

# Rishi Patel

## Curriculum Vitae

### Education

- PhD Thesis *Observation of a Higgs Boson decaying to photons using multivariate techniques at CMS*
- supervisors Yuri Gershtein
- Description The thesis describes the sequence of the analysis from vertex selection, photon energy reconstruction, photon identification and finally event selection. Each step is done using multivariate techniques. The Higgs boson is observed as a significant excess of events in the diphoton invariant mass spectrum from 100 to 180 GeV. For more information: <https://rucore.libraries.rutgers.edu/rutgers-lib/45409/>
- 2008–2014 **Ph.D**, *Rutgers University, Piscataway, NJ, High Energy Experiment.*
- 2004–2008 **B.A.**, *New York University, New York City, NY, Major: Physics, Mathematics* .  
Advanced Courses: Mathematical Analysis, Partial Differential Equations, Physics of Biology, Experimental Physics

### Academic Positions

- 2014–Present **Research Associate**, *Texas A&M University* , College Station, TX.
- 2008–2014 **Research Assistant**, *Rutgers University* , Piscataway, NJ.

### Research

- Analysis Focus
- I defined the strategy for the final statistical interpretation of the multi-category analysis and validated the output of the fitting procedure.
  - I worked with a team to integrate all the analysis measurements and uncertainties to provide the final interpretation of experimental upper limits on gluino and stop cross-sections.
  - I worked to understand the effect of control sample statistics on the measurement of the background from hadronically decaying tau leptons.
  - I worked with a team of Hadronic Supersymmetry analysts to understand experimental sensitivity to hadronic stop decays.
  - I co-led the first 13 TeV SUSY search in Run 2. SUS-15-002 was published as the first CMS SUSY paper in PLB 758, 152 (2016).

- Upgrade Work The CMS detector after the end of Run 2 will be upgraded to improve the electronic triggers responsible for data collecting. In particular a new Track Trigger will be installed to include the information from track measurements in the trigger decision. I have worked to gauge the improvement in physics performance using the information from reconstructed tracks in the Level-1 trigger system.
- I studied the improvement of jets identified from the primary interaction when including a fine granularity pixel detector in the Track Trigger.
  - I studied the effect of tagging b-quark jets to improve the trigger efficiency for heavy flavor jets while reducing the event rate from the huge number of minimum bias interactions. I studied specifically the resolution of the impact parameter of tracks from the Track trigger.
  - I studied the event rate from minimum bias interactions together with the improved trigger efficiency for potential physics signatures when applying a threshold on scalar sum jet transverse momentum and missing transverse energy. I looked at the effect of the individual thresholds on each variable, and applying a cross-trigger from both variables.
  - I compared the physics performance of different hardware approaches for the track trigger systems. Specifically I studied the tracking efficiency with Associated Memory chips in the hardware compared to the efficiency from other hardware approaches using just FPGA boards.
- Graduate School Research
- Main Research Focus: Large emphasis on the Run 1 data for the CMS experiment was the search for the Higgs boson, where one of the most promising modes of discovery is the 2-photon decay. The discovery of the Higgs was made in 2012 by the CMS experiment where a large amount of the sensitivity came from the 2-photon decay channel.
  - I worked to understand how Multi-variate techniques to improve the photon energy reconstruction, photon identification, and also the final signal categories that were crucial for the discovery of the Higgs. I also trained the multivariate energy correction for photons.
  - Toward the end of Run 1, I also worked to improve measurement of vector-boson fusion Higgs by using a fitting procedure to separate the dominant gluon-fusion mode from the vector boson-fusion.
  - I was the main developer of the CMS Particle Flow photon algorithm. I designed the new supercluster shape to account for the shower of the photons in the tracker. These photon objects are used by the CMS experiment in Run 2.
  - Hardware Experience: Develop the Pixel Luminosity Telescope responsible for measuring the number of protons bunches for the luminosity calculation and track the proton beam direction as it enters the CMS detector. I used a simple test stand with a radiation source to calibrate the individual diamond sensors and also gauge their performance on the pixel level of the sensors. The Luminosity Telescope has been installed in the CMS detector since 2012 and is currently used for the luminosity measurement.
  - PhD Qualifier Project: I studied the effect of ECAL timing resolution on the sensitivity to searches for long lived particles.

## Conference Presentations

- Recontres Du Vietnam 2013** *Measurements of Higgs boson properties*  
**New Frontiers in Physics 2013** *Observation Of A Higgs-Like Boson in the Two Photon Decay*  
**Lake Louise Winter Institute 2016** *Supersymmetry results from LHC Run2 from CMS*

## Computer skills

- Machine Learning** *Boosted Decision Trees Algorithms for Classification and Regression*  
**Roofit** *Functional modeling of data distributions using probability density functions. Also use it to build and test Likelihood ratios.*  
**Programming Languages** *C++, Python, C shell-scripting*

## Interests

Science Communication  
Creative Writing  
Improvisational Acting

## Languages

English **Fluent**  
French **Intermediate**  
Hindi **Intermediate**

## Publications

- [1] CMS Collaboration. Search for Heavy, Long-Lived Neutralinos that Decay to Photons at CDF II Using Photon Timing. *Phys. Rev.*, D78:032015, 2008.
- [2] CMS Collaboration. Observation of a new boson with mass near 125 GeV in pp collisions at  $\sqrt{s} = 7$  and 8 TeV. *JHEP*, 06:081, 2013.
- [3] CMS Collaboration. Search for supersymmetry in the multijet and missing transverse momentum final state in pp collisions at 13 tev. *Physics Letters B*, 758:152 – 180, 2016.