

LPCC Forward Physics Working Group

Low Luminosity WG



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Physics Topics

- There are many processes. We should choose perhaps one per section to highlight physics goals.
- This can be spread among the experiments / theorists based on personal and group interest and expertise.
- “Standard” minimum bias. Both with / without proton tag: pp , IPp , $IPIP$. Partial isolation of diffractive component of many aspects of event dynamics.
- Charged particle multiplicity, energy flow, event shapes, underlying event, particle correlations.
- Gap survival probability - look at new DIME MC.
- Separation of Eikonal and Enhanced survival factors?
- Also on the MC side, look at SuperCHICK and Herwig++ for high p_T dijets + AFP.

Physics Topics II

- Diffractive studies with proton tag. pp and pPb .
- Soft and hard diffraction (dijet, W), DPE dijets, characteristics of the diffractive mass.
- Central jet / multiplicity studies with identified forward particle p (TOTEM/ALFA/AFP) or π^0 , n (ZDC).
- Central exclusive studies with proton tag:
- $\pi\pi$, ee , $\mu\mu$, $\gamma\gamma$, KK , $p\bar{p}$, χ_c , $X(3872)$
- Greater focus on MC tuning in the forward region.
- More links with cosmic-ray generator community.

Progress

- ATLAS, work progressing on physics studies for ATLAS Forward Physics and proton-tagged diffraction. AFP now entering ATLAS review phase.
- CMS have discussed investigating CEP di-jets, diffractive W/Z.
- Not a large amount of progress since Calabria (mostly due to the August factor!). More to be worked out via email / twiki soon.

Thoughts on data taking

- Suppose we dedicate *all* trigger bandwidth to MinBias.

$L \approx 10^{28} \text{cm}^{-2} \text{s}^{-1}$, $\mu \approx 0.003$, ≈ 10 colliding bunches. $\rightarrow 500 \text{ Hz}$ inelastic interactions.

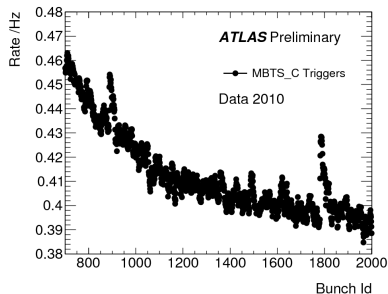
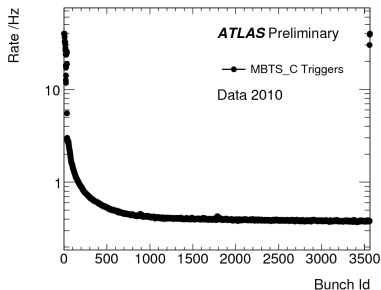
- Important that bunches are well separated, allow collision-induced activity to reduce.
- This is baseline LHC GPD experiment throughput. Any more luminosity and we can't store it all!
- Save all this and collect **2nb^{-1}** per day.
- This is plenty to reproduce LHC minimum bias results. This time with the goal of tagging forward protons and with collaborations which are much more comfortable with their forward detectors.

Thoughts on data taking III

- The only way to build a dataset for many exclusive processes etc.
- Suitable also for high-cross section hard probes: CMS diffractive dijets done with 2.7 nb^{-1} . Though EW probes will need more!
- **But we can be cleverer than this.**
- Lots of space left in the LHC ring, include more bunches, pre-scale the inelastic rate to 400 Hz and accept 100 Hz jet data? Need to work out the right balance.
- **For the group:** What optics to use, this will have to be agreed. Ideally we want good reach in ξ . But also need acceptable resolution \rightarrow low β^* . Loose low t , but therefore fewer elastics.
- **For the group:** Where does low-lumi end and mediu-lumi begin?
- Define two running conditions: MinBias & Dijet, W/Z?
- These questions will be answered for the paper and scenarios proposed to maximise the physics yield for the minimum amount of beam time.

Thoughts on data taking IV

- (Personal opinion), going above $\mu > 0.01$ or colliding bunches closer than 250ns will detrimentally affect pristine quality of data. And don't forget, LHC detectors can be *very sensitive*!

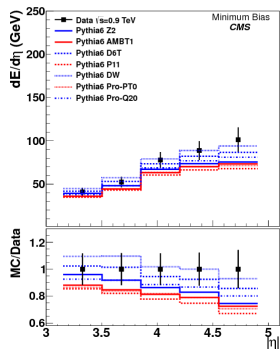
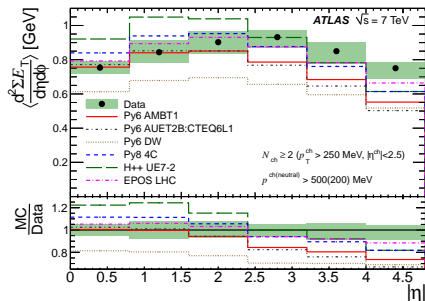


Common Topics I

- Forward energy flow. Large topic of discussion in Italy.
- ATLAS, CMS, LHCb all have common overlap in which to compare energy flow.
- Useful data for the cosmic ray generators.
- Fiducial volume proposed that is
 1. A sub-sample of the published ATLAS measurement so should be 'easy' to reproduce and
 2. Accessible to LHCb and (in theory) CMS, but this should be discussed more.
- Deciding this now will benefit us in the future.
- No ATLAS manpower on this at the moment, but I see it as being feasible in the coming months.

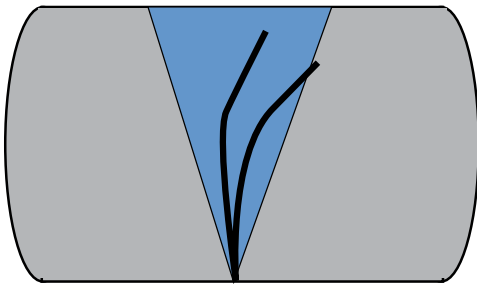
Common Topics II

Current ATLAS [JHEP11 (2012) 033] and CMS [J. High Energy Phys. 02 (2012) 055] results.



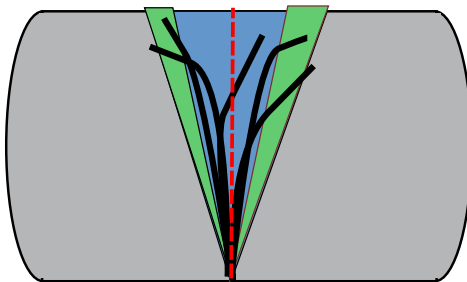
Common Topics III

- Current:
 - Events with $N_{\text{ch}} \geq 2$ in $|\eta| < 2.5$ with $p_{\text{T}} > 250$ MeV.
 - Record energy of charged(neutral) particles with $p > 500(200)$ MeV over $-4.8 < \eta < 4.8$.
 - Average forward and backward bins ($|\eta|$).



Common Topics IV

- Proposed:
 - Treat each event as two, a forward event and a backward event.
 - Forward: Require $N_{\text{ch}} \geq 2$ in $1.9 < \eta < 2.5$ with $p_T > 250$ MeV.
 - Backward: Require $N_{\text{ch}} \geq 2$ in $-1.9 > \eta > -2.5$ with $p_T > 250$ MeV.
 - Record energy over hemisphere. Most events will sum over the whole detector, some will only sum over one hemisphere.



Common Topics V

By looking at PYTHIA8 4C generator distributions, we can see that this is a non-trivial change of fiducial volume. Will require additional analysis rather than just rescaling of published data.

