

# CMS Report - all experimenters meeting

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July 11 2016

# Reminder

Last report by Nadja Strobbe on June 6, 2016

- Already 3 fb-1 delivered to CMS
- Max peak luminosity:  $7.46 \times 10^{33} \text{ cm}^{-2}\text{s}^{-1}$

|    | Apr                       |                       |    | May     |              |    |         |     | June |     |                   |    |    |
|----|---------------------------|-----------------------|----|---------|--------------|----|---------|-----|------|-----|-------------------|----|----|
| Wk | 14                        | 15                    | 16 | 17      | 18           | 19 | 20      | 21  | 22   | 23  | 24                | 25 | 26 |
| Mo | 4                         | 11                    | 18 | 25      | 2            | 9  | Whit 16 | 23  | 30   | 6   | 13                | 20 | 27 |
| Tu |                           |                       |    |         |              |    | VdM     |     |      |     |                   |    |    |
| We |                           | Injector TS (8 hours) |    |         |              |    |         |     |      | TS1 |                   |    |    |
| Th |                           |                       |    |         | Ascension    |    |         |     |      |     | beam* 2.5 km dev. |    |    |
| Fr | Recommissioning with beam |                       |    |         | May Day comp |    |         | VdM |      |     |                   |    |    |
| Sa |                           |                       |    |         |              |    |         |     |      |     |                   |    |    |
| Su |                           |                       |    | 1st May |              |    |         |     |      |     |                   |    |    |

# LHC Status

|    | July |      |    | Aug               |    |    |    | Sep  |    |         |     |                            |    |
|----|------|------|----|-------------------|----|----|----|------|----|---------|-----|----------------------------|----|
| Wk | 27   | 28   | 29 | 30                | 31 | 32 | 33 | 34   | 35 | 36      | 37  | 38                         | 39 |
| Mo | 4    | ★ 11 | 18 | 25                | 1  | 8  | 15 | 22   | 29 | 6       | 13  | 19                         | 26 |
| Tu |      |      |    |                   |    |    |    | MD 2 |    |         |     | beta* = 2.5 km data taking |    |
| We |      |      |    |                   |    |    |    |      |    |         | TS2 |                            |    |
| Th |      |      |    | MD 1              |    |    |    |      |    | Jeune G |     |                            |    |
| Fr |      |      |    |                   |    |    |    |      |    |         |     |                            |    |
| Sa |      |      |    |                   |    |    |    |      |    | MD 3    |     |                            |    |
| Su |      |      |    | beta* 2.5 km dev. |    |    |    |      |    |         |     |                            |    |

The only machine interruption was due to an electrical perturbation on week 27

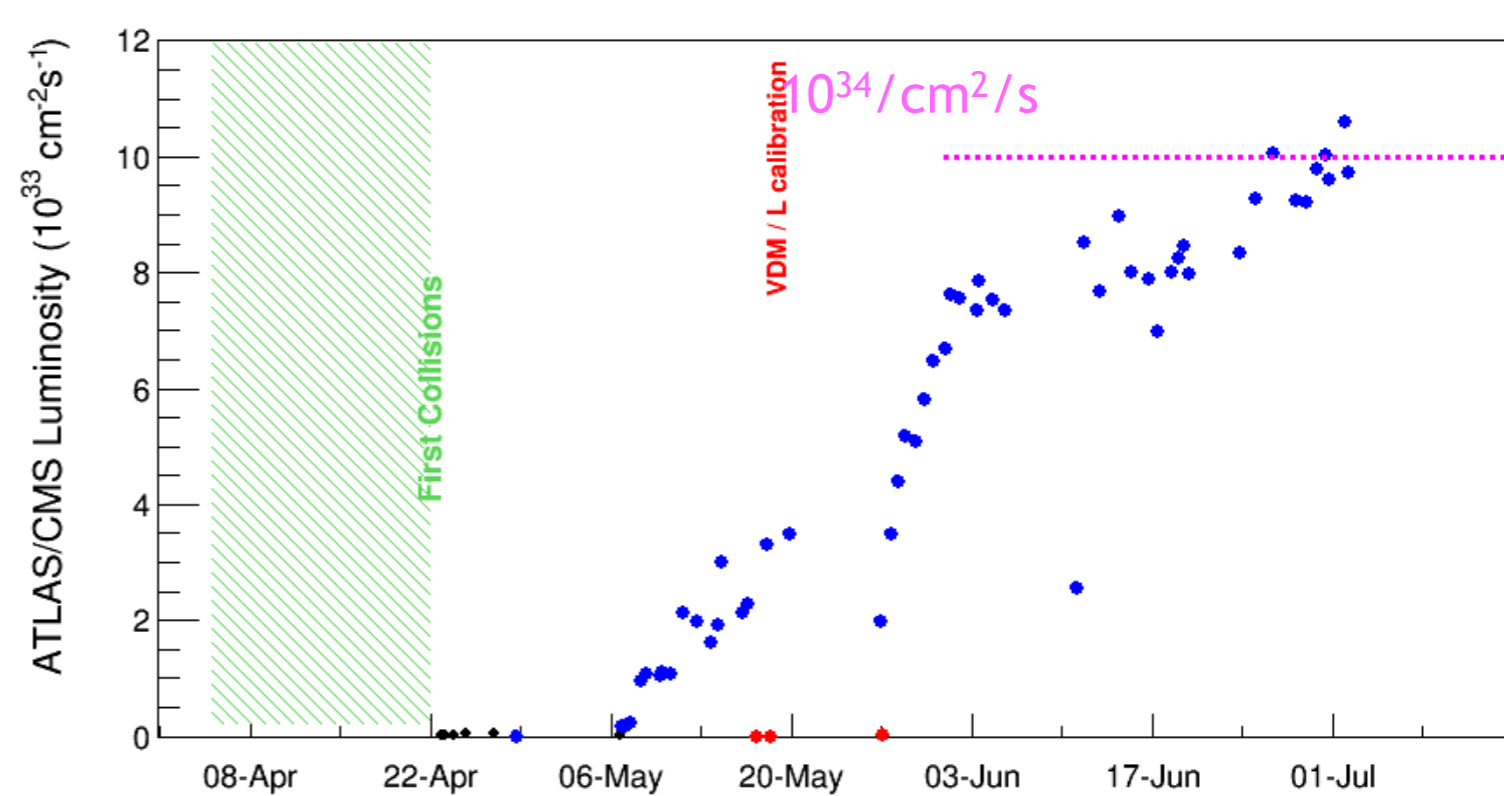
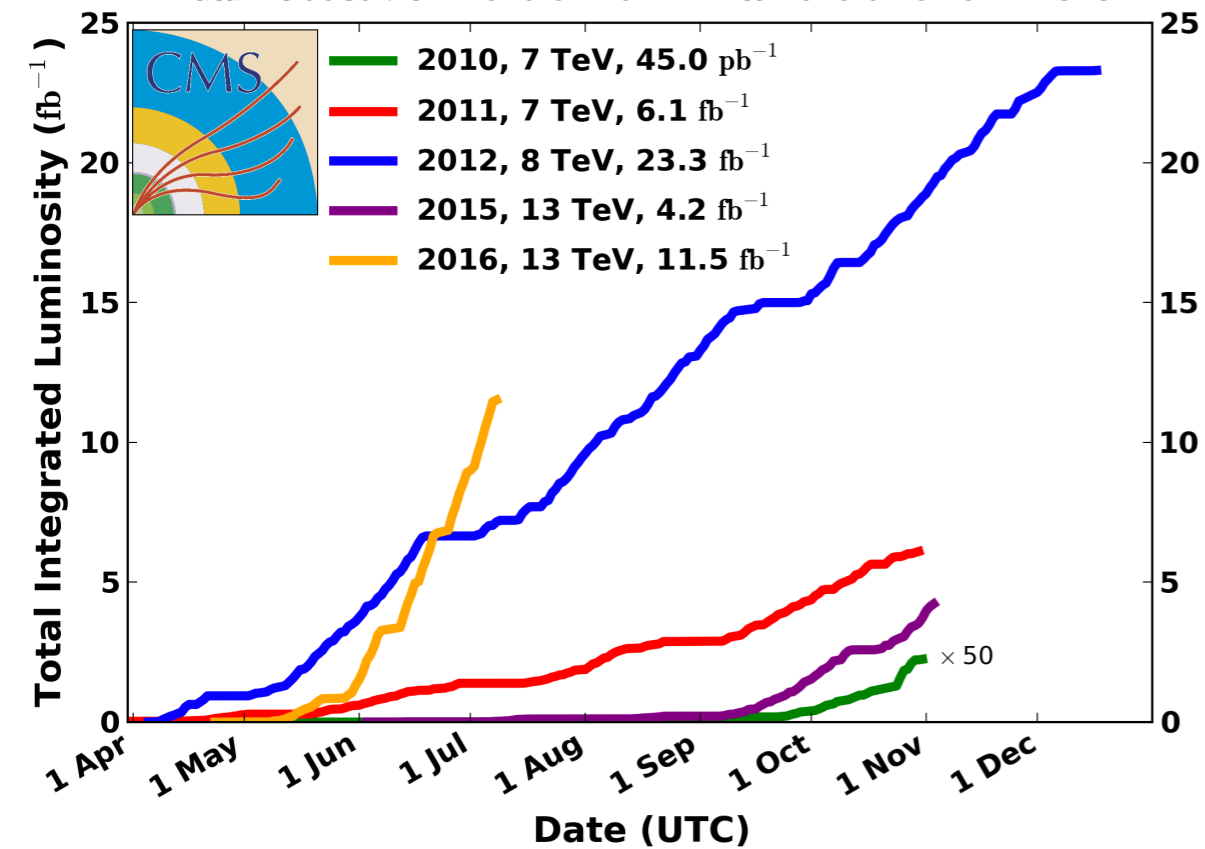
|    | Oct  |    |    | Nov |      |     | Dec        |                |    |       | End of run [06:00]               |            |          |
|----|------|----|----|-----|------|-----|------------|----------------|----|-------|----------------------------------|------------|----------|
| Wk | 40   | 41 | 42 | 43  | 44   | 45  | 46         | 47             | 48 | 49    | 50                               | 51         | 52       |
| Mo | 3    | 10 | 17 | 24  | 31   | 7   | 14         | 21             | 28 | 5     | ↓ 12                             | 19         | 26       |
| Tu | MD 4 |    |    |     |      |     | ions setup |                |    |       | Extended year end technical stop |            |          |
| We |      |    |    |     |      | TS3 |            |                |    |       |                                  |            |          |
| Th |      |    |    |     |      |     |            | Ion run (p-Pb) |    |       |                                  | Lab closed |          |
| Fr |      |    |    |     | MD 5 |     |            |                |    |       |                                  |            |          |
| Sa |      |    |    |     |      |     |            |                |    |       |                                  |            |          |
| Su |      |    |    |     |      |     |            |                |    | Pb MD |                                  | Xmas       | New Year |

- Technical Stop
- Machine development
- Recommissioning with beam
- Special physics runs - provisional dates
- Scrubbing

# Luminosity

**CMS Integrated Luminosity, pp**

Data included from 2010-03-30 11:22 to 2016-07-07 04:17 UTC



**Design luminosity: achieved!**

# CMS online luminosity

Lumi delivered/collected so far at  $\sqrt{s}=13$  TeV in 2016

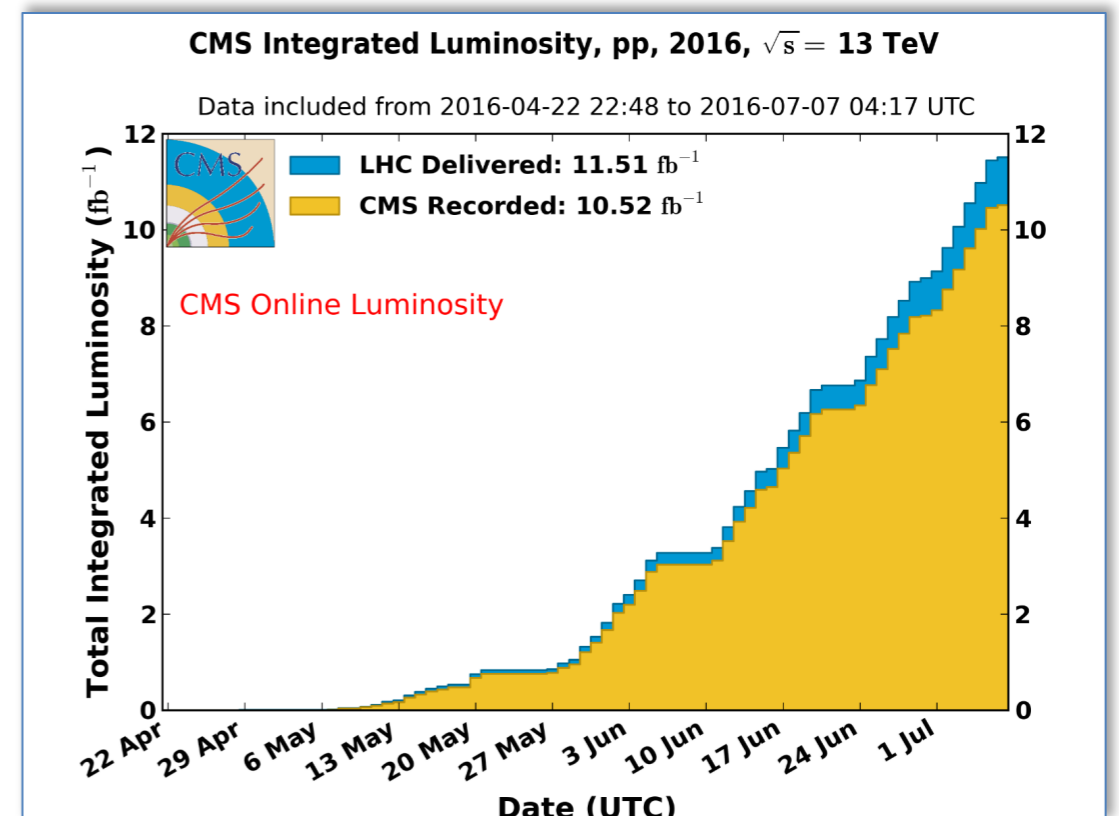
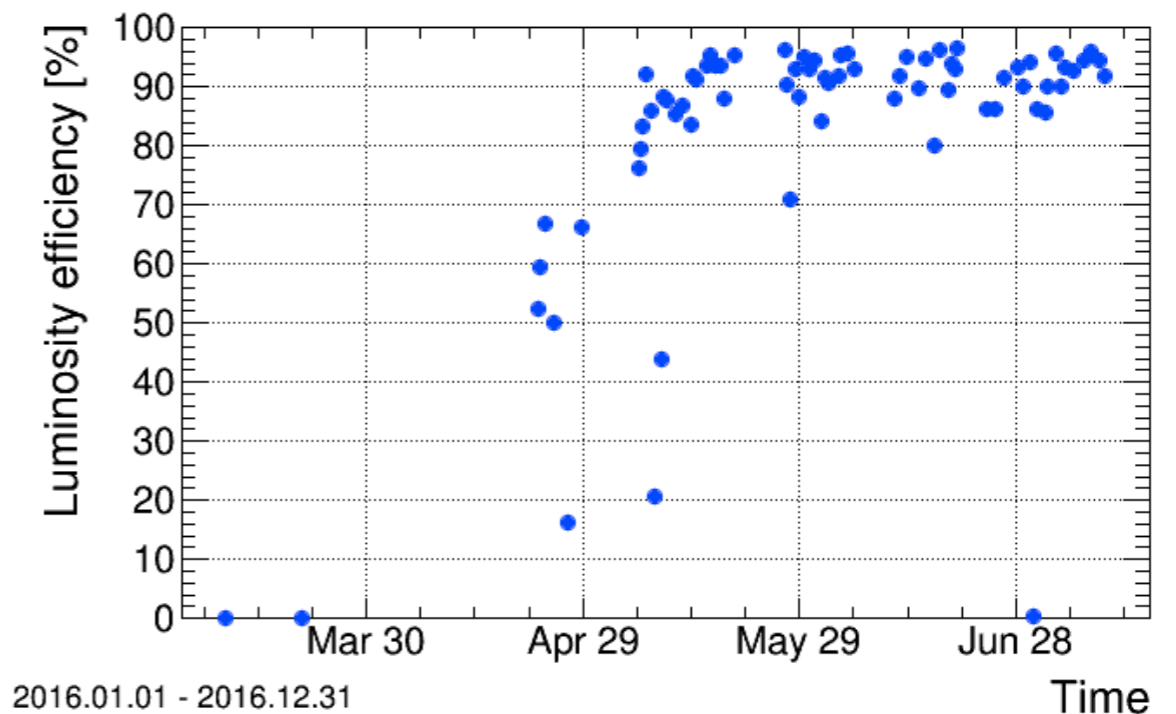
- CERN-wide power glitch led to CMS cooling failures
  - Lost 2 fills due to magnet ramp + subsystem recovery

CMS taking data 95% of the time and collecting 91% of delivered Lumi

If they continue at same pace, LHC on track to deliver 30/fb

- Identified pileup dependent non-linearity in PLT
  - 5-6% at beginning of fill, 2-3% at end of fill
- ~10% increase in CMS lumi at start of fill

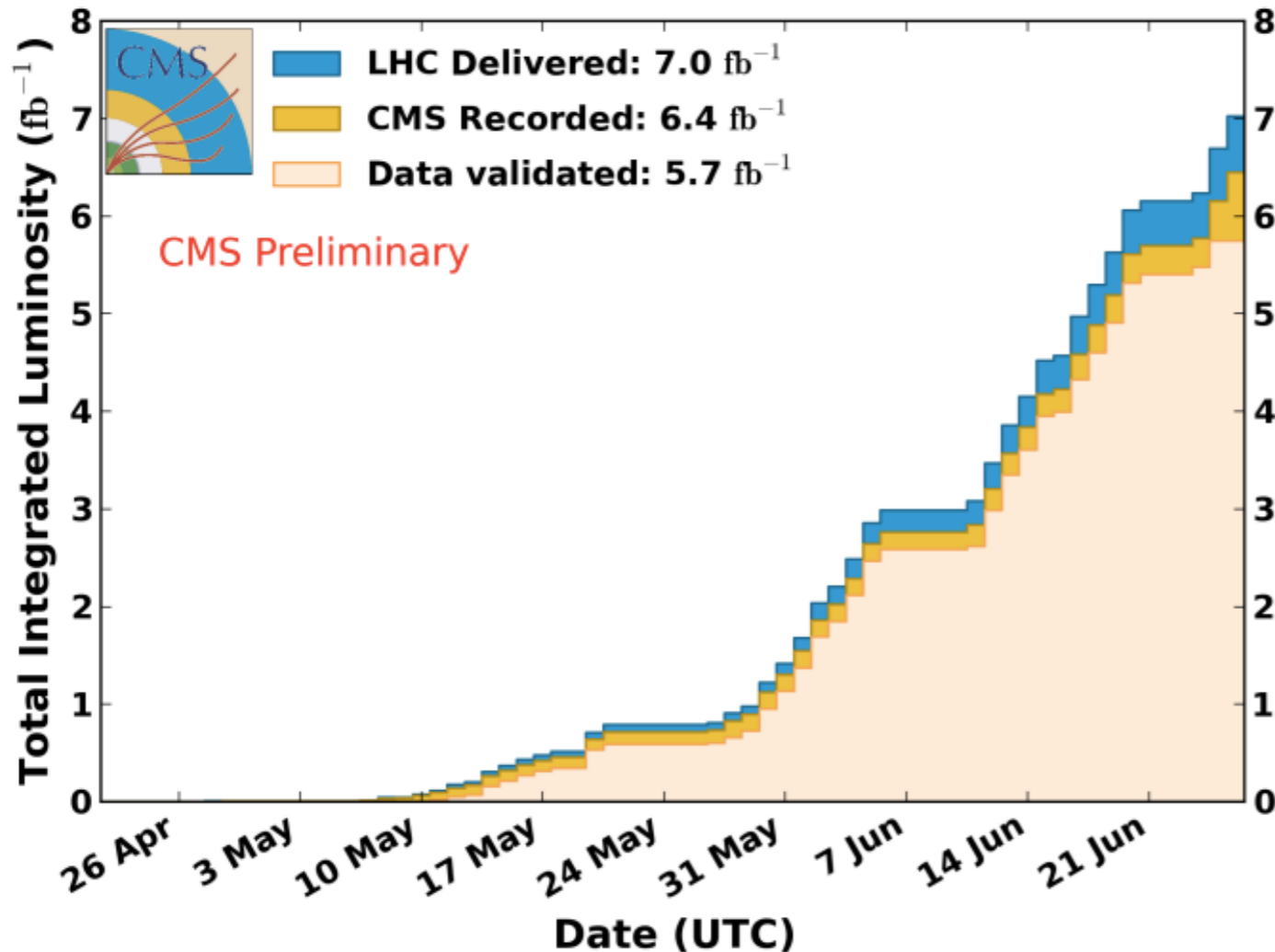
2016 CMS Datataking Efficiency per Fill (online) [pp]



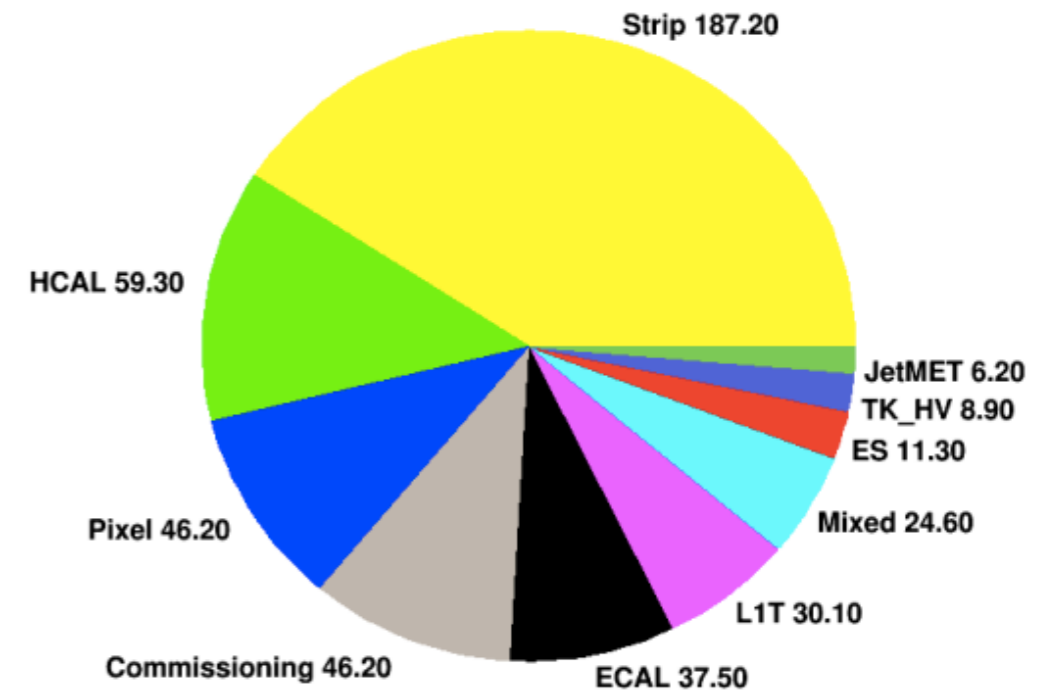
# Data quality

## CMS Integrated Luminosity, pp, 2016, $\sqrt{s} = 13$ TeV

Data included from 2016-04-22 22:48 to 2016-06-26 23:59 UTC



## Exclusive Luminosity Losses in /pb



Only loss  $> 1/\text{pb}$  are considered

Recorded  $6.2/\text{fb}$

Good for physics:  $5.74/\text{fb}$

lost:  $458/\text{pb}$     Data defined as good: 93%

# CMS trigger status

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- HLT and L1 trigger working on tuning and finalizing pre-scale columns for higher luminosity ( $1.1 \cdot 10^{34}$ ,  $1.2 \cdot 10^{34}$ ,  $1.3 \cdot 10^{34}$ ).
- We have been running with logging rates in excess of 1.5 KHz at the beginning of the fill in the past weeks
  - stress on the network and Tier0 resources
  - will aim to be back at baseline of 1KHz averaged over the fill by after the 1st period of Machine development

# CMS Physics

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- Preparing for ICHEP:
  - More than 50 pre-approvals taking place between last Friday and the end of this week.
  - Physics object groups are finalizing efficiencies/scale factors and recommendations for analyzers
- Present concerns:
  - 1) Heavy Ionizing Particle effects (not just on tracking, but also on muons and electrons - under study), particularly if the instantaneous luminosity keeps increasing;
  - 2) trigger and offline efficiencies for muons in the endcap region;
  - 3) muon trigger drop in MC re-HLT for the muon endcap region (potentially affecting the calculation of b-tagging scale factors);



# Next: Batch Compression Merging and Splitting

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$$L = \frac{N^2 k_b f \gamma}{4\pi \epsilon_n \beta^*} F$$

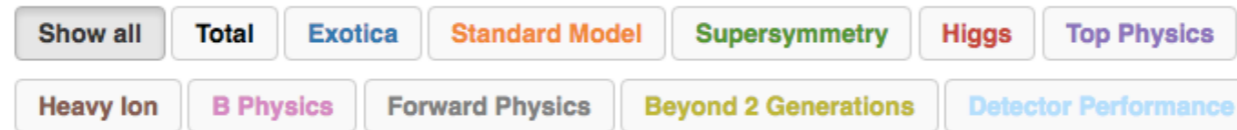
|              |  |
|--------------|--|
| N            | Number of particles per bunch          |
| $k_b$        | Number of bunches                      |
| f            | Revolution frequency                   |
| F            | Reduction factor due to crossing angle |
| $\epsilon_n$ | Normalized emittance                   |
| $\beta^*$    | Beta function at Interaction Point     |

LHC plan: reduce the “transverse size of bunches”

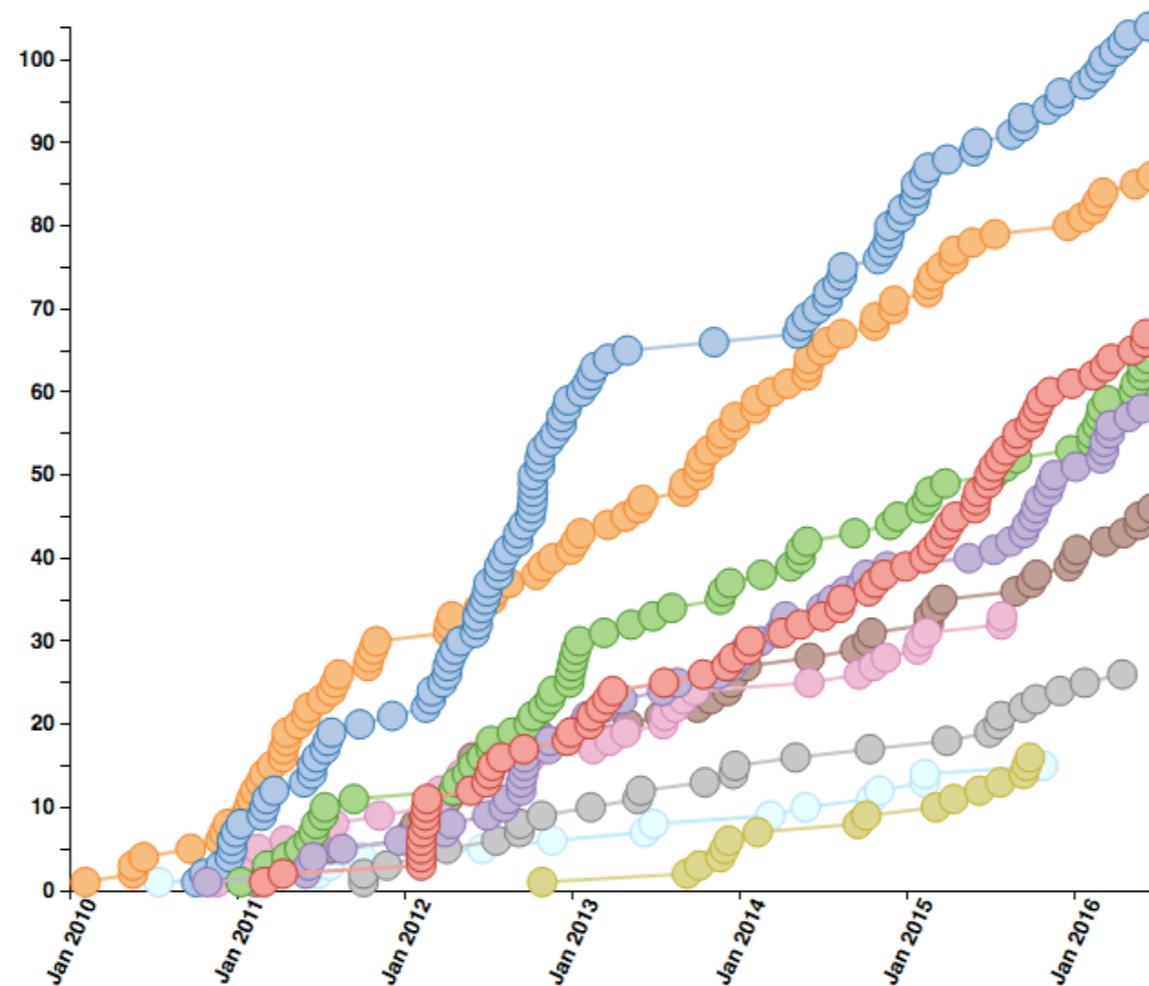
- BCMS injection scheme to inject the low emittance beams ( tests have gone on in June).
- No change with respect to the present conditions will be implemented until the ICHEP dataset will be secured (July15)
- The estimated potential is an increase of integrated lumi by >30%..the price to pay is increased pileup
  - up to  $1.5 \cdot 10^{34}$  instantaneous lumi with pileup of 50

# Recent CMS publications

| Run 2 Publications |                            |   |                   |              |
|--------------------|----------------------------|---|-------------------|--------------|
| 11                 | <a href="#">SUS-15-011</a> | Search for new physics in final states with two opposite-sign, same-flavor leptons, jets, and missing transverse momentum in pp collisions at $\sqrt{s} = 13$ TeV | Submitted to JHEP | 4 July 2016  |
| 10                 | <a href="#">EXO-16-018</a> | Search for resonant production of high-mass photon pairs in proton-proton collisions at $\sqrt{s} = 8$ and 13 TeV   | Submitted to PRL  | 13 June 2016 |



514 collider data papers submitted as of 2016-06-21



# Summary and Outlook

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LHC in physics mode with goal to deliver  $\sim 20/\text{fb}$  by ICHEP

- \*  $\sim 11/\text{fb}$  delivered already
- \* CMS fully commissioned and taking good data (magnet on)

CMS is engaged on multiple fronts

- \* Data taking
- \* Producing physics results with new 13 TeV dataset
- \* Phase 1 upgrade, (pixel, HCAL)
  - \* making good progress for installation in early 2017
- \* Phase 2 upgrade: TDR due to next year