Proton opacity in light of LHC diffractive data

Misha Ryskin, Alan Martin, Valery Khoze

- Possible to describe all pp (and $p\bar{p}$) $d\sigma_{el}/dt$ collider data in terms of 3-channel eikonal model of a single Pomeron

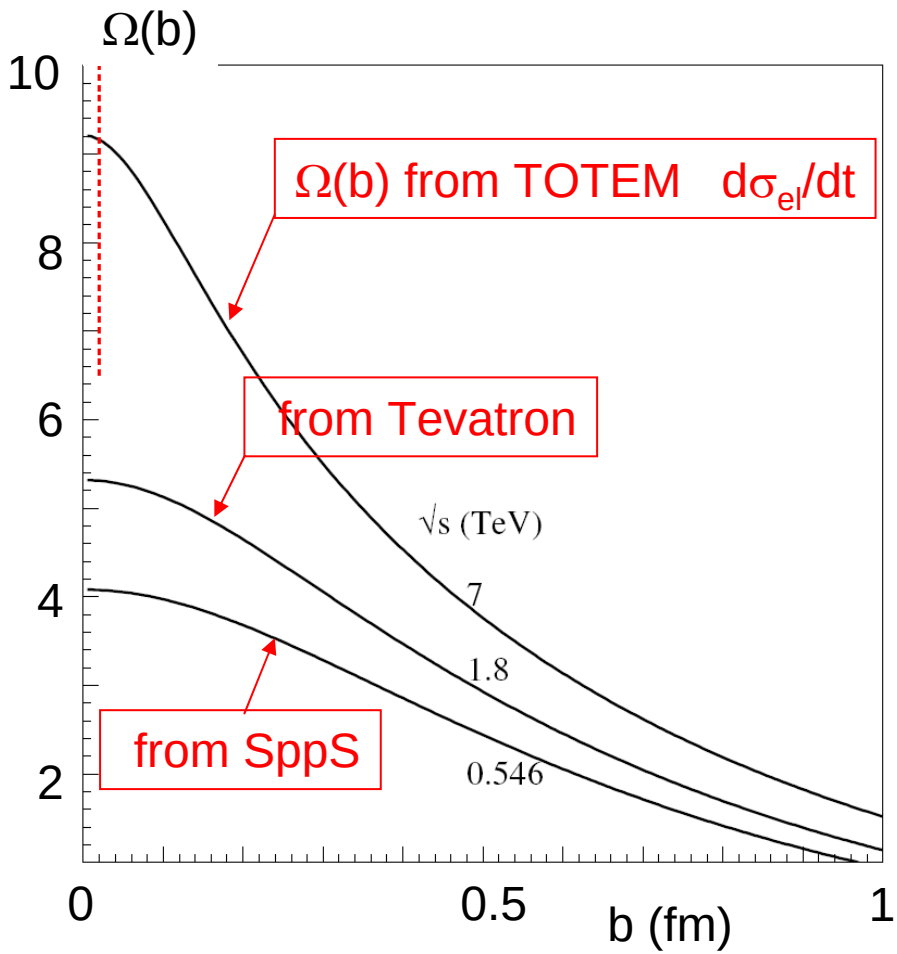
- Parameter-free description of ATLAS data for $d\sigma/d\Delta\eta$ with rapidity gaps $\Delta\eta > 5$ -- absorptive corrections appreciably modify the value and the $\Delta\eta$ behaviour

- Will CMS measure $d\sigma/d\Delta\eta$ versus $\Delta\eta$?

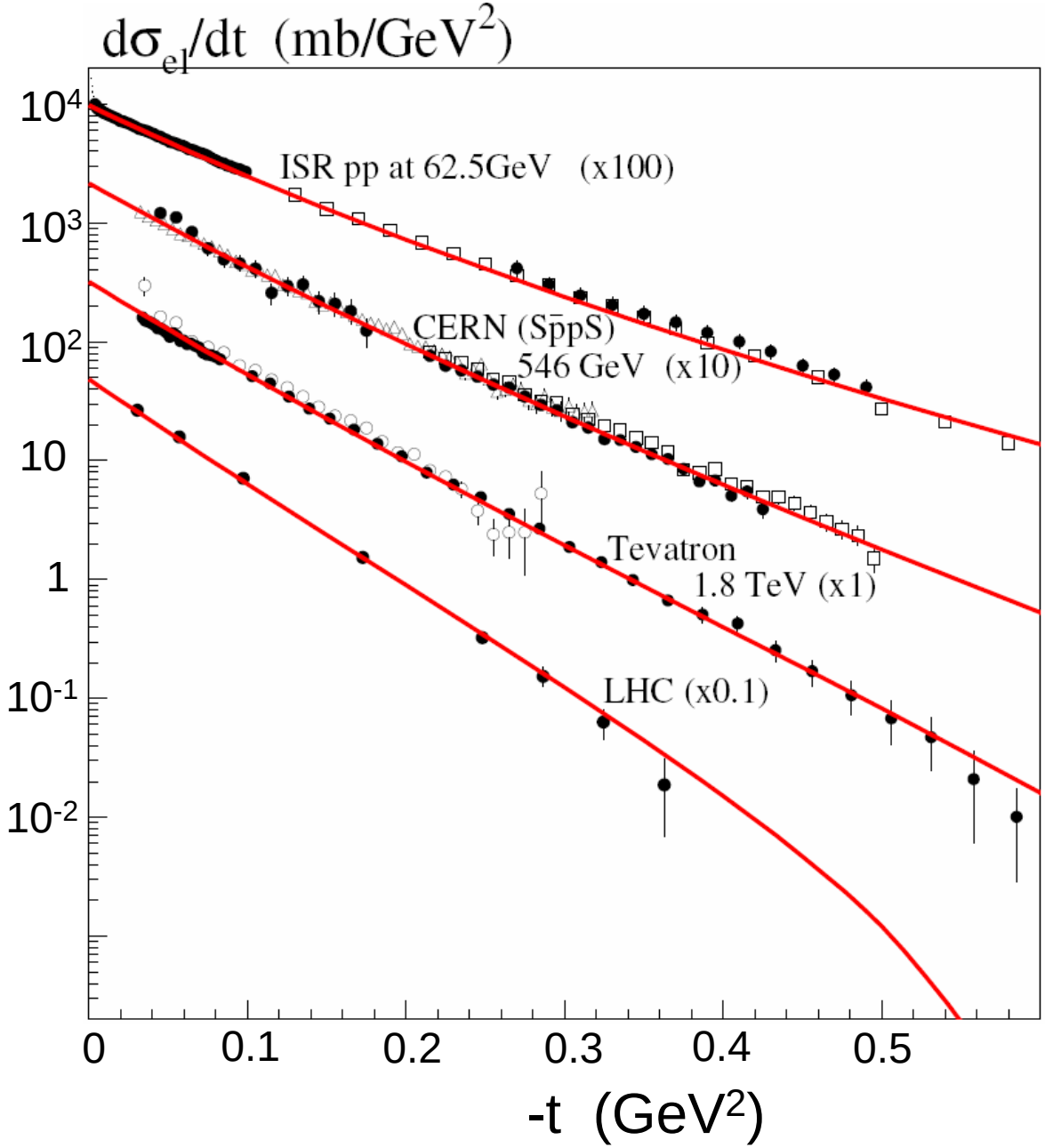
$$\mathrm{Im}T(b) = \int \sqrt{\frac{d\sigma_{\mathrm{el}}}{dt}\frac{16\pi}{1+\rho^2}}\, J_0(q_t b)\, \frac{q_t dq_t}{4\pi} \qquad T(b) = i(1-e^{-\Omega(b)/2})$$

$\frac{d\sigma_{\mathrm{el}}}{dt}$ data → Im T(b) → Ω(b)

so opacity Ω(b) is determined directly by data



Altho' TOTEM indicates growth of opacity for b~0 (saturation) --- still possible to describe all collider with a single Pomeron



V.good description of forward peak obtained with ecomonical parametrization of 3-ch eikonal with 3 diffractive eigenstates.

Straightforward to fit TOTEM diffractive dip at $-t \sim 0.53$ GeV^2, but at expense of more complicated paramet^n of diffractive estates.

Now use resulting opacity to calculate ATLAS rap gap X-sect.

but first look at σ(inel)

Lets look at σ_{inel}

TOTEM

$\sigma_{inel} = \sigma_{tot} - \sigma_{el}$
$= 73.5$ mb

(KMR fit $\sigma_{inel} = 73.6$ mb)

ignore exptal errors
just to show trends!

Results of KMR description

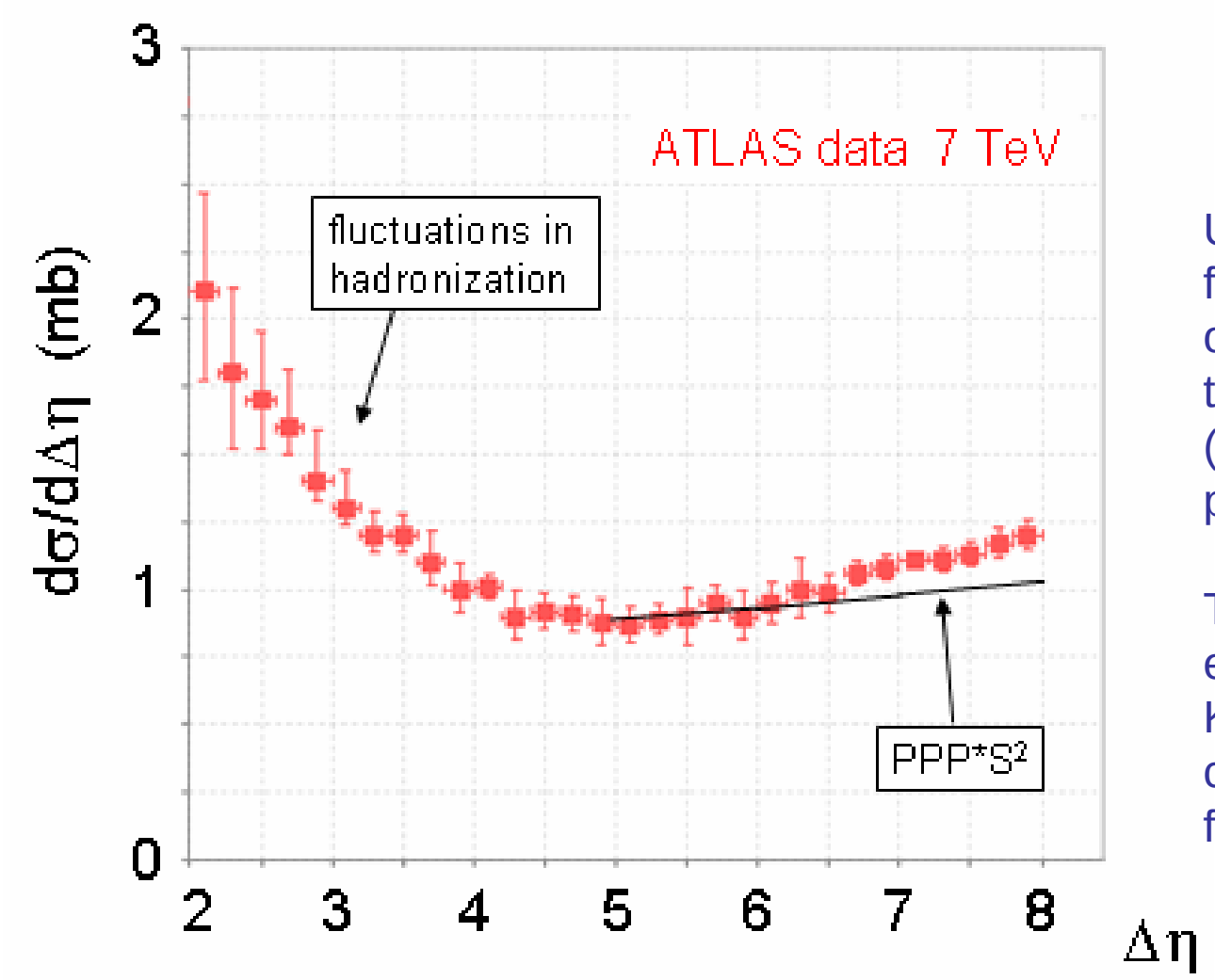
energy	σ_{tot}	σ_{el}	B	$\sigma^{SD}_{low\,M}$	$\sigma^{DD}_{low\,M}$
0.0625	43.8	7.3	13.4	3.0	0.3
0.546	65.2	13.4	16.1	4.8	0.5
1.8	79.3	17.9	18.0	5.9	0.7
7	97.4	23.8	20.3	7.3	0.9
14	107.5	27.2	21.6	8.1	1.1
100	138.8	38.1	25.8	10.4	1.6

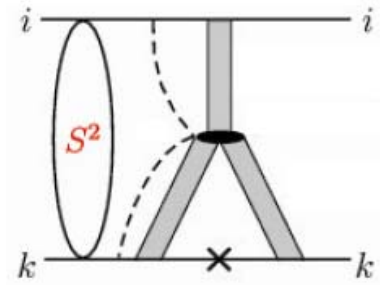
ATLAS, CMS measure $\sigma_{inel} \sim 60$ mb for $M > 15.7$ GeV

~ 64 mb after allowing for $3 < M < 15.7$ GeV
high-mass diff^{ve} dissoc^{n} using ATLAS
$d\sigma/d\Delta\eta \sim 1$ mb/unit rapidity

Conclude missing 73.5 – 64 = 9.5 mb is due to low-mass ($M<3$ GeV) dissoc^{n}

(note KMR model gives $\sigma_{(low\ M)} = 7.3 + 0.9 = 8.2$ mb -- so consistent)





Use known opacity Ω(b) for parameter-free calc^{n} of absorptive corrections to triple-Pomeron formula. (Would not expect pred^{n} to be so precise)

The smaller slope is expected, since this KMR model does not contain high k_T partons forming Pomeron