



# CERN Korea Committee Meeting



CKC 12

October 29, 2012

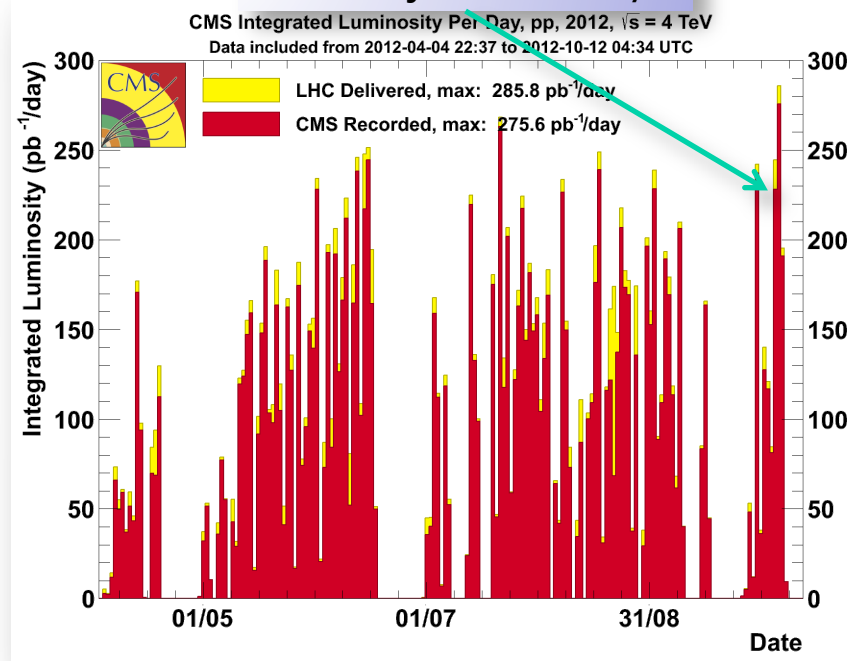
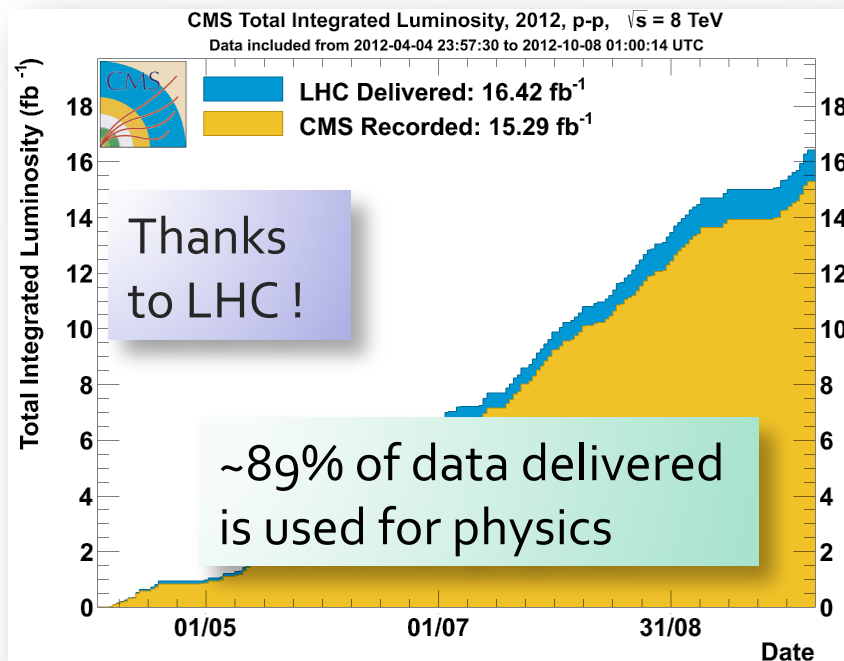
*Joe Incandela*  
*On behalf of the CMS Collaboration*  
*UCSB/CERN*





# CMS data-taking 2012

Record  $\int L dt$  in 1 day



Period	Delivered* fb <sup>-1</sup>	Recorded* fb <sup>-1</sup>	Efficiency	Downtime	Dead-time
April-June	6.78	6.26	92.3%	5.9%	1.8%
July-21 Aug**	4.97	4.73	95.1%	3.8%	1%
22 Aug-16 Sep	2.99	2.74	94.4%	4.1%	1.5%
26 Sept-7 Oct	1.44	1.37	95.1%	3.4%	1.5%

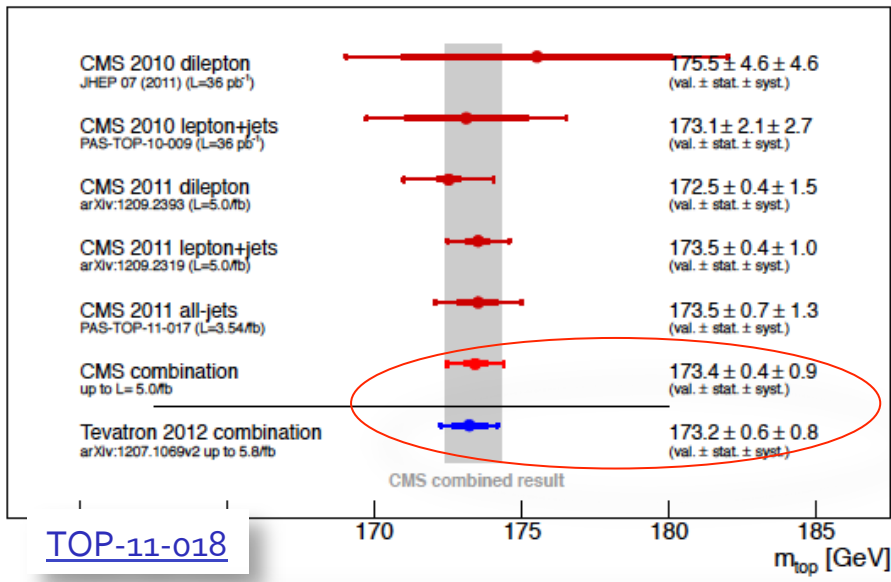
Several incidents cost > 0.5 fb<sup>-1</sup>



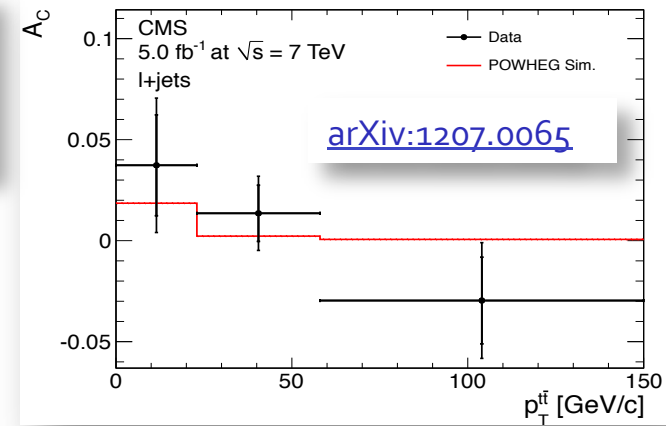
# Top Highlights: Properties

$m_t = 173.36 \pm 0.38$  (stat.)  $\pm 0.91$  (syst.) GeV

CMS Preliminary



- $t\bar{t}$  differential measurements:
  - e.g. Q asymmetry



Associated production  
 $t\bar{t} + ME_T$

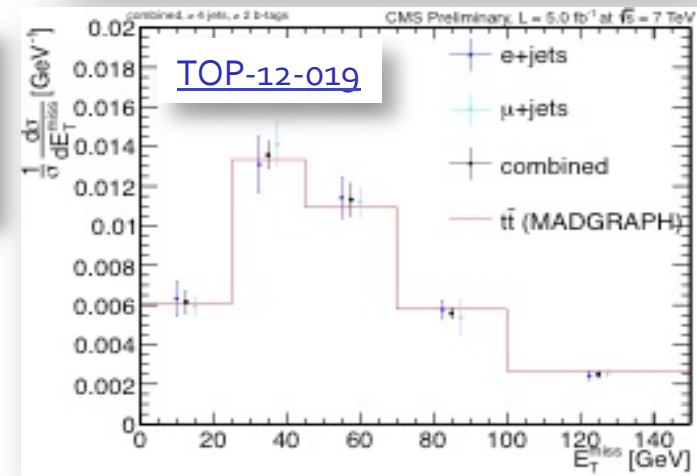


Table 2: Correlation coefficients between the input measurements

	Di-lepton 2010	Lepton+jets 2010	Di-lepton 2011	Lepton+jets 2011	All-jets 2011
Di-lepton 2010	1.00				
Lepton+jets 2010	0.30	1.00			
Di-lepton 2011	0.35	0.67	1.00		
Lepton+jets 2011	0.26	0.44	0.64	1.00	
All-jets 2011	0.36	0.59	0.71	0.56	1.00

Associated production  $t\bar{t}b\bar{b}$

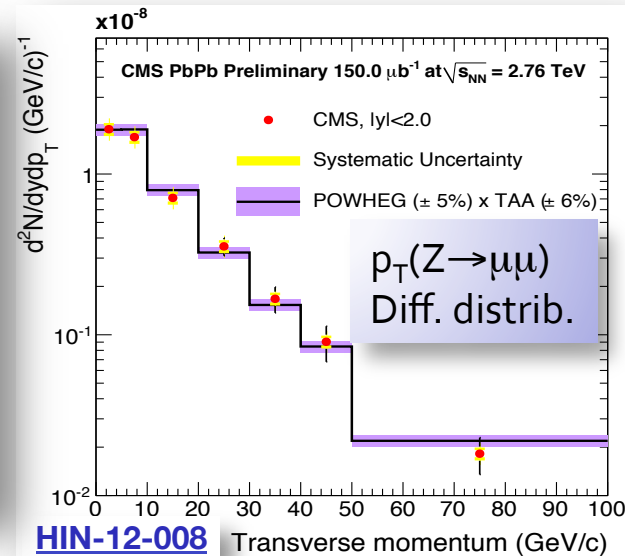
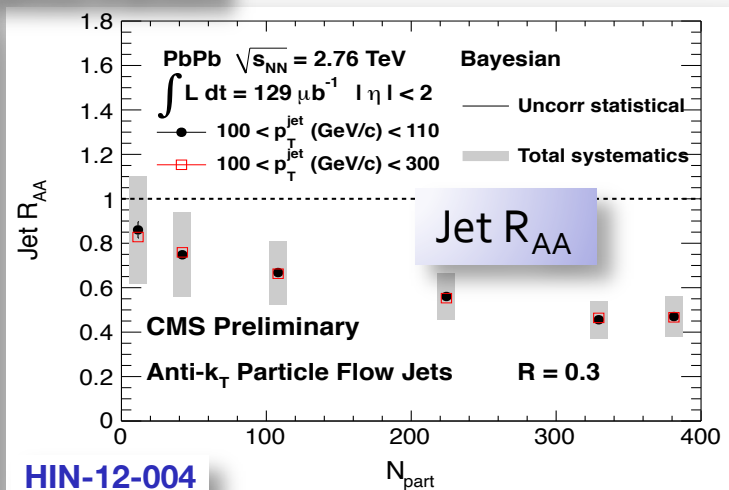
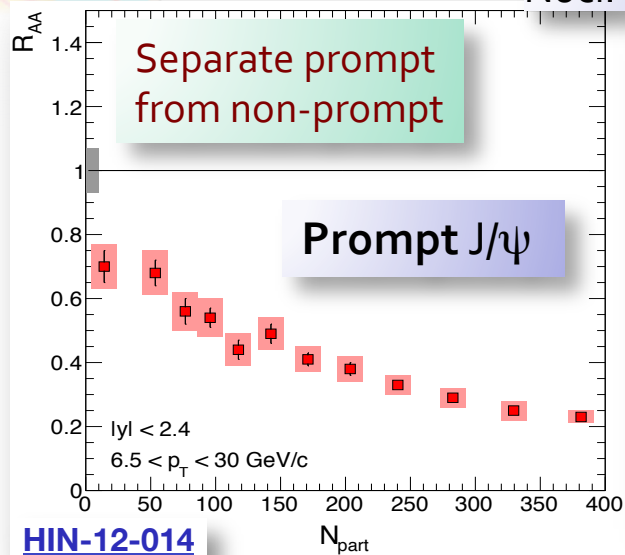
$\sigma(t\bar{t}b\bar{b}) / \sigma(t\bar{t}jj) = 3.6 \pm 1.1$  (stat.)  $\pm 0.9$  (sys.) %

FCNC top decay limit: [arXiv:1208.0957](http://arxiv.org/abs/1208.0957)  
 $B(t \rightarrow Zq) < 0.24\%$  @ 95% CL

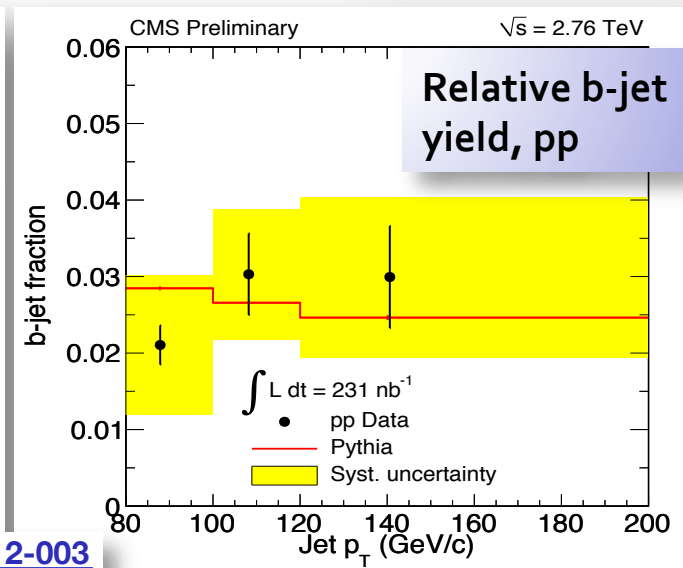
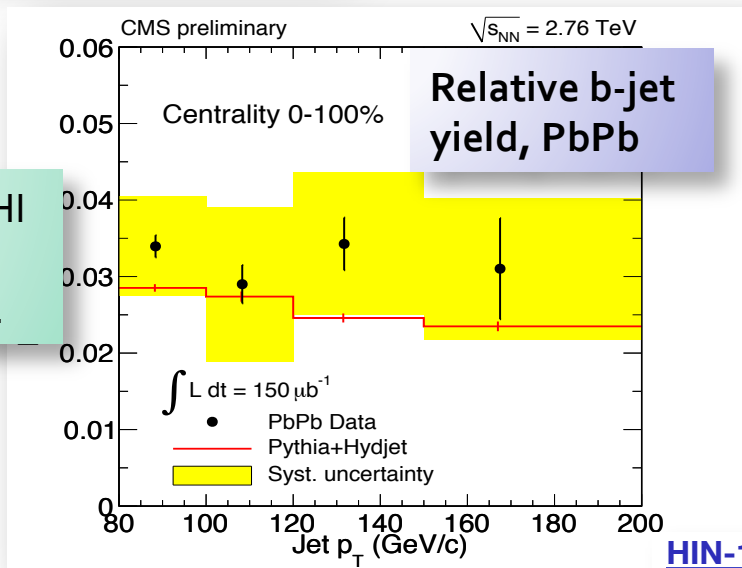


# Heavy-Ion Highlights

## Nucl. Mod. Factors



First bjet ID in HI collisions. Also quenched.

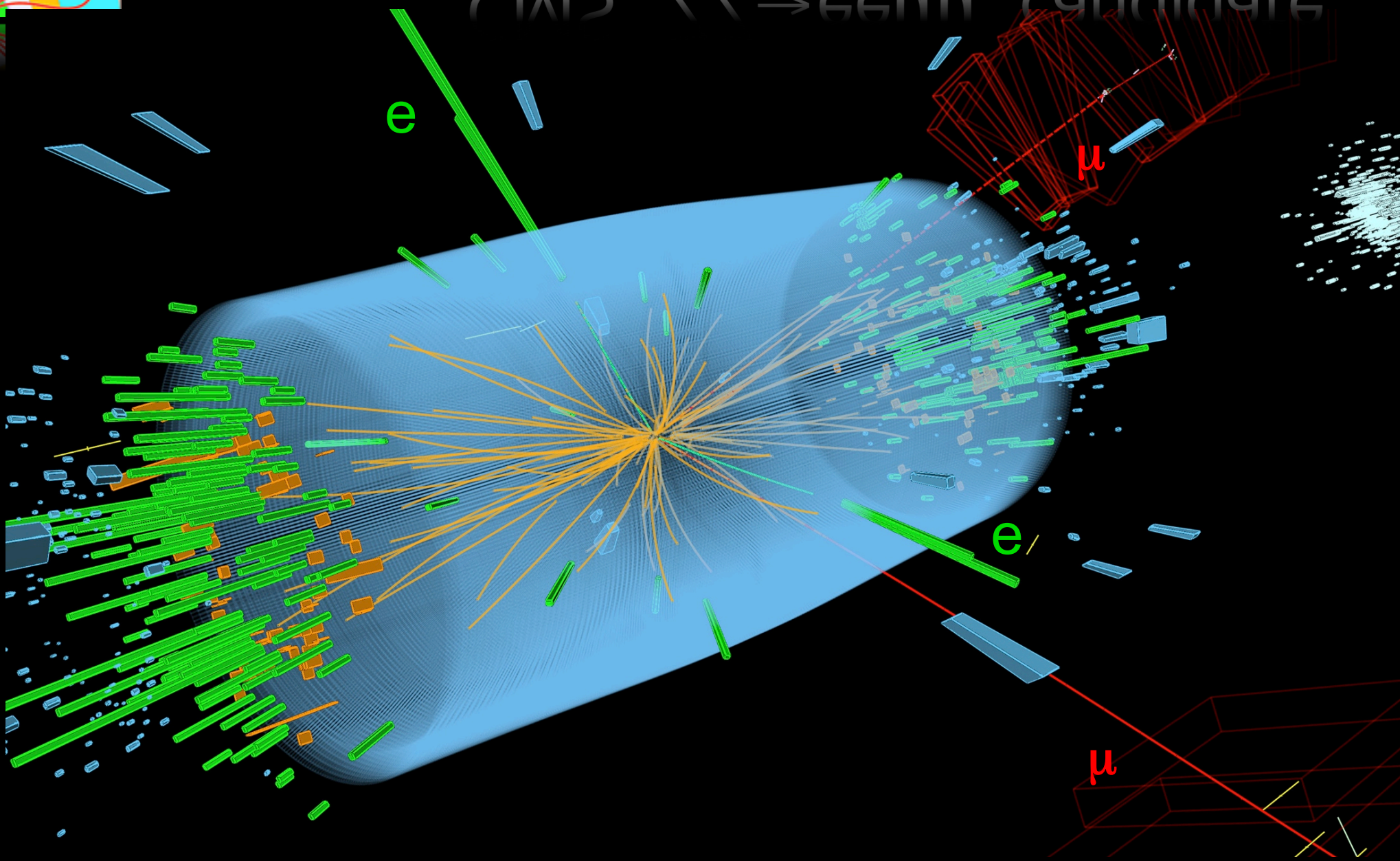






# CMS $ZZ \rightarrow ee\mu\mu$ candidate

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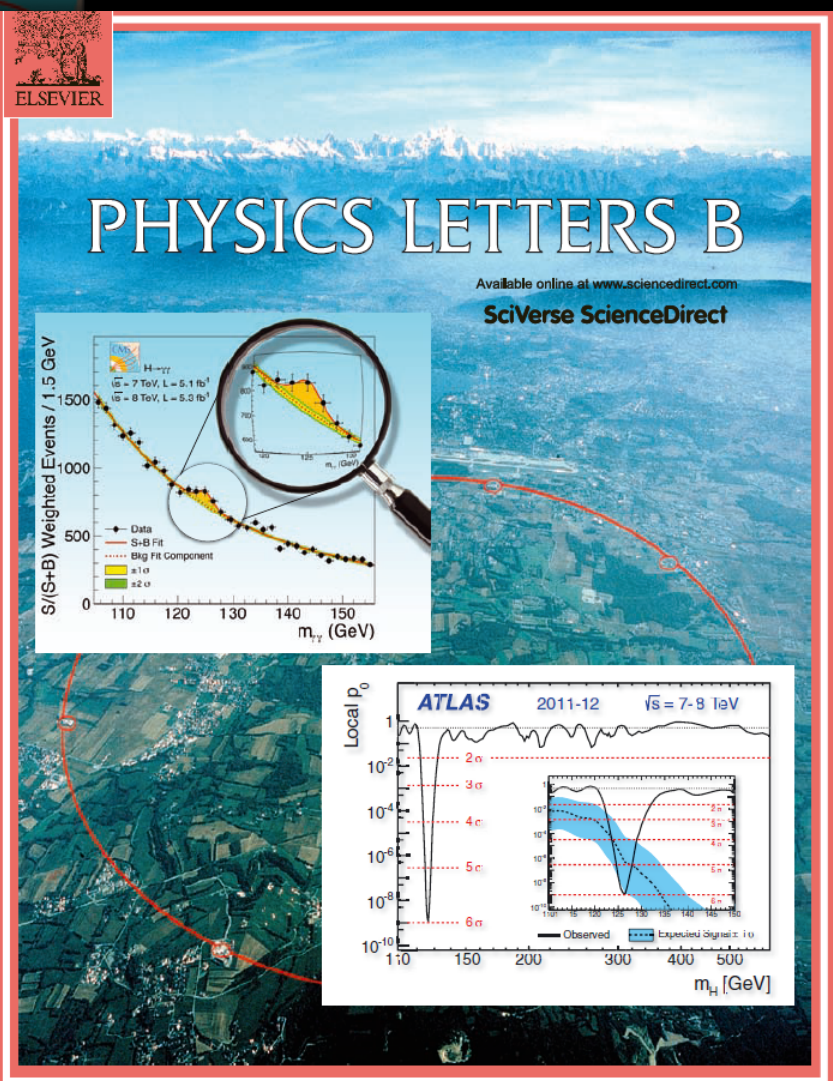






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# Higgs



<http://www.elsevier.com/locate/physletb>

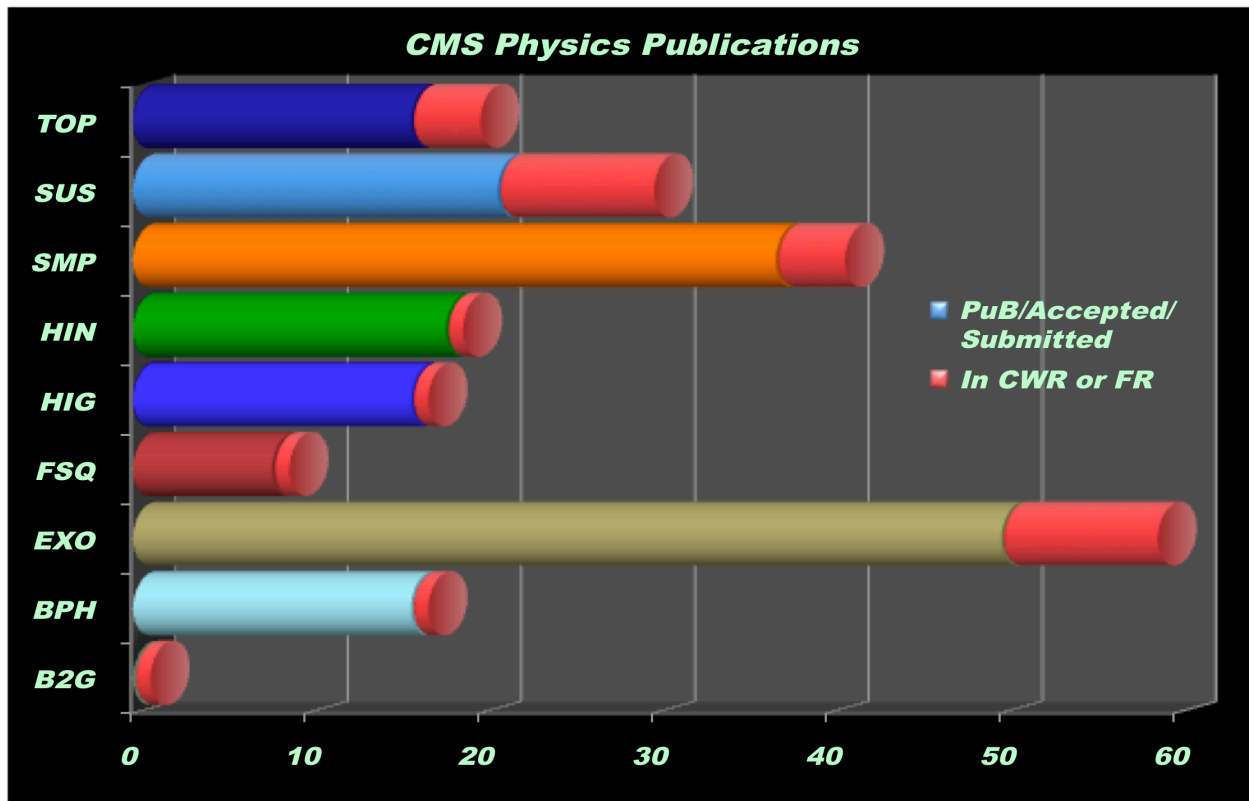






# CMS publications on LHC data

215 Published-submitted-CWR/FR (~30)



Remaining (planned) pubs with 2011 data

Pub Plan	Planned
B2G	10
BPH	18
SMP	22
EXO	1
FWD/FSQ	15
HIG	5
HIN	2
SUS	0
TOP	7
	70

+ 6 detector performance papers

+19 CRAFT papers

Publications plan for 2012 data: in formation



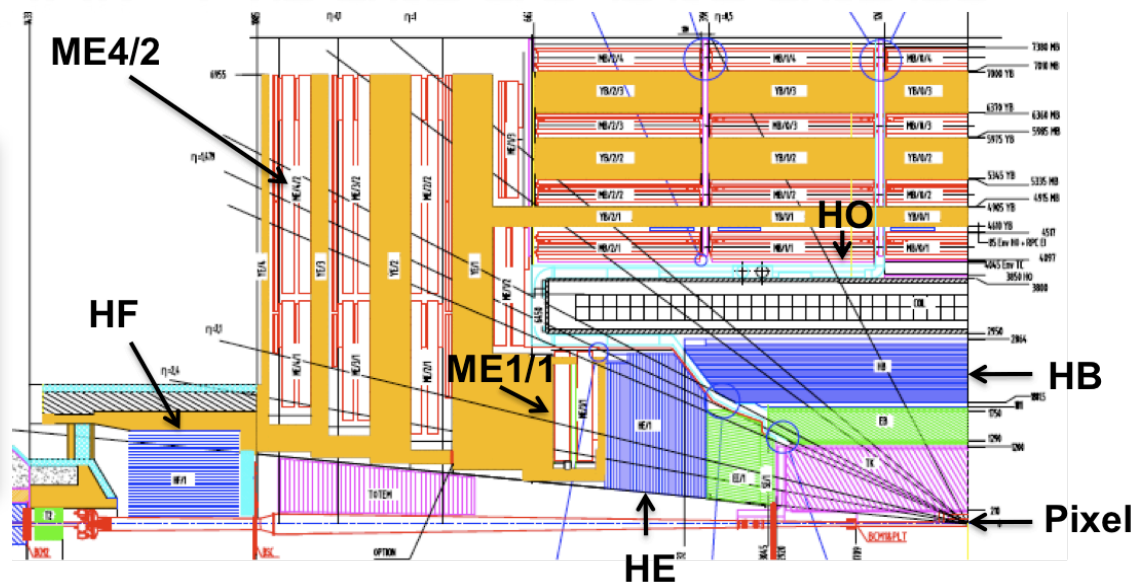
# CMS Upgrade program

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## LS1 Projects: in production

- Complete muon coverage (ME<sub>4</sub>)
- Improve muon operation (ME<sub>1</sub>), DT electronics
- Replace HCAL photo-detectors in HF (new PMTs) and HO (HPD → SiPM)



LS1

LS2

LS3

## Phase 1 Upgrades (TDRs)

- Pixel detector replacement
- HCAL electronics upgrade
- L<sub>1</sub>-Trigger upgrade
- Preparatory work during LS<sub>1</sub>
  - New beam pipe for pixel upgrade
  - Install test slices of pixel, HCAL, L<sub>1</sub>-trigger
  - Install ECAL optical splitters for L<sub>1</sub>-trigger upgrade and transition to operations

## Phase 2: Now being defined

- Tracker Replacement, Track Trigger
- Forward : Calorimetry and Muons and tracking
- Further Trigger upgrade

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# Upgrades TDRs and LHCC response

- Upgrades TDRs for Pixels and HCAL reviewed by LHCC:
  - **“The LHCC endorses the HCAL and pixel upgrades without reservations.”**
  - *“Technical Design Reports (TDR) ... were presented ... providing a complete and comprehensive roadmap for delivering the detectors. Excellent progress was demonstrated in R&D and design.”*
  - *“ The physics studies demonstrate a strong motivation for the upgrade.”*
- The committee also endorsed the installation of parallel optical inputs during LS<sub>1</sub> to allow development and commissioning of the L1-Trigger upgrade concurrent with operations



# Project Costs

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- Updated cost estimates for Pixels, HCAL, and Common Items.
  - Interest expressed covers the needs of the detector projects
  - ~4M CHF of Common Items haven't had FA interest expressed.
- Overall sharing of Upgrade costs based on proportionate PhD share of each FA
  - Based on PhD count in 2010
    - Any change is subject to re-negotiation with FA's and RRB approval
- Overall cost rose 3%

Subsystem/Common Item	Budget (kCHF)	
	Revised	Original
Pixel Tracker	17,100	17,350
HCAL	8,044	5,817
HF - Phototubes	1,990	1,990
Muon CSC	5,570	5,570
Muon DT	2,200	2,200
Muon RPC	4,220	4,220
DAQ	6,700	6,700
Trigger	4,600	4,600
<b>Common Items</b>	<b>16,196</b>	<b>16,000</b>
Magnet power and cryo	1,567	1,330
Beam Instrumentation	1,672	1,540
Infrastructure	5,423	6,315
Test Beam Facilities Upgrade	620	610
Safety systems upgrade	540	964
Electronics Integration	1,780	1,575
Engineering Integration	4,594	3,666
<b>Grand Total</b>	<b>66,620</b>	<b>64,447</b>





# Muon Upgrades

- Muon Projects are well underway and expected to be completed in LS1
- RPCs
  - Original estimate 4'220 kCHF, current working estimate 4'127 kCHF, 60% spent
  - Remaining funding agreed
  - Here Korea is playing a critical role in gap production!
- DTs
  - *Original estimate 2'200 kCHF, current working estimate 2'212 kCHF, 15% spent*
  - *Remaining funding agreed*
- CSCs
  - *Original estimate 5'570 kCHF, current working estimate 6'574 kCHF, 54% spent*
  - *Finalizing agreement on remaining funding*
  - *Increase of 1'004 kCHF (18%) due to*
    - *updated cost estimate (300 kCHF)*
    - *production schedule change (200 kCHF)*
    - *inclusion of costs for mechanical work at Point 5 omitted from original estimate (500 kCHF)*

# Common Item Upgrades

- Original estimate 16'000 kCHF now 16'196 kCHF to be funded through:
  - Common Fund (6'445 kCHF shared according to PhD count of 2010)
  - Contributions to specific Items

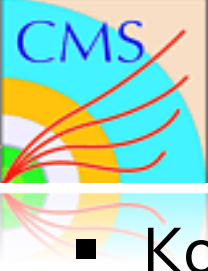
## Common Items (kCHF)

Covered by Common Fund*	6,445
Covered by targeted pledges from FAs	5,643
<b>Common Items expected contributions</b>	<b>12,088</b>
<b>Balance Common Item costs</b>	<b>-4,108</b>

\* Assumed that all FAs contribute to the Common Fund

- Common Fund
  - Most FAs have responded and most funds are committed
  - We need all FA's to meet their obligations in order to cover work through LS1
- Still to be covered
  - About 4 MCHF funds still needed in specific contributions, mostly beyond 2015
  - We'd be very happy if all FA's, including Korea, could consider contributions here
- MoU Addendum
  - With the extension of the Construction MoU, we will prepare an Addendum formalizing the financing of Common Items





# Korea's role in CMS

- Korea is among the stronger non-member nations in CMS
  - Roughly 70 people from 7 institutes
  - Important contributions to Physics
    - Greatly helped by presence at CERN
- Maintaining and even increasing Korea's involvement in CMS and presence at CERN is important to CMS!
- Korea has Key roles in muon upgrades
  - RPC gap production (KODEL/Korea Univ.)
    - To be completed by the end of 2013
  - RPC chamber production (SKKU): MOU is ready to sign
  - KCMS LS2 preparation team launch (UOS, CNU)
    - Detector R&D, CMS Upgrade
- CMS is relying on Korea to complete work on schedule and to specifications - a big responsibility
- We thank Korea for pledging to support the Upgrades, and especially for already contributing to the Common Fund!!





# Summary

- LHC continues to excel, CMS has a huge array of physics
- For this to continue, the Upgrades are critically important
  - Muon Projects must be completed in LS1
  - Common Fund is critical to completion of LS1 program of work
    - Majority of FA's have made commitments
    - Critically important that all FA's fulfill their share as early as possible
  - Common Items
    - In addition to the CF, essential that FA interest/pledges fully cover the Common Items
    - Roughly 4M CHF to come in new pledges, cost savings or surpluses in other areas
    - We will work on covering this over the next two years
- CMS will continue striving to ensure the most efficient use of resources and stay within the planned cost estimates



# Conclusions

- CMS performing extremely well
  - In 3<sup>rd</sup> year of operation!
- Major Discovery:
  - A new boson with mass of 125 GeV
- Wave of publications on 2011 data, 2011+2012 data
- Good progress preparing for the future
- There is much to do
  - And Korea will play major roles in CMS' future success