

# Arash Yunesi

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## CONTACT INFORMATION

CMSE Room 1515  
Engineering Building  
Michigan State University  
East Lansing, MI 48823

Cell: (850) 980-5693  
E-mail: [yunesiar@msu.edu](mailto:yunesiar@msu.edu)  
[www.linkedin.com/in/arash-yunesi](http://www.linkedin.com/in/arash-yunesi)  
[Google Scholar Profile](#)

## RESEARCH INTERESTS

Statistics, Single-Cell RNA Sequencing, Machine Learning, Soft-Collinear Effective Theory (SCET), Effective Field Theories, Dark Matter, Baryogenesis, Physics Beyond Standard Model, High Energy Physics, Theoretical Physics

## EDUCATION

**Michigan State University**, East Lansing, Michigan

- PhD Candidate in Statistics and Probability
- PhD Candidate in Computational Math, Science, and Engineering
  - Advisor: Professor Yuying Xie
  - Cumulative GPA: 3.94/4

**Florida State University**, Tallahassee, Florida

- PhD in Physics, Summer 2019
  - Advisor: Professor Takemichi Okui
  - Cumulative GPA: 4.00/4
- MSc in Physics, Summer 2015
  - GPA: 4.00/4

**Sharif University of Technology**, Tehran, Iran

- BSc in Theoretical Physics, 2013
- Minor in Mathematics, 2013

## PUBLICATIONS

- S. Chinn, M. Heft Neal, A. Manousidaki, **A. Yunesi**, “**Analysis of Pathways in Stem Cells in Head and Neck Tumors**” (To be published.)
- **A. Yunesi**, L. Huang, Y. Xie, “**Novel Techniques for Selection of Differentially Expressed Marker Genes and Data Integration in scRNA-seq Data**” (To be published.)
- S. Chakraborty, T. Okui, and **A. Yunesi**, “**Topics in soft collinear effective theory for gravity: The diffeomorphism invariant Wilson lines and reparametrization invariance**”, [Phys.Rev.D 101 \(2020\) no. 6, 066019](#)
- T. Okui and **A. Yunesi**, “**Soft Collinear Effective Theory for Gravity**,” [Phys. Rev. D 97, no. 6, 066011 \(2018\)](#)
- Y. Cui, T. Okui, and **A. Yunesi**, “**LHC Signatures of WIMP-triggered Baryogenesis**,” [Phys.Rev. D 94, no. 11, 115022 \(2016\)](#)

## PHD RESEARCH PROJECTS

- Expression Variation Analysis of Head and Neck Tumors**
  - Analysis of gene expression of cancer stem cells
  - Comparison of different pathways for cancer stem cells
- Cloud Computing Fellowship**
  - Seminar-based lectures on Cloud Computing using Microsoft Azure

- Developing scRNA-seq data integration on the cloud
- Utilizing scalability of cloud architecture to learn models on big scRNA-seq data sets
- Protect patient data and comply with HIPAA regulations

#### scRNA-seq

- Developed novel gene selection method.
- Developing new computationally stable data integration to remove batch effect
- Implementation of new integration method in Python and Matlab
- Machine learning on scRNA-seq data using Python

#### Two-Neutron Separation Energy in Atomic Landscape

- Developing statistical model
- Prediction of two-neutron separation energy in atomic nuclei
- Building model based on Gaussian Processes

#### Control of COVID-19 Transmission Dynamics

- Built a model for controlling the spread of COVID-19 in the US
- Predicted necessary steps based on this model to stop spread of the virus in the US

#### Reparametrization Invariance for Soft Collinear Effective Gravity

- Formulated Reparametrization Invariance for perturbative gravity
- Calculated scattering amplitudes containing gravitons
- Carried out symbolic calculations using FORM software

#### Soft Collinear Effective Gravity

- Developed theoretical model for effective interactions of gravitons and matter
- Performed detailed calculations to match full theory to Effective Theory
- Calculated symbolic scattering amplitudes using Mathematica and FORM

#### Baryogenesis from a Weakly Interacting Massive Particle

- Developed theoretical model for generating baryon asymmetry from decays of WIMPs
- Calculated benchmarks for the model using Mathematica
- Produced UFO files from FeynRules
- Studied phenomenology of the model at LHC using MadGraph5

#### CONFERENCE & SEMINAR TALKS

“**Soft-Collinear Effective Gravity**”, Theoretical Advanced Study Institute (TASI), University of Colorado Boulder, Summer 2018, Student Talk

“**Soft-Collinear Effective Gravity**”, Phenomenology Symposium 2018, University of Pittsburgh, Spring 2018, Parallel Talk

“**SCET for Gravity**”, High Energy Physics Seminar, FSU Physics Department, 2018

“**WIMP-triggered Baryogenesis: SUSY Embedding and LHC Phenomenology**”, High Energy Physics Seminar, FSU Physics Department, 2017

“**Baryogenesis and a 750-GeV Diphoton Resonance at LHC**”, Dirac Lectures, FSU Physics Department, 2016

#### HONORS & AWARDS

**Cloud Computing Fellowship**, Michigan State University, 2022

**Evelyn and John Baugh Research Presentation Scholarship**, FSU Physics Department, 2018

**The Hagopian Family Endowment Fund** (for outstanding research in High Energy Physics),

FSU Physics Department, 2018

**The Dirac Fellowship**, FSU Physics Department, 2017

**Evelyn and John Baugh Research Presentation Scholarship**, FSU Physics Department, 2017

**Congress of Graduate Students Presentation Grant**, FSU, 2014 & 2017

**Dean's Graduate Scholarship**, FSU, 2013

Ranked 52th among 100,000 participants in nation-wide universities entrance exam, Iran, 2008

Semifinalist in National Mathematics Olympiad, Iran, Spring 2007

SCHOOLS ATTENDED

- Theoretical Advanced Study Institute (TASI), University of Colorado Boulder, Summer 2018
- Prospects in Theoretical Physics (PiTP), Institute for Advanced Study, Princeton NJ, Summer 2017
- Dirac Lectures, Florida State University, Spring 2016
- SLAC Summer Institute (SSI), Stanford Linear Accelerator, Summer 2014

COMPUTER SKILLS

- Statistics Software: R
- Programming Languages: Python, C/C++
- Mathematics Software: Matlab, Mathematica
- High Performance Computing Skills
- Physics Packages: FeynRules, MadGraph\_aMC, FORM, Monte Carlo event generators
- Applications:  $\LaTeX$ , common Windows/Linux software
- Operating Systems: Linux, Windows, MacOS

TEACHING EXPERIENCE

Introductory Statistics (TA), MSU, 2019 - 2022  
Electrodynamics I & II (Grader), FSU, Fall 2018 & Spring 2019  
College Physics Recitation (TA), FSU, Spring 2017  
Quantum Field Theory II (Grader), FSU, Spring 2016  
Statistical Physics (Grader), FSU, Spring 2015  
Theoretical Dynamics (Grader), FSU, Fall 2014  
College Physics I & II (Lab Instructor), FSU, Fall 2013, Spring & Summer 2014  
Physics of Stars (Undergrad TA), Sharif University of Technology, Fall 2011  
Special Relativity (Undergrad TA), Sharif University of Technology, Spring 2012  
Mathematical Physics (Undergrad TA), Sharif University of Technology, Fall 2012  
General Physics I & II (Undergrad Tutor), Summer 2010 & Fall 2012

STATISTICS AND COMPUTATIONAL MATHEMATICS COURSES

- Statistical Linear Models using R
- Generalized Linear Models using R
- Generalized Linear Mixed Models using R
- Multivariate Statistical Analysis using R
- Sampling Methods using R
- Numerical Linear Algebra using Matlab and Python
- Parallel Computing using MSU High Performance Computing
- Stochastic Processes and Applications
- Statistical Learning and Data Mining

UNDERGRADUATE CORE COURSES IN MATHEMATICS

- General Mathematics I
- General Mathematics II
- Differential Equations
- Discrete Mathematics

- Theory of Probability and Applications
- Linear Algebra I
- Real Mathematical Analysis I
- Real Mathematical Analysis II
- Complex Functional Analysis I
- Abstract Modern Algebra I
- Stochastic Processes
- History of Mathematics
- Mathematical Physics I
- Mathematical Physics II
- Group Theory and Lie Algebras

COMMUNITY  
SERVICE

- FSU Physics Department Open House, presented physics experiments to the general public, February 2019
- Capital Regional Science and Engineering Fair Judge, February 2018
- Iranian Student Association at FSU, Outreach Officer, 2017-2018
- Tallahassee Science Festival, Tallahassee, Florida, January 2017

STANDARD TESTS

**TOEFL**, 114/120 (Reading 29, Listening 29, Speaking 30, Writing 26)  
**GRE**, 317/340 (Verbal 152, Quantitative 165, Writing 3.5)

LANGUAGE SKILLS

**English**, Professional proficiency, TOEFL 114/120  
**Kurdish**, mother tongue  
**Farsi/Persian**, native  
**Arabic**, intermediate reading and writing

REFERENCES

**Yuying Xie**

- Professor, MSU CMSE & Department of Statistics
- [xyy@msu.edu](mailto:xyy@msu.edu)

**Longxiu Huang**

- Assistant Professor, MSU CMSE & Department of Mathematics
- [huangl3@msu.edu](mailto:huangl3@msu.edu)

**Takemichi Okui**

- Professor, FSU Physics Department
- [okui@hep.fsu.edu](mailto:okui@hep.fsu.edu), (850) 644-3523