MC needs for Run3
(i.e. trying to predict the future)

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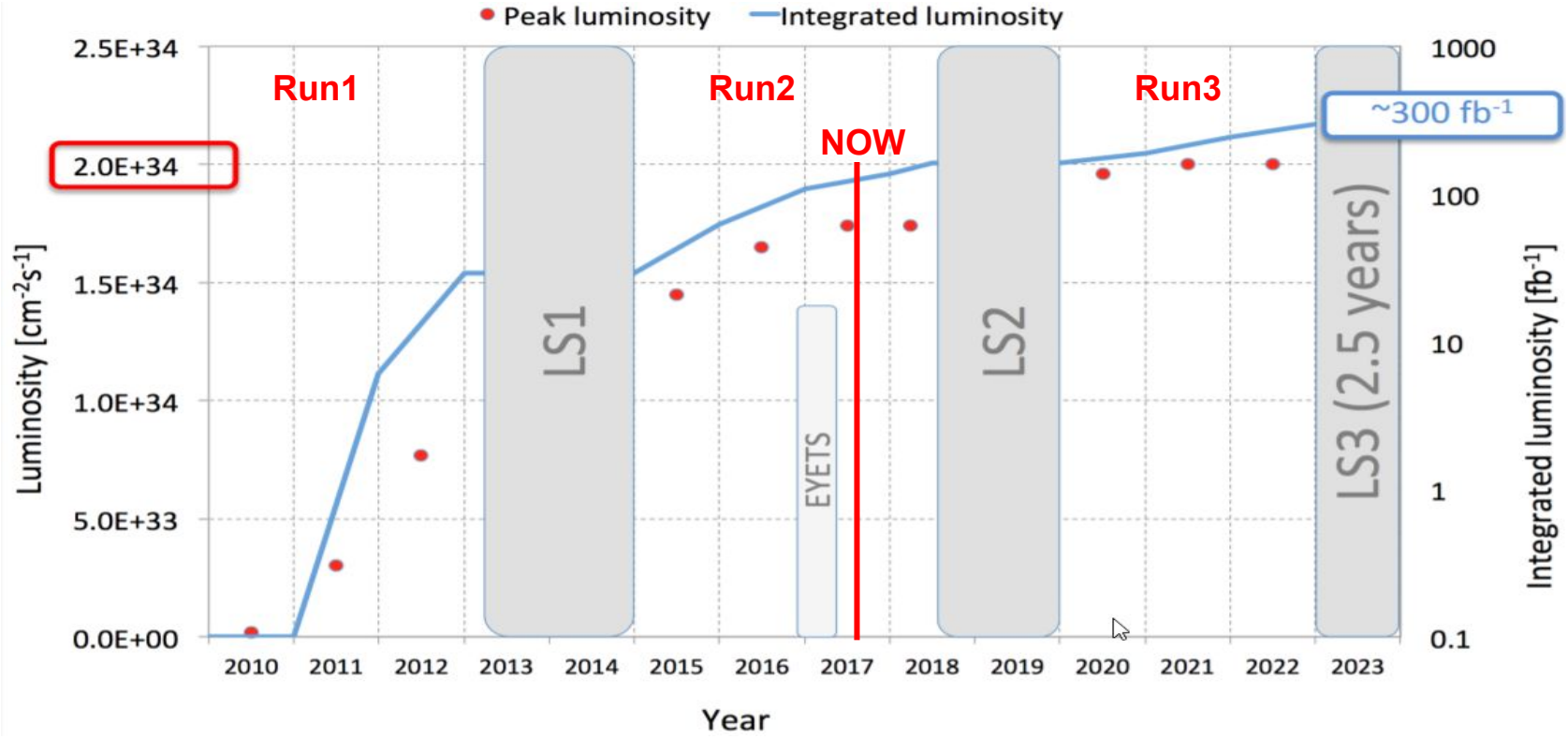
with inputs from the CMS and ATLAS collaborations

Run3: timescales and luminosity



MC priorities and budgets from now to Run3

- Rule of thumb figures of merit:
  - MC planning driven by physics priorities
  - Physics priorities driven by machine conditions
    - No major center of mass energy jumps
      - 13 to 14 TeV will not be a dramatic increase as from 8 to 13 TeV
    - Once “bulk of the distributions” explored, focus on “tails” of the phase space
      - Notable exceptions are ultimate precision SM measurements (e.g. Weinberg’s angle, top mass, W mass)
  - Need to “fight” against conflicting requirements:
    - (Much) larger datasets
    - Increased measurement precision
    - Need for alternative samples for systematics (different generators or parameters)
    - Flattening of computing resources (both cpu and space)
  - Need to find a evolution “model” that scales already for Run2, as data x5 wrt Run1
    - Not to mention HL-LHC...

MC priorities and budgets from now to Run3

- So far, MC production planned O(6) months in advance
  - Software version, tunes and other inputs frozen, all configurations and workflows validated
  - Computing resources planned ~1.5-2 years in advance
  - Current CMS budget consisting of O(10B) events per year
    - This will NOT scale linearly with luminosity

- Moving more and more from fully inclusive datasets to fully exclusive datasets
  - We'll have to make this work with more efficient slicing and weighting

Examples of useful technical developments

- Drastic reduction of events with negative weights
  - E.g. folding of the integration phase space implemented in POWHEG
- Drastic increase of the matching efficiency
  - Currently ~30%
- Continue pursuing reduction of memory consumption to match higher jets and parallelization
  - Currently up to 4j at LO, up to 2j at NLO (expected more with low mem multicore option)
- Complete integration of process independent NLO QCD x EWK corrections
  - up to high multiplicity final states
  - for both virtual and real contributions
  - Properly interfaced to parton shower
- Bias weights for both LO and NLO
- Large flexibility for LHE level cuts for both LO and NLO
  - HT, VpT, number of additional jets, VBF-like, etc
- Single-gridpack parameter scan
  - Especially for BSM scans, so far very high number of gridpacks required

Examples of useful technical developments

- “Reweighting” to new physics parameters in MadGraph has been recently adopted at CMS
  - At times technically challenging, e.g. often encountered issues with specific models and scaling to the large scale production of CMS
  - However, having this parameter scan feature can easily save huge overhead in detector simulation (e.g. 100 weights vs. 100 separate simulations)
  - There is large interest in this workflow and CMS, which would only increase with improved stability/reliability

- General Uncertainties, especially in the context of the ME+shower interface
  - More of a push to the pheno community
  - For example matching scale or QCD scale choice
    - which is better defined, but can still be a big effect if you take widely different functional forms of dynamic scales

Examples of process specific developments

- Reduce scale uncertainties for VBF when applying jet veto
  - Allow FxFX
  - Integrate NNLO results through reweighting or similar
- Improve Higgs spectrum at high pT
  - e.g. finite mass effects
- More generally, NNLO reweighting a la POWHEG+MiNLO NNLOPS
- EFT @ NLO
  - Can one imagine to have the pseudo-observables amplitude decomposition with QCD effects implemented in aMC@NLO? (Higgs-context in particular)
- Specifically for BSM models
  - Signals generated at LO
    - High fraction of events with negative weights show-stopper so far