

CHEN SUN

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POSTDOC EXPERIENCE

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

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

EDUCATION

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

Astrophysical constraints of axion and dark matter

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

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.* axion potential

Neutrino phenomenology

- solar neutrino *v.s.* monopole
- solar neutrino *v.s.* 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)
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 |

Authorship is in alphabetical order following HEP standard. Up-to-date list can be found [here](#)

Novel astrophysical probes of axion

19. N. Bar, K. Blum, and C. Sun, “Galactic rotation curves vs. ultralight dark matter II,” [arXiv:2111.03070](#) [hep-ph]
18. M. A. Buen-Abad, J. Fan, and CS, “Axion Echos from the Supernova Graveyard,” [arXiv:2110.13916](#) [hep-ph]
17. J.-F. Fortin, H.-K. Guo, S. P. Harris, D. Kim, K. Sinha, and CS, “Axions: From magnetars and neutron star mergers to beam dumps and BECs,” *Int. J. Mod. Phys. D* **30** no. 07, (2021) 2130002, [arXiv:2102.12503](#) [hep-ph]
16. M. A. Buen-Abad, J. Fan, and CS, “Constraints on Axions from Cosmic Distance Measurements,” [arXiv:2011.05993](#) [hep-ph]
15. H.-K. Guo, K. Sinha, CS, J. Swaim, and D. Vagie, “Two-Scalar Bose-Einstein Condensates: From Stars to Galaxies,” *JCAP* **10** (2021) 028, [arXiv:2010.15977](#) [astro-ph.CO]

Gravitational wave probe of light dark sector

14. H.-K. Guo, K. Sinha, and CS, “Probing Boson Stars with Extreme Mass Ratio Inspirals,” *JCAP* **09** (2019) 032, [arXiv:1904.07871](#) [hep-ph]
13. D. Croon, J. Fan, and CS, “Boson Star from Repulsive Light Scalars and Gravitational Waves,” *JCAP* **04** (2019) 008, [arXiv:1810.01420](#) [hep-ph]
12. D. Croon, M. Gleiser, S. Mohapatra, and CS, “Gravitational Radiation Background from Boson Star Binaries,” *Phys. Lett. B* **783** (2018) 158–162, [arXiv:1802.08259](#) [hep-ph]
11. D. Croon, A. E. Nelson, CS, D. G. E. Walker, and Z.-Z. Xianyu, “Hidden-Sector Spectroscopy with Gravitational Waves from Binary Neutron Stars,” *Astrophys. J. Lett.* **858** no. 1, (2018) L2, [arXiv:1711.02096](#) [hep-ph]

Neutrino probe of BSM

10. S. K. Agarwalla *et al.*, “Constraints on flavor-diagonal non-standard neutrino interactions from Borexino Phase-II,” *JHEP* **02** (2020) 038, [arXiv:1905.03512](#) [hep-ph]
9. N. Houston, T. Li, and CS, “A new solar neutrino channel for grand-unification monopole searches,” *JCAP* **10** (2018) 034, [arXiv:1803.02835](#) [hep-ph]
8. A. Ankowski *et al.*, “Supernova Physics at DUNE,” in *Supernova Physics at DUNE*. 8, 2016. [arXiv:1608.07853](#) [hep-ex]

Particle physics and model building

7. M. A. Buen-Abad, J. Fan, M. Reece, and CS, “Challenges for an axion explanation of the muon $g - 2$ measurement,” *JHEP* **09** (2021) 101, [arXiv:2104.03267](#) [hep-ph]
6. U. Aydemir, D. Minic, CS, and T. Takeuchi, “ B -decay anomalies and scalar leptoquarks in unified Pati-Salam models from noncommutative geometry,” *JHEP* **09** (2018) 117, [arXiv:1804.05844](#) [hep-ph]
5. U. Aydemir, D. Minic, CS, and T. Takeuchi, “Pati-Salam unification from noncommutative geometry and the TeV-scale W_R boson,” *Int. J. Mod. Phys. A* **31** no. 01, (2016) 1550223, [arXiv:1509.01606](#) [hep-ph]
4. L. N. Chang, D. Minic, A. Roman, CS, and T. Takeuchi, “On the Physics of the Minimal Length: The Question of Gauge Invariance,” *Int. J. Mod. Phys. A* **31** (2016) 1630012, [arXiv:1602.07752](#) [hep-th]

3. U. Aydemir, D. Minic, **CS**, and T. Takeuchi, “The 750 GeV diphoton excess in unified $SU(2)_L \times SU(2)_R \times SU(4)$ models from noncommutative geometry,” *Mod. Phys. Lett. A* **31** no. 18, (2016) 1650101, [arXiv:1603.01756 \[hep-ph\]](#)
2. L. N. Chang, D. Minic, **CS**, and T. Takeuchi, “Observable Effects of Quantum Gravity,” [arXiv:1605.04361 \[gr-qc\]](#)
1. U. Aydemir, D. Minic, **CS**, and T. Takeuchi, “Higgs mass, superconnections, and the TeV-scale left-right symmetric model,” *Phys. Rev. D* **91** (2015) 045020, [arXiv:1409.7574 \[hep-ph\]](#)

INVITED TALKS

UC Irvine	2021/12
· Axion Archaeology – Echos from Ancient Supernova Remnants	
Fermilab Theory Seminar	2021/11
· Axion Archaeology – Echos from Ancient Supernova Remnants	
University of Amsterdam	2021/11
· Axion Archaeology – Echos from Ancient Supernova Remnants	
University of Chicago KCTP	2021/11
· Axion Archaeology – Echos from Ancient Supernova Remnants	
University of Maryland	2021/11
· Novel Astrophysical Probes of Axion Dark Matter	
UC Santa Cruz	2021/11
· Axion Echoes from Supernova Remnants	
Hebrew University	2021/05
· Constraints on Axions from Cosmic Distance Measurements	
Notre Dame	2021/02
· Constraints on Axions from Cosmic Distance Measurements	
U. Oklahoma	2019/05
· Gravitational Wave Signatures of Beyond Standard Model Physics	
Neutrino-Electron Scattering at Low Energies Workshop	2019/04
<i>UMass, Amherst</i>	
· Constraints on Non-Standard Neutrino Interactions from Borexino Phase-II	
Signals of Dark Matter in its Natural Habitat Workshop	2019/02
<i>TRIUMF</i>	
· Boson Star from Repulsive Scalars, at LIGO and LISA	
Carleton	2018/10
· Particle Phenomenology in the Era of Gravitational Wave Astronomy	
Perimeter Institute	2018/10
· Particle Phenomenology in the Era of Gravitational Wave Astronomy	
Joint Tufts/MIT Cosmology Seminars	2018/10
<i>MIT</i>	
· Boson Star from Repulsive Light Scalars and Gravitational Waves	
Queen’s University	2018/10
· Particle Phenomenology in the Era of Gravitational Wave Astronomy	
McGill	2018/10
· Particle Phenomenology in the Era of Gravitational Wave Astronomy	

Stanford	2018/11
· Boson Star from Repulsive Light Scalars and Gravitational Waves	
UC Irvine	2018/11
· Boson Star from Repulsive Light Scalars and Gravitational Waves	
U. Utah	2018/11
· Boson Star from Repulsive Light Scalars and Gravitational Waves	
North-East Cosmology Workshop 2018, McGill University <i>McGill</i>	2018/03
· New Astrophysical Probes of Beyond SM Physics	
Brown University	2017/12
· Gravitational Wave Cosmology & Particle Physics	
New England Theoretical Cosmology and Gravity Workshop <i>MIT</i>	2017/10
· The Limits of Dark Matter from Electroweak Symmetry Breaking	
Duke Regional String Meeting <i>Duke University</i>	2015/10
· Rethinking Gauge Theory through Connes' Noncommutative Geometry	
SPOCK meeting <i>University of Cincinnati</i>	2015/08
· Rethinking Gauge Theory through Connes' Noncommutative Geometry	



PROGRAMMING

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

DATA ANALYSIS

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, Borexino Phase II

CODING PROJECTS

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	
Ultralight Dark Matter from Galaxy Dispersion 	2021
· load and parse SPARC data set	
· construct χ^2 estimator and perform Frequentist analysis using emcee as a smart grid	
Axion Echo from Supernova Remnant 	2021
· regex parse SNR catalog (Green 2019), scrapy crawler of SN data, process of Haslam 408 MHz map	

- construct supernova remnant light curve, compute echo signal from stimulated decay

Constraining Axions from Cosmic Distance Measurement

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

Self-gravitating Bose-Einstein Condensate 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

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

Kfir Blum	Department of Particle Physics and Astrophysics, Weizmann Institute of Science Phone: +972-8-934-3181 Email: kfir.blum@weizmann.ac.il
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