

# NAN LU

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## Education

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### University of Michigan - Ann Arbor

September 2011 – May 2017

*Ph.D. in Experimental Particle Physics*

*Ann Arbor, US*

- Advisor: Bing Zhou
- Dissertation: Property measurements of the Higgs boson and search for high mass resonances in four-lepton final state with the ATLAS detector at the LHC

### University of Science and Technology of China

September 2007 – June 2011

*B.S. in Physics*

*Hefei, China*

- Advisor: Zhengguo Zhao
- Undergraduate Thesis: Search for the decay  $J/\psi \rightarrow \gamma + \text{invisible}$  at BESIII

## Professional Experience

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- 1) Postdoctoral Scholar in Physics, California Institute of Technology, Pasadena USA, June 2020 – present
- 2) David and Ellen Lee Postdoctoral Scholar in Physics, California Institute of Technology, Pasadena USA, June 2017 – May 2020

## Fellowships and Awards

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- 1) David and Ellen Lee Postdoctoral Fellowship in Physics, California Institute of Technology, June 2017 - May 2020
- 2) Best Team Award at the CMS Data Analysis School (CMSDAS) at Peking University, facilitator, December 2019
- 3) Rackham Conference Travel Grant, University of Michigan-Ann Arbor, October 2014, August 2015
- 4) “Single resonance  $Z \rightarrow 4\ell$  cross section measurement with ATLAS 7 TeV and 8 TeV Data” (poster), Best Physics Poster Award at 2012 U.S. ATLAS Physics Workshop, Ann Arbor, USA, August 2012
- 5) Physics Department Fellowship, University of Michigan-Ann Arbor, 2011 - 2012
- 6) 2010 Mathematical Contest in Modeling (administered by the Consortium for Mathematics and Its Applications, U.S.) Meritorious Winner, February 2010
- 7) Outstanding Student Scholarship, University of Science and Technology of China, 2007 - 2008, 2009 - 2010

## Leadership Positions

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- 1) **Level-3 convener** for future Higgs studies in the Future Higgs and Standard Model Group, co-managed in the Upgrade Performance Study Group (UPSG) and the Higgs Physics Analysis Group (PAG), September 2020 - August 2021
- 2) **Contact person** for Higgs physics in UPSG, February 2020 - August 2020
- 3) **Contact person** for the CMS MIP Timing Detector (MTD) with BRIL radiation simulation group, January 2020 - present
- 4) **Contact person** for the Caltech CMS Precision Timing Lab for the CMS Barrel Timing Layer Detector R&D and prototyping, May 2019 - present
- 5) **Level-3 convener** for the Hadron Calorimeter (HCAL) Calibration Group in CMS, March 2018 - March 2019
- 6) **Contact person** for  $H \rightarrow ZZ^* \rightarrow 4\ell$  analysis in the combined measurements of Higgs boson couplings in ATLAS, April 2016 - January 2017
- 7) **Contact person** for  $ZZ$  analyses in the combined search for heavy scalar resonances in diboson final states in ATLAS, January 2016 - July 2016

## Research Experience

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### CMS Experiment, Physics Analyses

- 1) **Search for  $H \rightarrow \mu\mu$  decay with Run 2 dataset**, leading the Caltech Team and supervising Caltech PhD student Irene Dutta for PhD thesis with an end-to-end full chain analysis and made important contributions to the most sensitive channel: VBF channel
  - \* data and MC comparisons in the control region to help validate the Deep Neural Network (DNN) discriminant is modeled well by the Monte Carlo samples including the systematic uncertainties
  - \* proposal and validation of the p-value vs mass scan method
  - \* contributions to the systematic uncertainty, statistical analysis and final result
  - \* studies for the analysis approval and review process
  - \* event displays
- 2) **Combined search for the non-resonant di-Higgs production using 2016 dataset**, August 2017 - April 2018, published in Phys. Rev. Lett. 122 (2019) 121803.
  - \* contributing to the statistical modeling and analysis of the  $HH \rightarrow b\bar{b}\gamma\gamma$  channel
- 3) **Search for the non-resonant di-Higgs production in  $HH \rightarrow b\bar{b}\gamma\gamma$  channel using Run 2 dataset**, July 2018 - February 2019
  - \* mentor Caltech PhD student Thong Nguyen on using advanced machine learning tools to develop a DNN to suppress the background events from single Higgs production
  - \* writing of the supporting document

- 4) **Search for di-Higgs production using boosted Higgs bosons in hadronic final states**,  $HH \rightarrow bbbb \rightarrow JJ$  ( $J$  presents a large-radius jet) channel, September 2020 - present
  - \* signal modeling
- 5) **Coordination for future Higgs studies**, Higgs contact person (February-August 2020) and **Level-3 convener** for future Higgs studies in the Future Higgs and Standard Model Group (September 2020 - August 2021)
  - \* CMS Phase-II Upgrade High-Level Trigger (HLT) Technical Design Report (TDR): Higgs physics studies
  - \* Beam Radiation Instrumentation and Luminosity (BRIL) TDR: impact of the luminosity uncertainty on the precision Higgs boson coupling measurements at HL-LHC
  - \* double Higgs production studies for HL-LHC Experiment Data Quality Working Group Summary Report, provide physics guidance on whether the crab cavity is needed in the HL-LHC machine
  - \* Higgs physics studies for the CMS experiment's contribution to the US Snowmass particle physics community planning process

#### CMS experiment, CMS MIP Timing Detector for the Phase-II Upgrade

- 1) **Contact person for Caltech Precision Timing (CPT) Lab**, leading the Barrel Timing Layer (BTL) module prototyping and testing activities, and supervising the BTL thermal study at CPT lab, documented in CMS DN-2019/039, May 2019 – present.
- 2) **MTD contact person** with BRIL Radiation Simulation Group, January 2020 – present.
- 3) **BTL sensor radiation study in collaboration with Caltech HEP Crystal Laboratory led by Ren-Yuan Zhu**, measurement of the radiation induced noise in the BTL crystals under the dose rate and neutron flux expected at the HL-LHC (CMS DN-2019/043), to be reported in 2020 IEEE Nuclear Science Symposium and Medical Imaging Conference (IEEE NSS/MIC 2020), June 2019 - November 2019.
- 4) **Measurements on crystals from different vendors for BTL in collaboration with Caltech HEP Crystal Laboratory led by Ren-Yuan Zhu**, key contribution to the measurements of the time resolution performance, November 2019 - January 2020
- 5) **Testing of the first BTL module prototype readout by the TOFPET2 ASIC** using laser test stand at CERN, achieving good time resolution of 35 ps per sensor, September - December 2017.
- 6) **BTL sensor performance and design optimization**, study the time resolution performance of different BTL sensor designs in test beam campaigns at CERN and Fermilab, including test setup installation in the test beam experimental area, real time data analysis to give prompt feedback during test beam, data-taking shifts and intensive data analysis, documented in CMS DN-2018/032 and CMS DN-2019/042, result published in CMS-TDR-020, June 2017 - May 2019.
- 7) **Using timing information at Level-1 Trigger**, study physics motivation, result published in CMS-TDR-020, January - April 2019.

## CMS Experiment, Detector Commission and Calibration

- 1) **Development and deploy of a new calibration method with muons** for the SiPM readout of HCAL Phase-I Endcap Detectors using 2018 and 2017 pp collision data, documented in CMS DN-2018/028, DN-2017/044 and CMS-DP-2018-019, August 2017 - January 2019.
- 2) **Level-3 convener of HCAL Calibration Group**, March 2018 – March 2019, leading HCAL calibration team to achieve successful calibration of the HCAL detectors in Run 2 using 13 TeV data, paper on HCAL calibration published in JINST 15 (2019) P05002.
- 3) **Commissioning shifts** for the HCAL Endcap Detector Phase-I Upgrade, Spring 2018.

## ATLAS Experiment, Run 2 Physics Analyses

- 1) **Combined measurements of the Higgs boson production and decay rates in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  and  $H \rightarrow \gamma\gamma$  decay channels using  $36.1 \text{ fb}^{-1}$  of 13 TeV data, contact person for the  $H \rightarrow ZZ^* \rightarrow 4\ell$  analysis**, published the EPS 2017 ATLAS conference note ATLAS-CONF-2017-047.
- 2) **Higgs coupling measurements in  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel based on full 2015 and 2016 dataset, contact editor of supporting documentation**, design of the ttH-enriched category, Boosted Decision Tree(BDT) discriminant optimization for the 1-jet categories, theoretical uncertainties on the main  $ZZ^*$  continuum background, published in JHEP 03 (2018) 095.
- 3) **Measurement of inclusive and differential cross sections in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel based on full 2015 and 2016 dataset**, theoretical uncertainties on the main  $ZZ^*$  continuum background, published in EPJC 10 (2017) 132.
- 4) **Higgs coupling measurements in  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel using  $14.8 \text{ fb}^{-1}$  of 13 TeV data, contact editor of supporting documentation** for the ICHEP 2016 ATLAS conference note, producing final results for the measurements of Higgs boson production cross sections from different production mechanisms, discriminant optimization using BDT and matrix element method, category optimization, published in ATLAS-CONF-2016-079.
- 5) **Combined measurements of the Higgs boson production and decay rates in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  and  $H \rightarrow \gamma\gamma$  decay channels using more than  $13.3 \text{ fb}^{-1}$  of 13 TeV data, contact person for the  $H \rightarrow ZZ^* \rightarrow 4\ell$  analysis**, produce final results including measurements of the global signal strength and Higgs boson production cross sections from different production mechanisms, study the compatibility between the observed results and the Standard Model expectations in various models, published in ICHEP 2016 ATLAS conference note ATLAS-CONF-2016-081.
- 6) **Combined search for heavy scalar resonances in diboson final states, contact person for the ZZ analyses**, combination of  $ZZ \rightarrow 4\ell$ ,  $ZZ \rightarrow \ell\ell\nu\nu$ , and  $ZZ \rightarrow \ell\ell qq$  channels in the mass range from 200 GeV to 1 TeV, combination of  $ZZ \rightarrow \ell\ell J$  and  $ZZ \rightarrow \nu\nu J$  channels in the mass range from 1 TeV to 3 TeV, study of the expected sensitivity of 2HDM models in  $4\ell$  final state with  $3.2 \text{ fb}^{-1}$  of data.
- 7) **Search for high mass resonances in the  $\nu\nu qq$  final state using  $3.2 \text{ fb}^{-1}$  of data**, acceptance challenge for event selection, theory uncertainties on the signal acceptance, expected sensitivity combining boosted and resolved analyses, published in JHEP 09 (2016) 173.
- 8) **Search for high mass resonances in the  $4\ell$  final state using  $3.2 \text{ fb}^{-1}$  of data, contact editor**

**of supporting documentation** of the ATLAS conference note for the CERN 2015 End of Year Event, produce final limits on the inclusive production cross section times branching ratio to  $4\ell$  in the mass range from 200 GeV to 1 TeV, acceptance challenge for event selection and cross-checks on the data candidates, published in ATLAS-CONF-2015-059.

### ATLAS Experiment, Run 1 Physics Analyses

- 1) **Higgs boson spin and parity hypothesis tests** in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel using BDT method based on Run 1 data, combination of the Higgs boson spin and parity hypothesis tests in the di-boson decay channels using Run 1 data, **contact editor of supporting documentation** of Moriond 2015 ATLAS conference note and the subsequent Run 1 ATLAS legacy paper EPJC 75 (2015) 476 cover page.
- 2) **Measurements of inclusive four-lepton production in  $pp$  collisions at 8 TeV**, using Boosted Decision Tree multivariate analysis technique to derive the ratio of the measured cross section of the gluon-fusion component relative to its leading-order theoretical calculations in the region where both Z bosons are produced on-shell, published in Phys. Lett. B 753 (2016) 552-572.
- 3) **Single resonance  $Z \rightarrow 4\ell$  cross section measurement**, study signal process using POWHEG-BOX, comparison of data and Monte Carlo simulations in the signal region, calculation of extrapolation and correction factors, published in Phys. Rev. Lett. 112 (2014) 231806.
- 4) **Early  $H \rightarrow ZZ^* \rightarrow 4\ell$  analysis after Higgs Boson Discovery**, contributing to  $ZZ^*$  background theory uncertainty study.

### ATLAS Experiment, ATLAS Muon Spectrometer

- 1) Monitored Drift Tube (MDT) chambers Front-end electronics test and development for Run 2 operations, **fixing the rare 12.5 ns  $T_0$  time shifts in MDT chambers** observed in Run 1 operation, including reproducing the issue in lab for the first time, finding out the cause and testing new firmware for the readout electronics to solve the issue.
- 2) New Small Wheel (NSW) small-strip Thin Gap Chambers (sTGC) simulation studies for the ATLAS Phase-I Upgrade.

### Publications and Conference Notes

- 1) CMS Collaboration, “Measurement of Higgs boson decay to a pair of muons in proton-proton collisions at  $\sqrt{s} = 13$  TeV”, **CMS-PAS-HIG-19-006**, paper in preparation.
- 2) CMS Collaboration, “A MIP Timing Detector for the CMS Phase-2 Upgrade”, **CERN-LHCC-2019-003, CMS-TDR-020**
- 3) CMS Collaboration, “Combination of searches for Higgs boson pair production in proton-proton collisions at  $\sqrt{s} = 13$  TeV”, **Phys. Rev. Lett. 122 (2019) 121803**
- 4) CMS Collaboration, “Calibration of the CMS hadron calorimeters using proton-proton collision data at  $\sqrt{s} = 13$  TeV”, **JINST 15 (2019) P05002**
- 5) ATLAS Collaboration, “Measurement of the Higgs boson coupling properties in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel at  $\sqrt{s} = 13$  TeV with the ATLAS detector”, **JHEP 03 (2018) 095 (contact**

### editor for the supporting documentation)

- 6) ATLAS Collaboration, “Measurement of inclusive and differential cross sections in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel in pp collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector”, **EPJC 10 (2017) 132**
- 7) ATLAS Collaboration, “Searches for heavy diboson resonances in pp collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector”, **JHEP 09 (2016) 173**
- 8) ATLAS Collaboration, “Combined measurements of the Higgs boson production and decay rates in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  and  $H \rightarrow \gamma\gamma$  channels using  $\sqrt{s} = 13$  TeV pp collision data collected with the ATLAS experiment”, **ATLAS-CONF-2017-047**, EPS 2017 (contact person for  $H \rightarrow ZZ^* \rightarrow 4\ell$  analysis)
- 9) ATLAS Collaboration, “Measurements of four-lepton production in pp collisions at  $\sqrt{s} = 8$  TeV with the ATLAS detector”, **Phys. Lett. B 753 (2016) 552-572**
- 10) ATLAS Collaboration, “Study of the spin and parity of the Higgs boson in di-boson decays with the ATLAS detector”, **EPJC 75 (2015) 476** (contact editor for the supporting documentation)
- 11) ATLAS Collaboration, “Combined measurements of the Higgs boson production and decay rates in  $H \rightarrow ZZ^* \rightarrow 4\ell$  and  $H \rightarrow \gamma\gamma$  final states using pp collision data at  $\sqrt{s} = 13$  TeV in the ATLAS experiment”, **ATLAS-CONF-2016-081**, ICHEP 2016 (contact person for  $H \rightarrow ZZ^* \rightarrow 4\ell$  analysis)
- 12) ATLAS Collaboration, “Study of the Higgs boson properties and search for high-mass scalar resonances in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel at  $\sqrt{s} = 13$  TeV with the ATLAS detector”, **ATLAS-CONF-2016-079**, ICHEP 2016 (contact editor for the supporting documentation)
- 13) ATLAS Collaboration, “Measurements of the Higgs boson production cross section at 7, 8 and 13 TeV centre-of-mass energies and search for new physics at 13 TeV in the  $H \rightarrow ZZ^* \rightarrow \ell^+\ell^-\ell'^+\ell'^-$  final state with the ATLAS detector”, **ATLAS-CONF-2015-059**, CERN End of Year Event 2015 (contact editor for the supporting documentation)
- 14) ATLAS Collaboration, “Search for diboson resonances in the  $\nu\nu qq$  final state in pp collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector”, **ATLAS-CONF-2015-068**, CERN End of Year Event 2015
- 15) ATLAS Collaboration, “Measurement of the  $4\ell$  cross section at the Z resonance and determination of the branching fraction of  $Z \rightarrow 4\ell$  in pp collisions at  $\sqrt{s} = 7$  TeV and 8 TeV with the ATLAS detector”, **Phys. Rev. Lett. 112 (2014) 231806**

### Conference, Workshop, School and Seminar talks

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#### Conference

- 1) “Precision Timing with the CMS MTD Barrel Timing Layer for HL-LHC”, **40th International Conference on High Energy Physics, ICHEP 2020**, July 2020.
- 2) “Data Analysis with GPU-Accelerated Kernels”, **40th International Conference on High Energy Physics, ICHEP 2020**, July 2020 (co-author).

- 3) “New possibilities in Higgs measurements from detector upgrades and modern software tools”, **8th Annual Large Hadron Collider Physics Conference, LHCP 2020**, May 2020.
- 4) “Status of the CMS MIP Timing Detector”, **CMS week**, Bangkok, Thailand, December 2019.
- 5) “The CMS MIP Timing Detector Level 1 Trigger”, **CMS week**, CERN, February 2019.
- 6) “The CMS Hadron Calorimeter calibration overview”, **CMS week**, CERN, December 2018.
- 7) “Review of the muon MIP depth-inter calibration for the CMS Hadron Calorimeter”, **CMS week**, CERN, June 2018.
- 8) “Searches for di-Higgs production from ATLAS and CMS”, **6th Annual Large Hadron Collider Physics Conference, LHCP 2018**, Bologna, Italy, June 2018.
- 9) “Summary of the the CMS Hadron Calorimeter calibration on 2017 data”, **CMS week**, CERN, April 2018.
- 10) “Combination of couplings of the Higgs boson by the ATLAS experiment with Run 1 data”, **4th International Conference on New Frontiers in Physics, ICNFP 2015**, Crete, Greece, August 2015
- 11) “Study of the spin and parity of the Higgs boson in di-boson decays with the ATLAS detector”, **2015 Meeting of the APS Division of Particles and Field, DPF 2015**, Ann Arbor, USA, August 2015
- 12) “Study of the spin and parity of the Higgs boson in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel with the ATLAS detector”, **2014 American Physical Society April meeting, APS 2014**, Savannah, USA, April 2014
- 13) “Observation of single resonance  $Z \rightarrow 4\ell$  in  $pp$  collisions with the ATLAS detector”, **2013 American Physical Society April meeting, APS 2013**, Denver, USA, April 2013

### Seminar

- 1) “Evidence for Higgs boson decay to a pair of muons from the CMS experiment”, **High Energy Physics Seminar**, University of Science and Technology of China, China, Fall 2020.
- 2) “Evidence for Higgs boson decay to a pair of muons from the CMS experiment”, **Seminar at LBNL Physics Division Research Progress Meetings**, Lawrence Berkeley National Laboratory, USA, October 2020.
- 3) “Recent  $H \rightarrow \mu\mu$  results from the ATLAS and CMS experiments (CMS result)”, **High Energy Physics Seminar**, Center for High-Energy Physics, Peking University, China, August 2020.
- 4) “New possibilities in Higgs measurements from detector upgrades at the HL-LHC”, **High Energy Physics Seminar**, California Institute of Technology, USA, July 2020.
- 5) “Picosecond Timing: extending the physics potential of the High Luminosity LHC with the CMS MIP timing detector”, **HEP - Astro Seminars in the Department of Physics**, University of Michigan, Ann Arbor, USA, April 2019.
- 6) “Higgs Boson Property Measurements with ATLAS at the LHC”, **HEP - Astro Seminars in the Department of Physics**, University of Michigan, Ann Arbor, USA, April 2017.

- 7) “Higgs Boson Property Measurements with ATLAS at the LHC”, **Seminar at LBNL Physics Division Research Progress Meetings**, Lawrence Berkeley National Laboratory, Berkeley, USA, December 2016.

### Workshop and School

- 1) “Barrel Timing Layer module prototyping at Caltech Precision Timing Lab”, **Barrel Timing Layer Tray and Module Workshop**, CERN, January 2020.
- 2) “Search for SM Higgs boson decaying to a pair of muons with Run 2 data”, **CMS Data Analysis School (CMSDAS)**, Peking University, Beijing, China, December 2019.
- 3) “Measurements with BTL module prototype and TOFPET2 ASIC”, **Timing Days 2017**, CERN, October 2017
- 4) “Developments in the calibration of the SiPM readout of HCAL wedge HEP17 with muons using 2017 pp collision data”, **SiPM mini-workshop**, CERN, November 2017
- 5) “HCAL Muon calibration”, **HCAL DPG Mini-workshop**, CERN, December 2017
- 6) “Combining the ZZ decay channels in searching for a heavy scalar at 13 TeV”, **ATLAS Higgs-ZZ Workshop 2016**, Munich, Germany, April 2016
- 7) “ATLAS HZZ analysis ideas and questions for SM coupling measurements”, **ATLAS Higgs-ZZ Workshop 2016**, Munich, Germany, April 2016
- 8) “Prospect study: Rediscovery of Higgs with the first few  $\text{fb}^{-1}$   $pp$  collision data in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  channel”, **ATLAS Physics Workshop: ready for Run II: young speakers session**, Aix-Les-Bains, France, November 2014
- 9) “Cross section measurement of single resonance  $Z \rightarrow 4\ell$  in  $pp$  collisions at 8 TeV with the ATLAS detector”, **2013 U.S. ATLAS Physics Workshop**, Argonne National Laboratory, USA, July 2013

### CMS Detector Performance Summaries and Detector Notes

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- 1) Nan Lu *et al.* “Radiation Damage Effect in the Sensors of the Barrel Timing Layer Detector for the CMS Phase II Upgrade”, **DN-2019/043**.
- 2) Si Xie *et al.* “Barrel MIP Timing Detector testbeam setup in 2018 and 2019”, **DN-2019/042**.
- 3) Nan Lu *et al.* “Thermal performance of the Barrel Timing Layer for the CMS Phase-II Upgrade”, **DN-2019/039**.
- 4) Nan Lu *et al.* “BTL sensor performance in testbeam campaigns at FNAL and Lab source measurements”, **DN-2018/032**.
- 5) CMS Collaboration, “Results related to the Phase-I HE upgrade”, **CMS-DP-2018-019**.
- 6) Nan Lu *et al.* “Calibration of the SiPM readout of HCAL Endcap detectors with muons using 2018 pp collision data”, **DN-2018/028**.
- 7) Nan Lu *et al.* “Calibration of the SiPM readout of HCAL wedge HEP17 with muons using 2017 pp collision data”, **DN-2017/044**.



## Student Supervision

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- 1) Irene Dutta, Caltech PhD student: search for  $H \rightarrow \mu\mu$  using Run 2 data (August 2018 - present), HCAL calibration using muon signal (August 2018 - January 2019), BTL module testing with TOFPET 2 readout ASIC at CPT lab (February 2020 - present).
- 2) Jiajing Mao, Caltech PhD student: HCAL calibration using muon signal (Spring - Fall 2018), BTL module testing with TOFPET 2 readout ASIC at CPT lab (January 2020 - present).
- 3) Christina Wang, Caltech PhD student, February 2020 - present: BTL module testing with TOFPET 2 readout ASIC at CPT lab (February 2020 - present).
- 4) Olmo Cerri, Caltech PhD student: BTL thermal study at CPT lab (November 2019 - May 2020)
- 5) Matthew Valdez, Pasadena City College undergraduate student: physics object reconstruction using timing information from the MTD at HL-LHC (July 2020 - present)
- 6) Madeline Gardner, Caltech undergraduate student: BTL thermal study at CPT lab (June 2019 - June 2020)
- 7) Thong Nguyen, Caltech PhD student: search for  $HH \rightarrow b\bar{b}\gamma\gamma$  channel with Run 2 data (July 2018 - February 2019)

## Teaching Experience

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Graduate Student Instructor at University of Michigan-Ann Arbor

- 1) Fall 2011 and Winter 2012, Physics 141 Mechanics Introductory Lab, 2 sections.
- 2) Fall 2012, Physics 141 Mechanics Introductory Lab, 4 sections.
- 3) Winter 2013, Physics 136 Mechanics Introductory Lab for Life Science, 4 sections.

## Outreach

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- 1) Member of the Caltech Postdoctoral Association Outreach Division, February 2020 - present.
- 2) Invited speaker on CMS experiment at FUTURE of Physics Event in the years of 2018 and 2019 at California Institute of Technology, Pasadena, USA.
- 3) Poster presentation at recruitment weekends for prospective graduate students in the Physics Department at University of Michigan-Ann Arbor, Ann Arbor, USA.
  - \* “Study of the spin and parity of the Higgs boson in the  $H \rightarrow ZZ^* \rightarrow 4\ell$  decay channel with the ATLAS detector”, March 2014
  - \* “Higgs boson physics”, March 2013
- 4) Member of University of Michigan Society of Women in Physics.
  - \* Coordinator for Speaker and Faculty Lunches, 2013 - 2014
  - \* Volunteer at girl scouts physics day, November 2013
  - \* Present the demonstration Rayleigh Scattering to students at Slauson Middle school, February 2012