

# CHEN SUN

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## POSTDOC EXPERIENCE

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<b>Tel Aviv University</b> <i>Postdoctoral Researcher</i>	2019 - Present <i>Tel Aviv, Israel</i>
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## VISITING EXPERIENCE

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<b>Brown University</b> <i>Long-term visitor (KITPC Travel Award)</i>	2018 - 2019 <i>Providence, USA</i>
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<b>Boston University</b> <i>Short-term visitor (three months)</i>	2018 <i>Boston, USA</i>
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<b>Dartmouth College</b> <i>Long-term visitor (KITPC Travel Award)</i>	2017 - 2018 <i>Hanover, USA</i>
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## EDUCATION

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<b>Virginia Tech</b> <i>Ph.D. in Particle Physics, Advisor: Tatsu Takeuchi</i>	2013 - 2017 <i>Blacksburg, USA</i>
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## RESEARCH INTERESTS

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### **Astrophysical constraints of axion and dark matter**

- cosmic distance measurement *v.s.* axion-photon coupling
- galaxy velocity dispersion *v.s.* ultralight dark matter
- supernova remnant echo *v.s.* axion dark matter stimulated decay

### **Effective field theory**

- dark matter direct detection *v.s.* EFT of stellar cooling
- muon g-2 *v.s.* axion EFT and completion

### **Gravitational wave from BSM sources**

- neutron star binary mergers *v.s.* long range force
- gravitational wave of boson stars *v.s.* shape of ALPs potential

### **Neutrino phenomenology**

- solar neutrino *v.s.* monopole, large non-standard interaction
- DUNE *v.s.* supernova neutrino

### **BSM Theory**

- Pati-Salam extension from noncommutative geometry

## AWARDS

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| · Israel Academy of Sciences and Humanities (IASH)<br>Foreign Postdoctoral Fellowship from Israel Academy of Science | 2019-2021 |
| · Travel Award from the Chinese Academy of Science (KITPC)   | 2017-2019 |
| · Clayton Williams Graduate Fellowship   | 2015-2016 |
| · Sigma Xi Outstanding Ph.D. Research Award  | 2015      |

## INVITED TALKS

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| <b>Hebrew University</b><br>· Constraints on Axions from Cosmic Distance Measurements   | 2021/05 |
| <b>Notre Dame</b><br>· Constraints on Axions from Cosmic Distance Measurements  | 2021/02 |
| <b>U. Oklahoma</b><br>· Gravitational Wave Signatures of Beyond Standard Model Physics  | 2019/05 |
| <b>Neutrino-Electron Scattering at Low Energies Workshop</b><br><i>UMass, Amherst</i><br>· Constraints on Non-Standard Neutrino Interactions from Borexino Phase-II | 2019/04 |
| <b>Signals of Dark Matter in its Natural Habitat Workshop</b><br><i>TRIUMF</i><br>· Boson Star from Repulsive Scalars, at LIGO and LISA                             | 2019/02 |
| <b>Carleton</b><br>· Particle Phenomenology in the Era of Gravitational Wave Astronomy  | 2018/10 |
| <b>Perimeter Institute</b><br>· Particle Phenomenology in the Era of Gravitational Wave Astronomy   | 2018/10 |
| <b>Joint Tufts/MIT Cosmology Seminars</b><br><i>MIT</i><br>· Boson Star from Repulsive Light Scalars and Gravitational Waves  | 2018/10 |
| <b>Queen's University</b><br>· Particle Phenomenology in the Era of Gravitational Wave Astronomy  | 2018/10 |
| <b>McGill</b><br>· Particle Phenomenology in the Era of Gravitational Wave Astronomy  | 2018/10 |
| <b>Stanford</b><br>· Boson Star from Repulsive Light Scalars and Gravitational Waves  | 2018/11 |
| <b>UC Irvine</b><br>· Boson Star from Repulsive Light Scalars and Gravitational Waves   | 2018/11 |
| <b>U. Utah</b><br>· Boson Star from Repulsive Light Scalars and Gravitational Waves   | 2018/11 |
| <b>North-East Cosmology Workshop 2018, McGill University</b><br><i>McGill</i><br>· New Astrophysical Probes of Beyond SM Physics                                    | 2018/03 |
| <b>Brown University</b><br>· Gravitational Wave Cosmology & Particle Physics  | 2017/12 |
| <b>New England Theoretical Cosmology and Gravity Workshop</b><br><i>MIT</i><br>· The Limits of Dark Matter from Electroweak Symmetry Breaking                       | 2017/10 |
| <b>Duke Regional String Meeting</b><br><i>Duke University</i><br>· Rethinking Gauge Theory through Connes' Noncommutative Geometry                                  | 2015/10 |
| <b>SPOCK meeting</b><br><i>University of Cincinnati</i><br>· Rethinking Gauge Theory through Connes' Noncommutative Geometry  | 2015/08 |

## PROGRAMMING

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Languages	Python, C, regex, bash, MATLAB, C++, Mathematica
ODE Solving	Shooting and relaxation for Singular Boundary Value problems
Boltzmann Solver	CLASS
MCMC	emcee, MontePython
Parallel Computation	mpi4py, multiprocessing, ipyparallel, TensorFlow-GPU
Machine Learning	TensorFlow, Keras
CMB Analysis	healpy

## DATA ANALYSIS

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Data Acquisition	Scrapy web scraping, Regex parsing
Data Simulation	CMB pixel level local non-Gaussian map simulation
Data Sets	BOSS DR12 (real/ $k$ space), Pantheon SNIa, SPARC, Bonamente galaxy clusters, Green's Catalog of SN Remnants, Planck 2018 likelihood

## CODING PROJECTS

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### CMB Machine Learning (on-going) 2021

- simulate CMB maps (gaussian and non-gaussian) at the pixel level
- process with noise maps from Planck FFP10
- apply neural network for anomaly hunting that gives well-defined statistics

### ULDM Galaxy Dispersion 2021

- load and parse SPARC data set
- construct  $\chi^2$  estimator and perform Frequentist analysis using `emcee` as a smart grid

### SuperNova Remnant Ghost Buster 2021

- regex parse Green 2019 catalog, scrapy crawler of SN data, process of Haslam 408 MHz map
- construct supernova remnant light curve, compute Gegendeschein signal from stimulated decay

### Cosmo Axions 2020

- construct axion-photon conversion model inside IGM and ICM
- load and process Pantheon, Bonamente galaxy clusters, BOSS DR12
- perform Bayesian and Frequentist analysis with `emcee` sampler

### ULDM Solver 2019

- relaxation solver of Bose-Einstein condensate system with two axions
- shooting solver of Bose-Einstein condensate system with one axion, stiffness detection and switch

## OUTREACH AND COMMUNITY

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### Cosmicdicord.net 2019-present

A blog that features background of my research, fun facts of astroparticle physic, as well as tutorials of simple coding projects.

### Women in Science Project (WISP) 2018

Introduction of physics research to female starting undergraduates. Co-mentoring short term interns from selected groups.

### Dartmouth-TRIUMF HEP Tools Bootcamp 2017

One of the three organizers. Invited authors of computational programs in both high energy physics and cosmology to give online lectures series through the Vidyo platform. The workshop had nearly 200 participants from six continents and received very positive feedback.

## REFERENCES

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