CMS/LHC Status Report

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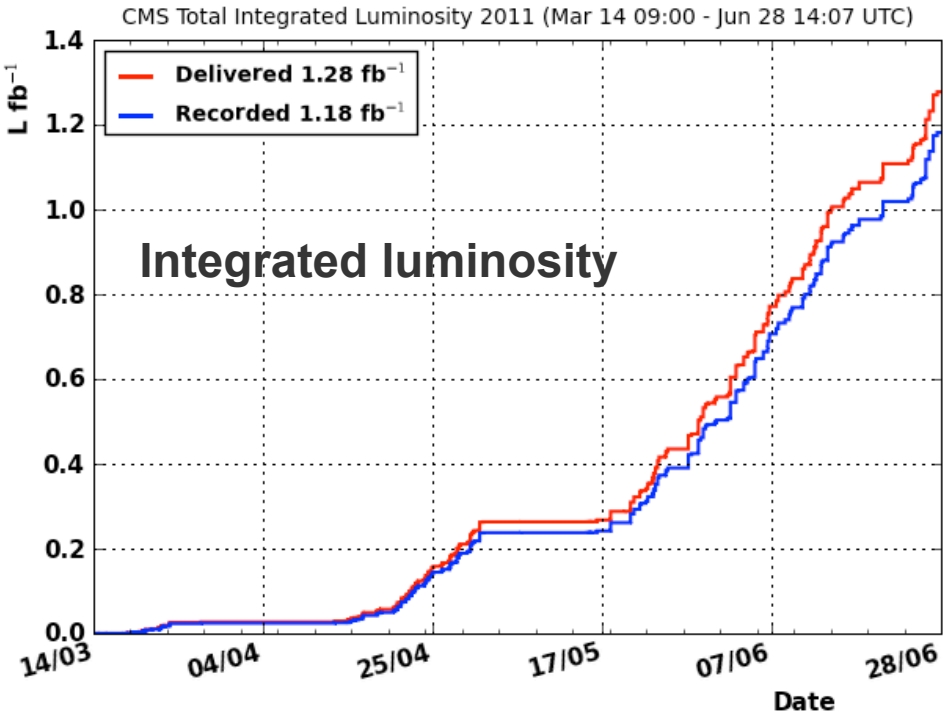
- ☑ Firmly into the fb^{-1} era
- ☑ Undergoing machine development
- ☑ Preparing for high instantaneous luminosity & high pileup

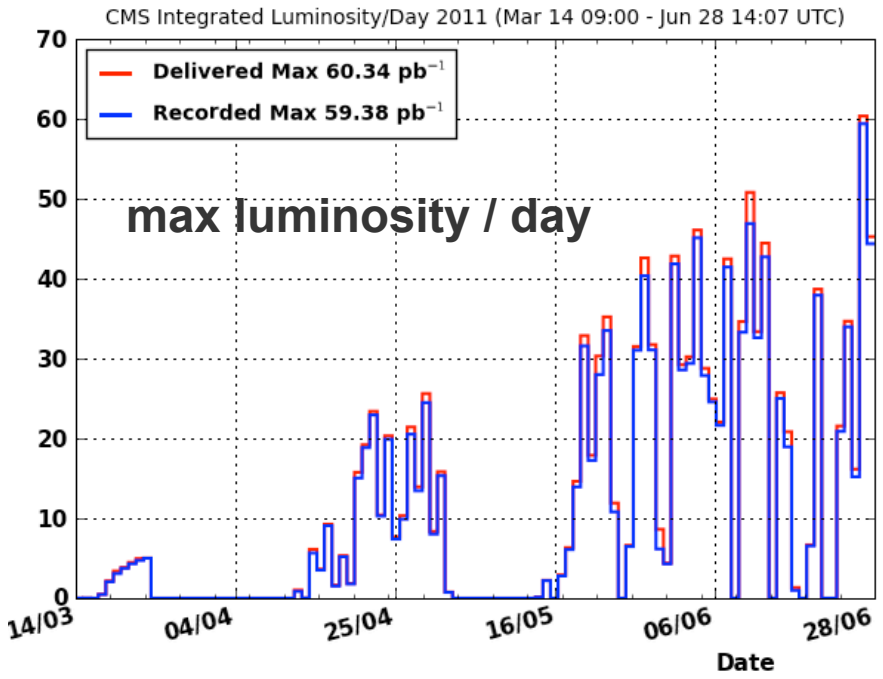
All Experimenters' Meeting, July 11, 2011

LHC/CMS performance so far in 2011

- LHC delivered luminosity: **1.28** fb^{-1}
  - CMS recorded **1.18** fb^{-1}
  - Overall data taking efficiency **~93%**

Now firmly in fb^{-1} era





Managed to run with **1380** bunches, peak luminosity **1.3** x **10^{33}** **$cm^{-2}s^{-1}$**

Currently undergoing machine development

Main achievements so far

- **50 ns**: collisions with twice the nominal **intensity 2.3 x10^{11}** and **emittance 1.7 µm** @450 GeV, lifetimes acceptable (will be better at 3.5 TeV)

- **25 ns**: first injection of 25 ns bunch trains with up to **216 bunches, 1.2 x 10^{11} protons** per bunch, **emittance 2.7µm** (additional tests will be done over summer)

- **Crossing angle** (to gain aperture) down to **48 µrad** (i.e., 40% of the nominal)

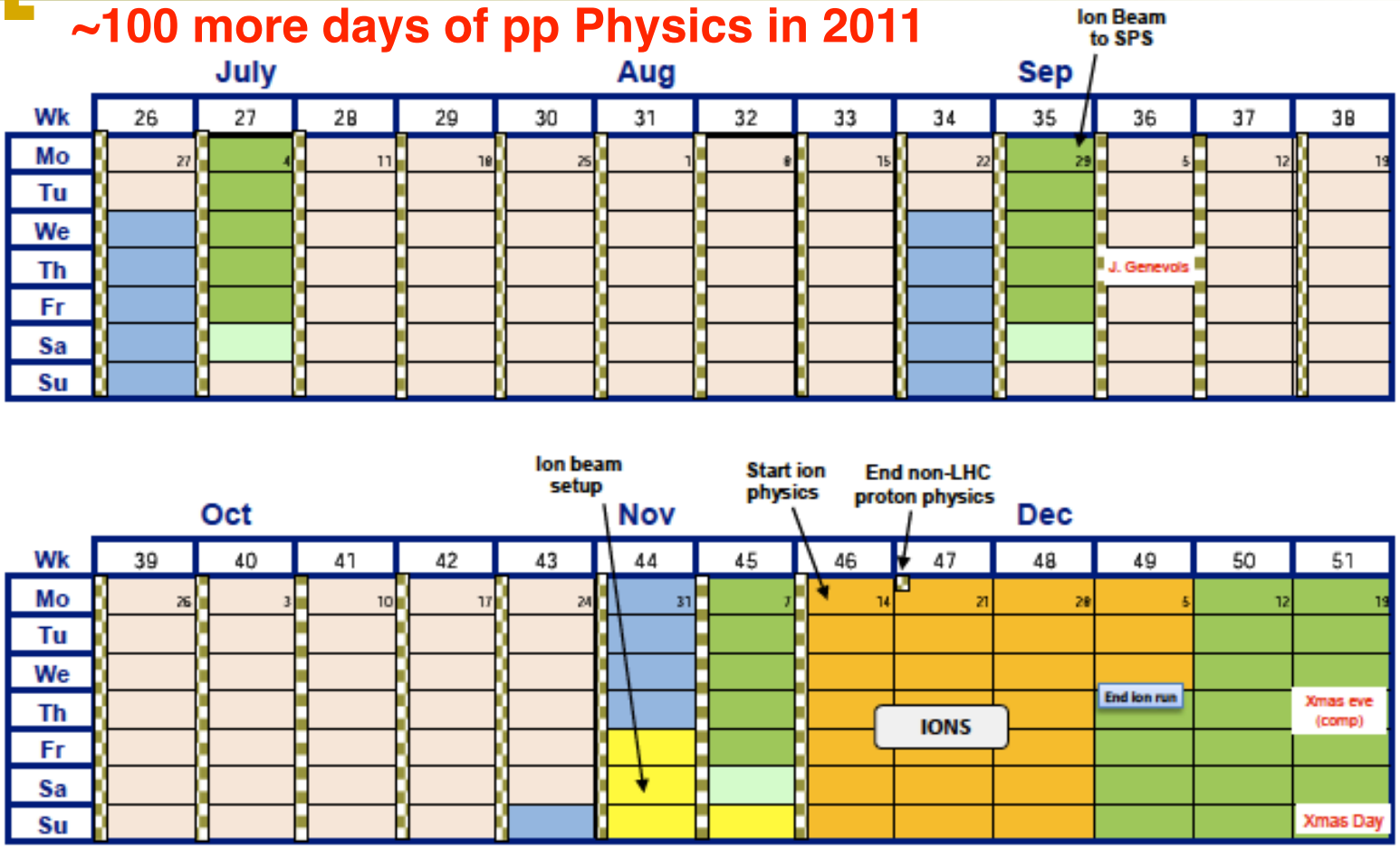
- **β***: squeeze down to **0.3 m** (at IP1) with pilot beam, flat machine.

LHC can potentially exceed **5 x 10^{33} cm^{-2}s^{-1}** this year even with 50 ns bunch spacing – by exceeding the design number of protons per bunch. Can get **5 fb^{-1}** with no changes, **~10 fb^{-1}** with 4–**5 x 10^{33} cm^{-2}s^{-1}** this year. But pile-up conditions can be challenging.

Mini-Chamonix workshop will be held on July 15 to define in detail the next steps listening carefully to the opinions of the experiments.

LHC schedule for the rest of 2011

~100 more days of pp Physics in 2011

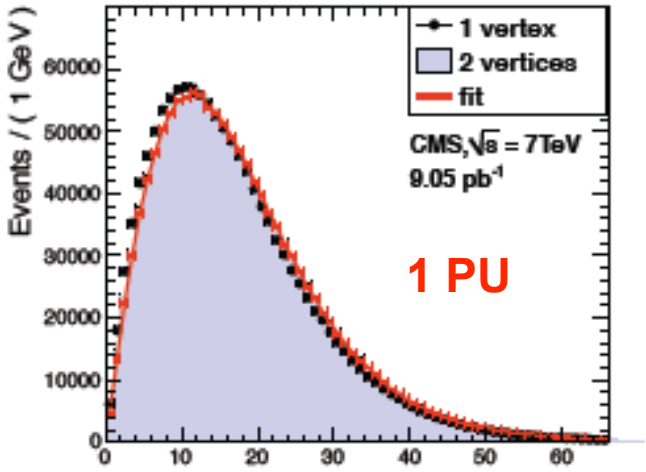


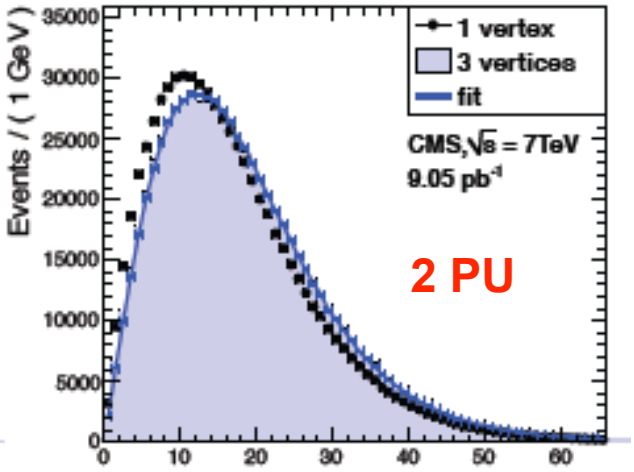
Technical Stop
Recommisssoning with beam
Machine development
Ion run
Ion setup

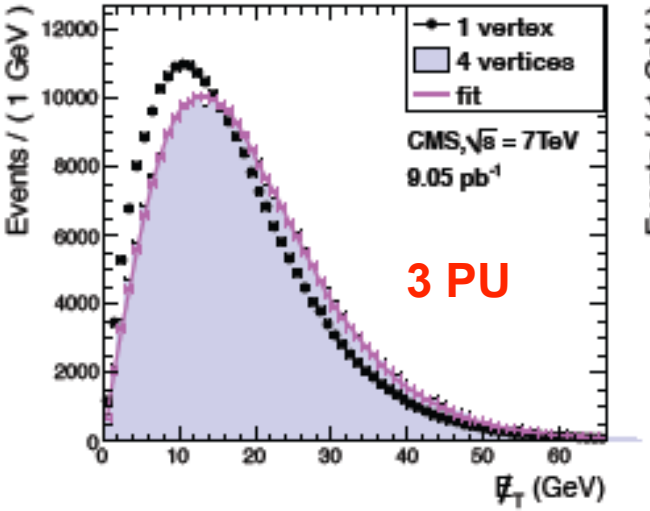
Next Machine Development + Tech. stop:
Aug. 24 - Sept. 2, Oct. 30 - Nov. 11
(Ion beam setup Nov. 4-6) The HI run is from Nov. 14 to Dec. 7

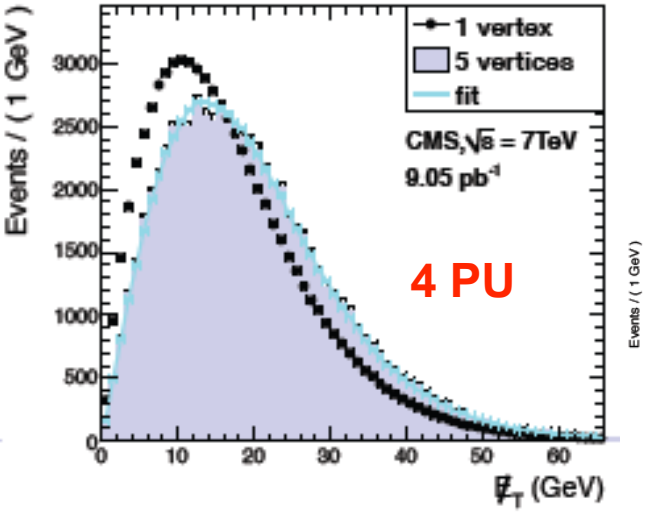
Example of the pileup effect: in $\not{E}_T$ in jet data

With each additional primary vertex in the event particle flow MET shifts by ~0.5 GeV and the resolution gets degraded progressively.





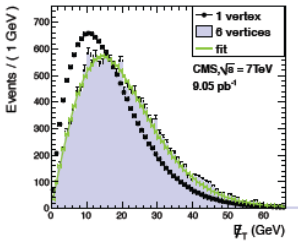




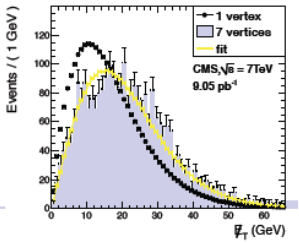
More details at: http://cdsweb.cern.ch/record/1294501?ln=en

Currently we are getting 4−6 pileup per event. Could rise up to 20/event, and 25 ns running would increase problem with out-of-time pile-up.

5 PU



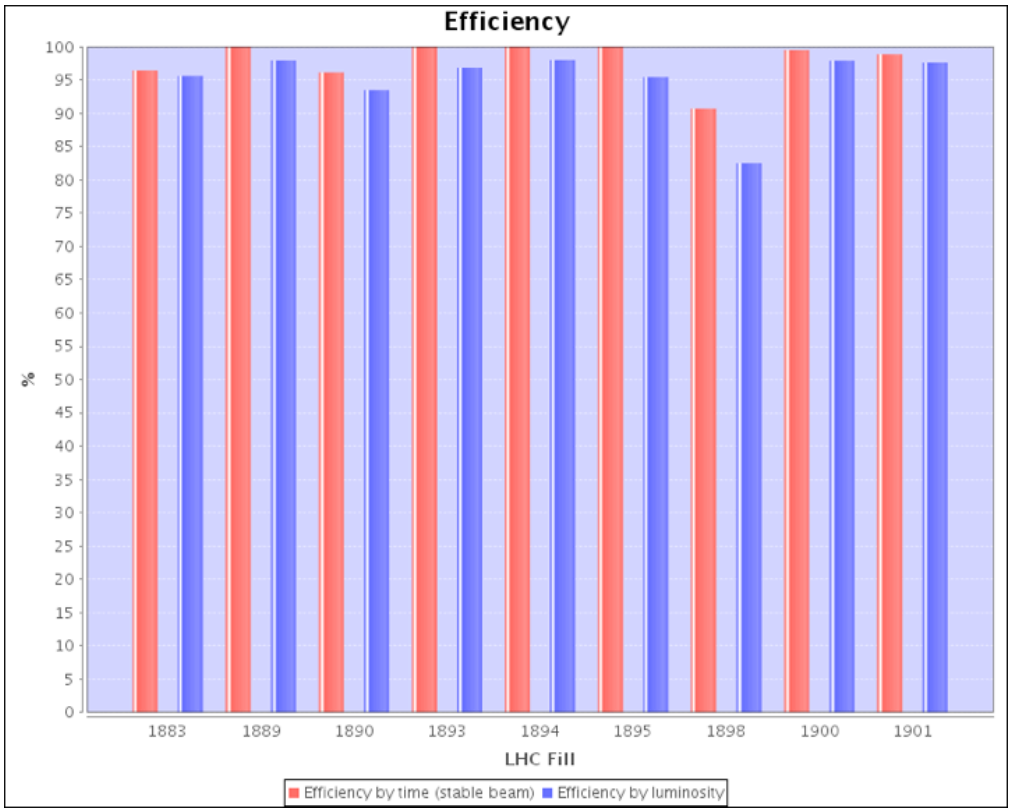
6 PU

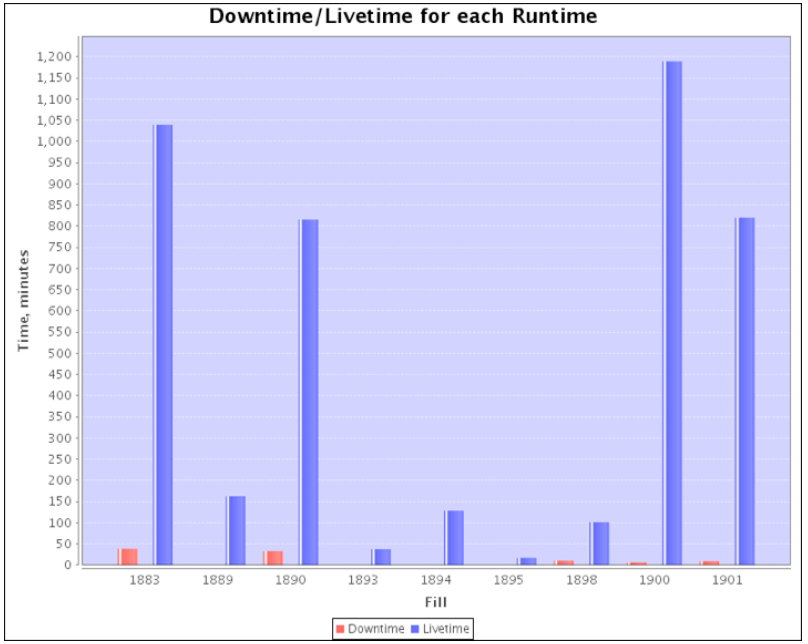


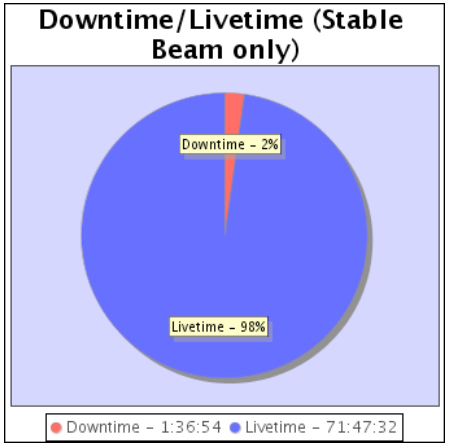
CMS: summary of last two weeks

Provided by the USCMS effort

CMS has been efficiently collecting data



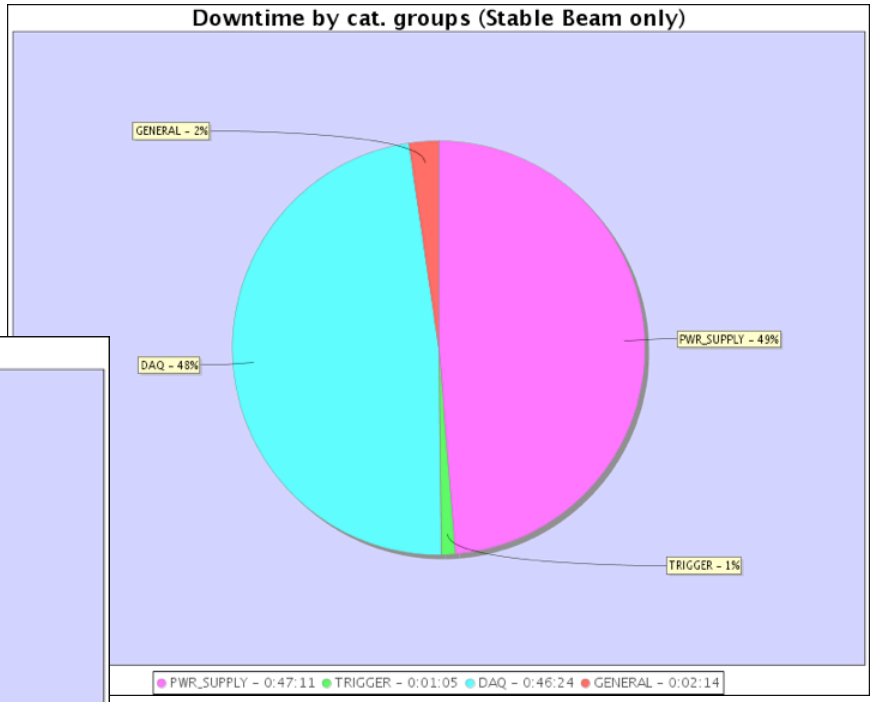


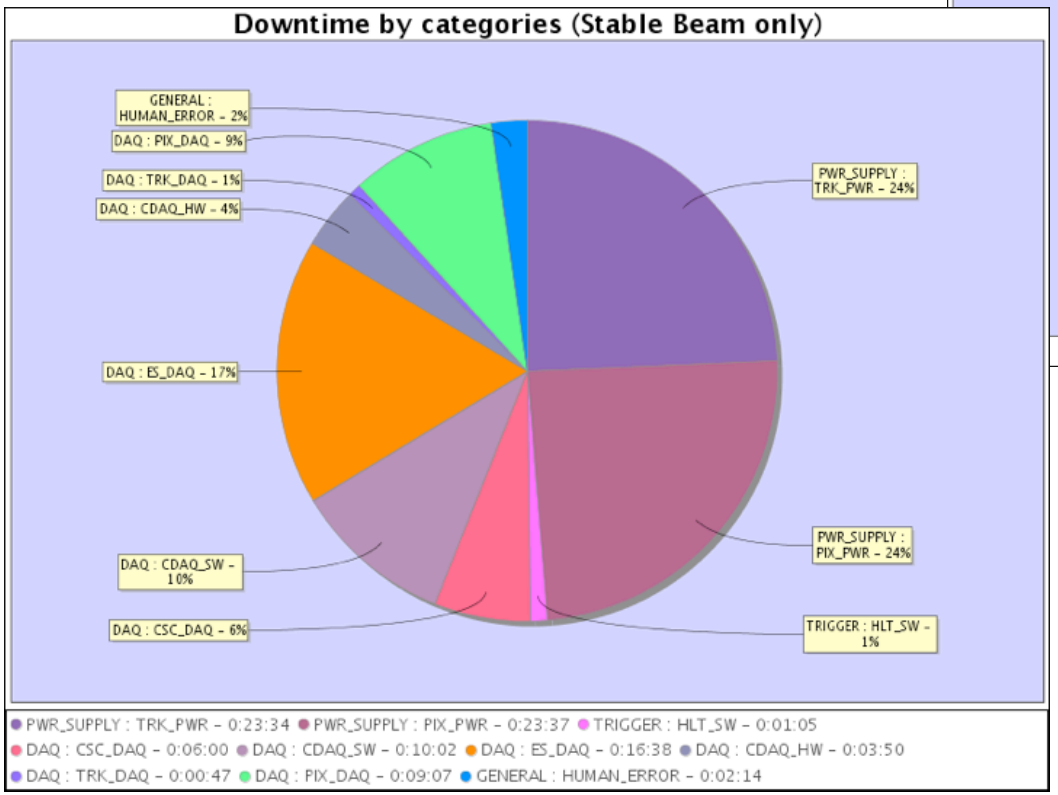


Average data collection efficiency has been > 91% throughout the year

CMS: detailed breakdown of the downtime

Provided by the USCMS effort
(Web based monitoring)





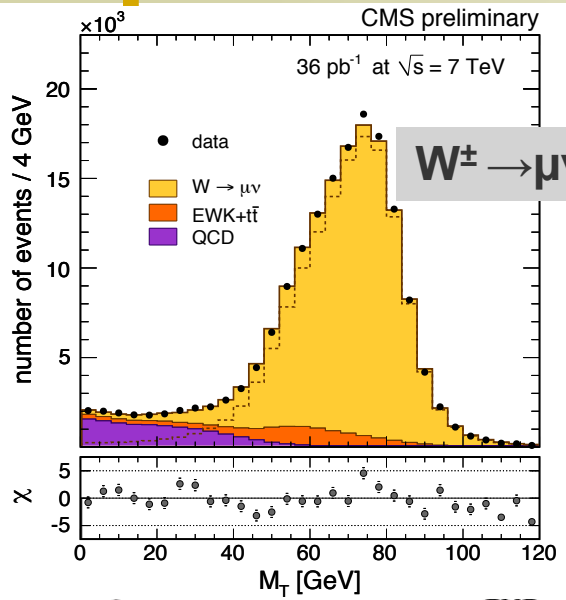
Power supply was a big contributor this time

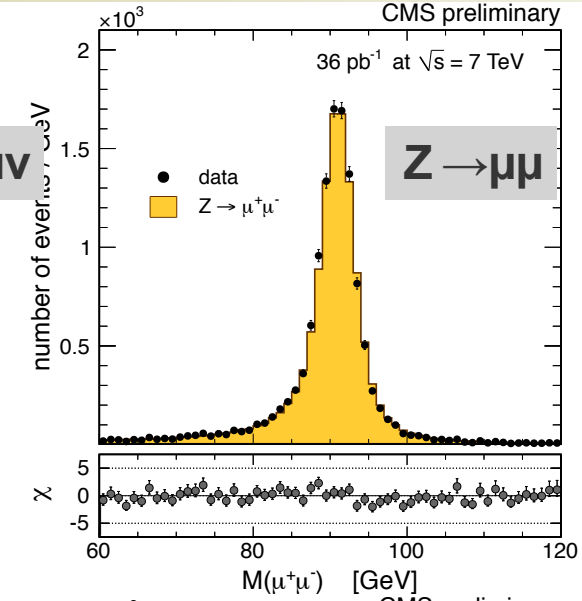
Saga of power supply interruptions

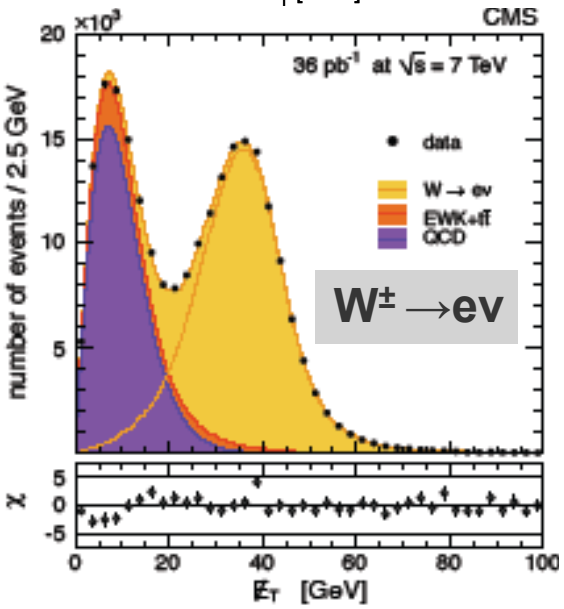
- LHC had major power supply interruptions yesterday (Sunday).
  - Three interruptions: 11:03, 11:11, and 11:34 am local time
  - LHC loop feed from P2 at 13:28 (false inter-trip on MP7, i.e., connection from Prevessin to Meyerin, second time in 3 months.)
  - Back at standard configuration by 16:00

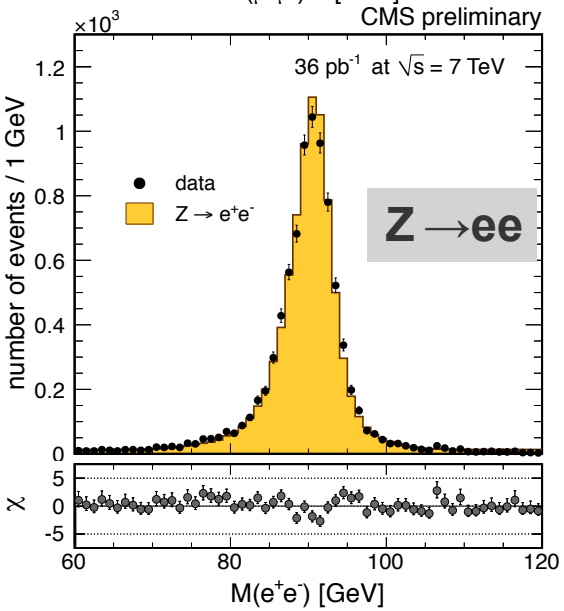
- CMS got power back two hours after the accident. ATLAS was off for 2h30.
  - ATLAS managed to ramp down slowly, but lost the helium. They have to refill... It will take days to recover.
  - CMS: to save power and avoid overheating, most of the non-vital equipments were switched off, both in the control room and in USC.

Physics: Measurement of W and Z production







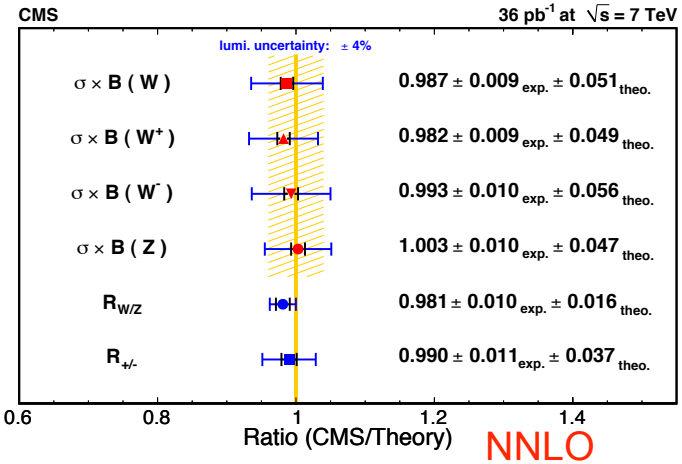


More details at:

http://cdsweb.cern.ch/record/1337017?ln=en

- Fully reco'ble, high purity
- MET well understood
- Lepton energy scale and resolution well measured
- Tiny experimental errors
  - luminosity, theory dominate uncertainty

In 36 pb^{-1} data
280000 W's 20000 Z's
Excellent agreement with SM



NNLO

BACKUP SLIDES

Studies of pileup effect in jet data

In this Section, we study the behaviour of the PF $\not\!\!E_T$ distributions in samples containing high p_T jets when pile-up is present. The data are selected using a prescaled H_T trigger with a threshold of 100 GeV, where H_T is defined as the scalar sum of the transverse momenta of PF jets ($p_T > 20$ GeV, $|\eta| < 3$). Additionally, in the offline analysis, each event is required to have H_T (calculated using PF jets)> 200 GeV to avoid bias from the trigger.

PF $\not\!\!E_T$ distribution with increasing number of vertices can be modeled by convoluting the x- and y-components of the one-vertex $\not\!\!E_T$ shape with a Gaussian (G) whose mean is $(n-1)\cdot\Delta\mu_x$ and with standard deviation $\sqrt{n-1}\cdot\Delta\sigma_x$:

$$\not\!\!E_{T,n} = \sqrt{(\not\!\!E_{x1} \otimes G[(n-1)\cdot\Delta\mu_x, \sqrt{n-1}\cdot\Delta\sigma_x])^2 + (\not\!\!E_{y1} \otimes G[(n-1)\cdot\Delta\mu_y, \sqrt{n-1}\cdot\Delta\sigma_y])^2}$$

where $\not\!\!E_{x,y}$ are the x and y components of $\vec{\not\!\!E}_T$. Here we assume that each additional vertex contributes with a constant $\Delta\sigma_x$ ($\Delta\sigma_y$) to the $\not\!\!E_T$ resolution such that the resolution with n pile-up interactions is related to that with one primary vertex via: $\sigma^2_{xn} = \sigma^2_{x1} + (n-1)\Delta\sigma^2_x$. In addition we also allow for a linear shift of $\not\!\!E_x$ and $\not\!\!E_y$ by $\Delta\mu_x$ ($\Delta\mu_y$) such that $\mu_{xn} = \mu_{x1} + (n-1)\Delta\mu_x$. A fit of Eq. (2) to data results in $\Delta\sigma_x = \Delta\sigma_y = 3.7$ GeV, consistent with the results from Section 6.5.1. This fit is performed simultaneously on the $\not\!\!E_T$ distributions of events containing two to seven vertices. The shifts of the x and y $\not\!\!E_T$ components are estimated to be $\Delta\mu_x = 0.5$ GeV and $\Delta\mu_y = -0.3$ GeV respectively, which are small compared to $\Delta\sigma$ and are consistent with the expected shift seen in simulation due to non-functional channels.