7 TeV

PG 23/9/2016

At 7 TeV both experiments used the luminosity dependent method
(TOTEM in addition also used the luminosity independent method).

Using the luminosity dependent method one can easily show that if there is a normalisation error
in the scale of the differential elastic cross section (best candidates are luminosity and track efficiency)
of the order of 2ε i.e. $Scale_{el}^{True} = (1+2\varepsilon)\ Scale_{el}^{measured}$

then

$$\sigma_{tot}^{True} / \sigma_{tot}^{Measured} = 1+\varepsilon$$

$$\sigma_{el}^{True} / \sigma_{el}^{Measured} = 1+2\varepsilon$$

$$\sigma_{inel}^{True} / \sigma_{inel}^{Measured} = 1+2/3\varepsilon$$

7 TeV

A scale error of one experiment relative the other of 2 ε = 0.06 = 6 % describes well the data

$\sigma_{tot}^{TOTEM}/\sigma_{tot}^{ATLAS}$ = 1+ε	= 1.03	(If ε =0.03)
$\sigma_{el}^{TOTEM}/\sigma_{el}^{ATLAS}$ = 1+2ε	= 1.06	
$\sigma_{inel}^{TOTEM}/\sigma_{inel}^{ATLAS}$ = 1+2/3ε	=1.02	

Data 7 TeV

$\sigma_{tot}^{TOTEM}/\sigma_{tot}^{ATLAS}$	=98.6 /95.35	= 1.034
$\sigma_{el}^{TOTEM}/\sigma_{el}^{ATLAS}$	= 25.43/24.0	= 1.06
$\sigma_{inel}^{TOTEM}/\sigma_{inel}^{ATLAS}$	= 73.15/71.3	=1.026

8 TeV

At 8 TeV the comparison is more complicated because ATLAS still uses
the luminosity dependent method while TOTEM used only the
luminosity independent method .
However it turns out that one gets similar(though not identical) formulae for the luminosity independent method replacing the scale error of the differential elastic cross section
with a measurement error in the inelastic rate,

With 2ε being the relative mistake in the inelastic rate
i.e. $N_{inel}^{True} = (1-2\varepsilon)\, N_{inel}^{measured}$ in a similar way one gets

$$\sigma_{tot}^{True} / \sigma_{tot}^{Measured} = 1+3/2\varepsilon$$

$$\sigma_{el}^{True} / \sigma_{el}^{Measured} = 1+3\varepsilon$$

$$\sigma_{inel}^{True} / \sigma_{inel}^{Measured} = 1+\varepsilon$$

8 TeV

$\sigma_{tot}^{TOTEM} / \sigma_{tot}^{ATLAS} = 1+\varepsilon = 1.06$ (If $\varepsilon = 0.06$)

$\sigma_{el}^{TOTEM} / \sigma_{el}^{ATLAS} = 1+2\varepsilon = 1.12$

$\sigma_{inel}^{TOTEM} / \sigma_{inel}^{ATLAS} = 1+2/3\varepsilon = 1.04$

A scale error of 12 % using the luminosity dependent method

These are equivalent

$\sigma_{tot}^{TOTEM} / \sigma_{tot}^{ATLAS} = 1+3/2\varepsilon = 1.06$ (If $\varepsilon = 0.04$)

$\sigma_{el}^{TOTEM} / \sigma_{el}^{ATLAS} = 1+3\varepsilon = 1.12$

$\sigma_{inel}^{TOTEM} / \sigma_{inel}^{ATLAS} = 1+\varepsilon = 1.04$

An error of the inelastic rate of 8 %
For the luminosity independent method

Data 8 TeV

$\sigma_{tot}^{TOTEM} / \sigma_{tot}^{ATLAS} = 101.7 / 96.1 = 1.06$

$\sigma_{el}^{TOTEM} / \sigma_{el}^{ATLAS} = 27.1/24.3 = 1.12$

$\sigma_{inel}^{TOTEM} / \sigma_{inel}^{ATLAS} = 74.7/71.7 = 1.04$

DEMOCRATIC SHARING
A scale error of the differential elastic cross section of ATLAS of 6% and an error in the inelastic rate of TOTEM of 4 % gives perfect agreement with data