MD Wishes from the Experiments

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Introduction

- Had first discussion on possible experimental requests on Monday last week
  - Likely not a full wish list presented today
- Most requests related to achieving precision luminosity measurements
  - Partly as follow-up from LHC Lumi Days 2019 workshop
- Not all requests are necessarily meant to happen during regular MD periods
  - Some might be more natural to do during VdM run period
  - Others during/at end of regular Physics fills
- Not covering setup of VdM beams etc.
  - Prerequisite for VdM scans themselves and MD studies related to these
  - Expect this to be mostly done during beam recommissioning
  - Critical that high-quality VdM beams be produced by injector chain and propagated to the LHC

Luminosity Uncertainty

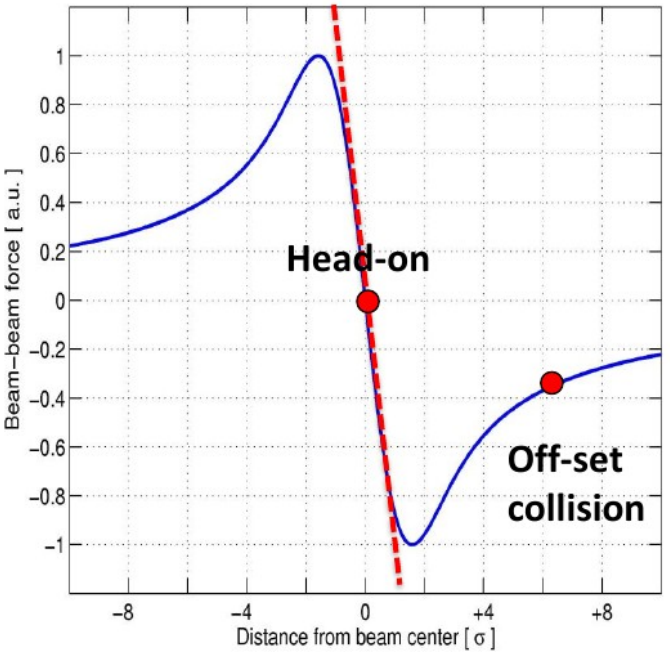
- Luminosity uncertainty dominant for some precision cross section measurements in ATLAS and CMS
- Strong effort over last years to get luminosity uncertainty down to 2-2.5%
- Long-term aim is to approach 1% uncertainty
  - Requires reducing individual uncertainties to <<1%
  - Have to be sure no uncertainty is missing or underestimated
- Request to recheck beam-current instrumentation
  - Reproducibility and precision
  - During beam-commissioning or needs MD?

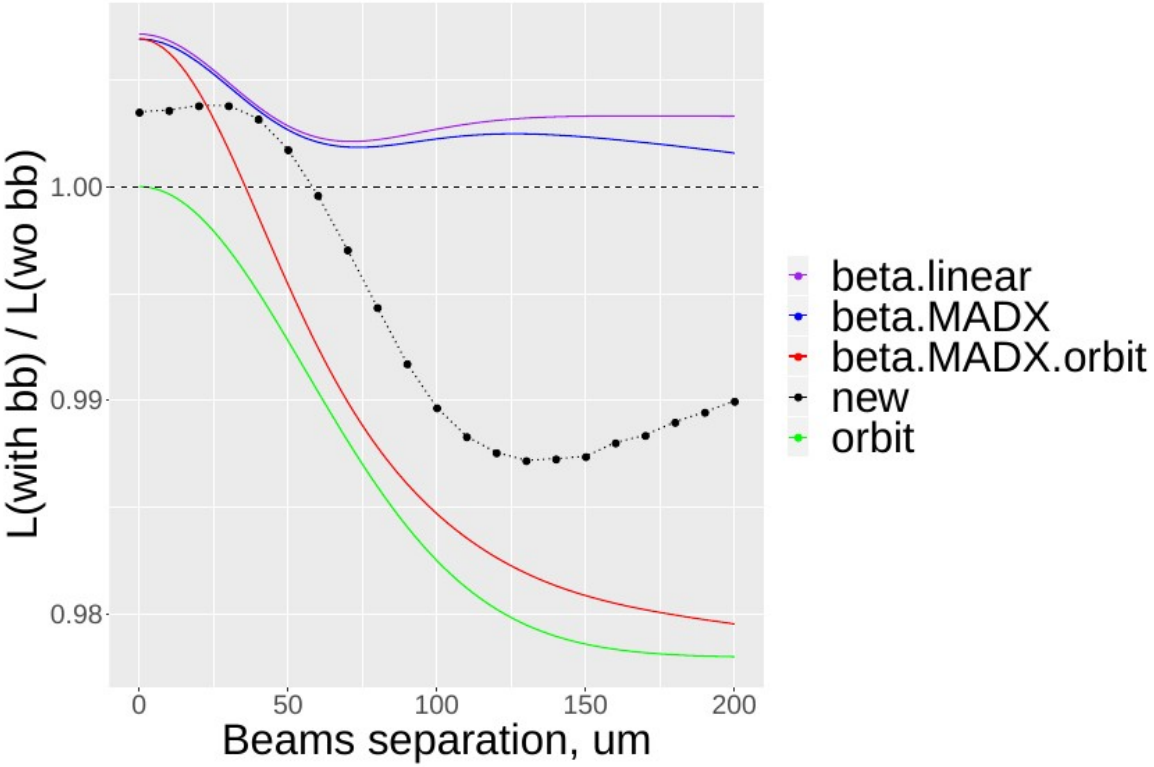
ATLAS luminosity uncertainties

Data sample	2015+16	2017	2018	Comb.
Integrated luminosity (fb^{-1})	36.2	44.3	58.5	139.0
Total uncertainty (fb^{-1})	0.8	1.0	1.2	2.4
Uncertainty contributions (%):				
DCCT calibration†	0.2	0.2	0.2	0.1
FBCT bunch-by-bunch fractions	0.1	0.1	0.1	0.1
Ghost-charge correction*	0.0	0.0	0.0	0.0
Satellite correction†	0.0	0.0	0.0	0.0
Scan curve fit model†	0.5	0.4	0.5	0.4
Background subtraction	0.2	0.2	0.2	0.1
Orbit-drift correction	0.1	0.2	0.1	0.1
Beam position jitter†	0.3	0.3	0.2	0.2
Beam-beam effects*	0.3	0.3	0.2	0.3
Emittance growth correction*	0.2	0.2	0.2	0.2
Non-factorization effects*	0.4	0.2	0.5	0.4
Length-scale calibration	0.3	0.3	0.4	0.2
ID length scale*	0.1	0.1	0.1	0.1
Bunch-by-bunch σ_{vis} consistency	0.2	0.2	0.4	0.2
Scan-to-scan reproducibility	0.5	1.2	0.6	0.5
Reference specific luminosity	0.2	0.2	0.4	0.2
Subtotal for absolute vdM calibration	1.1	1.5	1.2	-
Calibration transfer†	1.6	1.3	1.3	1.3
Afterglow and beam-halo subtraction*	0.1	0.1	0.1	0.1
Long-term stability	0.7	1.3	0.8	0.6
Tracking efficiency time-dependence	0.6	0.0	0.0	0.2
Total uncertainty (%)	2.1	2.4	2.0	1.7

Study Beam-Beam Effects in VdM

- Beam-beam effect changes orbit and dynamic beta when beams are separated in VdM scan
  - Affects position and rate estimates
  - Corrected for in VdM analysis (1-1.8% effect) and an uncertainty is added (0.2-0.6% in CMS)





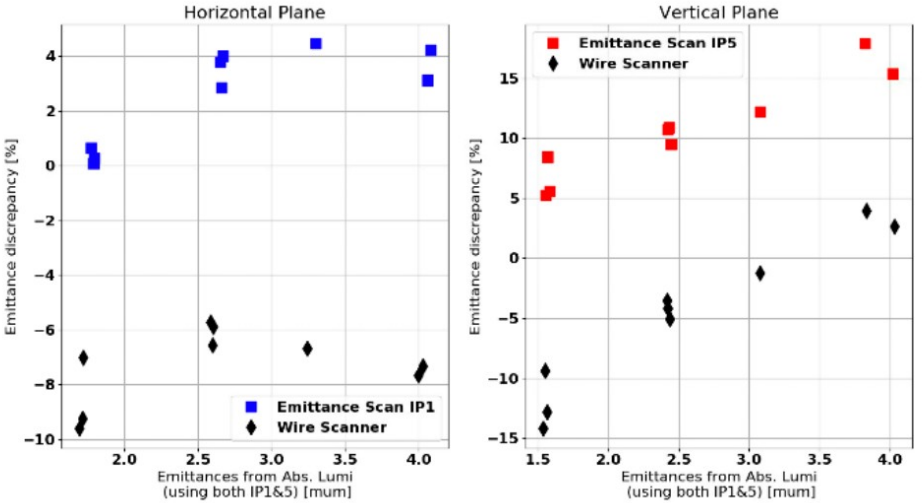
- Questions on the modeling uncertainties
  - Would like to measure actual effect
- Present vdM optics (β*~L*) makes it difficult to measure β* precisely at some IPs
  - Reoptimize VdM β*?
  - Under discussion among experiments

Study Beam-Beam Effects in VdM

- Goal is to cross-check the beam-beam modeling in the VdM scan setup
- Since effect normally is %-level, need to increase the effect to allow measurement
- Two proposals from ATLAS and CMS:
  - 1) Different β* at IP2/8 to maximize the effects at IP1/5
  - 2) High brightness, i.e. I_b>1.2e11ppb and ε<2μm
  - Both make use of VdM optics (β*=19m), individual bunches, head-on collisions etc.
- Quantitative comparison of measurements with beam-beam simulations requires the precise knowledge of β* at all 4 IPs and of the phase advances from one IP to the next
  - These measurements would be an integral part of setting up a new VdM configuration with different β*
  - They should be carried out even if the present β* is kept
- Ideally should happen early in Run 3
  - Possibly during first VdM scan period?

Emittance Scan MDs

- CMS is relying strongly on emittance scans to monitor the long-term stability of their luminometers
- See some not understood jumps across luminometers, i.e. likely not detector effects
  - Calculated emittances also do not match measurements from the machine
- Propose several studies to improve understanding:
  - Varying β*
  - Crossing angle precision (how well is angle known?)
  - Longitudinal profile
    - Needs full beam profiles, not just sigma



Luminometers Check

- CMS would like to check the performance of their luminometers, specifically hadronic forward one (HF), to very high pile-up
  - Would like to measure up to pile-up of ~200
  - Expect this need to be with a regular length train

Collimator Settings for Roman Pots

- The maximum mass reach of both PPS (CMS) and AFP (ATLAS) depends on the opening of TCL4 and TCL5
- In Run 2 had TCL4 @ 15σ and TCL5 @ 35σ
- Configuration in Run 3 under discussion in collimation WG
  - Experiments desire largest possible opening
- Might be useful to have study of losses as a function of TCL4 position with TCL5 open
  - Risk of quench in study?
  - To use it to optimize configuration for most of physics running would have to happen early (i.e. 2021)