

# Fast Timing, Phase 2 Calorimetry, and Searches for New Physics

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**DOE Meeting at LPC**

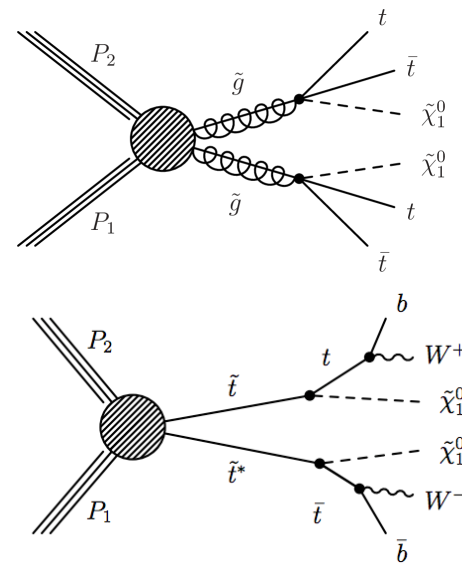
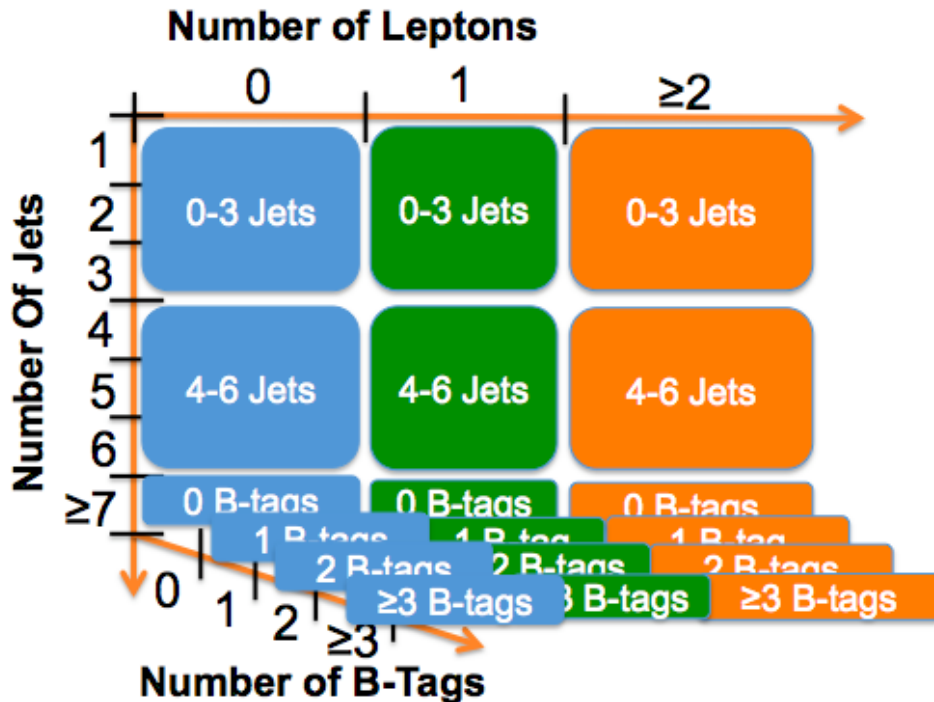
05/24/2016

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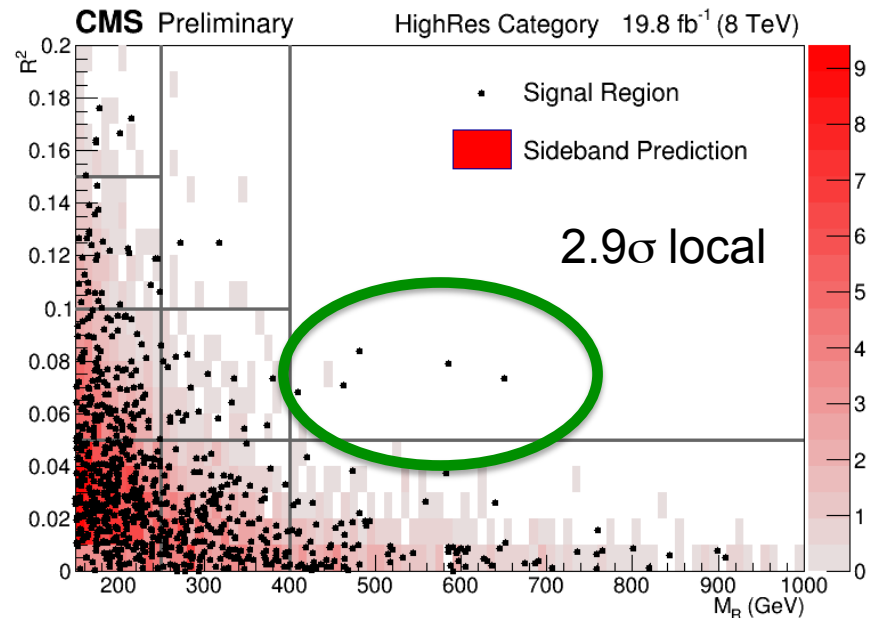
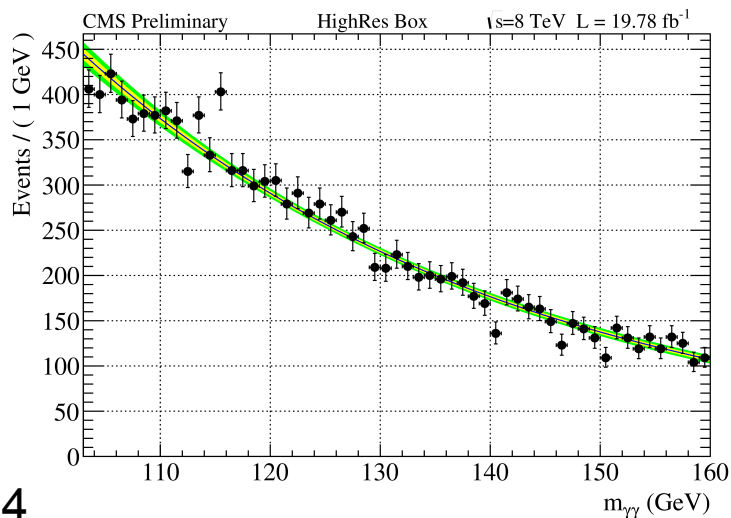
Gluino Pair Production

Stop Pair Production

# Search for SUSY and Anomalous Higgs Production

- Searches to cover very broadly the theory parameter space
  - Inclusive search for SUSY
  - Search for electroweak SUSY production

Higgs-aware SUSY search:  
Use the Higgs decay channel



# Search for SUSY and Anomalous Higgs Production

- Searches to cover very broadly the theory parameter space
  - Inclusive search for SUSY
  - Search for electroweak SUSY production
- Close synergies with other LPC groups working on similar searches: FNAL, UCSB, UCSD, Texas A&M, Colorado, UC Riverside
- Inclusive search publication using 2015 data about to enter CWR
- Higgs-aware SUSY search with Run1 data: PAS out, paper being prepared

# Search for SUSY and Anomalous Higgs Production

- LPC Distinguished Researcher Appointment greatly facilitated my new role as SUSY Photon subgroup convener
  - Financial and Travel support
  - Building synergies with LPC groups working on SUSY photon analyses
- Eg. SUS-15-012: Search for SUSY in diphoton plus Jets and MET with 2015 data. Going towards publication now.

# Resonance Searches

- Lots of attention on the diphoton “bump” at 750 GeV since beginning of the year
- Since April, started a collaborative effort @ LPC on these resonance searches in  $\gamma\gamma$  and dijet final states

## Diphoton

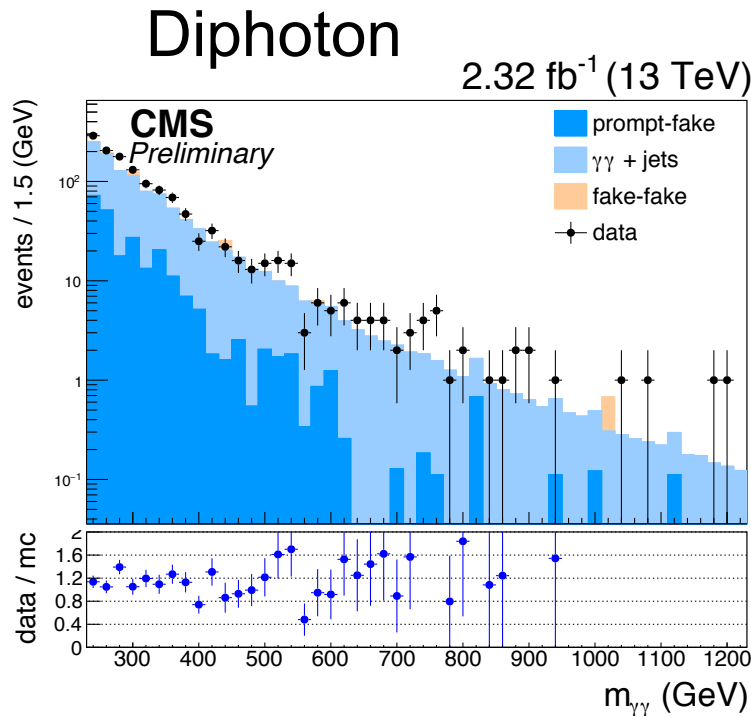
- Serving as official cross-check, using independent framework from 2015 CMS analysis

## Dijet

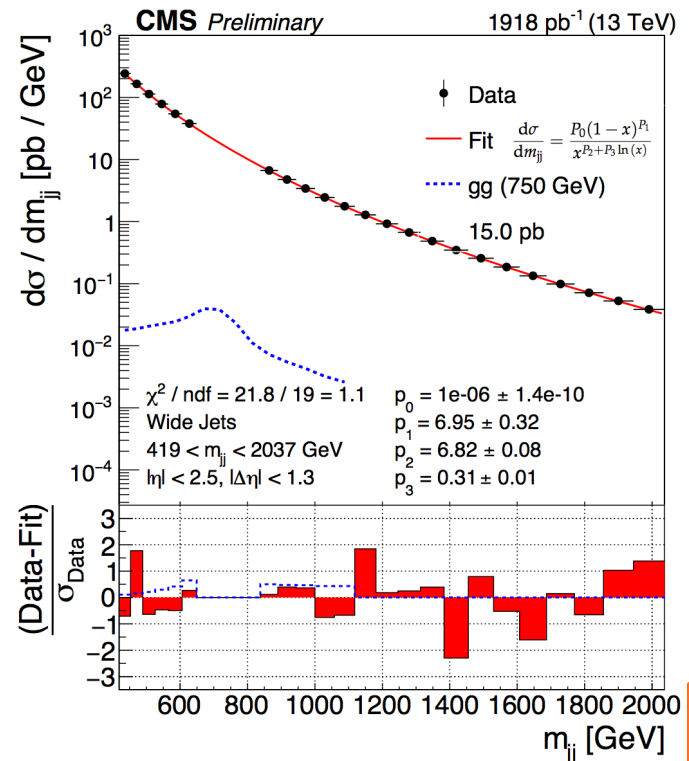
- Calo-scouting effort allows to search in 750 GeV region without impact from trigger turn-on effects

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# Resonance Searches

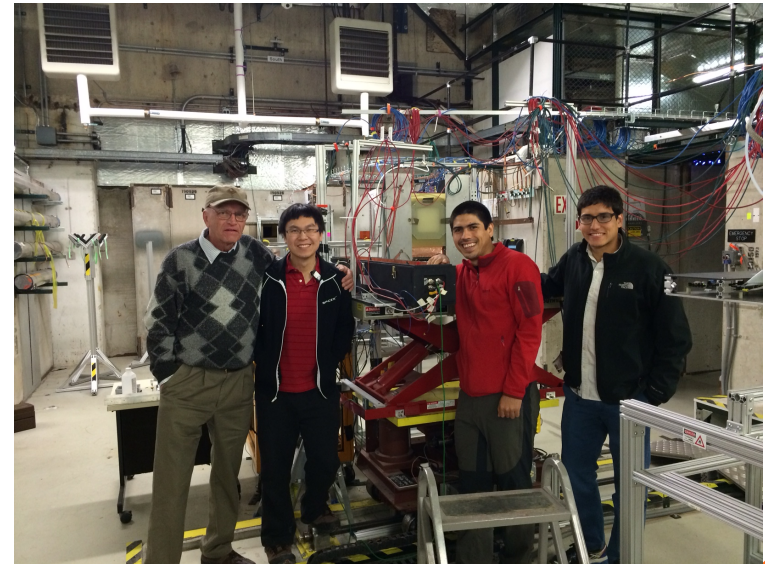
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LPC Collaborators:  
FNAL, Rutgers

Local expertise in Jet energy calibration facilitates the work tremendously

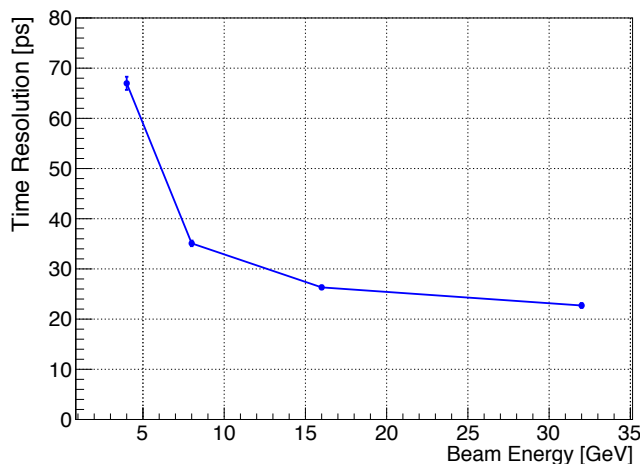
# Precision Timing R&D

- A lot of future detector R&D on precision timing detectors
- Past 2 years work resulted in 6 publications in NIM...and with still more to come
  - Collaboration @ LPC has been critical to this effort
  - Testbeam facilities and labs at FNAL were vital



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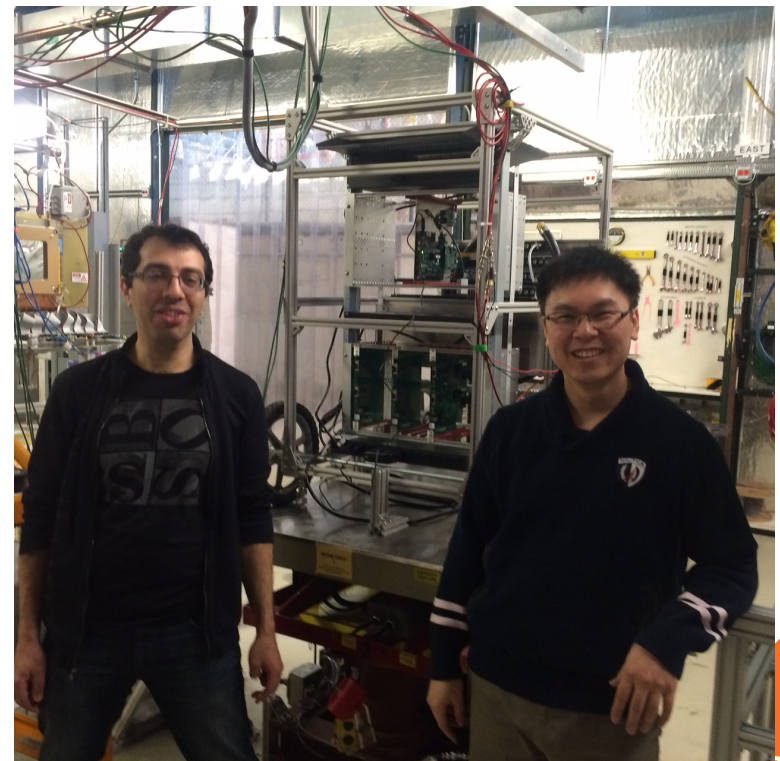
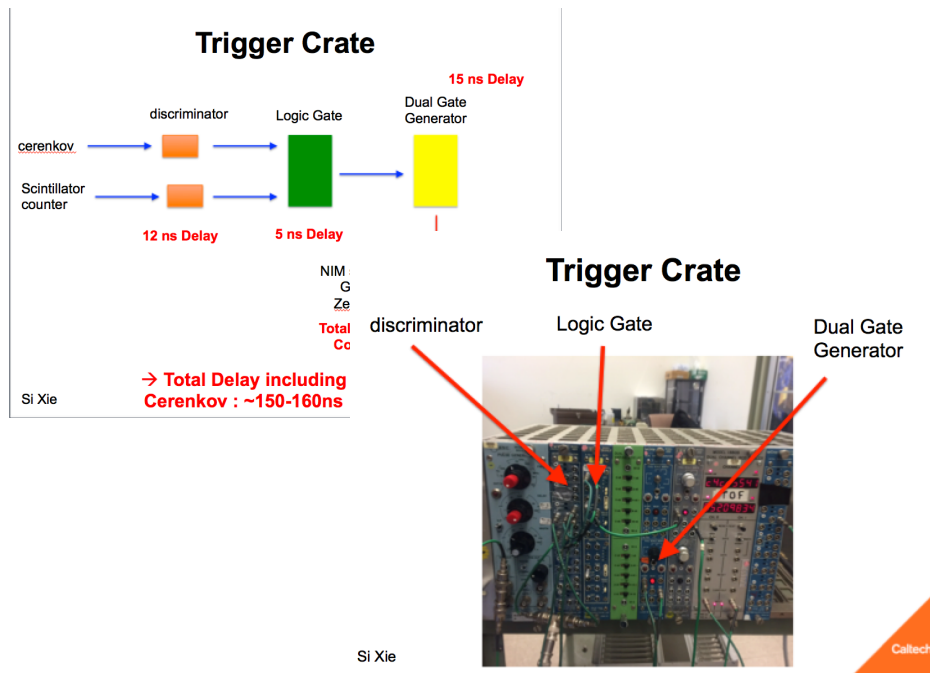
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- A critical mass with interest in precision timing starting to form @ LPC and CMS
  - FNAL, Caltech, Princeton, Milano, CERN
- Very close synergy with the HGC effort
- Recent testbeam demonstrate proof-of-concept for precision timing with silicon

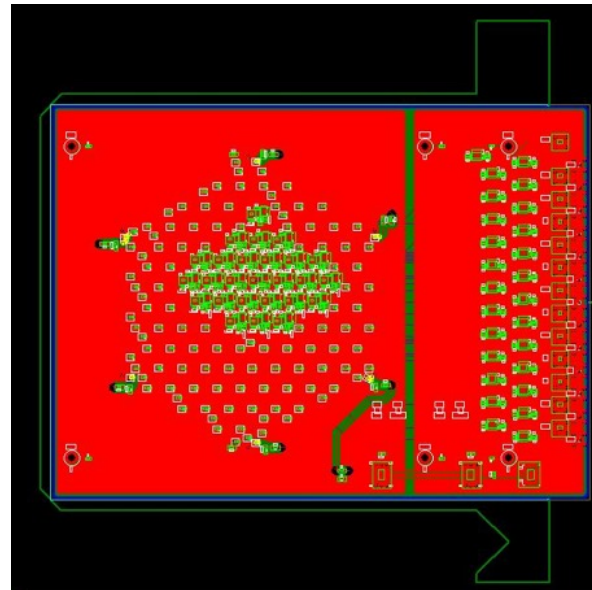
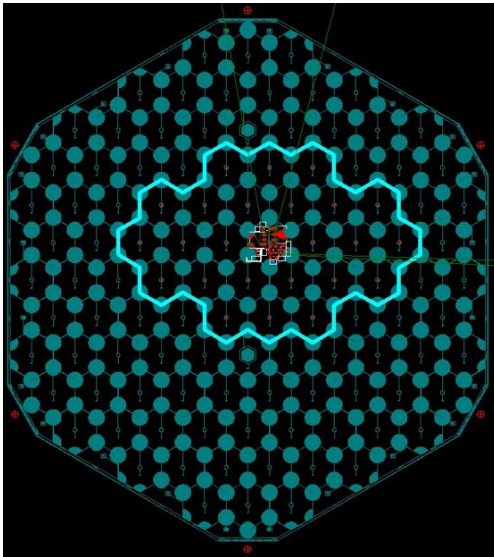
# High Granularity Calorimeter

- Capitalizing on the opportunity at the LPC to make contributions to a critical future detector technology
- Contributing to the HGC effort as a “local” expert on testbeams



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- Capitalizing on the opportunity at the LPC to make contributions to a critical future detector technology
- Contributing to the HGC effort as a “local” expert on testbeams
- Using the opportunity to initiate more realistic tests of precision timing with the HGC



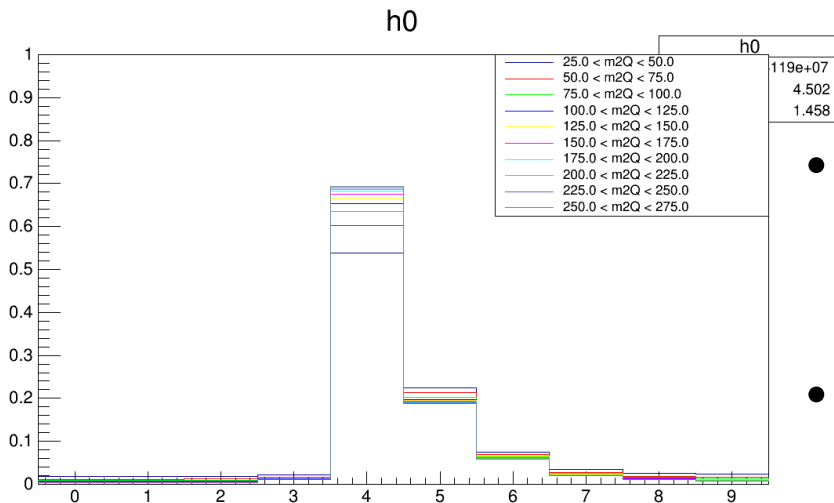
# New Dark Matter Group Formed at LPC

- Since March, formed a new dark matter group centered at the LPC:
  - Focused on Razor Dijet+MET dark matter search as the first product
  - Intentions to expand to boosted dijets+DM, diHiggs+DM, diboson+DM searches
- Collaborators: FNAL, Johns Hopkins, MIT



# HCAL Pulse Shape Modeling

- Started an effort with a 1<sup>st</sup> year Caltech PHD student on improving the HCAL pulse shape model
- Use pure in-time collision data ( heavy ion, lone bunch ) to derive better model of pulse shape dependence on total charge



- LPC presence has been very important as many issues have been resolved at the “local” level
- Collaborators: FNAL, Baylor, Texas A&M, MIT

# Summary

- A lot of transformational work being done here
  - New physics searches
  - CMS Phase 2 Upgrade
  - Future Detector R&D
- Support, opportunity & collaboration at the LPC has been critical to all aspects of my work
- The Distinguished Researcher appointment gives me great opportunity and financial support to continue these important activities.