LHC Physics Center at Fermilab - LPC

- LPC was founded in 2004 as a regional center for CMS
- Serves as a resource and physics analysis hub, primarily for USCMS
- Housed on 10th and 11th floors of Wilson Hall
  - Proximity to a broad range of CMS expertise in variety of areas under one roof
  - Easy access to Fermilab resources:
    • outstanding computing
    • software support
    • engineering staff, hardware experts
    • theory department
- A vibrant intellectual community
- Coordinators: B. Klima (FNAL), M. Narain (Brown)
Founding of the LPC

From Sarah Eno’s presentation to USCMS in 2004

What is the LPC?

An attempt to reproduce the benefits of being at the lab in our time zone, on our side of the Atlantic.

• a critical mass (clustering) of young people who are actively working on software (reconstruction, particle identification, physics analysis)
• one stop shopping for your analysis questions
• analysis tools such as large meeting rooms, video conferencing, large scale computing, “water cooler”
• virtual control room for active participation in the running and quality control of the experiment
Founding of the LPC

From Sarah Eno’s presentation to USCMS in 2004

11th floor

(Kaori Maeshima)

- high speed internet access
- transient area on cross over
- lockers for transients
- 1 large and 2 small meeting rooms
- secretary support, printers, etc
- Italian espresso machine
- remote control room
- offices for permanent workers

Trying to understand appropriate balance between transient and resident areas. Can not afford wasted space, but want everyone to be comfortable

Your input is needed!!
Founding of the LPC

• Early efforts focused on software, “object ID”
  - Significant contribution to rewrite of CMS software framework
  - Local groups based on “objects” (electrons, jets, etc.)
  - Many questions about how the local efforts fit within the international CMS groups
  - Some resistance from CMS management about whether we were creating a parallel structure

• Training has always been an important component of the LPC
  - Started with half-day “CMS 101”
    • Evolved first into a 3-day “J-term” in January, and eventually the CMS Data Analysis School
  - Hosted a series of workshops to ease Tevatron-LHC transition
  - Most controversial were physics workshops for USCMS before startup
  - We now have an extensive program of seminars, tutorials, etc.
Programs and Activities at the LPC

- The LPC hosts a range of activities for members of CMS and the wider LHC community, including ATLAS and theorists
  - **CMS Data Analysis School (CMSDAS)**
    - 5-day school with hands-on exercises designed to teach new members how to use CMS software and do analysis at CMS
  - **Hands-On Advanced Tutorials (HATS)** - 1-2 day tutorials on a specific topic
  - **Topic of the Week lectures**
    - Visiting scientists give 1-2 seminars on a specific topic related to LHC theory/phenomenology or experimental methods
    - Organizing committee includes two FNAL theory contacts
  - **Physics Forum**
    - Two scientists leading “blackboard” style discussion
    - “Open” forum pairs an experimentalist with a theorist
    - “Closed” allows for internal CMS discussion
  - **Multi-day Workshops** - both CMS internal and Open (e.g. BSM Higgs)
  - **Coffee chat** - informal discussion once per month
9th CMS Data Analysis School  
12-16 January 2015 at the Fermilab LPC

This school is designed to teach CMS members how to perform data analyses with the CMS analysis software. The school starts with inspirational plenary lectures, followed by many hands-on short tutorials and long physics exercises.

The focus of this school is “Preparation for Run 2 Physics”

Organizing Committee: Boaz Klima, Sudhir Malik, Meenakshi Narain

Plenary Lectures:
Welcome: Boaz Klima (Fermilab)
The CMS Data Analysis School: Sudhir Malik (UPRM)
The CMS Detector: Tiziano Camporesi (CERN)
The LPC: Chandra Shekhar Bhat (Fermilab)
The Big Picture: Natalia Toro (Perimeter Institute)
CMS Physics & Outlook: Jim Olsen (Princeton University)
The LHC: Chandrashekhara Srinivasan (SLAC)
CMS Data Analysis School: Boaz Klima (Fermilab)

Short Exercises (Physics Objects/Tools):
Triggers, Electrons, Photons, Muons, Jets, Missing Et,PILE-up, Tracking, b-tagging, Generators, Event displays, Statistics

Facilitators:
J. Antoshchik (OSU), A. Aparayu (Columbia), A. Seshu (FSU), A. Anindya (UTK), J. D erste (FSU), S. Barwell (UofG), T. Bose (UofI), A. Cakir (DIP), G. Cerati (UCSB), S. Das (IIT-K), J. Dolen (Butler), D. Dugan (Adu), F. Dufour (ITB), D. Frenkel (Budapest), R. P. Gandreapala (Iowa), C. Gerbaud (UC), F. Golf (UFS), B. Gomber (CM), R. Harris (FAMU), M. Hildreth (Brown)

Long Exercises (Physics Analysis):
Heavy T5/3 search with same-sign dileptons
SUSY: razor search with jet substructure
Z/Å resonances with jet substructure
Dark matter searches with photons
SUSY searches (hadronic modes)
Exotica with displaced vertices
Higgs properties, Higgs \( \rightarrow b\bar{b} \)
Exotica with boosted jets
DiJet resonances

Facilitators:
J. Antoshchik (OSU), A. Aparayu (Columbia), A. Seshu (FSU), A. Anindya (UTK), J. D erste (FSU), S. Barwell (UofG), T. Bose (UofI), A. Cakir (DIP), G. Cerati (UCSB), S. Das (IIT-K), J. Dolen (Butler), D. Dugan (Adu), F. Dufour (ITB), D. Frenkel (Budapest), R. P. Gandreapala (Iowa), C. Gerbaud (UC), F. Golf (UFS), B. Gomber (CM), R. Harris (FAMU), M. Hildreth (Brown)

LPC Support: Jesus Orduna, Zhenbin Wu
Administrative Support: Carrie Farver, Terry Grozio, Terry Read, Sonya Wright

~120 attendees

Kevin Burkett | PPPL Meeting 09/16/15
### Past Topic of the Week Speakers

<table>
<thead>
<tr>
<th>THEORY</th>
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<tbody>
<tr>
<td>Kaustubh Agashe (Maryland)</td>
<td>Yevgeny Kats (Rutgers)</td>
<td>David Shih (Rutgers)</td>
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<td><strong>Tim Cohen (SLAC)</strong></td>
<td>Can Kilic (UTexas)</td>
<td>Andrzej Siodmok (Karlsruhe)</td>
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<td>Nathaniel Craig (IAS)</td>
<td>Mariangela Lisanti (Princeton)</td>
<td>Michael Spannowsky (Durham)</td>
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<td>David Curtin (Stonybrook)</td>
<td>Ian Low (Northwestern, ANL)</td>
<td>Matt Strassler (Rutgers)</td>
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<td>Raffaele D’Agnolo (IAS)</td>
<td>Markus Luty (UC Davis)</td>
<td>Zack Sullivan (IIT)</td>
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<td>Hooman Davoudiasl (BNL)</td>
<td>Konstantin Matchev (Florida)</td>
<td>Raman Sundrum (Maryland)</td>
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<td>Sally Dawson (BNL)</td>
<td>Michele Papucci (LBL)</td>
<td>Tim Tait (UC Irvine)</td>
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<td>Bogdan Dobrescu (FNAL)</td>
<td>Maxim Perelstein (Cornell)</td>
<td>Brock Tweedie (Pittsburgh)</td>
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<td>Steve Ellis (U. Washington)</td>
<td>Michael Peskin (SLAC)</td>
<td>Jesse Thaler (MIT)</td>
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<td>Rouven Essig (Stonybrook)</td>
<td>Frank Petriello (NWU, ANL)</td>
<td>Natalia Toro (Perimeter Institute)</td>
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<td><strong>Jared Evans (Rutgers)</strong></td>
<td>Matt Reece (Harvard)</td>
<td>Chris Vermilion (Louisville)</td>
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<td>Jonathan Feng (Irvine)</td>
<td>Joshua Ruderman (NYU)</td>
<td>Liantao Wang (UChicago)</td>
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<tr>
<td>Roni Harnik (FNAL)</td>
<td>Markus Schulze (ANL)</td>
<td>Itay Yavin (McMaster/Perimeter Inst.)</td>
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### Past Topic of the Week Speakers

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<tr>
<th>EXPERIMENT</th>
<th>Speakers</th>
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<tbody>
<tr>
<td>Juan Alcaraz (CIEMAT)</td>
<td>Daniel Elvira (FNAL) Sanjay Padhi (UCSD)</td>
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<tr>
<td>Artur Apresyan (CalTech)</td>
<td>Paolo Giacomelli (INFN, Bologna) Alexander Paramonov (ANL)</td>
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<td>Pushpa Bhat (FNAL)</td>
<td>Marcus Hohlmann (FIT) Anton Poluektov (Warwick)</td>
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<td>Antonio Boveia (UChicago)</td>
<td>Deepak Kar (Glasgow) Harrison Prosper (FSU)</td>
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<td>Sara Bolognesi (JHU)</td>
<td>Evan Friis (Wisconsin) Ricardo Vasquez Sierra (Davis)</td>
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<td>Adolf Bornheim (CalTech)</td>
<td>Joey Huston (MSU) Thomas Speer (Brown)</td>
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<td>Oliver Buchmueller (Imperial College London)</td>
<td>Ben Kilminister (Zurich) Roberto Tenchini (Sezione di Pisa)</td>
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<td>Claudio Campagnari (UCSB)</td>
<td>Andrey Korytov (Florida) Mayda Velasco (Northwestern)</td>
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<td>Tiziano Camporesi (CERN)</td>
<td>Christos Leonidopoulos Si Xie (CalTech)</td>
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<td>Anadi Canepa (TRIUMF)</td>
<td>Hugh Lippincott (FNAL) Daniel Whiteson (UC Irvine)</td>
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<td>Frank Chlebana (FNAL)</td>
<td>Ted Liu (Fermilab) Roger Wolf (MIT)</td>
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<td>Bob Cousins (UCLA)</td>
<td>Steven Lowette (UCSB) Steve Worm (RAL)</td>
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<tr>
<td>Albert De Roeck (CERN)</td>
<td>William Murray (STFC Warwick)</td>
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Summary of 2014 LPC Activities

- CMSDAS – 1
- Workshops – 8
  - CMS only – 6 (JME, TP, HCAL, Trig/Track, B2G, SUSY)
  - Global – 2 (BSM Higgs, Future Colliders)
- HATS – 11
  - ID – 4 (e, ET, b-tag, Jet-substructure)
  - Upgrade – 3 (Calo, Tracker, Trigger)
  - Tools – 4 (Statistics, Roostat, CRAB3, Delphes)
- TOTW – 19
- PF – 17
- CH – 9
Programs and Activities at the LPC

- Attract key scientists to spend time at LPC
  - CMS Distinguished Researchers
    • Current and future leaders, responsible for projects at LPC and in CMS
    • Provides support and some travel funding for ~50% time at LPC
    • 37 DRs awarded in the last two years, with a roughly 2:1 ratio of junior (postdoc) to senior (faculty)
  - Guest & Visitors
    • Facilitates CMS members to spend time at the LPC working on projects (hardware/software/physics) that advance, enrich, and impact CMS
    • Two calls for proposals each year
    • 36 proposals funded in FY14
Fermilab Contributions to the LPC

• In addition to hosting the LPC (providing offices, conference rooms, technical & admin support) many Fermilab scientists have leading roles in LPC activities
  - Co-Coordinators: Meenakshi Narain (Brown), Boaz Klima
  - Organizing committees are co-chaired by FNAL and university scientists
    • Events: Sudhir Malik (UPR), Andrew Whitbeck
    • Physics Forum: Andrew Askew (FSU), Sridhara Dasu (UW), Nhan Tran
    • Topic of the Week: Artur Apresyan (CalTech), Jim Hirschauer
    • Coffee Chat: Marc Weinberg (FSU), Souvik Das (UF), Kaori Maeshima
  - Many co-lead CMS DAS exercises and HATS tutorials
  - From the beginning, FNAL scientists have provided the relevant expertise that supports the analysis activities at the LPC

• LPCCAF, used by 70% of USCMS, is supported by the same experts that support the FNAL T1
LPC Contributions to CMS Physics

- LPC Publication Metrics: quantifying the impact of the LPC on the physics productivity of CMS
- Contributions to the CMS publications
  - Analysis Review Committee (ARC) Chairs
  - Number of ARC members
  - Primary Contact for Publication (CADI contact)
  - Number of Authors

- The analysis looks at the above variables in the context of CMS, USCMS and LPC
- Combine information from CMS Analysis DB, author lists of supporting notes for publications
  - Caveat: most of notes supporting Higgs analyses do not have an author list but instead say, e.g. “Hgg team” and are thus difficult to classify
LPC: Publications/review

Green: LPC co-authors from survey
Blue+Green: USCMS
RED: not USCMS

Analysis Contacts 18%

ARC Chairs 16%

ARC Members (incl. chairs) 60%

Total # of ARC Members 18%
Authors contributing to 52% of all pubs

majority of US co-authors from LPC
16 papers (out of ~90)

Green: LPC co-authors from survey
Blue+Green: USCMS
RED: not USCMS
Remote Operations Center

- Established in 2007
  - (2008: Centers at CERN Meyrin, DESY)
- Shift Activities
  - 50% of all CMS Offline DQM shifts
  - Online DQM shifts during commissioning
  - Tracker, HCAL subsystem, Tier-1 primary shifts, computing shifts
- Between 2/15/10 and 2/18/13, 1901 Offline DQM shifts were taken at the Fermilab ROC by individuals from ~25 U.S. Inst. + Mexico
  - Integrate into CMS operations while saving on travel expenses

- A key to the success of the ROC has been the development of Web-Based Monitoring (WBM)
  - Proposed to CMS by FNAL scientists in 2006, based on experience at the Tevatron
  - WBM tools have been used extensively in CMS data-taking operations at P5, FNAL, CERN, and many other remote locations.
  - Development ongoing, to keep up with evolution of CMS online