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# **Coherence of CMS Research, Operations, and Upgrades**

L.A.T. Bauerdick for the Fermilab CMS Group  
Fermilab Institutional Review, Parallel Session  
Feb 11, 2015

# CMS at Fermilab

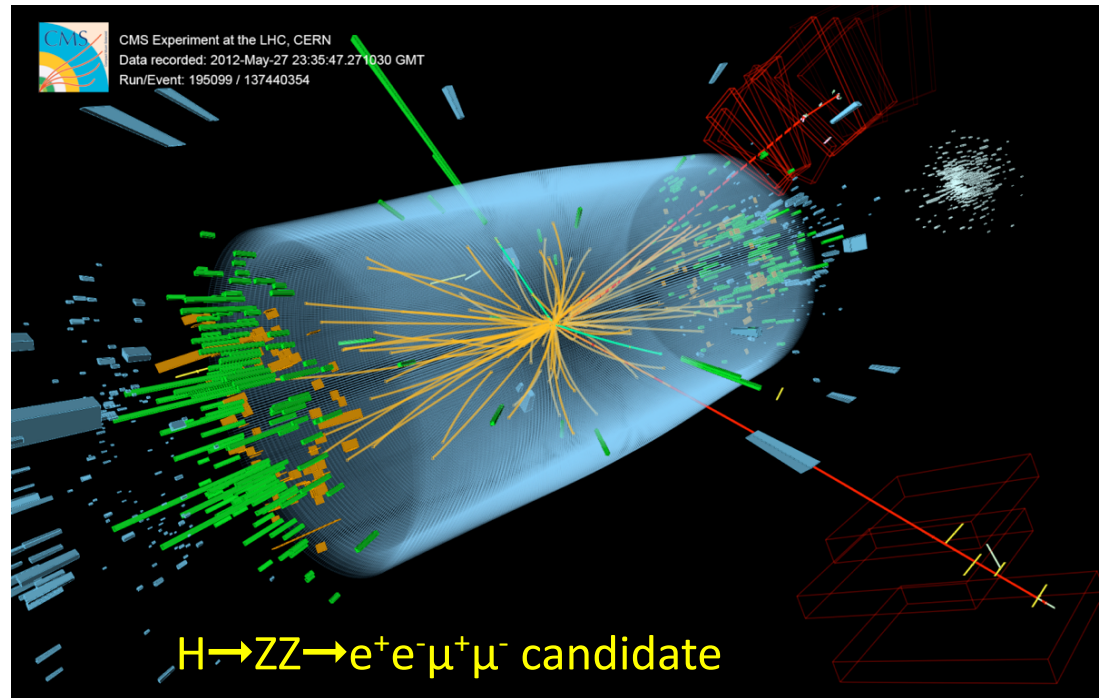
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- CMS at the LHC addresses major P5 Science Drivers
  - ★ Use the Higgs boson as a new tool for discovery
  - ★ Identify the new physics of dark matter
  - ★ Explore the unknown
- The Fermilab CMS group is aligned with these priorities
  - ★ Physics research directly addressing the key science drivers
  - ★ A leading role for CMS and USCMS in Run2 (this talk) preparing the detector, computing and software for Run 2
  - ★ and in building Phase-1 detector upgrades (next talk) and R&D for Phase-2 (session tomorrow)
- Important role of Fermilab for US Community
  - ★ Hosts LHC Physics Center (LPC) and Remote Operations Center (ROC)
  - ★ Very significant computing facilities: Tier-1 and Analysis Facility
  - ★ Manages USCMS Operations Program and Upgrade Projects

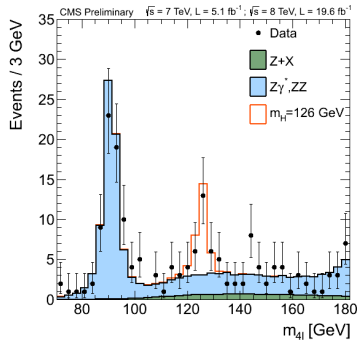


# Physics in LHC Run 1

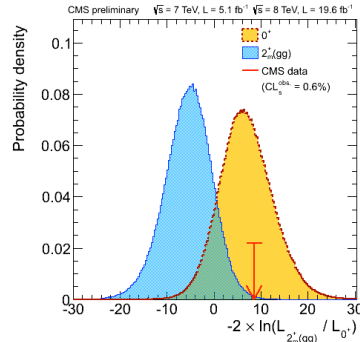
- In Run1, efforts of the Fermilab CMS group were focused primarily on:
  - ★ Higgs Physics
  - ★ SUSY Searches
  - ★ Standard Model measurements (esp. top, EWK) as indirect probes of new physics



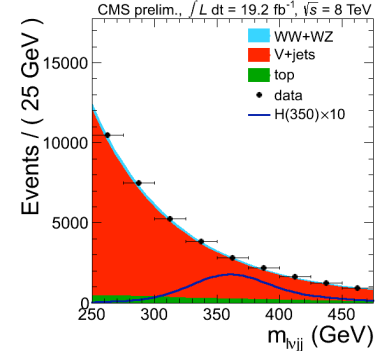
# Fermilab Example Contributions to Higgs Physics in CMS



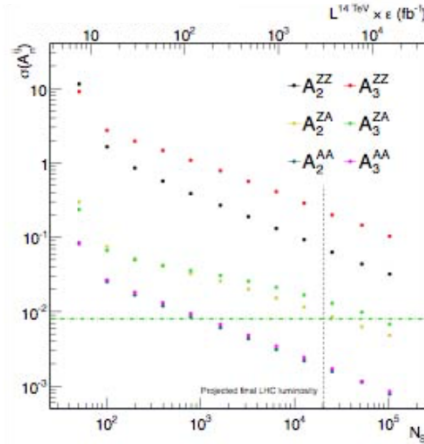
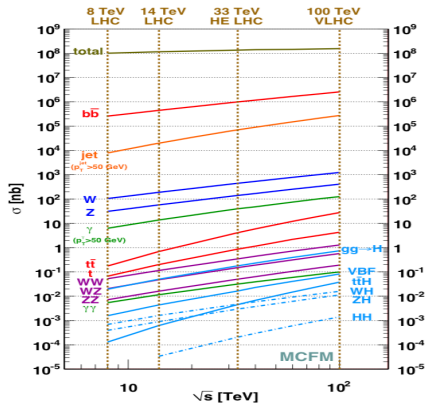
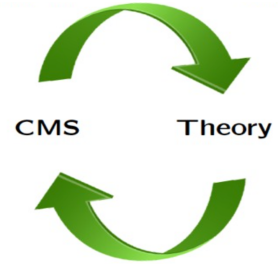
Kinematic discriminant for  $H \rightarrow ZZ \rightarrow 4l$



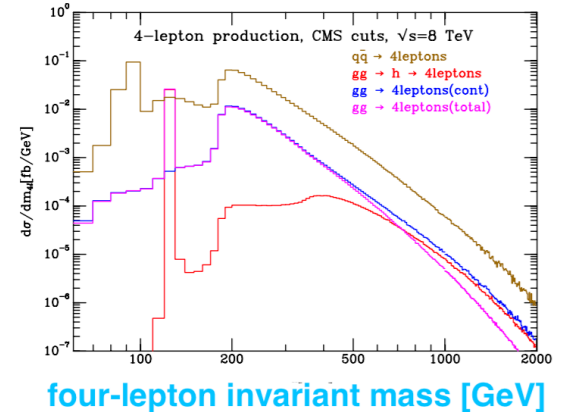
Spin/parity analysis in  $H \rightarrow WW \rightarrow 2l2v$



High Mass Higgs Search  $H \rightarrow WW \rightarrow lvjj$



H properties from kinematic distr.  
Analytic framework  $H \rightarrow 4$  leptons  
H coupling to gauge bosons



four-lepton invariant mass [GeV]

Precision studies of  $H \rightarrow VV$  far above resonance  
bounds on the H width

# Physics Signatures

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- **Leptons**

- ★ Higgs, SUSY and Top measurements by a team concentrating on the identification of isolated leptons.
  - Fermilab working with UCSD and UCSB (“Surf & Turf” team)

- **Hadronic**

- ★ SUSY and Exotica searches involving jets and MET
- ★ Leveraging Fermilab’s HCAL expertise and JetMET leadership
- ★ Pioneering work in jet substructure and boosted Higgs/W/Z.

- **Vector Bosons**

- ★ Final states with W or Z bosons for SM and Higgs measurements, BSM searches and anomalous couplings.

# SUSY Search Highlights (1)

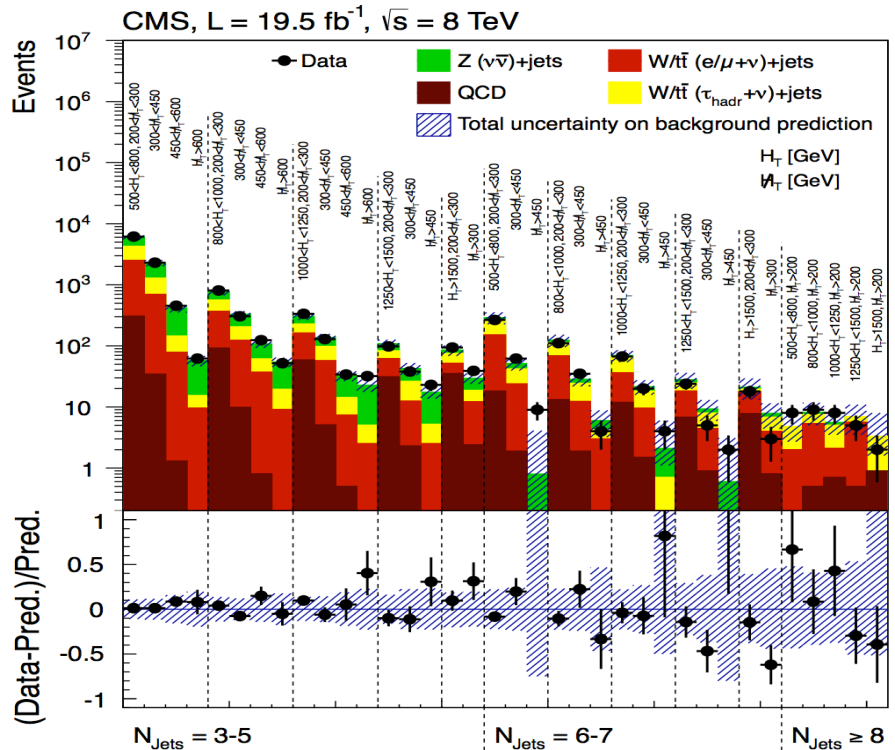
- Hadronic searches using all-jets and  $\gamma$ +jets final states
  - ★ Multijet search for gluinos and light squarks
  - ★ Direct stop production
  - ★ Gauge mediation (and extra dimensions)

## • Significant LPC collaboration

### Fermilab Collaborators:

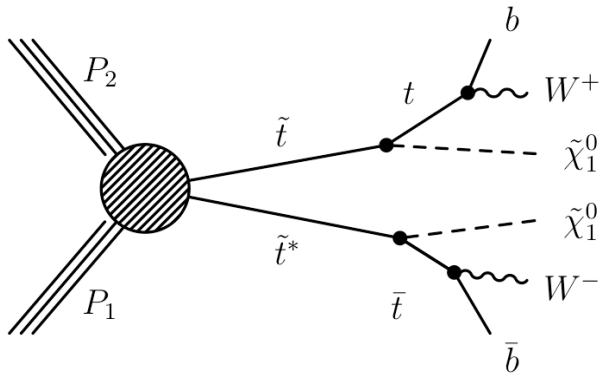
Baylor, Carnegie-Mellon, Colorado, Florida International, Florida State, Hamburg-DESY, UI Chicago, Iowa State, Notre Dame, UC Riverside, Rutgers, Rockefeller, Virginia

- 5 Fermilab members became SUSY subgroup leaders

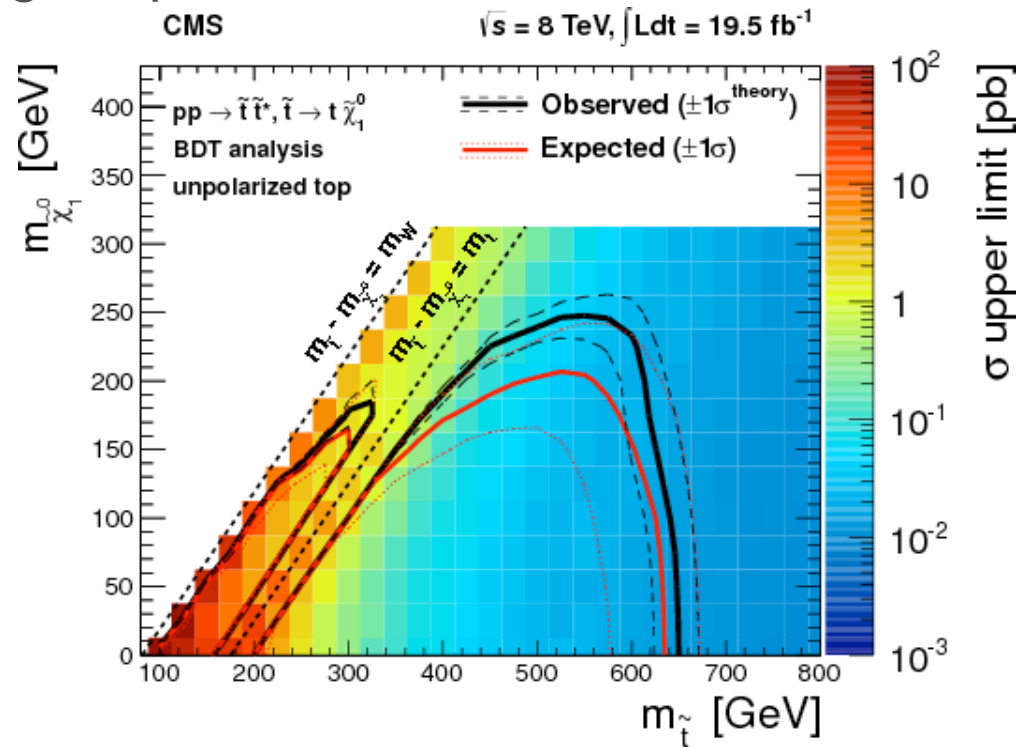


# SUSY Search Highlights (2)

- Leptonic searches using 1- and 2-lepton final states
  - ★ Inclusive searches with opposite charge dileptons and same charge dileptons
  - ★ Direct stop production in single lepton final state



Fermilab Collaborators:  
 Aachen, DESY, ETH-Zurich, Florida,  
 Strasbourg, UCSB, UCSD



# Fermilab Physics on CMS in Run 1

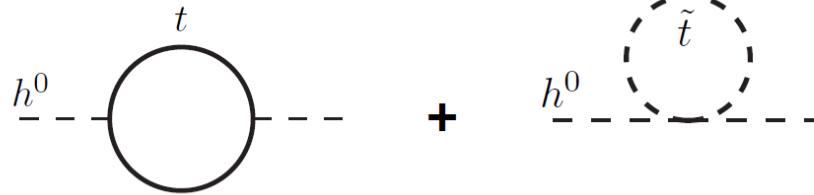
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- Fermilab people leading throughout physics while concentrating on Higgs + SUSY
- Higgs:
  - ★ Decays to WW ( $lv\ jj$  and  $lv\ lv$ ), ZZ (4l) & spin parity,  $\tau\tau$ ,  $Z\gamma$ ,  $bb$ , anomalous couplings
- SUSY (5 subgroup conveners):
  - ★ Squarks and Gluinos (Multijets + MET, dileptons+ Jets+ MET),  
Stop ( $4j2b$ +MET, semileptonic,  $2j\ lv\ 2b$  + MET),  
Gauginos and Neutralinos (Z + jets + MET),  
Photino and Wino (single photon + jets + MET, diphoton + jets + MET),  
Stealth SUSY (photons + jets + low MET, leptons + jets + low MET),  
R-Parity violating SUSY ( $\tau + X$ , multijets), MSSM Higgs, SUSY via VBF.
- Exotica (4 subgroup conveners):
  - ★ Dijet Resonances, Multijet Resonances, Contact Interactions in Dijets & Dileptons, 3rd Generation Leptoquarks( $\tau j$ ), di-W/Z resonances,  $t'$  pair production, Resonances in Z + multijets.
- Standard Model (a Physics Analysis Group and 2 subgroup conveners):
  - ★ Cross Sections ( $dijet$ ,  $\gamma$ +jet, W, Z, WW, WZ,  $Z\gamma$ ), top & W charge asymmetry, single W via VBF, top spin correlation & polarization, jet substructure & mass, anomalous gauge coupling
- Objects (4 Physics Object Groups and 3 subgroup conveners):
  - ★ All physics objects, global event description.



# Physics Plans for Run 2

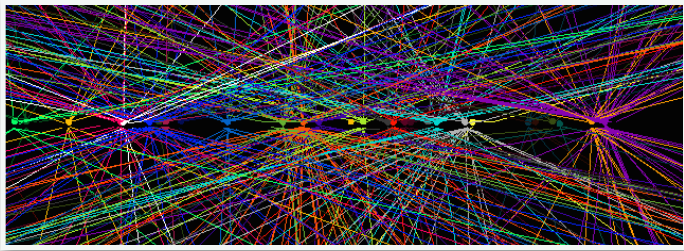
From Higgs  
in Run 1



To Top Partners  
in Run 2 !

- SUSY remains our primary focus
  - ★ Hadronic SUSY searches, using jet substructure
  - ★ Leptonic SUSY searches, especially stop
- Exotica with a hadronic signature
  - ★ Resonances from dijets, di-W/Z, di-higgs, dark matter, ...
- Higgs and Vector Boson physics
  - ★ Vector boson pair production, Higgs to  $bb$  & anomalous coupling where there is significant gain from increase of energy
- Moving the analyses forward
  - ★ Younger people taking new roles
    - “Teams” have changed, some new collaborating institutions
  - ★ Analyses have been improved
    - including the integration of boosted jet techniques

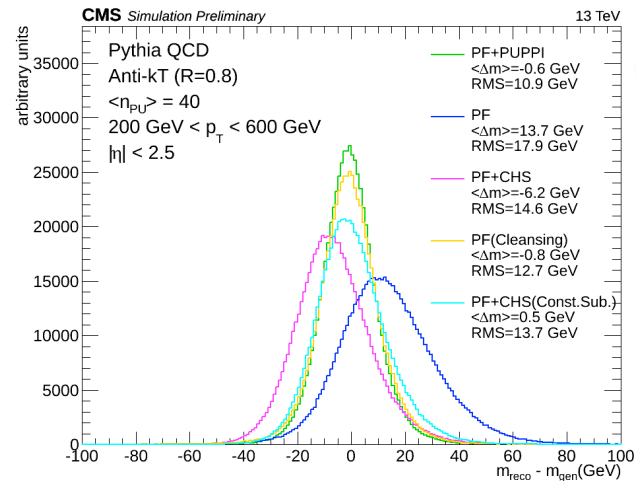
# LHC Run 2 and beyond — “boosted jets”



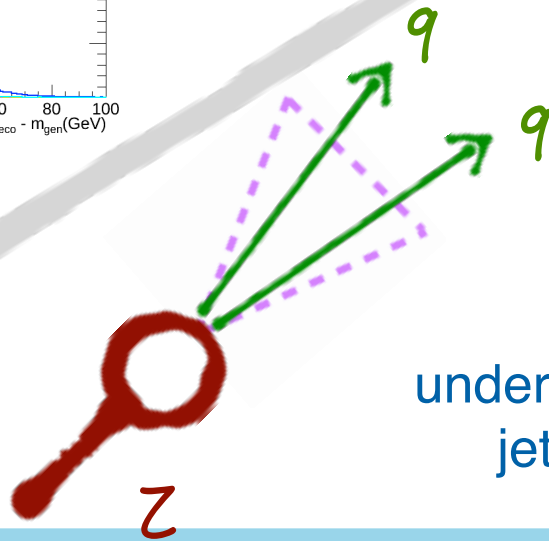
coherent, **per particle**, treatment of pileup improves performance of all CMS reconstruction  
**[PUPPI]**

*more energy  
 more boost*

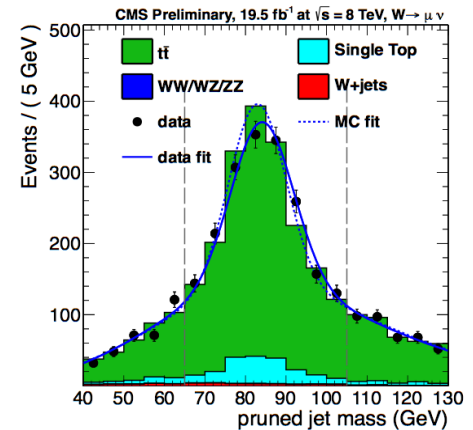
*characterizing radiation*



*more collisions  
 more pileup*



understanding structure of very energetic jets increases reach of LHC searches



# Getting Detector, Computing, Software Ready for Run-2

## LHC/CMS Schedule for Q1/Q2 2015

Jan 2015							Feb 2015							Mar 2015						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3	1	2	3	4	5	6	7	1	2	3	4	5	6	7
4	5	6	7	8	9	10	8	9	10	11	12	13	14	8	9	10	11	12	13	14
11	12	13	14	15	16	17	15	16	17	18	19	20	21	15	16	17	18	19	20	21
18	19	20	21	22	23	24	22	23	24	25	26	27	28	22	Beam commissioning					
25	26	27	MWGR10			31								29	30	31				
Apr 2015							May 2015							Jun 2015						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
			1	2	3	4						1	2		1 Tech stop/recovery					
5	6	7	8	9	10	11	3	4	5	6	7	8	9	7	8	Scrubbing			12	13
12	13	14	15	16	17	18	10	11	12	13	14	15	16	14	15	16	17	18	19	20
19	20	21	22	23	24	25	17	Collisions (few bunches)						21	Ramp-up (50ns)					
26	27	28	29	30			24	25	26	27	Special runs			28	29	30				
							31													

- ★ CMS Commissioning Program underway
  - starting cosmic runs without and with magnetic field
  - Fermilab involved in most aspects of CMS operations

# WBM (Web Based Monitoring)

## Support for Run Coordination and Monitoring

### Fermilab's role for CMS WBM

- Proposed in 2006 to CMS, strongly based on Tevatron experience by Fermilab people.
- Since then, Fermilab people consistently play major roles in design, development, maintenance, and improvements.
- The tools have been used extensively by CMS data taking operations at Point5, Fermilab, CERN, and many other remote locations.
- Enables effective Remote activities, e.g, allows central offline data quality monitoring to certify data.

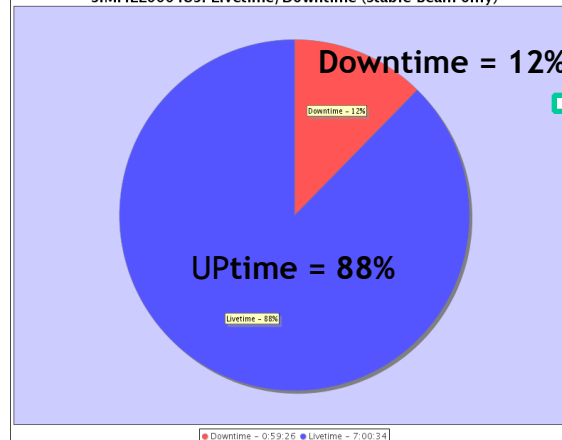
### WBM for Run2

- Indispensable in Run-1 and fully expected for Run-2.
- Ready as can be: Adjustments/Adaptions to many changes surrounding WBM have been on-going, along with internal improvements.
- Below is an example of WBM tools, Data-taking efficiency tool, used for the last week global commissioning running, used at the control room, and shown by the run coordinator preparing for Run2.

### Performance plots from CMS Web-Based Monitoring (WBM)

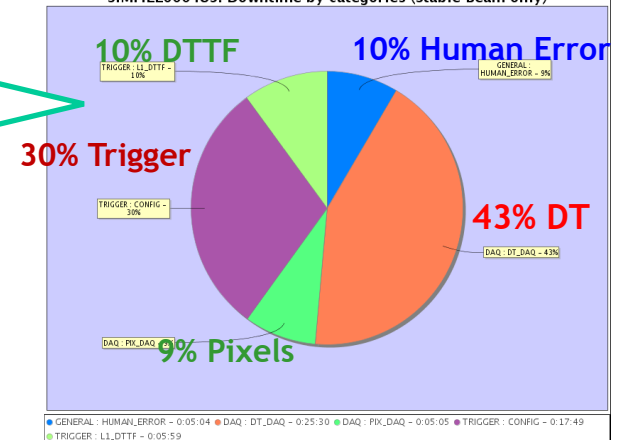
#### Total Up&downtime

SIMFILL000485: Livetime/Downtime (Stable Beam only)



#### Breakdown of downtime

SIMFILL000485: Downtime by categories (Stable Beam only)





# CMS Web-Based Monitoring

Central place for integrated CMS online information



## Subdetector Contributions

ECAL Calibration RunSummary information with data quality monitoring results and plots

ECAL Summary, Ver. 5.0

RunSummary selection form yields list of runs matching criteria

CMS sub-detectors are unique CMS WBM provides a platform and infrastructure in which they can develop specific tools and displays

## Run Summary information

Run listing links to details about specific run

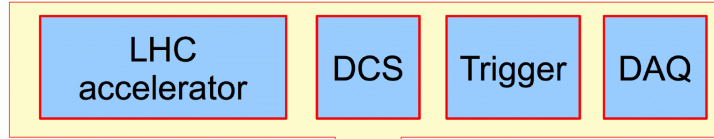
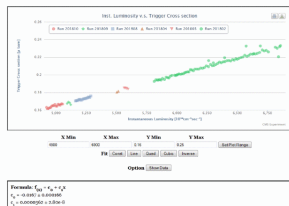
## L1 trigger Summary information

Drill-down from rates to plot vs. time Linkable and downloadable graphics in PNG and EPS

Plot & data, downloadable Root file ...or Text, XML, HTML raw data formats

First collision as seen in min-bias trigger!

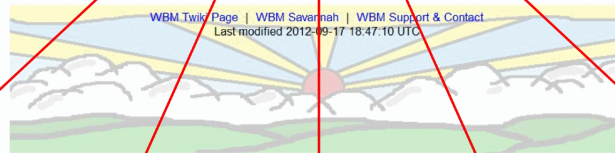
## Trigger History plots



CMS Web Based Monitoring online



- Subdetectors WBM**
- ECAL Summary
  - DTS Summary
  - RPC Summary
  - HCAL Home
  - CSC Summary
  - BRMS Snapshots
  - BCM1F Bunch Info
  - Trigger Modes
  - Tracker Tools
  - Pixel Home
  - S<sup>3</sup> Screen Snapshots
- Core Services**
- RunSummary [24h] [24h&1+trig]
  - RunTimeSummary [LHC Fills] Deadline
  - FillReport [Latest Fill] DataSummary
  - LumiScalers | Automatic Fill eMails
  - DataQualityLogger  $\beta$
  - TriggerHistory | TriggerRunListing
  - TriggerRates [Pre-DT L1] [Post-DT L1] [HLT]
  - LastValue | ConditionBrowser [iPlot]
  - MagnetHistory | CurrentBunches | BunchFill
  - LhcMonitor | LHCStatusDisplay | BLM | BPM | DIP
  - LhcCollimators | AbortGaps
  - ShiftAccountingTool
  - PageZero | CMS Page 1
- Links**
- DQM Run Registry
  - Online DQM GUI
  - FNAL ROC
  - Commissioning & Run Coordination
  - CMS Twiki: OnlineWB TriDAS
  - CMS Online
  - Shift eLog
  - Snappy eLogViewer
  - LHC Page 1



## Real-time L1 trigger displays

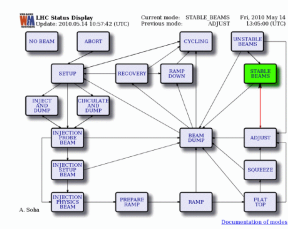
First collision as seen in min-bias trigger!

## ConditionBrowser (custom plots)

Plot any database quantity vs time or vs any other database quantity

Here: luminosity for squeezed beams (before, during, in lumi scan & after increase)

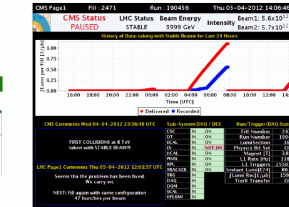
## Current LHC Beam Status



CMS PageZero

Accession Date	16/05/2012	Accession No.	10000000
Accession Date	16/05/2012	Accession No.	10000000
Accession Date	16/05/2012	Accession No.	10000000

## CMS Page 1



## Data Summary

Daily & weekly accumulated lumi and efficiency info

Fill # linked to FillReport

Run # linked to RunSummary

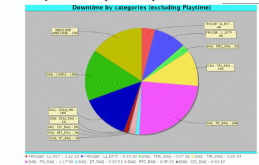
## Fill Report

Table with Fill info (online lumi, efficiency, runs, bunch scheme...)

Fill plots (online lumi, trigger, beam, efficiency...)

New: primary vertices, pileup, deadline, trigger & prescale change, collimators

## Downtime efficiency reports (RTL)



## Sub-detector status displays

Have alarms & limits, Drill-down details & plotting - current and historical

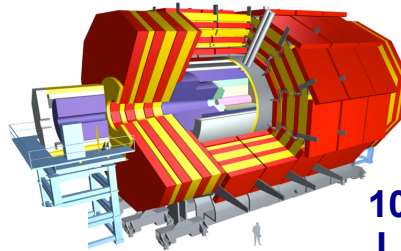
## Deadtime reports

Deadtime reasons breakdown (per run, fill or time range):

- Calibration
- Partition Controller
- Trigger Rules
- Evaluated DQD phases
- Also Partition Controller deadtime breakdown per FED or partition.

# DAQ System

- Fermilab role in coordination, software, system integration, DAQ on-call, run-field manager
- ★ Commissioning of DAQ2, a major upgrade, right now



Event size up to 1MB

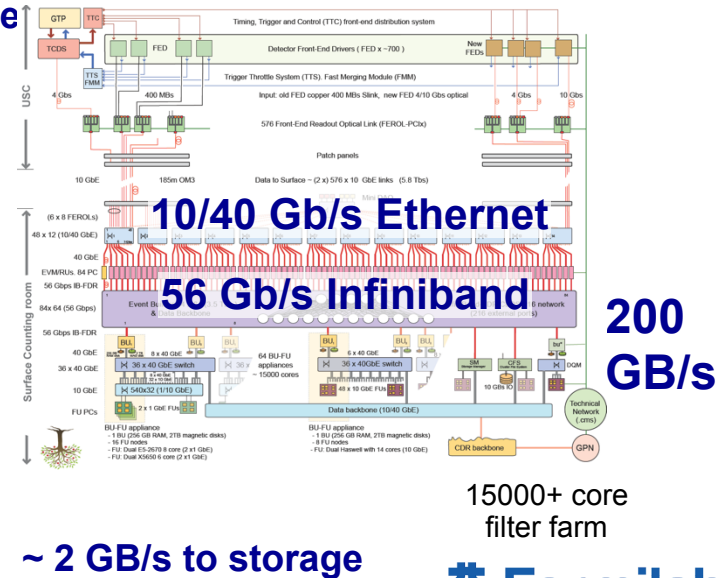
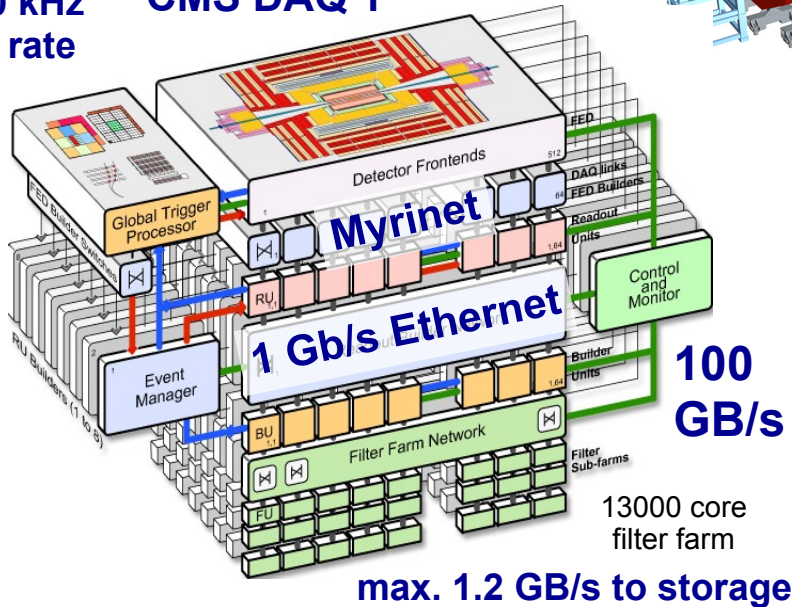
Event size up to 2MB (large margin)

100 kHz L1 rate

100 kHz L1 rate

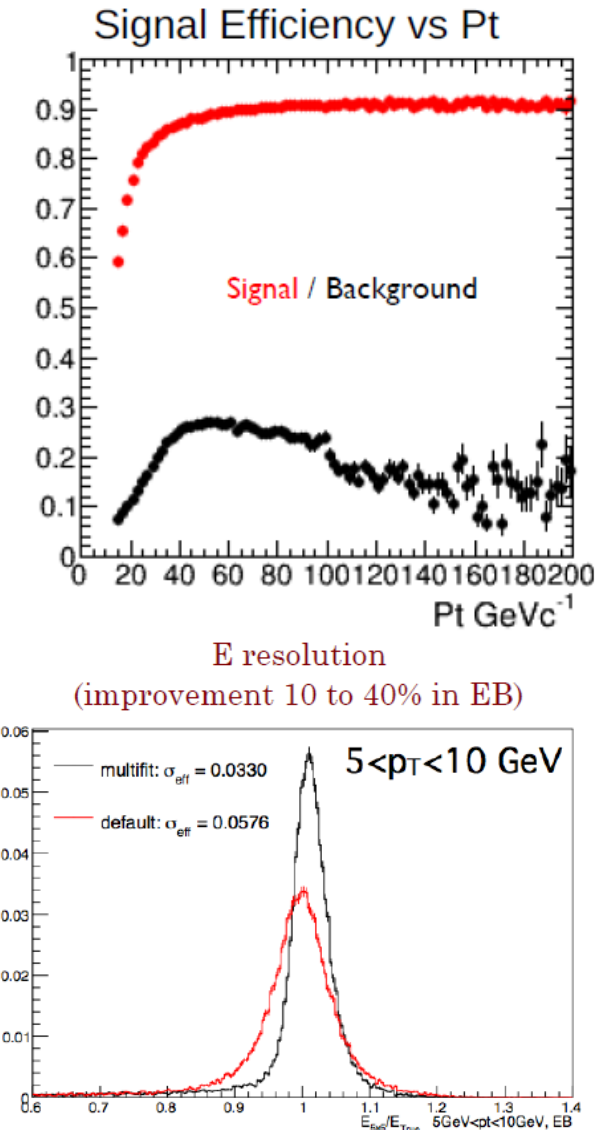
CMS DAQ 1

CMS DAQ 2



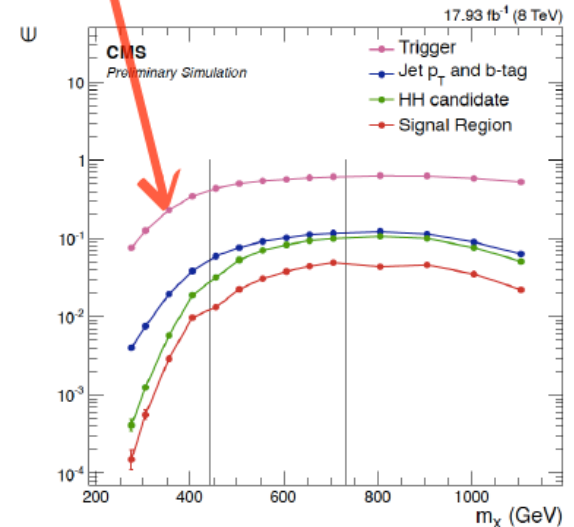
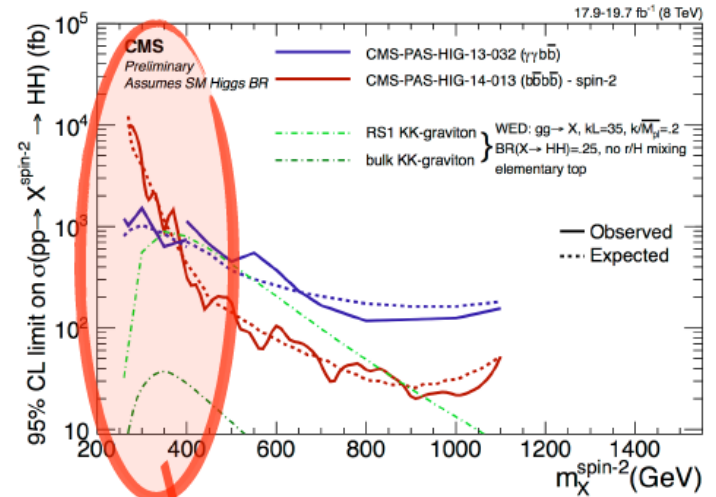
# Trigger and Physics Objects

- Working on hardware and algorithms
  - ★ Fermilab scientists, engineers responsible for new FPGA firmware of global calorimeter trigger
  - ★ Contributions to performance studies, commissioning
- Example: Fermilab leadership in Electron/ $\gamma$  Physics Object Group
  - ★ Reconstruction and identification techniques developed and validated for Run 2:
    - Photon and electron ID
    - New particle flow reconstruction of ECAL clusters
    - Improved HLT energy resolution
  - ★ => Particle flow reconstruction for HL-LHC calorimetry



# Improved Trigger algorithms

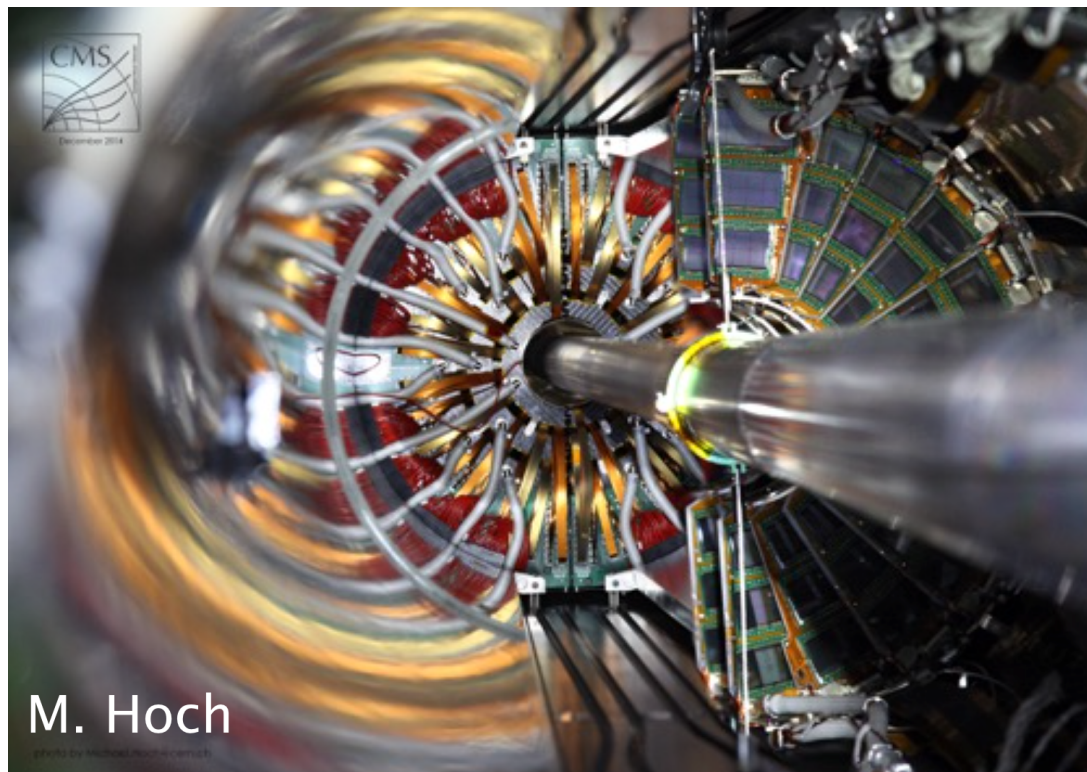
- Trigger algorithms revised
  - ★ higher cross section and PU at 13 TeV
  - ★ Example: search for resonant or non-resonant HH production in the  $4b$  final state
  - ★ L1 multijet trigger revised and multiple algorithms combined
  - ★ HLT algorithm incorporates retuned b-tagging to reduce QCD multijet background
  - ★ Good efficiency maintained in the sensitive region  $M(HH) > 400$  GeV





# Tracker - Strips and Pixels

- Most of the effort of the Fermilab group is now directed toward the Phase 1 FPIX project and the Phase 2 upgrades
  - ★ On-going role with the offline beamspot workflow
  - ★ Tracker DQM shifts in the ROC



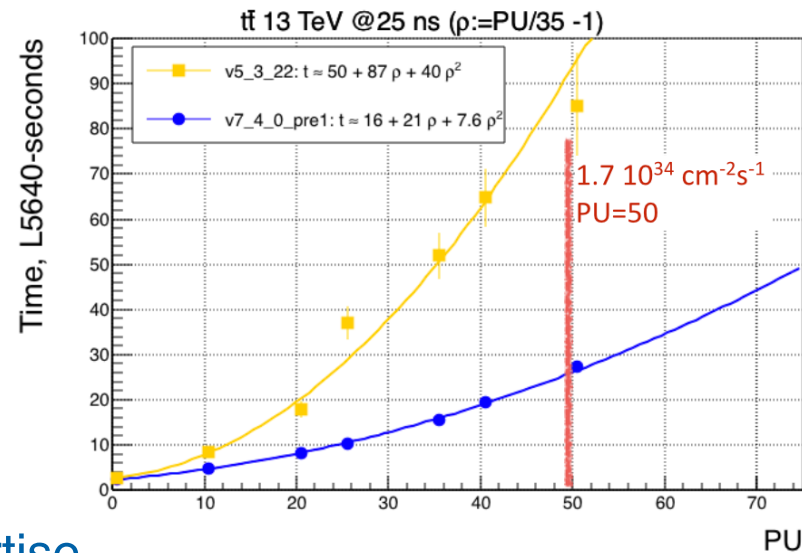
# HCAL

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- **Fermilab group to continue important HCAL roles in Run2**
  - ★ Management (during Run1 lead DPG, HCAL PM)
  - ★ Detector performance
  - ★ Operations
  - ★ Remote monitoring and feedback (ROC at Fermilab)
- **Fermilab HCAL improvements during LS1**
  - ★ Coordinated the integration, installation and commissioning of the LS1 improvements tasks for HCAL
  - ★ Replacement of HF PMT with thin window dual readout PMTs to reduce the effects of anomalous signals in HF
  - ★ Replacement of the HPDs in HO with SiPMs allowing the full eta coverage of HO
- **Major Fermilab roles in HCAL Phase1 Upgrades and Cal R&D**

# Core Software

- Fermilab group leads and are at the heart of all aspects of maintaining, evolving the software and computing infrastructure for Run 2 and beyond
  - ★ Software framework is basis of all data and MC production, processing, and analysis
  - ★ Significant milestone reached in 2014: enabling the framework to run “multi-threaded”
    - to use several CPU cores concurrently processing multiple events simultaneously
  - ★ Reconstruction enabled for multithreading
    - simulation and HLT trigger to follow
  - ★ Great improvements on software performance
- Fermilab group is a leader in simulation expertise
  - ★ CMS benefits from Fermilab Geant4 development and support team
    - Synergies with CMS HCAL group in PPD, contributions from USCMS S&C program
  - ★ Fermilab leads phase 2 upgrade simulation software infrastructure development
    - Implementation of full geometry, detector simulation (Geant4), electronics, pileup
    - Validation of Geant4 physics for phase 2 detectors
  - ★ Eventually implement parallelism to process single Geant4 event on multiple cores



# Computing Infrastructure and Systems

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- Fermilab experts are leading development and integration of the most critical CMS computing tools and systems
  - ★ Tier-0 and central processing infrastructure and metadata catalog.
  - ★ Significant changes to the software and computing systems for Run2
  - ★ Increased efficiency through dynamic data placement, remote access and unified submission infrastructure
  - ★ Improvements to GRID and Cloud submission infrastructure
    - Tier-0 at CERN now included in the world-wide glideinWMS system
    - extending available resources for prompt data reconstruction to also include Fermilab and other Tier-1 centers
    - enables opportunistic resources and overflow into on-demand resources, e.g. HLT
- Leadership, participation in HEP software and computing communities
  - ★ Engaging in HEP Software Foundation, Center for HEP Computing Excellence
- Expertise crucial for continuing computing and software upgrades as data samples and complexity increases with increasing luminosity

# Fermilab Centers and Facilities for CMS

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- **LPC LHC Physics Center**
  - ★ Fermilab through the LPC is a major center for universities participating in CMS
  - ★ in software development, calibrations, monitoring, to effectively participate in hardware and software projects, as well as in physics analysis and interacting with theorists
- **ROC Remote Operations Center**
  - ★ remote monitoring shifts at the ROC, provide prompt feedback on data quality, lowers costs for university groups to contribute to operations and gain authorship credits
- **Computing**
  - ★ outstanding computing facilities: Tier-1, analysis facility, and OSG support for university computing
- **Home of the USCMS Ops Program and Upgrade Project Management Teams**
  - ★ running the project offices, Fermilab scientist provide leadership and management effort
- **Many other facilities: testbeam, SiDet, ASISC eng., rad. testing etc**  
—> Upgrade discussions
  - ★ Fermilab is a natural center for testing and integration that is very widely used
  - ★ The test beam facility at Fermilab has been essential for qualification and testing of front-end electronics and measuring performance of new detector concepts
- **Fermilab provides unique and essential facilities for CMS and the wider HEP community that will continue to play a crucial role**

# LHC Physics Center (LPC)

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- **Founded in 2004 as a resource and physics analysis hub**
  - ★ Housed on all of the 11th and much of the 10th floors of Wilson Hall
  - ★ Easy access to Fermilab resources and proximity to a broad range of CMS expertise
    - outstanding computing and software support, engineering staff, hardware experts
    - a place for CMS to interact with Fermilab theory department
- **A vibrant intellectual community**
  - ★ Hosting activities for CMS and wider LHC community
    - CMS Data Analysis School, multi-day workshops, hands-on advanced tutorials, “Topic of the Week” lectures, Physics Forum, social interactions like “coffee chat”
- **Programs to attract key scientists to spend time at LPC**
  - ★ CMS Distinguished Researchers program
    - Junior and Senior DR, Provides support and some travel funding for ~50% time at LPC enabling them to take on projects at LPC and in CMS
  - ★ Guest & Visitors
    - facilitates CMS members to spend time at the LPC to work on projects (hardware/software/physics) that advance, enrich, and impact CMS
- **Much more detailed information and metric in this afternoon’s session**
  - ★ e.g. LPC impact on CMS physics productivity, participation from US community etc

# Remote Operations Center (ROC)

Located on Wilson Hall 1<sup>st</sup> floor



- CMS ROC at Fermilab

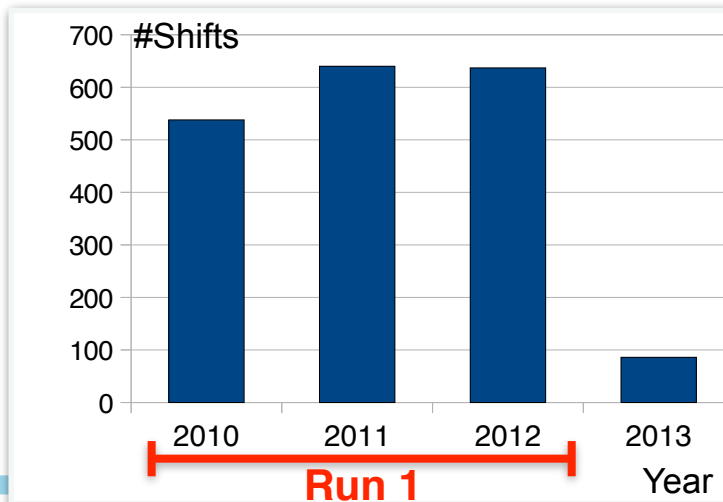
- ★ Pioneered remote operations (est. 2007)
- ★ Users have come from >25 U.S. Institutions
- ★ Integrate into CMS operations while saving on travel expenses
- ★ Development site for monitoring and operations support tools

For Run 1, **1901** Offline DQM shifts were taken at the Fermilab ROC by **99** individuals (02/2010 - 02/2013)



- Run 1 and planned Run 2 activities

- ★ 50% of all CMS Offline Data Quality Monitoring shifts
- ★ Tracker and HCAL subsystem shifts
- ★ Computing operations (Tier-0) and shifts
- ★ Fermilab Tier-1 primary shifts
- ★ Control room for CMS-related
- ★ Fermilab Test Beam Facility experiments
- ★ Outreach (hundreds of tours)



# Broad US Participation in CMS Ops at the Fermilab ROC

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- Example of a list of institutions who took 2012 DQM offline central shifts at FNAL ROC,
  - Brown Univ, Chicago, Cornell, Fermilab, Florida State, Florida Tech, Iowa, Johns Hopkins, Kansas Univ, Maryland, Mexico-Iberoam, Mexico-UASLP, Mississippi, Puerto Rico, Purdue, SUNY-Buffalo, Texas-Tech, UCSD, Wayne
- ★ Central/South America
  - including institutions from Mexico and two institutions from Brazil
- Computing operations team extensively uses the room
  - ★ mostly Fermilab and groups from Central & South America
- Testbeam users have been a combination of Fermilab staff and some users from international institutions



# Computing Facilities: Tier-1, LPC-CAF, OSG, SCD

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- Tier-1 is enabling the whole of CMS data processing and access
  - ★ Largest Tier-1 site for CMS, outstanding performance
    - 40% of the resources on the Tier-1 level w/ ~11,000 job slots
    - Data serving and archives for 40% of CMS data/MC
      - >10 PB high-performance disk servers, 22 PB → ∞ capacity tape library
    - high-bandwidth networks to worldwide CMS sites, 80 Gbps, easily 3Gbps TAN
  - ★ Facility team working with workflow and data operations teams
    - rapidly and effectively data processing, most difficult workflows
- Analysis facility LPC-CAF is enabling US researchers
  - ★ Interactive login for 700 US CMS physicists + international collaborators
    - Large analysis cluster w/ ~5,000 job slots
    - Large demand, regularly >50k jobs pending, waiting to run
  - ★ Access any data at the Tier-1 + 3PB user disk space to extract physics
- Open Science Grid is enabling CMS university computing
  - ★ Connecting Tier-2 and Tier-3, providing support for campuses and users
- Working with SCD to leverage expertise across HEP scientific computing
  - ★ CMS facility and workflow experts appointed to coordination positions in SCD

# CMS and US CMS Management

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- There are several Fermilab staff members serving in CMS management and coordination: MB, CB, L2s
  - ★ LATBauerdick (MB, EB, FB), L.Sexton-Kennedy (EB), O.Gutsche (EB), K.Burkett (CB), J.Freeman (HCAL IB), V.O'Dell (Conf. Com)
  - ★ A number of L2 positions: E.Vaandering (Computing), D.Hufnagel (Computing), Ch.Jones (Offline), L.Gray(e/gamma)
- Fermilab people lead US CMS Ops Program and Upgrades
  - ★ S.Nahn, V.O'Dell, LATBauerdick, L.Sexton-Kennedy
  - ★ management of US CMS is quite complex
    - funding level from DOE and NSF is ~ \$35M/year for Ops, + DOE Phase1 project
    - over half goes to the US universities to facilitate and enable their participation in CMS. US CMS consists of 48 universities and 2 national labs
    - requires “scientifically sensitive management”, with managers who can maintain the flexibility needed for a successful research program while satisfying the requirements of sound management, adherence to procedure, accountability, budget control, schedule, and respect for ES&H and diversity expected by US funding agencies

# Summary

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- Run 1 at the LHC was a great success for CMS and for the Fermilab CMS group, and during the Long Shutdown 1 we are achieving our goals to prepare CMS for the high-energy Run 2
- The group is now busy with preparation for Run 2 physics, construction of the Phase-1 upgrades, and R&D for the Phase-2 upgrades, plus software and computing for CMS
- The LPC, the ROC, the Computing Facilities, hosted by Fermilab, have all been successful in creating a hub of activity within the US and increasing the impact of US CMS physicists in CMS
- Our analysis activities, upgrade work, and hosting of these facilities are all well-aligned with the priorities from P5

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# Backup Slides

# Overview of the Group

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- CMS collaboration currently has ~2100 authors with ~700 from the US
  - Fermilab is the largest US group and the second largest group overall in CMS
- In 2015 we will have 55 CMS authors (+ 5 emeritus)
  - Total Fermilab effort (incl. professionals) on CMS is >100 FTE
- Research program supports 53 FTE
  - Concentrated in Particle Physics Division, Scientific Computing Division, with additional people in Technical Division
  - Includes 15 postdocs, 2 Wilson Fellows

# Current Positions of Past Fermilab Postdocs

<b><i>Jake Anderson</i></b>	<b><i>Data Scientist, Pearson Education Software</i></b>
<b><i>Ingo Bloch</i></b>	<b><i>DESY Staff</i></b>
<b><i>Vasundhara Chetluru</i></b>	<b><i>Data Scientist, Jump Trading</i></b>
<b><i>Yanyan Gao</i></b>	<b><i>Postdoc, U. of Edinburgh</i></b>
<b><i>Oliver Gutsche</i></b>	<b><i>Scientist, SCD, Fermilab</i></b>
<b><i>Jim Hirschauer</i></b>	<b><i>Wilson Fellow, PPD, Fermilab</i></b>
<b><i>Benjamin Hooberman</i></b>	<b><i>Asst. Professor, UIUC</i></b>
<b><i>Ketino Kaadze</i></b>	<b><i>Asst. Professor, Kansas State</i></b>
<b><i>Konstantinos Kousouris</i></b>	<b><i>CERN Staff</i></b>
<b><i>Verena Martinez Outschoorn</i></b>	<b><i>Asst. Professor, UIUC</i></b>
<b><i>Dave Mason</i></b>	<b><i>Applications Physicist, SCD, Fermilab</i></b>
<b><i>Kalanand Mishra</i></b>	<b><i>Data Scientist, Vectra Networks</i></b>
<b><i>Carsten Noeding</i></b>	<b><i>System &amp; Flight Safety Engineer, Northrop Grumman</i></b>
<b><i>Seema Sharma</i></b>	<b><i>Asst. Professor, IISER Pune India</i></b>
<b><i>Ping Tan</i></b>	<b><i>Postdoc, University of Iowa</i></b>
<b><i>Lorenzo Uplegger</i></b>	<b><i>Applications Physicist, SCD, Fermilab</i></b>
<b><i>Fan Yang</i></b>	<b><i>Trader, Quantitative Analyst, White Bay PT LLC, NY</i></b>
<b><i>Francisco Yumiceva</i></b>	<b><i>Asst. Professor, Florida Institute of Technology</i></b>

# Fermilab Physics Conveners for Run1/2

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- **SUSY (Five Subgroup Conveners)**
  - ★ Ben Hooberman (SUSY in lepton channel, 2012-13)
  - ★ Dave Mason (SUSY in photon channel, 2012-13)
  - ★ Rick Cavanaugh (SUSY in 3rd Generation, 2012-13)
  - ★ Daniel Elvira (SUSY in Hadronic channel, 2009-10)
  - ★ Seema Sharma (SUSY in Hadronic channel, 2014-15)
- **Exotica (Four Subgroup Conveners)**
  - ★ Jim Hirschauer (Exotica Lepton+Jets, 2012-13)
  - ★ Keti Kaadze (Exotica Lepton + Jets, 2014-15)
  - ★ Robert Harris (Exotica Multijets, 2012-13)
  - ★ Steve Mrenna (Monte Carlo Interpretations, 2014-15)
- **Standard Model (Three PAG and five subgroup/taskforce conveners)**
  - ★ Vivian O'Dell (QCD Convener, 2008-9)
  - ★ Jeff Berryhill (Electroweak Electron Analysis Subgroup, 2008-9)
  - ★ Jeff Berryhill (Vector Boson Task Force, 2010-11)
  - ★ Kostas Kousouris (QCD and Standard Model Convener, 2011-12)
  - ★ Jeff Berryhill (Standard Model Convener, 2012-13)
  - ★ Vasu Chetluru (QCD Photon Subgroup, 2009-10)
  - ★ Slawek Tkaczyk (SMP Boson subgroup, 2012-13)
  - ★ Jacob Linacre (Top Properties subgroup, 2013-14)
- **Objects (Four POG and six subgroup conveners)**
  - ★ Kevin Burkett (Tracking Convener, 2008-09)
  - ★ Daniel Elvira (JetMET Convener, 2008-09)
  - ★ Robert Harris (JetMET Convener, 2010-11)
  - ★ Jeff Berryhill (Electron/Photon Trigger Subgroup, 2011)
  - ★ Lindsey Gray (Electron/Photon Convener, 2014-15)
  - ★ Robert Harris (JetMET Jet Energy Correction Subgroup, 2008-09)
  - ★ Kostas Kousouris (JetMET, Jet Energy Correction Subgroup, 2010)
  - ★ Niki Saoulidou (JetMET, Jet Algorithms Subgroup, 2011-12)
  - ★ Lindsey Gray (Photon Subgroup, 2013)
  - ★ Nhan Tran (JetMET Algorithms and Reconstruction Subgroup, 2013-14)