SAMIRA ASLANI

Cosmology, Data Analysis

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EDUCATION

M.Sc. in Cosmology and Gravitational Physics

Shahid Beheshti University, Tehran, Iran

Sept. 2021 – 2024

GPA: 15.37/20 (class average: 14.1)
Thesis title: **Persistent Homology of Cosmic Web**
Supervisor: Prof. M. Sadegh Movahed

B.Sc. in Physics

Shahid Beheshti University, Tehran, Iran

Sept. 2016 – June 2021

GPA: 14.05/20 (class average: 14.17)
Thesis title: **Philosophy Of Newtonian Mechanics To Special Relativity**
Supervisor: Prof. H. Shojaie

SKILLS

Computer and Programming:

- **Proficient in *Python* and its major Scientific, Data Analysis, & Visualization libraries**
  NumPy, SciPy, TensorFlow, Keras, OpenCV, pandas, NetworkX, scikit-learn, Astropy, Matplotlib, Seaborn, Healpy, Nbodykit, GUTHI, Ripser , Django , pylians ,Pytorch
- **Intermediate Linux user and competent in Bash Scripting.**
- **N-body Simulation Codes' User: Gadget4 and CONCEPT Simualtions**
- **Casually using:**
  - **LaTeX(Professional)**
  - **Mathematica & XAct (Professional)**
  - **SQL (Intermediate)**
  - **R (Intermediate)**
  - **C++ (Intermediate)**
  - **Git (Intermediate)**
  - **C# (Intermediate)**
  - **HTML/CSS/JS (Intermediate)**
  - **Matlab (Elementary)**
  - **Fortran (Elementary)**

Languages:

- Persian (native)
- English (Duolingo English Test: 115)
- German (elementary)
- Turkish (Intermediate)
- Arabic (Intermediate)

RESEARCH AND ACADEMIC PROJECTS

Persistence Homology of Cosmic Web (2022-Ongoing)

Prof. M. Sadegh Movahed

My research explores the cosmic web's evolution using persistent homology. Analyzing Betti curves, persistence diagrams, and persistence entropy of dark matter density from N-body simulations, I gained insights into the hierarchical development of clusters, filaments, and voids. Key findings include: clusters and voids are strongly influenced by redshift changes, while filaments are less sensitive; persistence entropy analysis reveals filament formation is more redshift-dependent than clusters and voids; and voids better constrain the σ_8 parameter, while clusters are more useful for the matter density ω_m. This topological data analysis demonstrates the potential to refine theoretical models using persistence entropy and other persistent homology metrics.

Masking Foreground of CMB using Convolutional Auto-encoder (2021)

Dr. M. Farhang

My project began with an unmasked dataset of CMB (Cosmic Microwave Background), and then I applied a special machine learning method (CNN auto-encoder by Keras library) and using the Healpy package, CCG package to come up with a homogeneous format of CMB.

Simulating Time Evolution Of Wave Function of a Potential Well and double-well potential (2020)

Dr. S. S. Gousheh

The temporal evolution of a wave function trapped in an infinite square well. This project utilized Python libraries, including Matplotlib and Numpy. The ultimate product was an animation of the evolving wave function over time.

Physics Project Course: Philosophy Of Newtonian Mechanics To Special Relativity (2019)

Prof. H. Shojaie

For my B.Sc. Thesis Project, I conducted study on the structure of space-time, the concept of inertia, and their connection with Relativism philosophy from before and after Newton to Einstein's theory of relativity.

Video Ad Detection and Optimization using Computer Vision and Machine Learning (2024)

WatchOut Company

I leveraged computer vision and machine learning techniques to process over 20,000 video advertisements,

EXPERIENCES

Teaching:

- Tutor **Statistical Analysis of Cosmic Fields workshop** (2021)
- Teaching Assistant **Quantum Mechanics**, Dr. N. Riazi (2022)
- Teaching Assistant **Fundamentals of Numerical Simulation**, Dr. A. Hosseiny (2022)
- **Python Intructor** at Picha Club (Software, Game & Data Science) (2022-2024)
- **Astronomy, Astrobiology and Cosmology Teacher and Project Manager** at National Organization for Development of Exceptional Talents Highschool (2023)

Work:

- **Python Developer & Data Scientist** at WatchOut! (2024), Developing AI and Statistical Models on Videos | *Pytorch* | *OpenCv* | *Image & Video Processing* | *SQLAlchemy*
- **BackEnd Developer Intern** at Qorpi web development team (2023) | *Django* | *Computer Algorithms*
- **Data Scientist at BlueBee** Developing **Recommendation Systems** with e-commerce data, Azadi Innovation Factory, Tehran, Iran (2022)
- **Research Assistant** at Physics Data & Astronomical Technology (PDAT) laboratory, Research and Computations on **21cm Cosmology, Lyα and Epoch of Reionization** (Sep. 2022 - Present)
- **Technical Assistant** at Department of Physics, SBU (2021)

Talks and Presentations:

- **Defence Session: Persistence Homology of Cosmic Web** SBU (2024)
- **CONCEPT Simulation** at Computational Cosmology Group Meeting, SBU (2023)
- **Persistence Homology of Cosmic Web at z=0** at Computational Cosmology Group Meeting, SBU
- **Cosmology Class Presentation** →Subject: Gevolution (A Cosmological N-body Code Based On General Relativity) Dr. N. Khosravi (2020)
- **Superconductivity Class Presentation** →Subject: SQUID (Superconducting Quantum Interference Device) Dr. M. Houshiar (2020)

RESEARCH INTERESTS

- Cosmology of the Large Scale Structure, Galaxy Clustering & N-Body Simulations
- SMBHs, 21cm Cosmology, Epoch of Reionization & Evolution of Lyα
- Using Big Data, Topological Data Analysis & Machine Learning in Cosmology
- Statistical Physics, Stochastic processes & Complex Systems

PUBLICATIONS

Conference Proceedings

- **Samira Aslani** et al. (2024). "Reconstruction and Dynamical Evolution of the Central Supermassive Black Hole Mass using kramers-moyal expansion". In: *int'l.*

extracting key visual features and optimizing the detection of these ads in live TV broadcasts. The project involved integrating various technologies, including OpenCV, FFmpeg, PostgreSQL, and PyTorch, demonstrating my versatility in data science and algorithm optimization.

Mini Projects:

- Calculating Hubble Constant using **Linear** And **quadratic** Regression With **Mathematica** (2021)
- **Deep CNN Based Method** for Clinical Applicable Skin disease diagnosis using Dermoscopy and Pathology data (Ongoing)
- Calculating and Finding Probability for the distance to the last scattering surface for Cosmic Neutrino using Python and Mathematica (2021)

HONORS & AWARDS

- **Ranked in top 2% of National Physics Graduate Schools Entrance Examination (2021)**
  ranked 82 among 4000 participants
- **Ranked in top 1% of Nationwide University Entrance Examination (2016)**
  ranked 3700 among 200000 participants of Mathematics and Physics
- **Finalist of the 26th Physics National Olympiad for University Students**
  Ranked 30th among Students from all over the Country

SELECTED COURSES

Astronomy and Astrophysics:20/20	Dr. N. Khosravi (2019)
Advanced Statistical Mechanics19.25/20	Prof. R. Jafari (2022)
Cosmology: 16.5/20	Dr. N. Khosravi (2020)
Biophysics: 18/20	Dr. Z. Bagheri (2020)
Superconductivity: 17/20	Dr. M. Houshiar (2020)
Electrodynamics: 17.5/20	Dr. M. Dashtdar (2021)
Advanced Quantum Mechanics: 16.2/20	Dr. S. S. Gousheh (2021)
Advanced Astrophysics: 17.5/20	Dr. S. Nasiri (2022)

AUDITED AND ONLINE COURSES

- **Machine learning at Stanford University**
  Online Course At Coursera by Andrew Ng (2020)
- **Advanced Python Programming**
  Maktabkhooneh by Jadi Mirmirani (2018)
- **Statistics, Probability and Data Analysis**
  at SBU Physics by Dr. Farhang (2022)
- **Complex Systems**
  at SBU Physics by Prof. G.R Jafari(2022)
- **Quantum Information & Computation**
  At SBU Physics by Dr. Shahbazian (2021)

ATTENDED WORKSHOPS & CONFERENCES

- 13th International Conference on Mathematical Modeling in Physical Sciences
- **Cosmolgy From Theory to Observation**
  Gadget4, CosmoMc and CAMB Simulation & XAct at School of Astronomy, IPM (2023)
- **Physics of the Cosmic Microwave Background 2022**
  Online at International Max Planck Research School (IMPRS) by Eiichiro Komatsu (2022)
- **Summer School on Cosmology 2022**
  Online at The Abdus Salam International Centre for Theoretical Physics, ICTP (2022), Italy
- **Spring School of Python and Machine learning**
  at SBU (2021)
- **workshop for the collaboration of Iranian universities with the CMS experiment at CERN**
  at IUT (2021)
- **Career Development Workshop for Women in Physics**
  Online at The Abdus Salam International Centre for Theoretical Physics, ICTP (2021)
- **Quantum Machine Learning Workshop**
  Phanous Research and Innovation Center (2021)
- **Workshop on Topological Methods in Data Analysis**
  Online at Heidelberg University (2021)
- **Fundamental Problems In Basic Science**
  At The Institute for Research in Fundamental Sciences (IPM), (2019)
- **Interdisciplinary Physics School**
  At Sharif University of Technology, (2019)
- **Astronomical Photography Workshop**
  at Twanight (B. A. Tafreshi) (2017)
- **Contribution At Physics Weekly Seminars**
  at SBU(2016-present)

HOBBIES

Photography (2016-Ongoing):

- **Genres:** Night Sky, Street, Studio, Portrait, Theater, Children
- **Jobs:** IRANFUN Holding 's Photographer, Divar Darya Theater Photographer
- **Honor:** Award Winner Of International Festival Of Students Puppet Theater, 2020

Amateur Astronomy:

- **Content Creation:** Translation(Nojum Magazine, Tamana Student Circle), Social Media (Under Iran Sky)
- **Observational Astronomy:** Leader of SBU Physics Sky & Telescope Observation Tours (2017, 2019)=
- **Exhibitions and Presentations(2014 – 2018):** Having presentations on international astronomy day (mostly about Pseudoscience and the Life Cycle of Stars)

Running | Mindfullness-Meditation | Photography | Yoga | Reading Novels | Playing Setar | Listening to Music

OUTREACH & VOLUNTEER ACTIVITIES

- **Deputy Secretary of Scientific Association of Physics Students (2017)**
  Organizing events like seminars, workshops, students activities, promotional programs, etc.
  Under the supervision of Dr. Nima Khosravi
- **Documentary Photographer of Scientific Association of Physics Students, SBU (2016-2020)**
- **Co-organizer of SBU physics Department Open Day (2016- 2020)**
  Physics Outreach for High school students
- **Leader of SBU Physics Sky & Telescope Observation Tours (2016-2018)**

REFEREES

Dr. Javad Taghizadeh Firuzjaee
@ K. N. Toosi University of Technology, Tehran, Iran
firouzjaee@kntu.ac.ir
- Professor of Physics, KNTU
- Resident researcher, School of Physics, IPM
- Head of Physics Data & Astronomical Technology (PDAT) laboratory

Prof. H. R. Sepangi
@ Shahid Beheshti University, Tehran, Iran
hr-sepangi@sbu.ac.ir
- Professor of Fundamental Physics, SBU

Prof. G. R. Jafari
@ Shahid Beheshti University, Tehran, Iran
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- Professor of Fundamental Physics, SBU
- Head of Center for Complex Networks Social Data Science