# CMS PLANS for PDF CONSTRAINTS IN Run2

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# Introductory thoughts

- Run2 Standard Model analysis plan is evolving
  - The luminosity ramp up would shape our offer:
  - Low-x/high precision analyses would be done at low PU
  - (1 $pb^{-1}$, 100 $pb^{-1}$)
  - High-x analyses would wait for statistics to be accumulated
  - (1 $fb^{-1}$ at 50 ns , 10 $fb^{-1}$ at 25 ns)

# Strategy for 2015

- Restart with the similar 2012 parameters and a relaxed $\beta^*$ (80cm) (Alice 10m; LHCb 3m) to establish asap collisions at 13 TeV with 50 ns bunch spacing, no combined collide-squeeze, ramp-squeeze,...
- Absorb 2 week delay
  - **Don't touch** scrubbing, special runs (LHCf and VdM with same optics), TS, Ion run
- Lose 4 days MD, 10 days proton physics
- 1st scrubbing run (50ns+25ns; 7-9 days); accumulate up to 1fb-1 with 50 ns (around 20 d)
- Establish the running with 25 ns: enough time for the scrubbing (10-15 days and no pressure for production)
- Run at 25ns with $\beta^*$ (80cm) for 40 days and decrease the $\beta^*$ (60 cm- 40 cm?) to have around 44 days of operation to prepare 2016 and 2017
- One month for heavy ions

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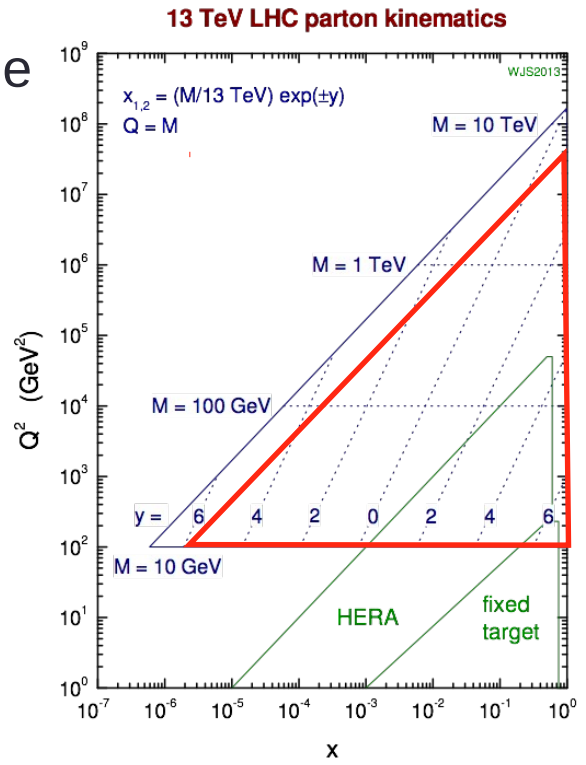
- Classical analyses will be repeated
  - Similar kinematics reach
  - But the higher partonic luminosity allows us to increase sensitivity in statistically limited phase space corners.
  - Ratio of cross sections would be regularly provided.




J. Stirling http://www.hep.ph.ic.ac.uk/~wstirlin/plots/plots.html

# Roadmap

- Inclusive jets
- Inclusive V
- V+HF
- Top production
- What PDFs do we plan to use in MC production for efficiency estimates

# 1.1) Inclusive jet measurements

- Repeat classical cross section vs $p_T$ measurement
  - Main task of SMP-J group in 2015.

- Ratio of inclusive jet cross section at different energies
  - 8 vs 2.76: in preparation
  - 13 vs 8 should be considered
  - Special care to build same scheme of JES uncertainties for optimal cancelation at 2.76, 8 and 13 TeV.

- Using dijets under consideration
  - Support analysis for Dijet bump search.
  - Correlations with inclusive jets production to be evaluated.
  - Triple differential measurement Mjj, yj1, yj2 adapted for NNLO predictions.

# 2.1) Vector boson production

- W charge asymmetry, DY, W/Z inclusive cross sections

- Repeat the measurements in different PU conditions relevant for them.
  - The precision on muons physics would not be much affected by PU.
  - Trigger threshold expectations :
    - For single muon : 20-25 GeV for hardest conditions
    - For single electron : 35-40 GeV limited by L1 trigger
    - The inclusive vector bosons physics with electrons would probably « die »  , except for a potential low PU run.
  - But this is not so critical... Electrons are important above 100 GeV where they resolution becomes better than muons one. Below they are mainly used for cross check.

# 2.2) Vector boson production

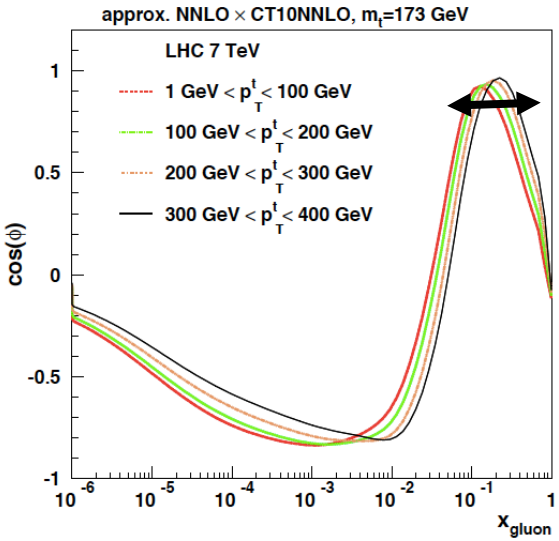
- Exploit qg dominance at high pT for medium to large x gluon PDF constraint
  - Z double differential production $d\sigma/dp_T dy$
  - W $p_T$ measurement
  - W+/W- ratio particularly sensitive to u/d ratio
  - Malik, Watt, arXiv.1304.2424
  - Double ratio 13 vs 8 TeV interesting as well.

- Explicit use of jet multiplicity under investigation at Run1
  - is it really an advantage? Not so obvious from original study

# 2.2) TOP production

correlation $\sigma_{tt}(p^t_T)$ vs g(x)

inclusive and differential top-pair production: sensitive to gluon at high x, $m_t$, $\alpha_S$

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LHC Run I measurements of inclusive and differential cross sections included in PDF fits ⇒ moderate improvement of accuracy of g(x)

- (Experimental precision of Run I measurements not yet sufficient)
- need Run II measurements of inclusive and differential top-quark distributions.
- measurements of single-particle kinematics can be used in PDF fits
- inclusion of $m_{tt}$ and $y_{tt}$ requires developments of fast phenomenology-tools

# 5.1) PDFs in LO MC production

- MC events would be produced with weights.
- Possible to quickly test PDF impact but one have to be carefull only ME change PDF, not PS. Risks of unconsistencies and wrong statements

MADGRAPH

NNPDF30_lo_as_0130.LHgrid
NNPDF30_lo_as_0130_nf_4.LHgrid
NNPDF30_lo_as_0118.LHgrid 1
NNPDF23_lo_as_0130_qed.LHgrid
NNPDF23_lo_as_0119_qed.LHgrid 1
cteq6l1.LHgrid
MMHT2014lo68cl.LHgrid
MMHT2014lo_asmzsmallrange.LHgrid
HERAPDF15LO_EIG.LHgrid

In addition

NNPDF30_nlo_as_0118.LHgrid 1
NNPDF23_nlo_as_0119.LHgrid 1
CT10nlo.LHgrid
MMHT2014nlo68cl.LHgrid 1

("1" means only the central set, otherwise uncertainties for the set are also included)

# 5.2) PDFs in NLO MC production

aMC@NLO

due to technical limitations
we can only include the weights corresponding to the uncertainties
on the central pdf set (nnpdf30nlo)

POWHEG

NNPDF30_nlo_as_0118 + uncertainties
NNPDF30_nlo_as_0117 central value
NNPDF30_nlo_as_0119 central value
(or replace all with nf4 versions where applicable)

MMHT2014nlo68cl + uncertainties
MMHT2014nlo_asmzsmallrange + uncertainties (which are just the alphas variations)
CT10nlo + uncertainties
CT10nlo_as_0117 (one member only)
CT10nlo_as_0119 (one member only)

# CONCLUSION

Tell us where you are

We would be

To see what we can we improve


And make all of us happy