










# Prasanth Shyamsundar, Ph.D.

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## Employment History

- Sep 2020 – . . .  **Postdoctoral research associate**, Fermilab Quantum Institute
- Sep 2020  **Other Personnel Services employee**, University of Florida, Department of Physics
- Aug 2014 – Aug 2020  **Graduate research and teaching assistant**, University of Florida, Department of Physics






## Education

- Aug 2014 – Aug 2020  **Ph.D. Physics**, University of Florida
- Aug 2012 – Jul 2014  **M.Sc. Physics**, Chennai Mathematical Institute
- Aug 2009 – Jul 2012  **B.Sc. (Honours) Physics**, Chennai Mathematical Institute

## Awards

- Summer 2020  **Institute of Fundamental Theory Fellowship**,  
Institute of Fundamental Theory, Physics Department, University of Florida
- Spring 2020  **CLAS Dissertation Fellowship**,  
College of Liberal Arts and Sciences, University of Florida  
Funded by the Charles Vincent and Heidi Cole McLaughlin Endowment
- May 2019  **PITT PACC Travel Award for Pheno 2019**,  
University of Pittsburgh Particle Physics Astrophysics and Cosmology Center
- Summer 2019  **CLAS Graduate Student Travel Award**,  
College of Liberal Arts and Sciences, University of Florida
- Apr – May 2019  **UF GSC Travel Award**, University of Florida Graduate Student Council
- 2018  **Wayne Bomstad II Memorial Award for Teaching Assistant (Discussions)**,  
Physics Department, University of Florida
- 2014–2017  **Grinter Fellowship**, University of Florida
- 2009–2012  **INSPIRE Scholarship**, Department of Science & Technology, Government of India

## Research Experience

- Sep 2020 – . . .  **Post-doctoral research**, Fermilab Quantum Institute  
Advisors: Dr. Gabriel Perdue, Dr. Stephen Mrenna  
Areas of Work: Quantum information science, machine learning, high energy physics
- May 2015 – Aug 2020  **Doctoral research**, University of Florida  
Advisor: Prof. Konstantin T. Matchev  
Areas of Work: High energy phenomenology, machine learning, and quantum computing
- Jul – Aug 2019  **LPC Guests & Visitors program**, LHC Physics Center, Fermilab
- Jul 2013 – Apr 2014  **Master's thesis**, Chennai Mathematical Institute  
Advisor: Prof. Alok Laddha  
Area of Work: Aspects of Quantum Field Theory in de-Sitter space
- May – Jul 2012  **Internship**, École Polytechnique  
Advisor: Prof. Vincent Boudry  
Area of Work: Semi-Digital Hadronic Calorimetry

## Research Experience (continued)

Aug 2011 – Apr 2012

- 📖 **Bachelor's thesis**, Indian Institute of Technology Madras  
For award of B.Sc. (Honours) in Physics from Chennai Mathematical Institute  
Advisor: Prof. L. Sriramkumar  
Area of Work: Early and late time acceleration of the universe

## Research Publications

- 1 D. Kim, K. Kong, K. T. Matchev, M. Park, and **P. Shyamsundar**, “Deep-Learned Event Variables for Collider Phenomenology”, [arXiv:2105.10126](https://arxiv.org/abs/2105.10126) [hep-ph].
- 2 **P. Shyamsundar**, “Non-Boolean Quantum Amplitude Amplification and Quantum Mean Estimation”, [arXiv:2102.04975](https://arxiv.org/abs/2102.04975) [quant-ph].
- 3 K. T. Matchev and **P. Shyamsundar**, “InClass Nets: Independent Classifier Networks for Nonparametric Estimation of Conditional Independence Mixture Models and Unsupervised Classification”, [arXiv:2009.00131](https://arxiv.org/abs/2009.00131) [stat.ML].
- 4 K. T. Matchev and **P. Shyamsundar**, “OASIS: Optimal Analysis-Specific Importance Sampling for event generation”, *SciPost Phys.* **10**, 034 (2021), doi:10.21468/SciPostPhys.10.2.034, [arXiv:2006.16972](https://arxiv.org/abs/2006.16972) [hep-ph].
- 5 K. T. Matchev, A. Roman, and **P. Shyamsundar**, “Finding wombling boundaries in LHC data with Voronoi and Delaunay tessellations”, *JHEP* **12**, 137 (2020), doi:10.1007/JHEP12(2020)137, [arXiv:2006.06582](https://arxiv.org/abs/2006.06582) [hep-ph].
- 6 K. T. Matchev, **P. Shyamsundar**, and J. Smolinsky, “A quantum algorithm for model independent searches for new physics”, [arXiv:2003.02181](https://arxiv.org/abs/2003.02181) [hep-ph].
- 7 K. T. Matchev, A. Roman, and **P. Shyamsundar**, “Uncertainties associated with GAN-generated datasets in high energy physics”, [arXiv:2002.06307](https://arxiv.org/abs/2002.06307) [hep-ph].
- 8 K. T. Matchev and **P. Shyamsundar**, “ThickBrick: optimal event selection and categorization in high energy physics. Part I. Signal discovery”, *JHEP* **03**, 291 (2021), doi:10.1007/JHEP03(2021)291, [arXiv:1911.12299](https://arxiv.org/abs/1911.12299) [physics.data-an].
- 9 K. T. Matchev and **P. Shyamsundar**, “Singularity Variables for Missing Energy Event Kinematics”, *JHEP* **04**, 027 (2020), doi:10.1007/JHEP04(2020)027, [arXiv:1911.01913](https://arxiv.org/abs/1911.01913) [hep-ph].
- 10 D. Kim, K. T. Matchev, and **P. Shyamsundar**, “Kinematic Focus Point Method for Particle Mass Measurements in Missing Energy Events”, *JHEP* **10**, 154 (2019), doi:10.1007/JHEP10(2019)154, [arXiv:1906.02821](https://arxiv.org/abs/1906.02821) [hep-ph].
- 11 A. Betancur, D. Debnath, J. S. Gainer, K. T. Matchev, and **P. Shyamsundar**, “Measuring the mass, width, and couplings of semi-invisible resonances with the Matrix Element Method”, *Phys. Rev. D* **99**, 116007 (2019), doi:10.1103/PhysRevD.99.116007, [arXiv:1708.07641](https://arxiv.org/abs/1708.07641) [hep-ph].

## Workshops Conducted

6 – 27 Jun, 2019





- 📖 **Probability and Statistics in Data Analysis**,  
URL: [drive.google.com/drive/folders/11K9KRxDQ47kL5IqPg\\_Nlqn4Gr890qKen](https://drive.google.com/drive/folders/11K9KRxDQ47kL5IqPg_Nlqn4Gr890qKen)  
Description: A seven session workshop intended primarily for physics and astronomy graduate students at UF. The stated purpose was “to build some intuition for data analysis in science and industry from the standpoint of probability and statistics.”

5 – 28 Feb, 2020

- 📖 **Programming (with Python 3)**,  
URL: [drive.google.com/drive/folders/1j22VwyOG5S9qw-b5af0c4Trgen1EEhN2](https://drive.google.com/drive/folders/1j22VwyOG5S9qw-b5af0c4Trgen1EEhN2)  
Description: An introductory workshop on programming, covering Python 3 language basics as well as some fundamental algorithmic paradigms illustrated using standard example algorithms.

## Summer/Winter Schools

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- 16 – 26 Jul, 2019  **CTEQ School**, University of Pittsburgh  
Topic: QCD and Electroweak Phenomenology
- Jun, 2018  **Theoretical Advanced Study Institute in Elementary Particle Physics (TASI)**, University of Colorado Boulder  
Topic: Theory in an Era of Data
- Dec, 2010  **Indira Gandhi Centre for Atomic Research**, Kalpakkam  
For award of B.Sc. (Honours) in Physics from Chennai Mathematical Institute  
Topic: Non-destructive evaluation of 3D objects using Compton scattering tomography  
Advisor: Dr. Shivaramu
- Jul, 2010  **Indian Institute of Science Education and Research**, Mohali  
For award of B.Sc. (Honours) in Physics from Chennai Mathematical Institute  
Topic: Various Experiments in Physics  
Advisor: Prof. Arvind

## Talks and Seminars

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### Long talks and seminars ( $\geq 30$ minutes)

#### **Some new developments in Machine Learning for High Energy Physics**

Plenary talk at Anomalies 2021 (remote), Indian Institute of Technology Hyderabad 11 Nov, 2021

#### **High Energy Physics and Quantum Information Science**

High Energy Physics Seminar (remote), U of Oklahoma and Oklahoma State U 5 Nov, 2020

#### **InClass nets for unsupervised classification, OASIS to meet HEP simulation requirements**

Particle Theory Seminar (remote), Cornell University 22 Oct, 2020

#### **OASIS: “Better” simulated events to allow for fewer simulated events**

Remote seminar, University of Kansas 31 Jul, 2020

LPC Physics Forum (remote), Fermilab 30 Jul, 2020

#### **ThickBrick: Optimal event selection and categorization in high energy physics (tutorial)**

PyHEP virtual workshop 2020 17 Jul, 2020

#### **A quantum algorithm for model independent searches for new physics**

Remote seminar, California Institute of Technology 17 Jun, 2020

#### **Quantum computing and machine learning in high energy data analysis**

Fermilab Quantum Institute job talk (remote) 16 Mar, 2020

Pheno & Vino Seminar, Princeton University 10 Mar, 2020

#### **Realigning the goals of machine learning with the goals of physics**

Fermilab Scientific Computing Division job talk 24 Jan, 2020

#### **Next generation kinematic variables for signal discovery and measurement**

High Energy Physics Seminar, University of Florida 25 Oct, 2019

High Energy Theory Seminar, Brookhaven National Lab 16 Oct, 2019

Special High Energy Physics Seminar, University of Maryland 10 Oct, 2019

LPC Physics Forum, Fermilab 1 Aug, 2019

#### **Artificial neural networks in event selection: New optimal cost functions**

High Energy Physics Seminar, University of Florida 19 Feb, 2019

#### **A methodological study on discovering new physics in colliders**

High Energy Physics Seminar, University of Florida 26 Oct, 2018

### Short talks ( $< 30$ minutes)

#### **Quantum Computing for Color Reconnection**

IEEE Quantum Week (QCE21): Workshop on Quantum Computing for HEP (remote) 21 Oct, 2021

## Talks and Seminars (continued)

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### Non-Boolean Quantum Amplitude Amplification and ML applications

IEEE Quantum Week (QCE21): Workshop on Quantum Artificial Intelligence (remote) 20 Oct, 2021

### ThickBrick: optimal event selection and categorization in high energy physics

IML Machine Learning Working Group Meeting (remote) 13 Jul, 2021

### Deep-Learned Event Variables for Collider Phenomenology

2021 Meeting of the Division of Particles and Fields of the American Physical Society 12 Jul, 2021

### Uncertainties associated with GAN-generated datasets in high energy physics

ML4Jets Workshop 2021 (remote) 8 Jul, 2021

### Artificial Event Variables for Collider Analyses

The 2021 Phenomenology Symposium (remote) 24 May, 2021

### Synthesizing Event Variables with Machine Learning

Workshop on Mass variables for SUSY searches, CMS SUSY Working Group (remote) 11 May, 2021

### Non-Boolean Quantum Amplitude Amplification and Quantum Mean Estimation

Sixth International Conference for Young Quantum Information Scientists (YQIS 6) 13 Apr, 2021

### A Guide to the Good Histogram: Choices and Consequences

LPC Physics Analysis Discussion (remote), Fermilab 26 Oct, 2020

### OASIS: Optimal Analysis-Specific Importance Sampling for event generation

New Perspectives 2020 (remote), Fermilab 20 Jul, 2020

### A quantum algorithm for model independent searches for new physics

The 2020 Phenomenology Symposium (remote) 4 May, 2020

### Realigning the goals of machine learning with the goals of physics

APS Virtual April Meeting 2020 21 Apr, 2020

ML4Jets Workshop 2020, New York University 17 Jan, 2020

### Next generation kinematic variables for signal discovery and measurement

Particle Physics on the Plains, University of Kansas 12 Oct, 2019

### A kinematic focus point method for mass measurements in ttbar events

Top Quark Physics at the Precision Frontier Workshop, Fermilab 15 May, 2019

### Machine Learning in event selection: Improving the supervisory signal and output usage

The 2019 Phenomenology Symposium, University of Pittsburgh 7 May, 2019

### Measuring the mass, width, and couplings of semi-invisible resonances with the matrix element method

The 2018 Phenomenology Symposium, University of Pittsburgh 7 May, 2018

### Particle Mass Measurements from Extreme Event Reconstruction and Focus Points

The 2017 Phenomenology Symposium, University of Pittsburgh 9 May, 2017

## Miscellaneous

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Public software

📖 RainDancesVI — An unsupervised classification tool  
[prasanthcakewalk.gitlab.io/raindancesvi](https://prasanthcakewalk.gitlab.io/raindancesvi)

ThickBrick — An HEP event selection and categorization tool  
[prasanthcakewalk.gitlab.io/thickbrick](https://prasanthcakewalk.gitlab.io/thickbrick)

Programming languages

📖 Strong: Python    Intermediate: C, C++

Scripting languages

📖  $\LaTeX$ , Bash

Natural languages

📖 English, Tamil (Strong reading, writing, and speaking)

Community service

📖 Volunteered as a middle school science fair judge  
(school level 2016, 2017; regional level 2017)

Volunteer with the penpal program “Letters to a Pre-Scientist” (2019 onwards)