 chambers partially broken GEM chambers on minus side

More uniform detector behaviour & reduced noise
Running strategy

RP alignment at nominal conditions after each optics change
... some data taking close to beam directly after
1 nominal bunch plus a few minibunches (1-2 x10^{10} p/b)

- Special runs with low intensity & normal optics:
  - approach RP to ~5 \sigma to reach lowest |t| around 0.2 GeV^2
  - pileup-free data for T2 and T1 (~ 10^{-2}) \Rightarrow
diffractive physics with T1, T2, RP \Rightarrow increase statistics for DPE
several (20) pilots (1-2 x10^{10} p/b)

- Constant running at ~14 \sigma in normal runs
  - improve statistics at large |t/-values
  - 50 ns operation should be OK for RP

- Prepare \beta^* = 90 m optics \Rightarrow
  measure \sigma_{tot} and L in special runs
Conclusions

- Finalizing medium & high |t| elastic dσ/dt measurement
- Good progress on understanding of T2 data & dN_{ch}/dη analysis
- TOTEM detector setup completed !!
- First data with T1 very promising
- Eagerly waiting higher β* to make σ_{tot}
The End
$dN/d\eta$ comparison

$p_T > 100$ MeV, $|\eta| < 2.5$, $n_{ch} \geq 2$

$\sqrt{s} = 7$ TeV

ATLAS Preliminary

Corrected data and Phojet/Pythia comparison

TOTEM preliminary

$\sqrt{s} = 7$ TeV
Low $\xi$ requirement

\[ x_{RP,56} \leftrightarrow \theta_x, \text{RP}56 \]

\[ y_{RP \text{ near,45}} \leftrightarrow y_{RP \text{ far,45}} \]
\[ (y_{RP \text{ near,45}} \leftrightarrow \theta_y, \text{RP45}) \]

Low $\Delta p/p$ protons

\[ \sigma(\Delta y) \approx 20\mu m \]

Inelastic & background
Elastic analysis

Good understanding of optics crucial!!
detailed analysis: good optics precision (<10%) & good agreement with data.

Elastic selection:

- **Topological requirements**
  - Tracks in both RPs/arm + diagonal configuration

- **Collinearity requirements**
  - $\theta_{45}^*$ vs $\theta_{56}^*$ compatible within beam divergence
    To minimize dependence on optics uncertainties:
    $\theta_x^*$ reconstructed from $\theta_x^{RP}$ and $\theta_y^*$ from $y^{RP}$

- **Low $\xi$ requirements**
  - Elastic-like dependence between position & angle in each RP arm