



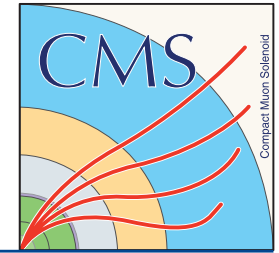
# INTRODUCTION AND GOALS OF THE WORKSHOP

CMS Commissioning Workshop, January 24<sup>th</sup> 2017  
Turin INFN & University, Sala Cavallerizza Reale  
Turin, Italy

Silvia Goy Lopez (CIEMAT) Greg Rakness (FNAL),  
Lucia Silvestris (INFN Bari)

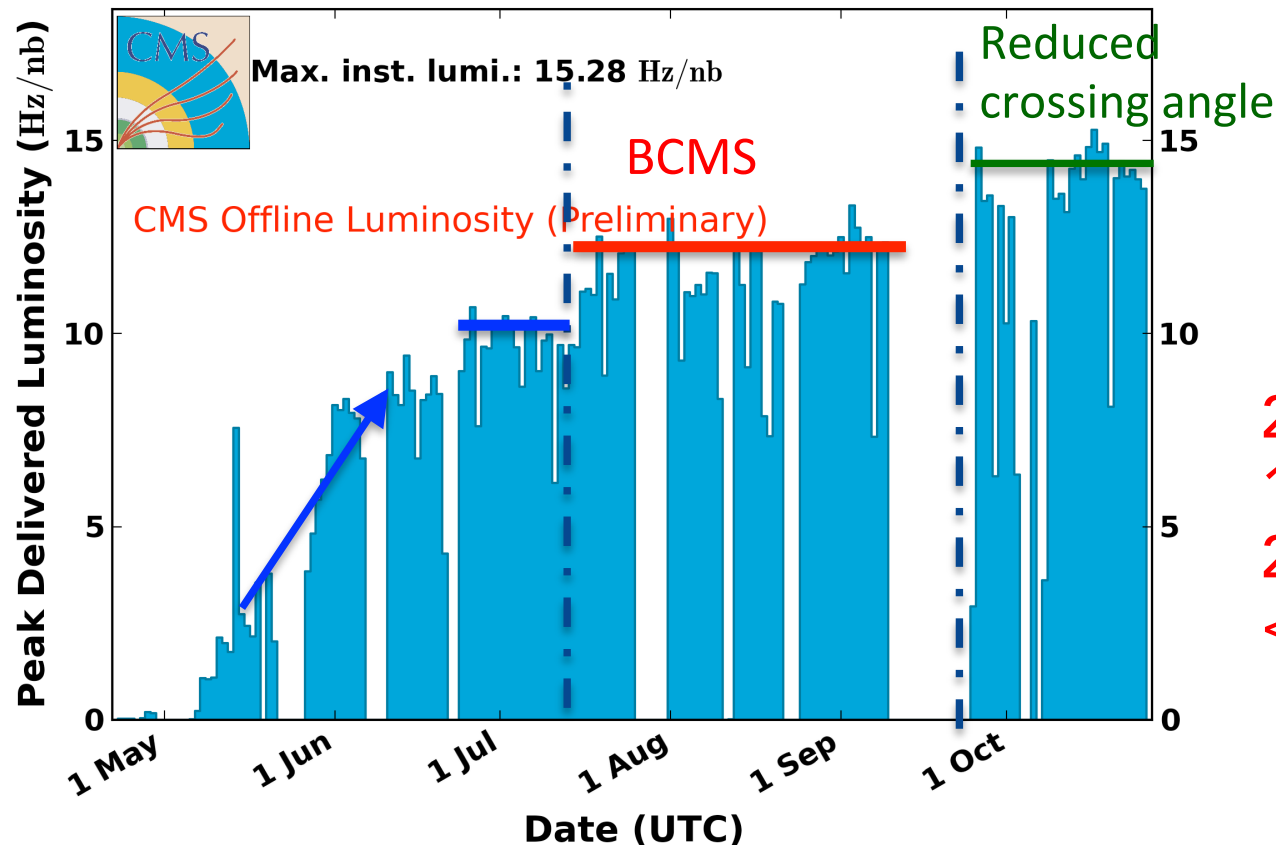
Additions to this in Silvia's talk on 2017 Plans, Sudan's talk on EYETs and  
Greg's talk on news from Chamonix tomorrow

# LHC Performance in 2016



## CMS Peak Luminosity Per Day, pp, 2016, $\sqrt{s} = 13$ TeV

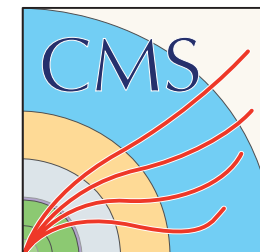
Data included from 2016-04-22 22:48 to 2016-10-27 14:12 UTC



Typical peak lumi at end of year  $\sim 1.4e34/cm^2/s$

2016 max peak lumi  
 $1.53 \times 10^{34}/cm^2/s$   
2208 colliding bunches &  
 $\langle \text{pileup} \rangle = 49.4$

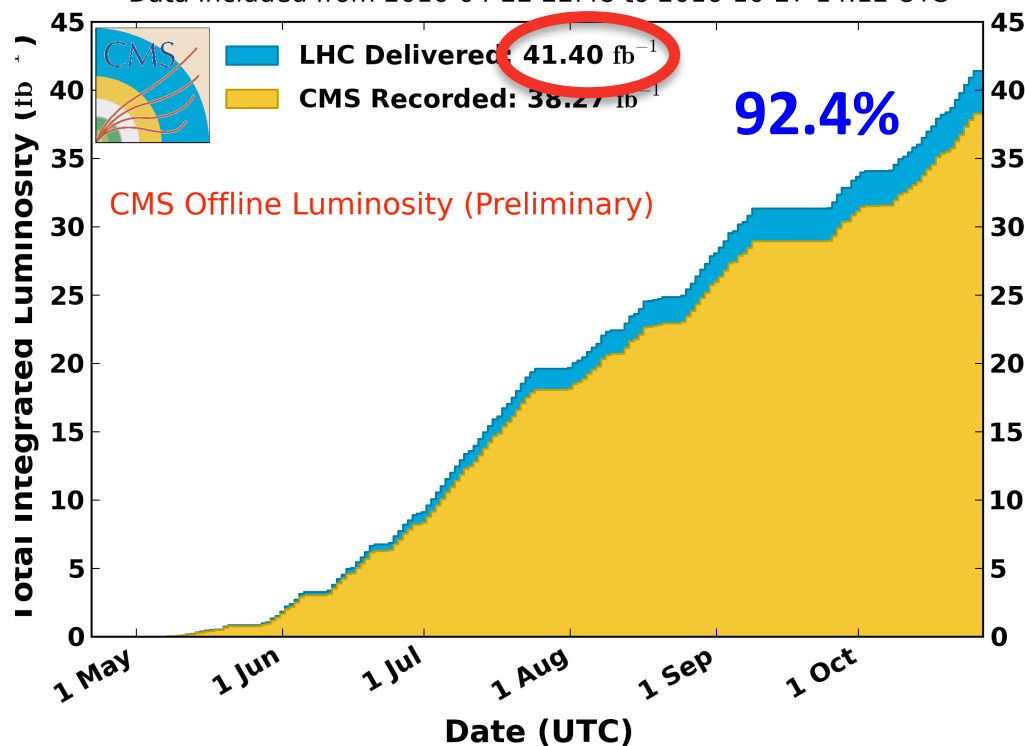
# CMS data taking in 2016



LHC has achieved 40% of Run 2 for pp

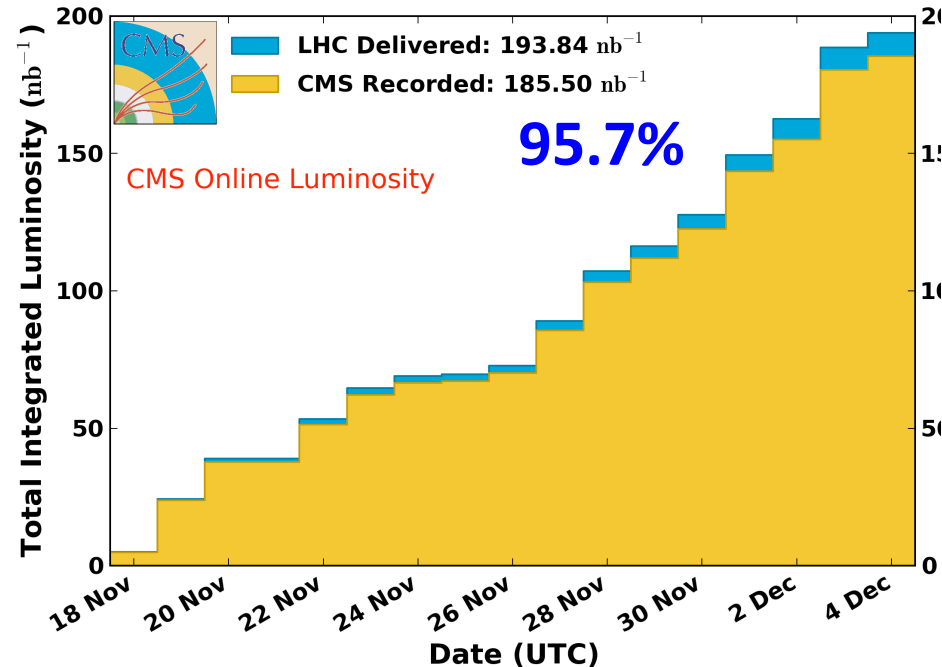
CMS Integrated Luminosity, pp, 2016,  $\sqrt{s} = 13$  TeV

Data included from 2016-04-22 22:48 to 2016-10-27 14:12 UTC



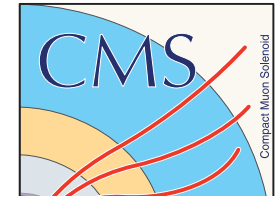
CMS Integrated Luminosity, pPb, 2016,  $\sqrt{s} = 8.16$  TeV/nucleon

Data included from 2016-11-18 04:11 to 2016-12-04 03:11 UTC

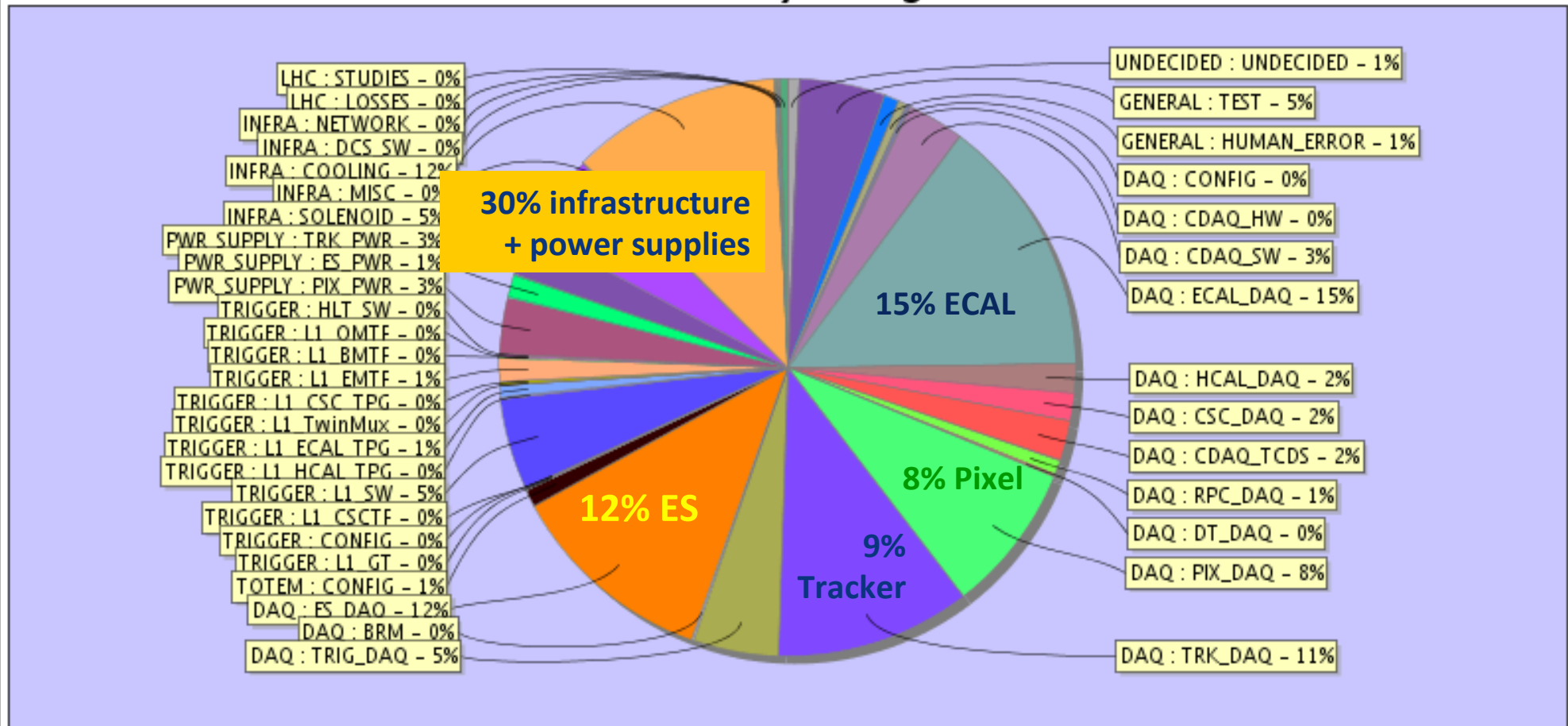


<https://twiki.cern.ch/twiki/bin/view/CMSPublic/LumiPublicResults>

# CMS Data taking operation



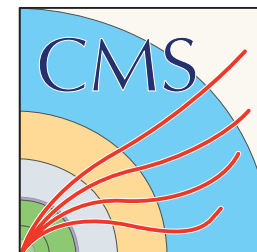
## Lumi lost by categories



**Data recording efficiency ~92%**

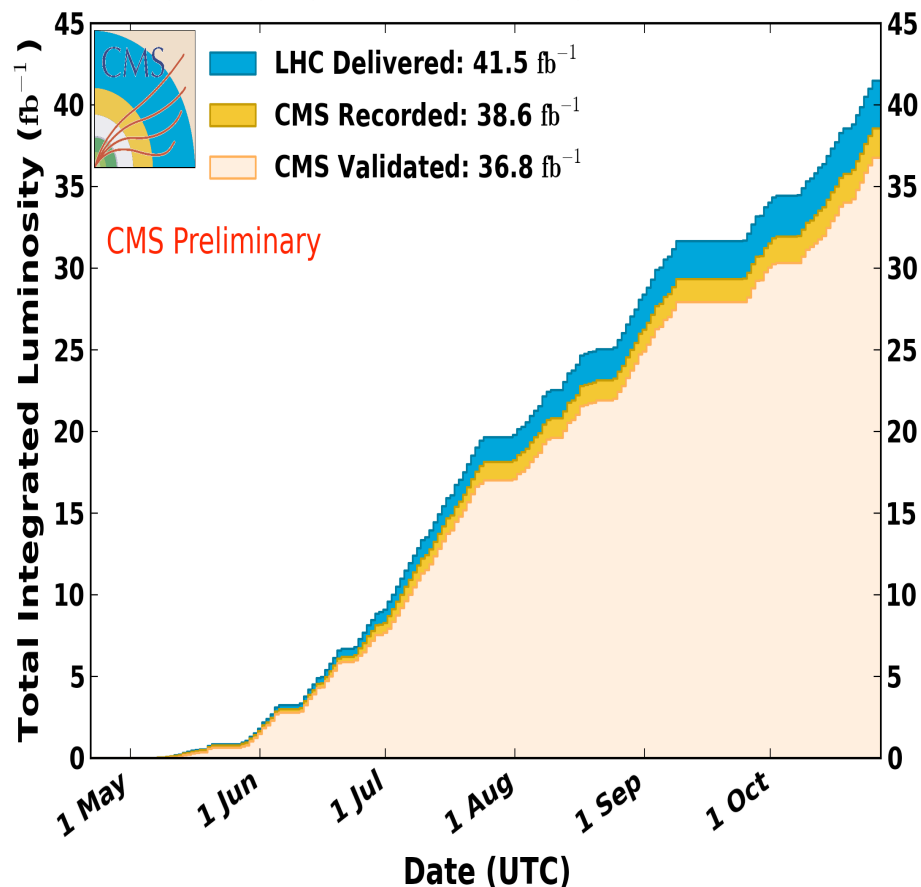
**2016 fills 4851-5456 Livetime ~96% and downtime ~4%**

# CMS Data Quality in 2016



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

Data included from 2016-04-22 22:48 to 2016-10-27 14:12 UTC



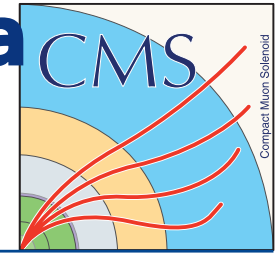
CMS data collection efficiency ~93%

CMS data certification efficiency = 95.3%

These two numbers are the result of a huge effort sustained over many years by all crews at p5 and beyond

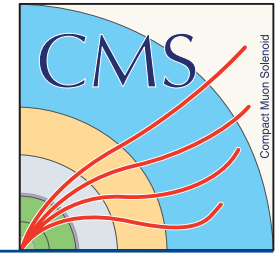
<https://twiki.cern.ch/twiki/bin/viewauth/CMS/DataQuality>

# How to further improve for 2017 data taking and data quality efficiencies...



- Launch failure scenario review campaign
- Request sent to the Detector operations, DPGs, POGs
  - To categorize list of occurrences of data label BAD in each subsystem
    - Why was BAD operationally?
  - To categorize list of occurrences of data changed from BAD to GOOD.
    - why did you decide to change from BAD to GOOD?
- Feedback to be provided by mid of February.
- Run & PPD Coordination topical meeting **end of Feb/mid of March.**

# Major achievements in 2016



- Efficient commissioning of new items
  - L1 Trigger: completely new L1 trigger
  - HCAL: HB & HE moved to uTCA (coupled with Trigger)
  - CT-PPS: TOTEM Si strips + diamond run w/CMS at high luminosity
  - Pixel pilot blade: included new Pixel blade in very last high luminosity fill without problems.
- Improved feedback from online  $\leftrightarrow$  certification via regular daily data certification from PFG (Prompt Feedback Groups) at daily run meetings

<http://cds.cern.ch/record/2241144?ln=en>



CMS Experiment at the LHC, CERN

Data recorded: 2016-Aug-27 23:44:01.739584 GMT

Run / Event / LS: 279685 / 178456860 / 95

Thanks !!

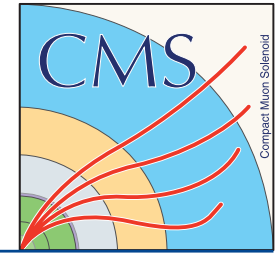
**The motivation of all sub-systems to continuously improve CMS performance**

**The dedication of many teams:**

**DOCs, sub-system experts, Run Field Managers, shift crews, operations managers, DPGs groups, Trigger, WBM, DAQ, PPD, computing, offline, Technical Coordination, LHC...Nespresso**

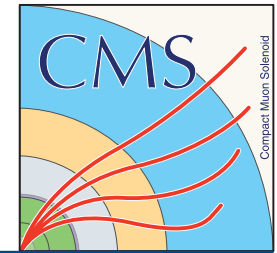


# Aim of the workshop



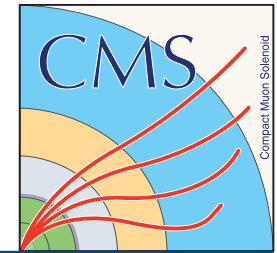
- Review the 2016 operational experience & detector performance and calibration;
- Plan the 2017 commissioning activities & detector performance and calibration;
- Plan Phase 1 commissioning for Pixel and HCAL (HF & HE Plan 1)
- Preparation for new LHC luminosity limits ...

# Tuesday's Agenda mostly focus on Performances



Plans for 2017 <i>Aula Magna, Cavallerizza Reale</i>	GOY LOPEZ, S 09:30 - 09:40	Strip Performance, calibration/alignment & commissioning: plans for 2017 commissioning <i>BOUDOUL, Gaelle</i>	Detector Performance
Preparation for High Luminosity Scenarios <i>Aula Magna, Cavallerizza Reale</i>	CHEN, Kai-Feng et al. 09:50 - 10:00	ECAL Performance and calibration: plans for 2017 commissioning <i>MASSIRONI, Andrea et al.</i>	
PPD/Offline & Computing Plans for 2017 data taking <i>Aula Magna, Cavallerizza Reale</i>	CERMINARA, Gianluca et al. 10:20 - 10:30	HCAL Performance and calibration: plans for 2017 commissioning <i>DE GUIO, Federico</i> 14:50 - 15:20	
Coffee Break <i>Aula Magna, Cavallerizza Reale</i>	10:55 - 11:00	DT Performance and calibration: plans for 2017 commissioning <i>CAVALLO, Francesca Romana</i>	<i>Aula Magna, Cavallerizza Reale</i> 13:50 - 15:50
L1 Performance: Plans for 2017 commissioning <i>Aula Magna, Cavallerizza Reale</i>	MATSUSHITA, Takashi 11:25 - 11:35	Coffee Break <i>Aula Magna, Cavallerizza Reale</i>	15:50 - 16:20
HLT Performance: Plans for 2017 Commissioning <i>Aula Magna, Cavallerizza Reale</i>	TOSI, Mia 11:50 - 12:10	CSC Performance and calibration/alignment: plans for 2017 commissioning <i>SUAREZ, Indara</i>	Detector Performance
Pixel Performance and calibration/alignment: plans for 2017 commissioning <i>Aula Magna, Cavallerizza Reale</i>	VESZPREM, Viktor 11:25 - 11:35	RPC Performance and calibration/alignment: plans for 2017 commissioning <i>HADJISKA, Roumyana Mileva</i>	16:20 - 17:30 <i>Aula Magna, Cavallerizza Reale</i>
		CT-PPS Performance: Plans for 2017 commissioning <i>AVATI, valentina</i>	
		Tracking Performance: plans for 2017 commissioning <i>Aula Magna, Cavallerizza Reale</i>	17:35 - 17:55 <i>INNOCENTE, Vincenzo</i>
		POGs Plans and inputs for 2017 Commissioning <i>Aula Magna, Cavallerizza Reale</i>	18:00 - 18:25 <i>RIZZI, Andrea et al.</i>

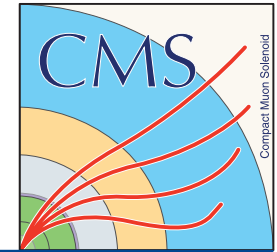
# Wednesday's Agenda mostly focus on Operations



<b>Impressions from LHC Chamonix Workshop</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>RAKNESS, Greg</b> 09:00 - 09:30	<b>L1 Commissioning/Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>KLABBERS, Pamela</b> 14:20 - 14:40	<b>Sub-systems Operations</b> <i>Aula Magna, Cavallerizza Reale</i>
<b>EYETS update</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>PARAMESVARAN, Sudarshan</b> 09:35 - 10:00	<b>HLT Commissioning/Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>SMITH, Geoffrey</b> 14:20 - 14:40	
<b>Muon Alignment: Plans for 2017</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>PERNIE, Luca</b> 10:05 - 10:25	<b>Pixel Commissioning/ Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>ANDREA, Andrea</b> 14:20 - 14:40	
<b>Luminosity Studies</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>LEONARD, Jessica Lynn</b> 10:05 - 10:25	<b>ECAL Commissioning/ Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>ANDREA, Andrea Davide et al.</b> 13:55 - 16:15	
<b>Coffee Break</b> <i>Aula Magna, Cavallerizza Reale</i>		<b>Coffee Break</b> <i>Aula Magna, Cavallerizza Reale</i>		<b>Coffee Break</b> <i>Aula Magna, Cavallerizza Reale</i>
<b>DAQ &amp; TCDS Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>SEAMAN, Jeron</b> 11:25 - 11:55	<b>Gem Demonstrator Performance &amp; Commissioning Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>KAMON, Toruki</b> 16:15 - 16:45	<b>Sub-systems Operations</b> <i>Aula Magna, Cavallerizza Reale</i>
<b>System administration Operations</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>ANDREA, Andrea</b> 12:20 - 12:35	<b>DT Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>MASETTI, Gianni</b> 17:20 - 17:40	
<b>DCS Operations</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>ANDREA, Andrea</b> 12:25 - 12:35	<b>CSC Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>IGNATENKO, Mikhail</b> 17:45 - 18:05	
	<b>ANDREA, Andrea</b> 12:00 - 12:35	<b>RPC Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>	<b>EYSERMANS, Jan</b> 18:10 - 18:30	
				<b>RPC Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>
				<b>RPC Operations and Plans</b> <i>Aula Magna, Cavallerizza Reale</i>

Conference Dinner at Ristorante "Il Circolo dei Lettori"  
 (<http://www.circololettori.it/il-ristorante/>)

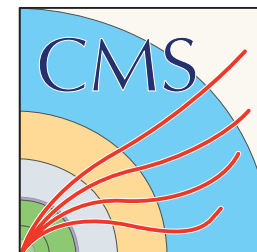
# Thursday's Agenda focus still on Operations ...



09:00	CT-PPS Commissioning/Operations and plans Aula Magna, Cavallerizza Reale 09:00 - 09:30	HOLLAR, Jonathan	Sub-systems Operations Aula Magna, Cavallerizza Reale 09:00 - 09:30
	WBM Operations and Plans for 2017 Aula Magna, Cavallerizza Reale 09:35 - 09:50	BEHRENS, Ulf	Central Operations Aula Magna, Cavallerizza Reale 09:35 - 10:50
10:00	Upgrade WBM plans and implications for the subsystems Aula Magna, Cavallerizza Reale 10:20 - 10:45	MOMMSEN, Remigius	
	DQM (Online & Offline) Operations Aula Magna, Cavallerizza Reale 10:20 - 10:45	VAN BESSEN, Bronn et al.	
1:00	Coffee Break Aula Magna, Cavallerizza Reale 10:50 - 11:20		
	Data Quality and certification Plans for 2017 Aula Magna, Cavallerizza Reale 11:20 - 11:45	AZZOLINI, Virginia et al.	Central Operations Aula Magna, Cavallerizza Reale 11:20 - 11:45
2:00	Additional discussion on 2017 commissioning Aula Magna, Cavallerizza Reale 11:45 - 12:20		
	Summary, Action items from the workshop Aula Magna, Cavallerizza Reale 12:25 - 12:50		

**Actions Items from the workshop**

# Acknowledgements



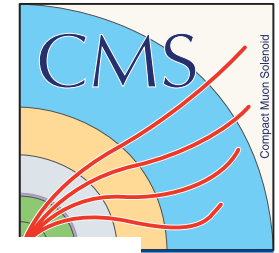
- We would like to thank:
  - The Torino group & the local organizing committee for the excellent organization and the nice welcome
  - All of you for being in Torino

We wish you a nice stay in Torino and  
a fruitful meeting

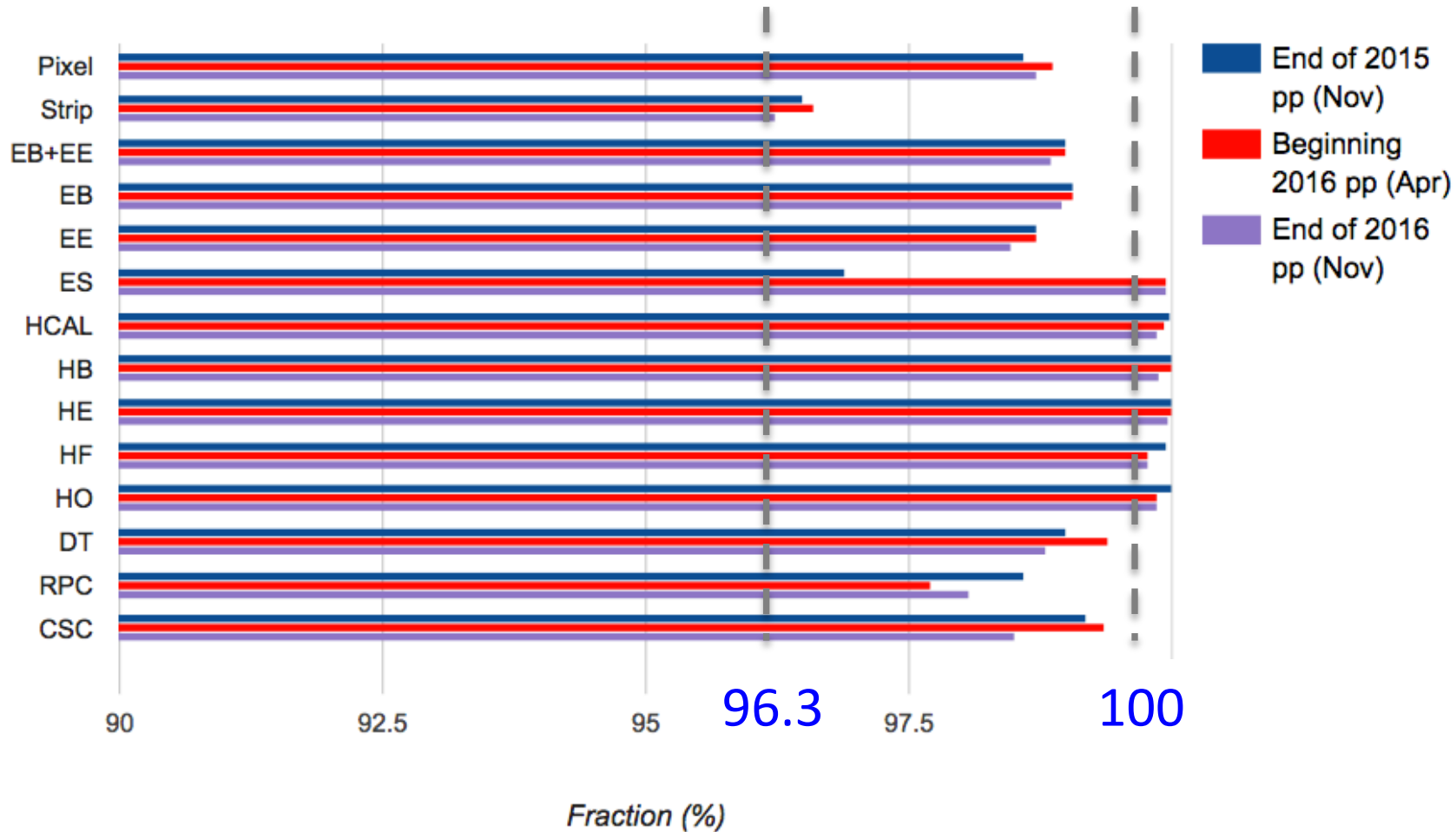
# Back-up slides



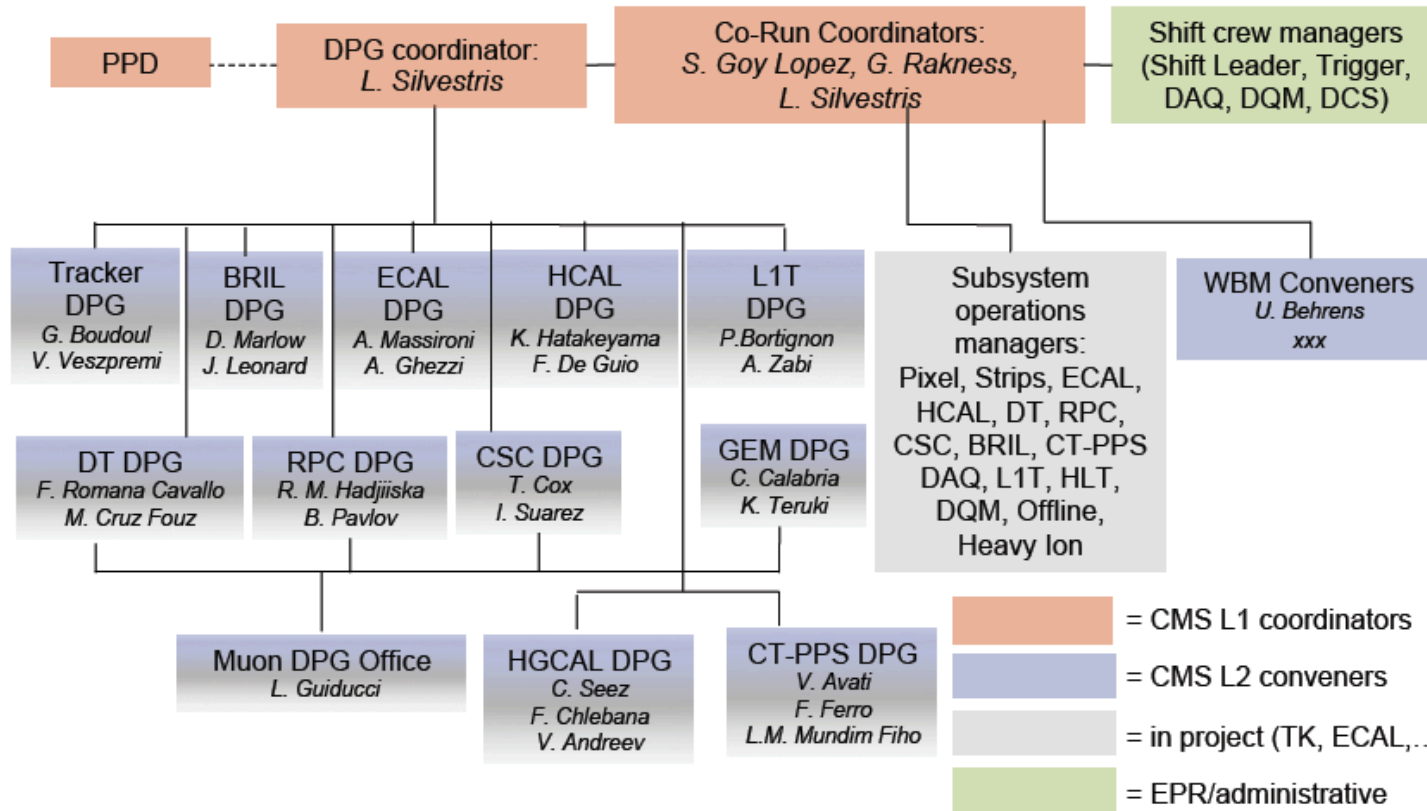
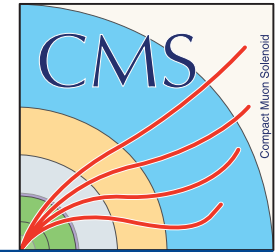
# CMS detector performance: Active Channels



**Detector Active Fraction**

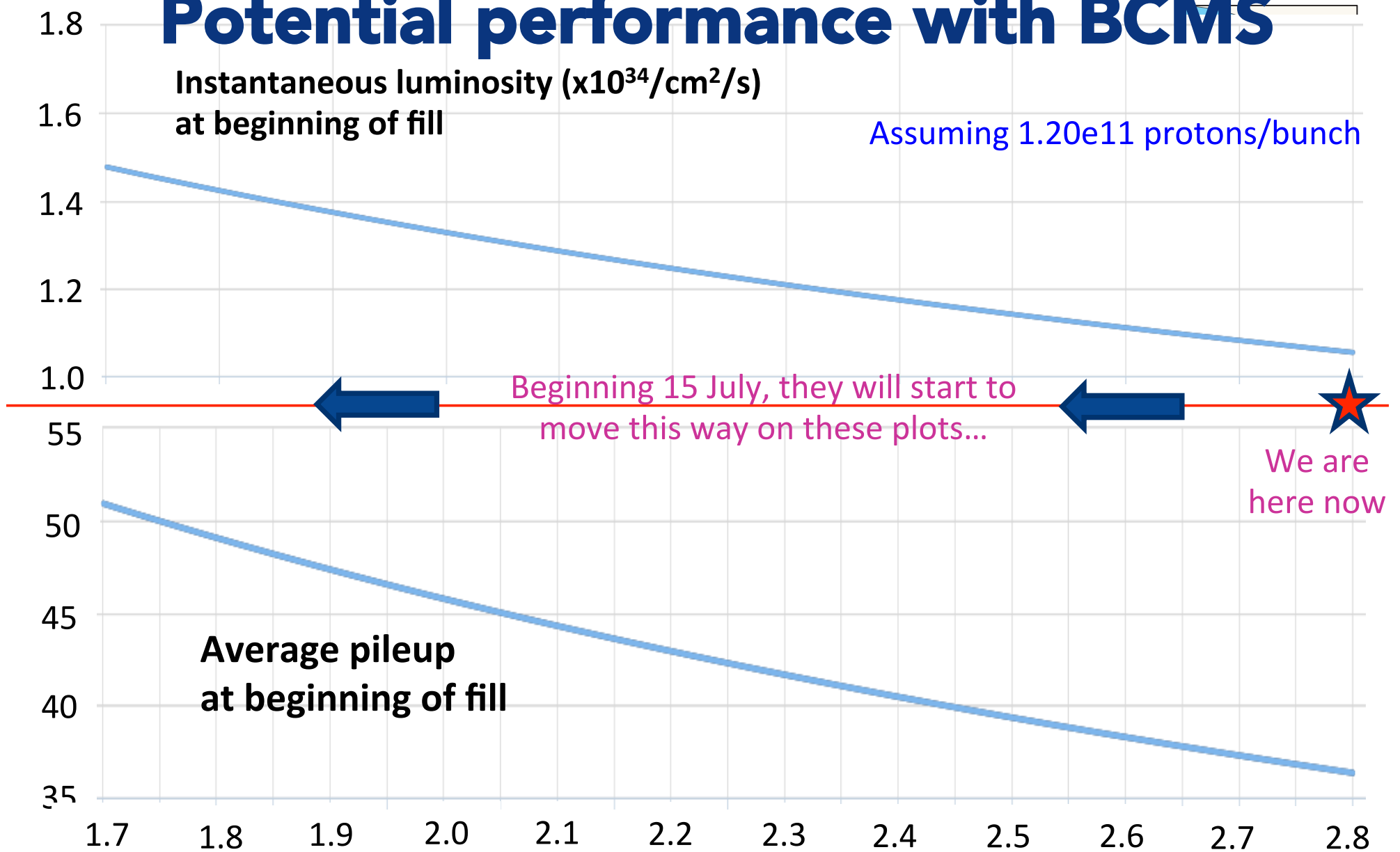


# 2017 Run Coordination Organization





# Potential performance with BCMS

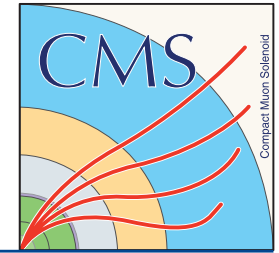


Minimized (optimal) blowup  
from PS  $\rightarrow$  SPS  $\rightarrow$  LHC

Emittance ( $\mu\text{m}$ )

Present lumi  
levels

# Daily data certification (PFG)



**Certification of Collision runs recorded in the last 5 days  
(Last update on Mon Nov 14 08:00:24 2016)**

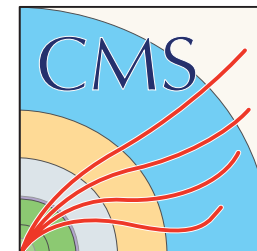
Run	B-field	Events	HLT	L1T calo	L1T muon	CSC	DT	RPC	ECAL	ES	HCAL	PIX	STRIP	TRACKING
285216	3.8 T	21256253532	WAIT	To be checked	To be checked	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	To be checked	To be checked	To be checked
285204	3.8 T	252645312	WAIT	To be checked	To be checked	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT
285203	3.8 T	30396156	WAIT	GOOD	GOOD	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT
285202	3.8 T	837072	WAIT	GOOD	GOOD	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT
285201	3.8 T	44677464	WAIT	GOOD	GOOD	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT
285199	3.8 T	9891348	WAIT	GOOD	GOOD	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT
285091	3.8 T	65000412	WAIT	GOOD	GOOD	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	BAD [...]	BAD [...]	BAD [...]
285090	3.8 T	1414989996	WAIT	GOOD	GOOD	WAIT	WAIT	WAIT	WAIT	WAIT	WAIT	GOOD [...]	GOOD [...]	GOOD [...]

Daily (online) data certification now in place to spot immediately problems and act on them ...

- <https://cms-service-dqm.web.cern.ch/cms-service-dqm/CAF/certification/Collisions16/13TeV/CertSummary/status.Collisions16.html>

Thanks to the PFG (Prompt Feedback Groups)

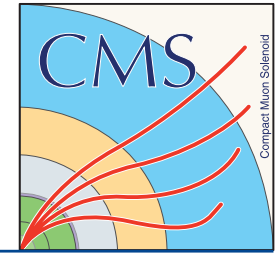
# 2016 Low pile-up data collected



- Overview of low pile-up data collected at 13 TeV in 2015
  - 20164 Low pile-up in 2015:
    - Run2015A at 0T : 85.6 /nb PU  $\sim$ 0.1 (with CASTOR)
    - Run2015B at 3.8T: 229 /nb PU  $\sim$ 1.6
    - Run2015C at 3.8T: 22 /nb (VdM) PU  $\sim$ 0.5
    - Run2015D at 3.8T: 663 /nb PU  $\sim$ 0.1 (with TOTEM)
    - pp at 5 TeV + AA at 5 TeV (with CASTOR)
- Low pile-up in 2016:
  - Run2016B at 3.8T: 43 /nb (VdM) PU  $\sim$ 0.6
  - mini ramp-up after MD:  $\sim$ 1.3 /pb PU  $\sim$ 0.5-1.0

Total available:  $\sim$ 2 /pb CMS data  
663 /nb CMS+TOTEM data

# 2017 Shifts Schedule



- 4 - 14 Jan (07:00-19:00 Mon-Sat): Technical Shifter + Shift Leader
  - Manage access to the experiment
- 16 Jan - 27 Mar (24h/24 7j/7): Technical Shifter + Shift Leader
  - Allow subsystems to turn on and remain on
  - Power/cooling is back the ~week before
- 8-10 Feb (24h/24): Full shift crew → 2017 Mid-Week Global Run #1
- 1-3 Mar (24h/24): Full shift crew → 2017 Mid-Week Global Run #2
- 15-17 Mar (24h/24): Full shift crew → 2017 Mid-Week Global Run #3
- 27 Mar-15 Dec (24h/24 7j/7): Full shift crew
  - CRUZET + CRAFT + Beams Commissioning + Physics
  - Gives ~1 month of time before beams to run full time
  - Should give us sufficient time for commissioning activities (pixel, HCAL...)

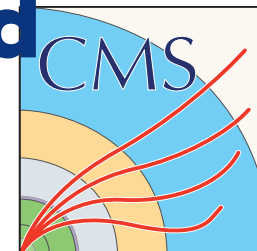
# 2017 LHC Running Conditions



	Nominal	BCMS	BCMS
Beta* (1/2/5/8)	0.4/10/0.4/3	0.4/10/0.4/3	0.33/10/0.33/3
Half crossing angle	-185/200/185/-250	-155/200/155/-250	-170/200/170/-250
Nb	2748	2460	2460
Nc	2736	2448	2448
Proton per bunch	1.05e11	1.05e11	1.25e11
Emittance into SB	3.2	2.3	2.3
Bunch length	1.25	1.25	1.05
Peak luminosity	~1.41e34	~1.79e34	~1.91e34
Peak pile-up	~37	~51	~56
Luminosity lifetime	~21	~15	~14
	38 fb <sup>-1</sup>	40+ fb <sup>-1</sup>	

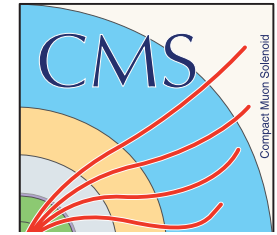
See Mike Lamont's talk this morning

# Looking forward: Planning YETS and 2017 data taking



- **2 Nov:** meeting on Year-End Technical Stop
  - LHC: A31L2 (dipole magnet) and ...
  - CMS: Pixel, HCAL, CT-PPS
- **14 – 17 Apr:** Easter weekend
- Some dates
  - **May 1<sup>st</sup> :** Machine restart
  - **June 12<sup>th</sup> :** (5 + 1) weeks (commissioning + scrubbing) after beam in machine: Stable Beams
- Understanding commissioning needs with subsystems
  - Major are Pixel and HCAL phase 1 upgrade
  - CRUZET/CRAFT
- Setting up shift schedule!

# 2017 LHC draft Schedule and CMS Commissioning



	Jan			Feb					Mar				13
Wk	1	2	3	4	5	6	7	8	9	10	11	12	13
Mo	2	9	16	23	30	6	13	20	27	6	13	20	27
Tu													
We													
Th													
Fr													
Sa													
Su													

Controls interventions (arrow pointing to Jan 2)

Technical stop (EYETS) (star in Feb 6-7)

CRUZET/CRAFT (vertical label on the right)

	Apr			May					June						
Wk	14	15	16	17	18	19	20	21	22	23	24	25	26		
Mo	3	10	Easter Mon	17	24	1st May	1	8	15	22	Whit	5	12	19	26
Tu															
We															
Th															
Fr															
Sa															
Su															

MWGR#1-3 (star in Apr 15)

B ON (star in May 20)

CRUZET/CRAFT (diagonal label on the left)

Machine checkout (star in Apr 17)

Recommissioning with beam (box in May 19-22)

Ascension (box in May 21)

Special physic run (box in June 25)