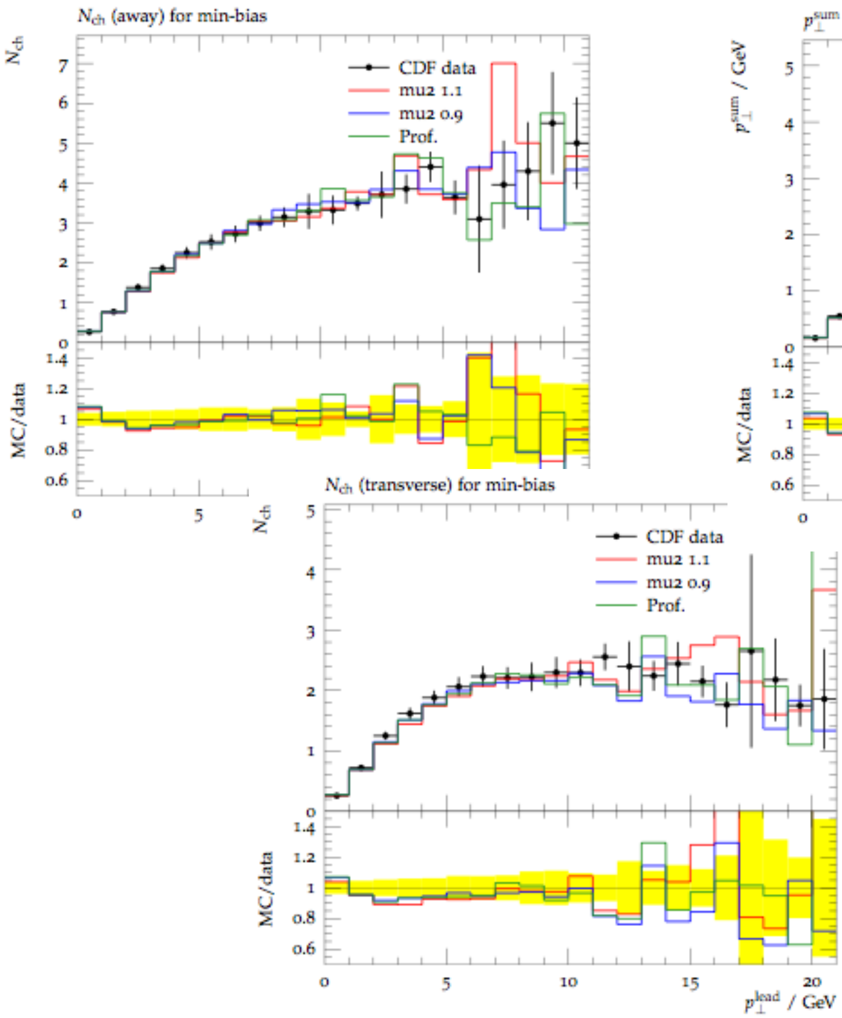
The University of Manchester

Underlying event at 1800 GeV

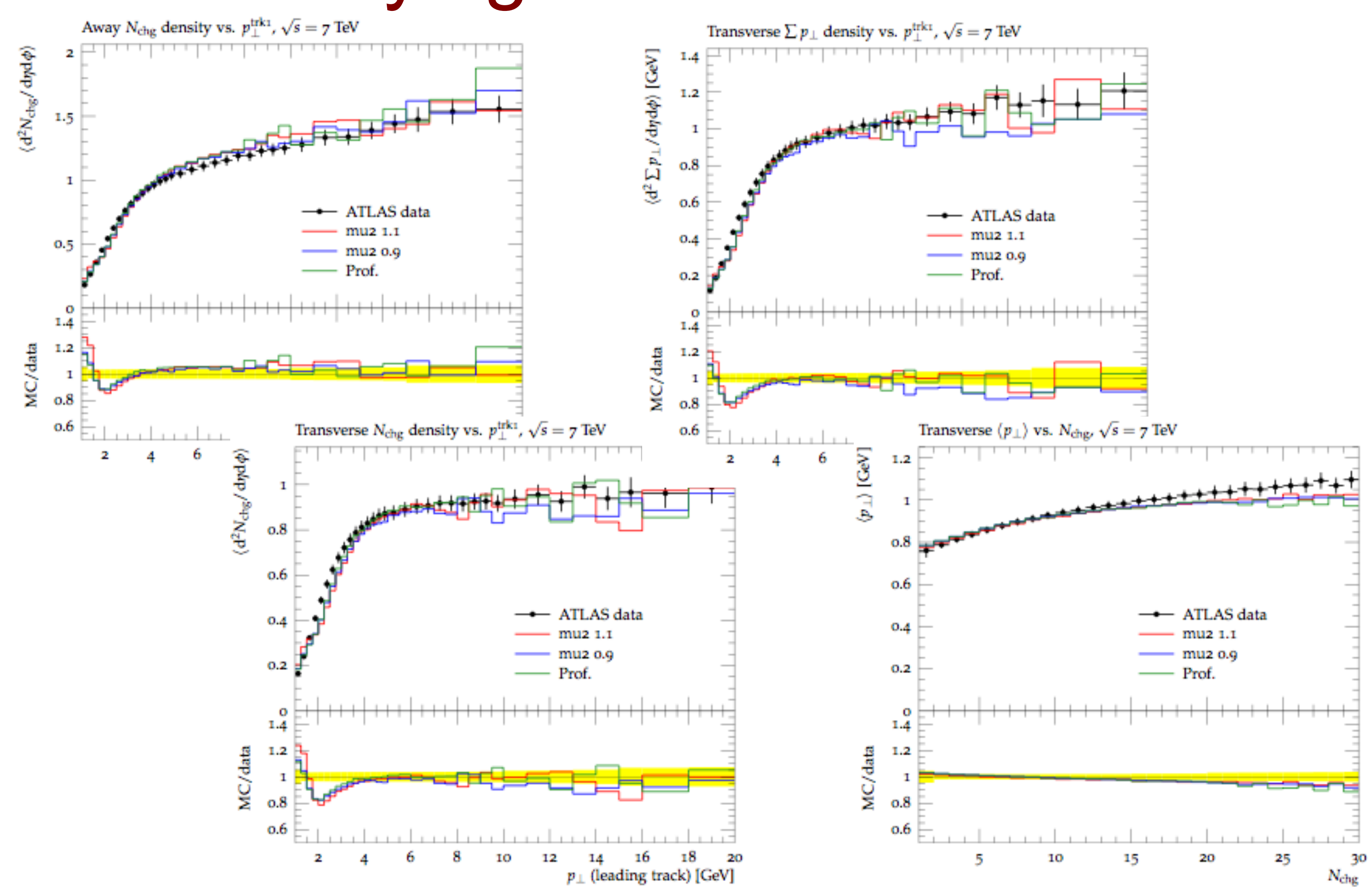


Towards region?

SM@LHC

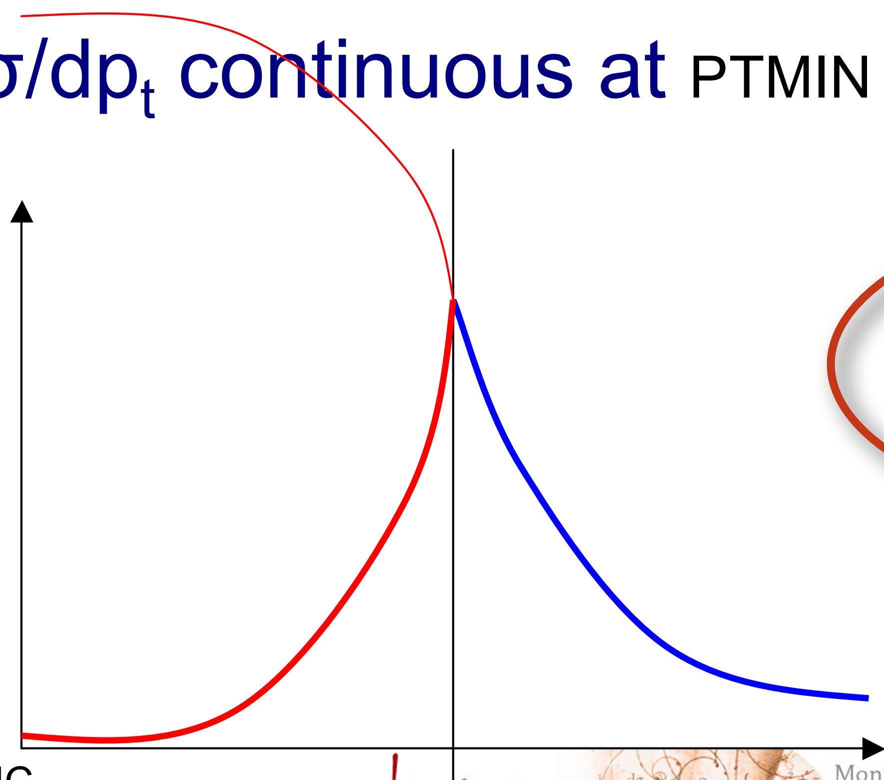
The University of Manchester

Underlying event at 7000 GeV



Final state implementation

- Pure independent perturbative scatters above PTMIN
- Gluonic scattering below PTMIN with total $\sigma_{soft,inc}$ and Gaussian distribution in p_t
- $d\sigma/dp_t$ continuous at PTMIN



→ possibility that entire process could be described perturbatively?

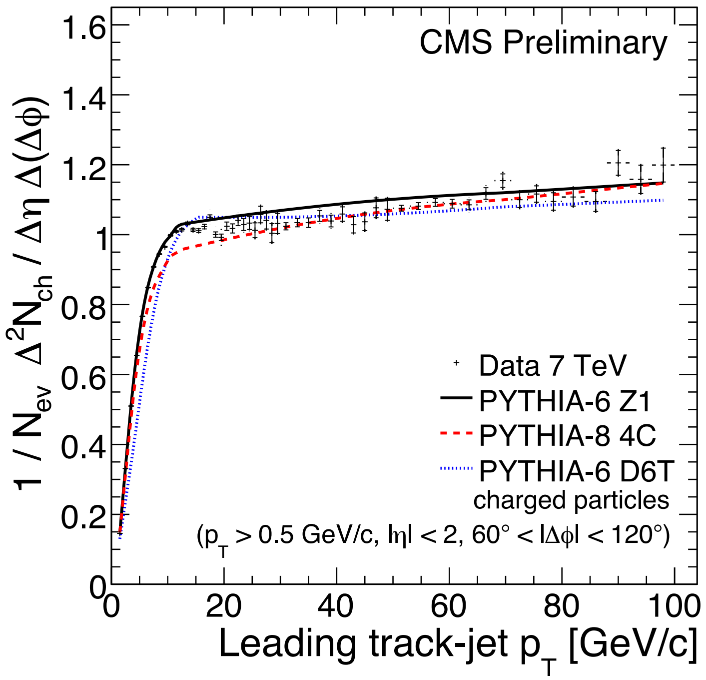
?

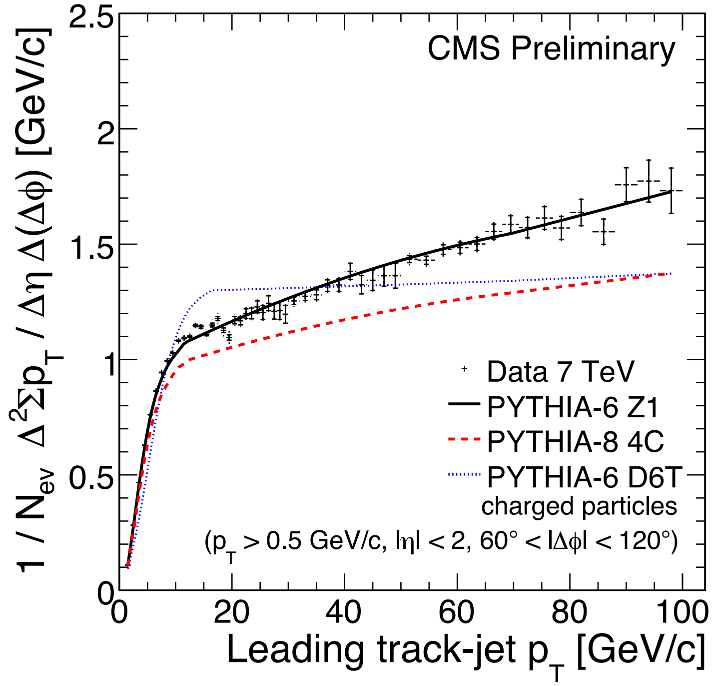
‘Interesting features’ of Herwig++ #1

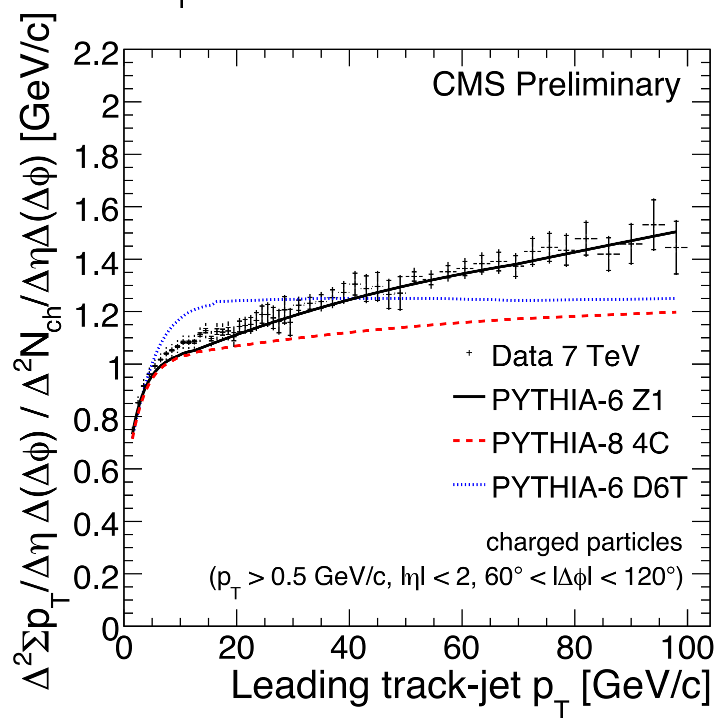
- The additional scatters are not p_t ordered, so it can occasionally happen that a high p_t jet comes from a low p_t primary scattering event
  - this is a disaster if you generate weighted primary scatters or mix event samples with different p_t ranges
  - it is safe to remove such events from your sample
    - provided they are a small fraction of the eikonal cross section
    - i.e. provided it is an underlying event not part of a soft inclusive sample

CMS underlying event results

Track jet 7 TeV N_{ch} and $\sum p_T$ profiles — NEW! & PRELIMINARY



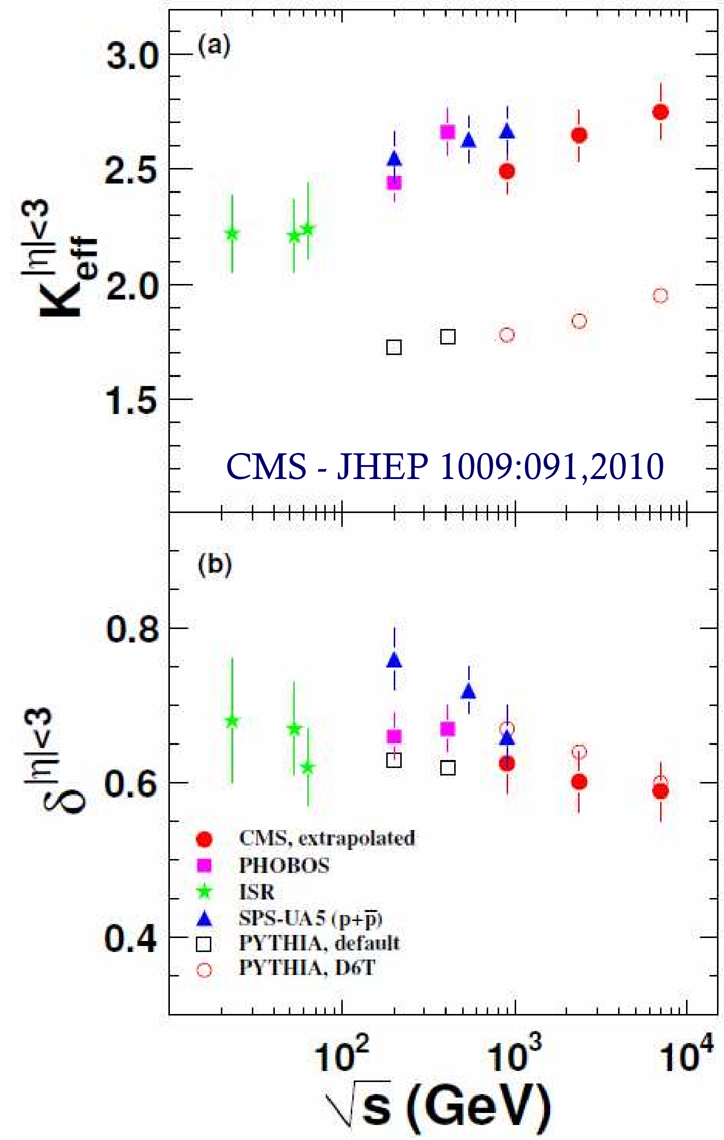




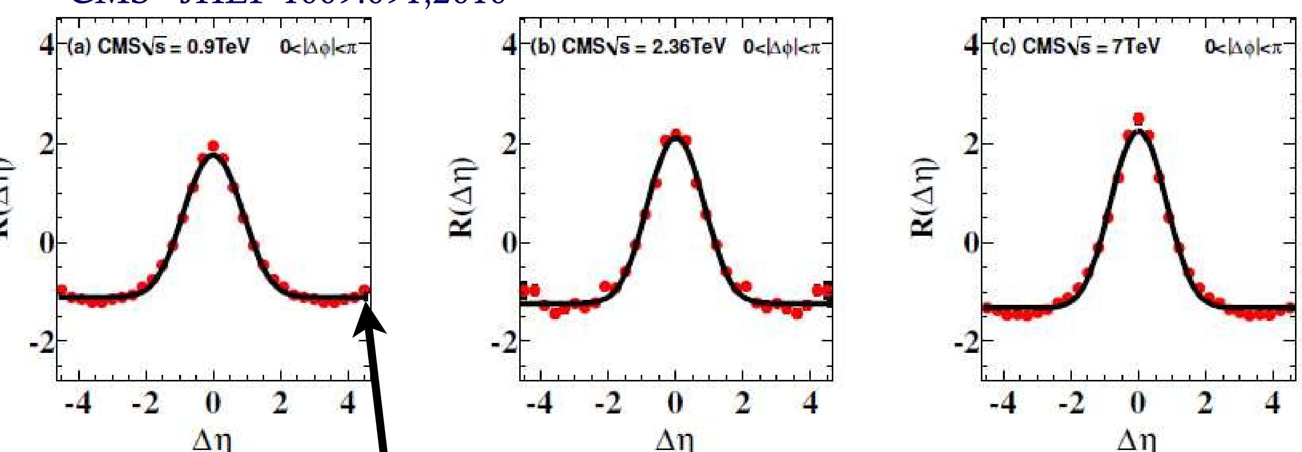
c.f. first talk and interaction between hadronisation params and UE

Δη vs Δφ correlations

- Short-range correlations in Δη, studied in MinBias events, are characterized using a simple "independent cluster" parametrization $R(\Delta\eta) = \alpha \left[\frac{\Gamma(\Delta\eta)}{B(\Delta\eta)} - 1 \right]$ in order to quantify their strength (cluster size) and their extent in η (cluster decay width).



CMS - JHEP 1009:091,2010

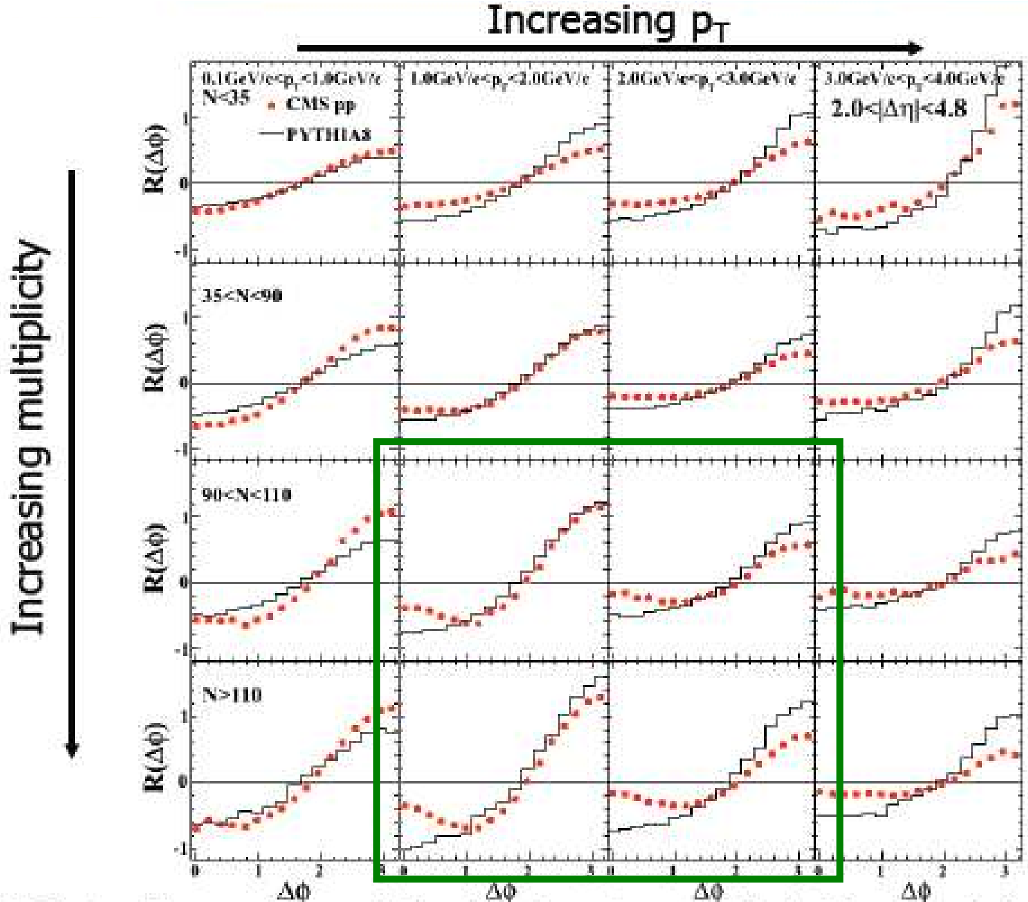


PYTHIA reproduces the energy dependence, matches the cluster width δ in data, underestimates the cluster size K_{eff}

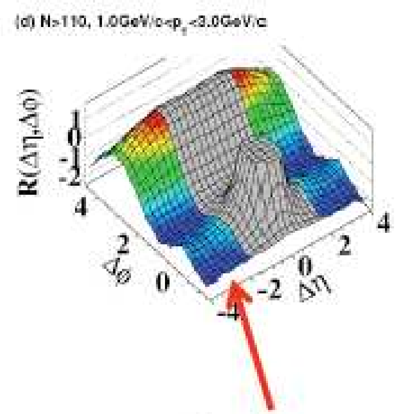
Fit driven by tails, tails = diffraction?

Should we care about this when the cluster Gaussian doesn't fit the data very well anyway

pp: Characterizing the ridge



CMS 7 TeV pp



Project $|\Delta\eta| > 2$ onto $\Delta\phi$

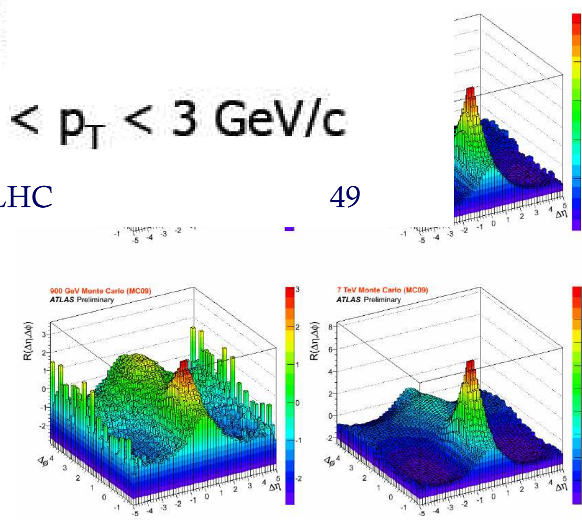
CMS - JHEP 1009:091,2010

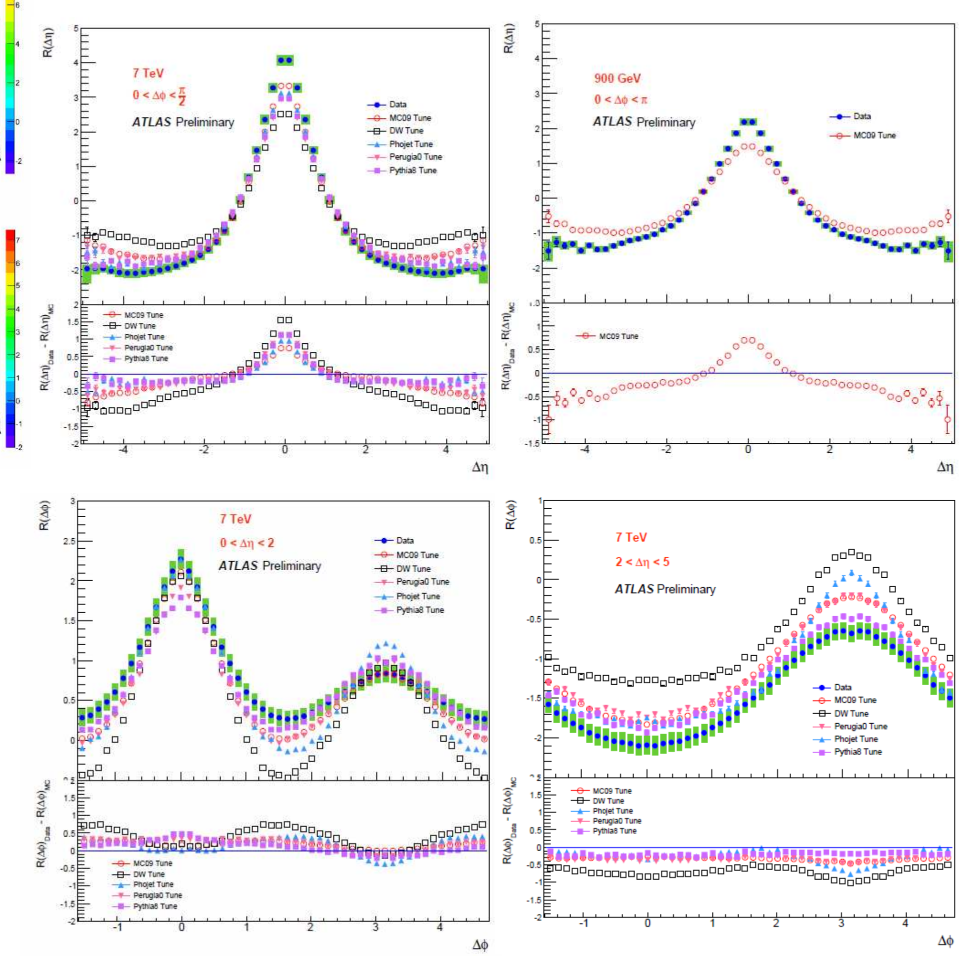
"Ridge" maximal for highest multiplicity and $1 < p_T < 3$ GeV/c

Changing of correlations with multiplicity -> possibility to use for tuning UE with

ing: Δη vs. Δϕ correlations

LAST SECOND UPDATE: ATLAS-CONF-2011-055

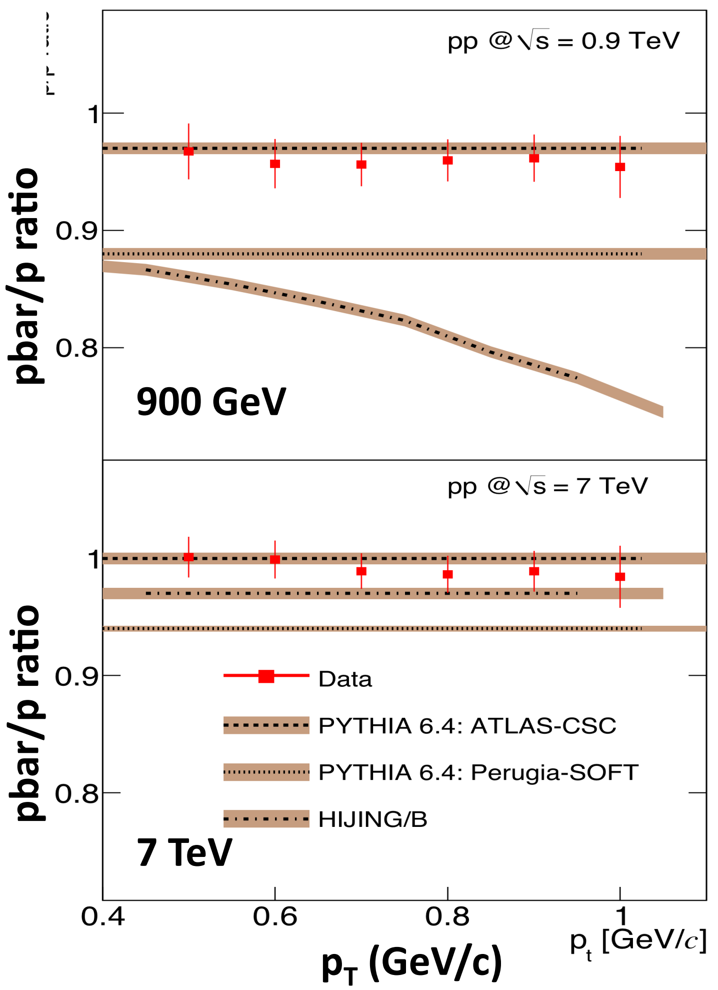




- "The structure of the correlation was explored in more detail by projecting the two-dimensional distribution into both Δη and Δϕ."
- "The results have been compared to Monte Carlo samples which show a similar complex structure in Δη and Δϕ but fail to reproduce the strength of the correlations seen in data."

Phys Rev Lett Vol.105, No.7, (2010)

ALICE anti-p/p Results

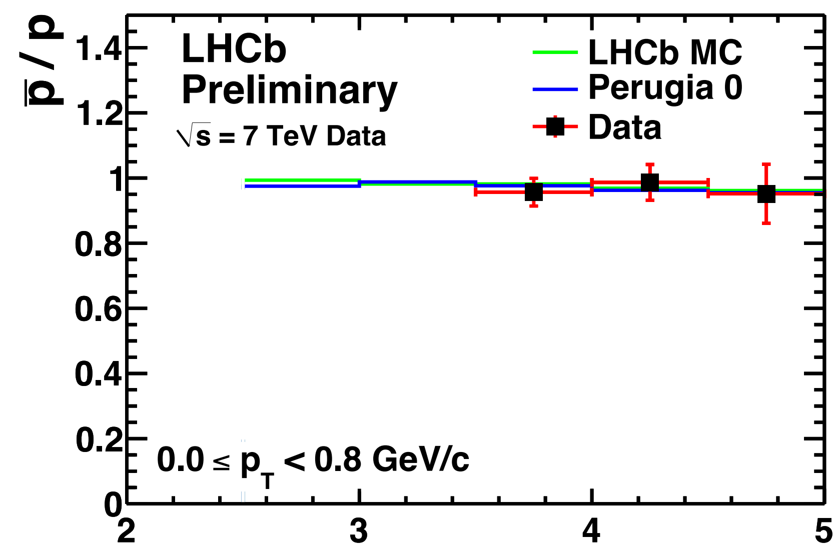


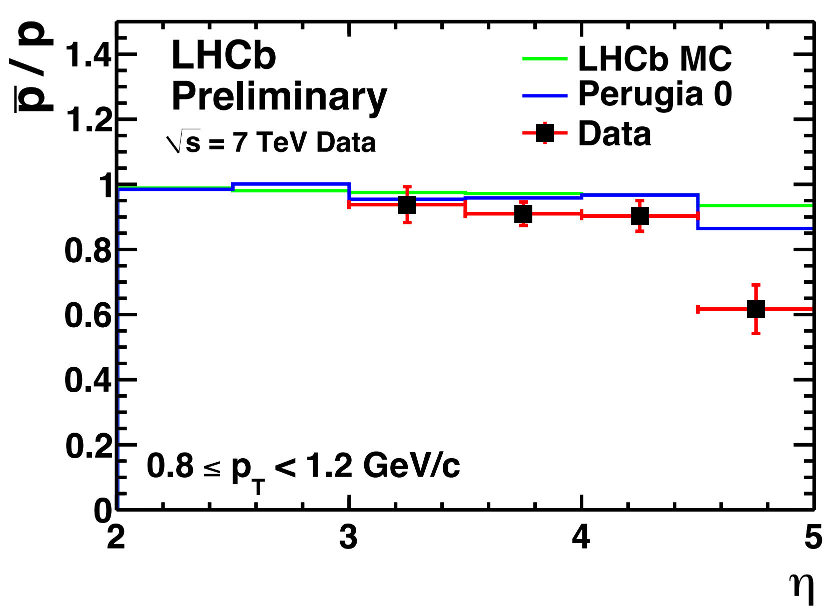
- No pT dependance
  - Either @ √s = 0.9 or 7 TeV
-
-
  - Ratio considered as a fnc. of η within bins of pT:
    - 0<pT<0.8 GeV
    - 0.8<pT<1.2 GeV
    - pT>1.2

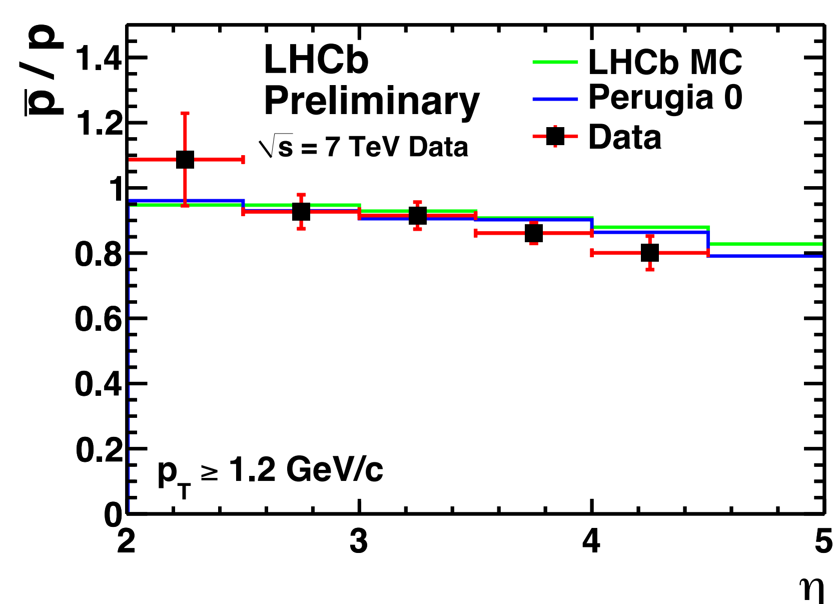
LHCb-CONF-2010-003

LHCb anti-p/p Results

$\sqrt{s} = 7$ Te



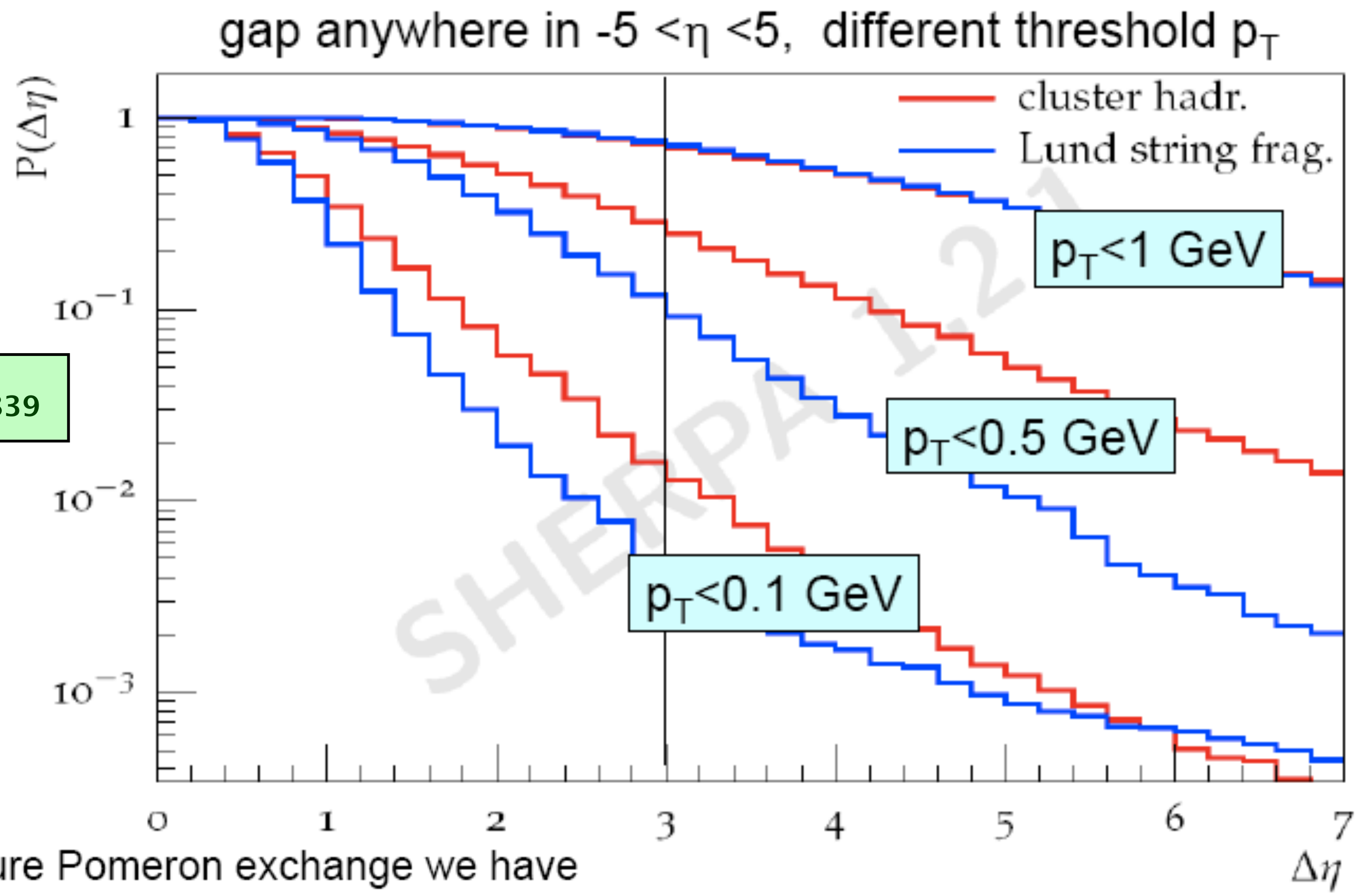




V. Khoze

Prob. of finding gap larger than $\Delta\eta$ in inclusive event at 7 TeV due to fluctuations in hadronization

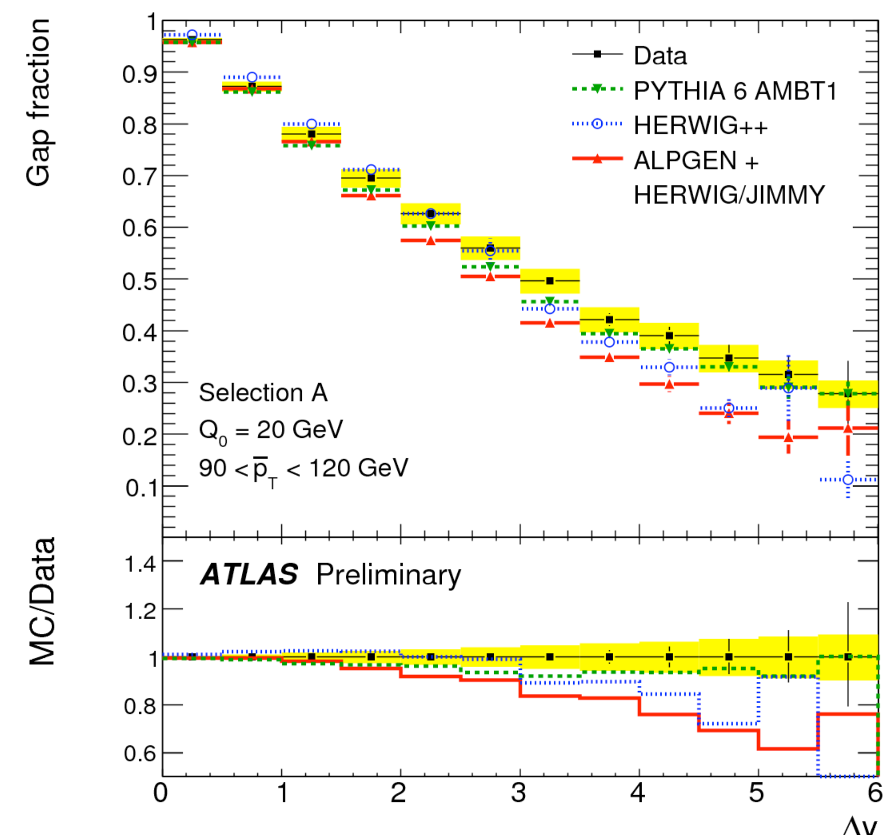
KKMRZ, arXiv:1005.4839



So to study pure Pomeron exchange we have

either to select much larger gaps

or to study the Δy dependence of the data, fitting so as to subtract the part caused by Reggeon and/or fluctuations.



The underlying event

"There is no such thing as ~~the underlying event~~" – R. Field, MPI@LHC, 2008

diffraction?

- UE is mainly a name that we give to a certain class of observables (cf

"di

sei

Us

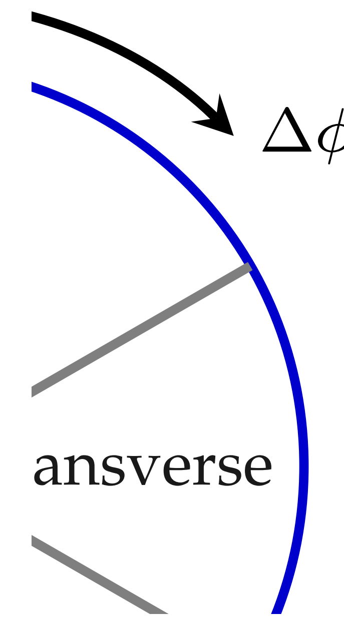
- Nc

frc

sta

eit

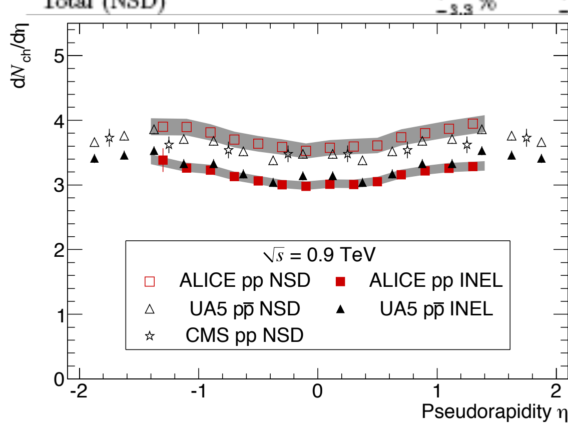
leading jet/track/Z

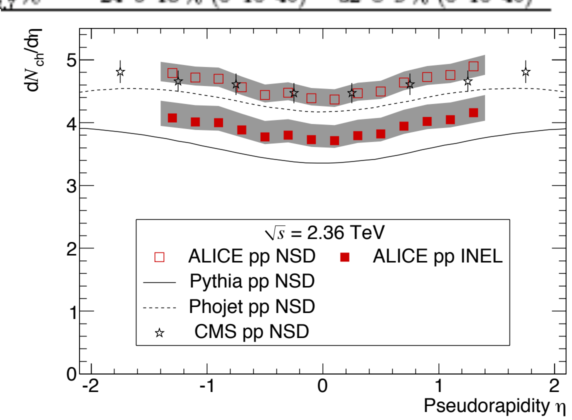


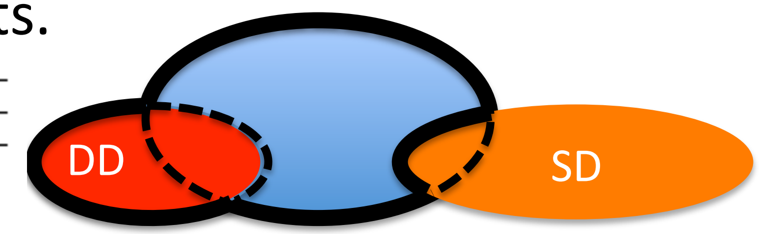
A practical issue for experiments

- NSD and INEL event classes defined to compare data between experiments. Corrections are largest contribution to systematic uncertainty in multiplicity measurements.

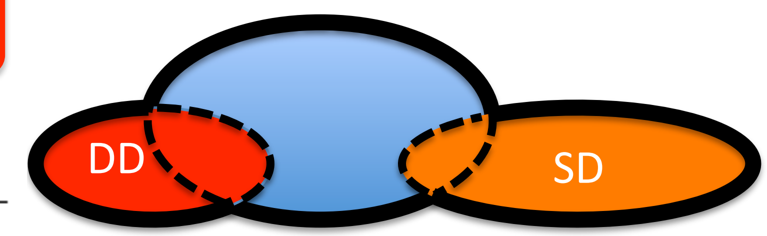
Uncertainty	$dN_{ch}/d\eta$ analysis		$P(N_{ch})$ analysis	
	0.9 TeV	2.36 TeV	0.9 TeV	2.36 TeV
Tracklet selection cuts	negl.	negl.	negl.	negl.
Material budget	negl.	negl.	negl.	negl.
Misalignment	negl.	negl.	negl.	negl.
Particle composition	0.5–1.0 %	0.5–1.0 %	included in detector efficiency	
Transverse-momentum spectrum	0.5 %	0.5 %	included in detector efficiency	
Contribution of diffraction (INEL)	0.7 %	2.6 %	3–0 % (0–5)	5–0 % (0–5)
Contribution of diffraction (NSD)	2.8 %	2.1 %	24–0 % (0–10)	12–0 % (0–10)
Event-generator dependence (INEL)	+1.7 %	+5.9 %	8–0 % (0–5)	25–0 % (0–10)
Event-generator dependence (NSD)	−0.5 %	+2.6 %	3–5–1 % (0–10–40)	32–8–2 % (0–10–40)
Detector efficiency	1.5 %	1.5 %	2–4–15 % (0–20–40)	3–0–9 % (0–8–40)
SPD triggering efficiency	negl.	negl.	negl.	negl.
VZERO triggering efficiency (INEL)	negl.	n/a	negl.	n/a
VZERO triggering efficiency (NSD)	0.5 %	n/a	1 %	n/a
Background events	negl.	negl.	negl.	negl.
Total (INEL)	$^{+2.5}_{-1.8}$ %	$^{+6.7}_{-3.1}$ %	9–4–15 % (0–20–40)	25–0–9 % (0–10–40)
Total (NSD)	$^{+3.3}_{-3.3}$ %	$^{+3.7}_{-2.7}$ %	24–5–15 % (0–10–40)	32–8–9 % (0–10–40)







NSD



INEL

To reduce uncertainties (cross-sections and kinematics): measure SD and DD processes at LHC, as precisely as possible

Diffraction studies with ATLAS

- Recent publication of the measurement of the inelastic cross section (arXiv:1104.0326v1)

$$\sigma\left(\xi > \frac{m_p^2}{s}\right) = 69.4 \pm 2.4(\exp.) \pm 6.9(extr.); \xi \equiv \frac{M_X^2}{s}$$

No p_T cut in this case, gives higher sensitivity to diffraction
ATLAS sensitivity down to $\xi > 5\times10^{-6}$
$M_X > 15.6$ GeV)

$$\mathbf{R_{SS}} = [10.02 \pm 0.03(\mathbf{stat})^{+0.1}_{-0.4}(\mathbf{syst})]\%$$

$$\frac{\mathbf{d}\sigma_{\mathbf{SD}}}{\mathbf{d}\xi} \propto \frac{1}{\xi^{1+\Delta}}(1+\xi); \quad \Delta \equiv \alpha(0) - 1;$$

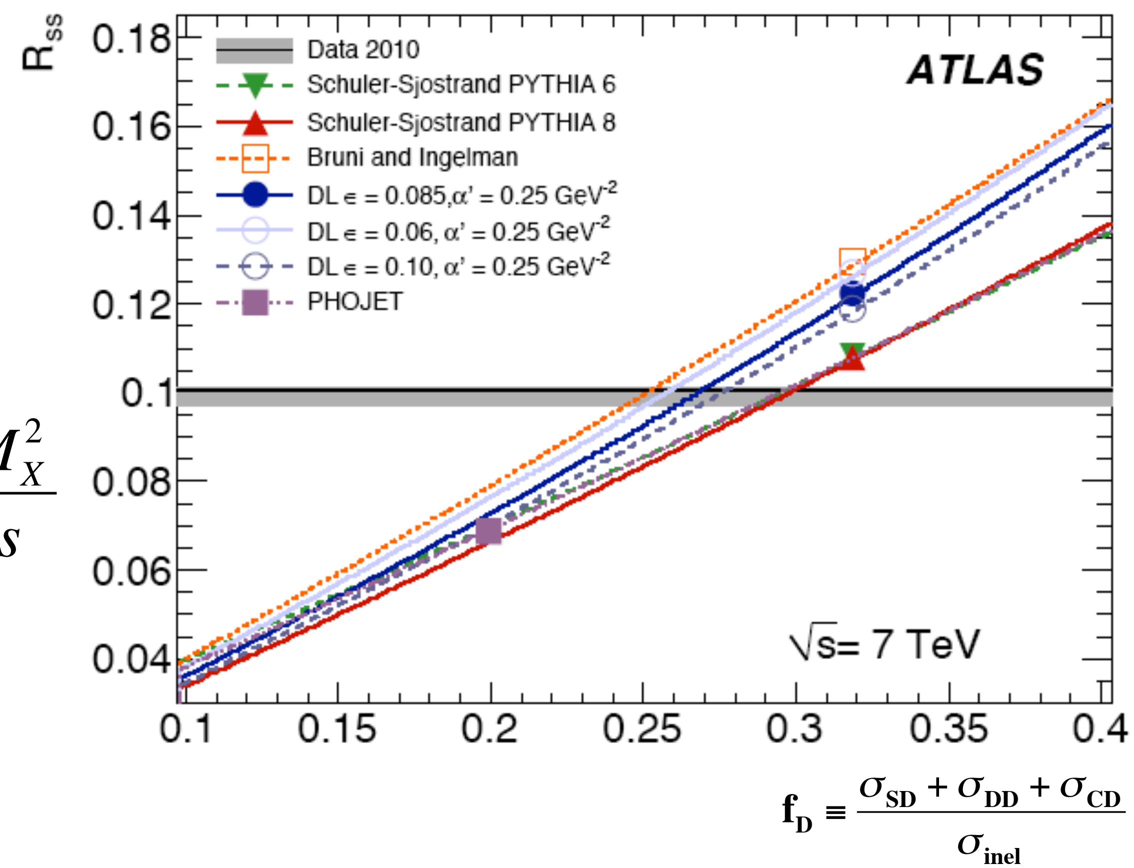
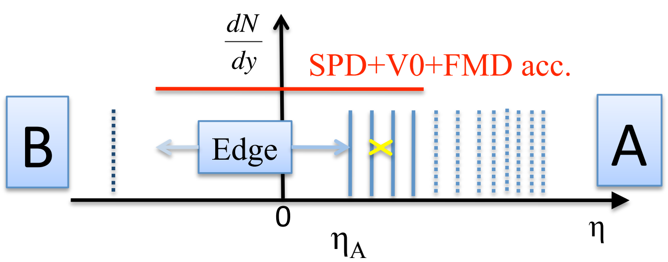


Figure 1: The ratio of the single-sided to inclusive event sample R_{ss} as a function of the fractional contribution of diffractive events to the inelastic cross-section f_D. The data value for R_{ss} is shown as the horizontal line with its systematic uncertainties (grey band). Also shown are predictions of several models as a function of an assumed value of f_D. The default f_D value (32.2% for all models but PHOJET which is 20.2%) is indicated by the markers.

of “tracks”, on an event per event basis

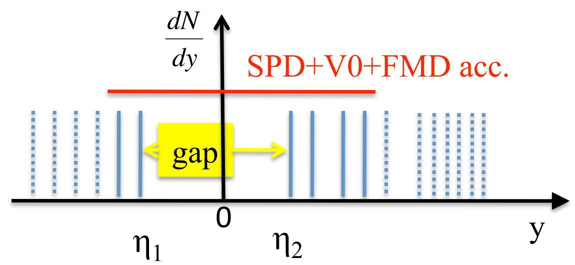
- **Classification of events into 1-arm or 2-arm triggers**

Example of A-side SD topology



1-arm trigger event

Example of DD topology

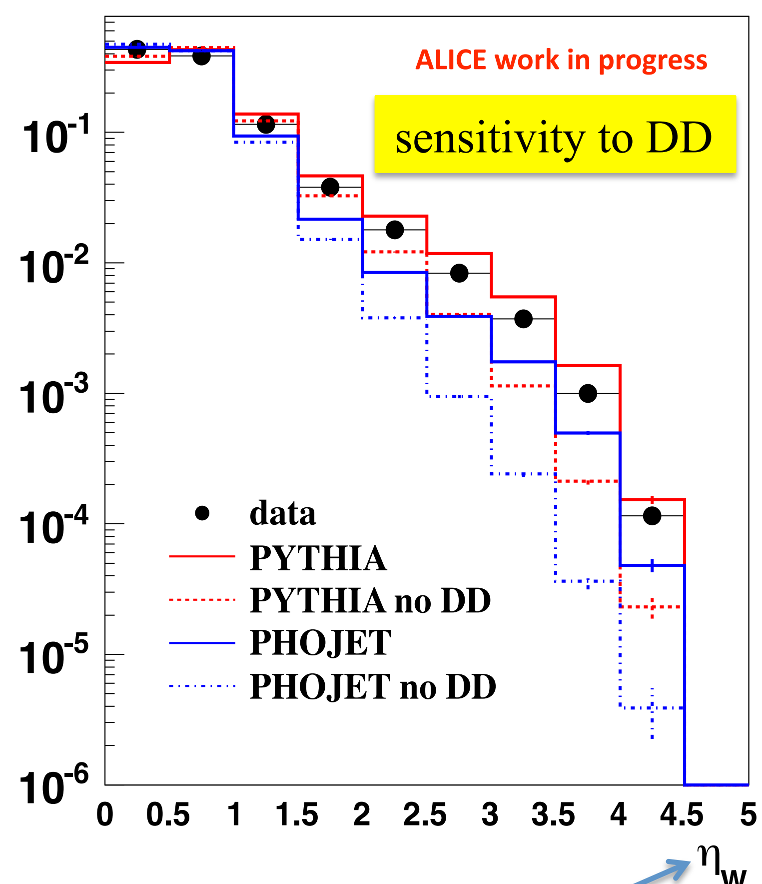


2-arm trigger event

SD and DD studies with ALICE

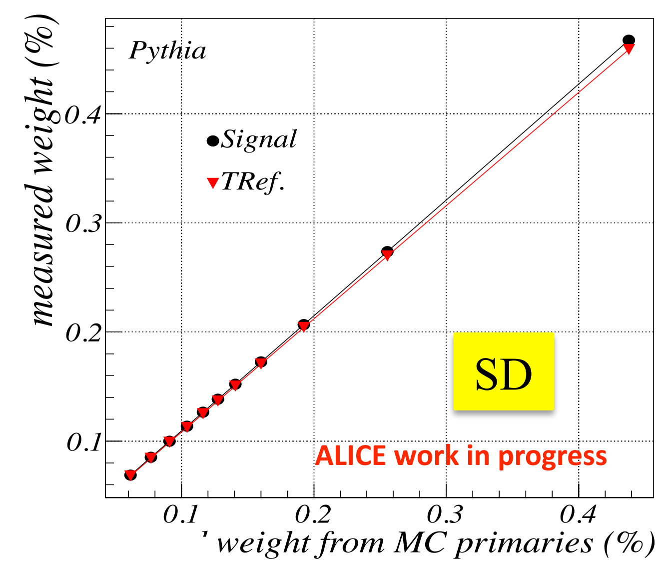
Response to varying SD and DD rates

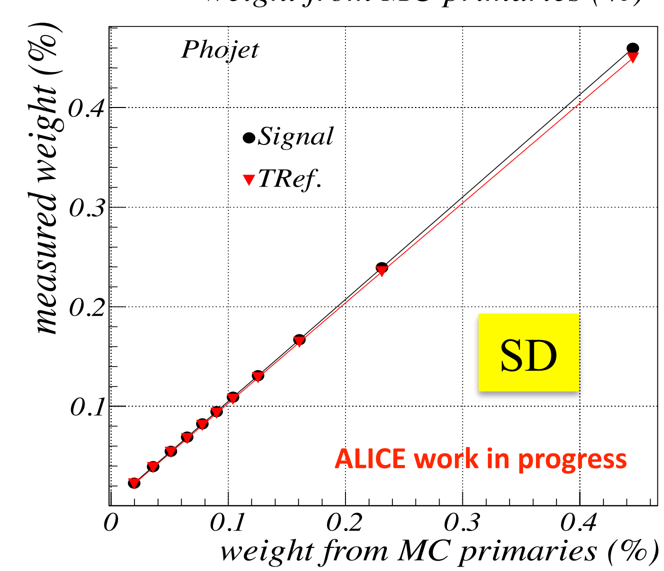
2-arm triggers



(Half the gap width)

1-arm triggers





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The simulation of detector response is not affecting the result