CHEN SUN

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POSTDOC EXPERIENCE

Tel Aviv University 2019 - Present
Postdoctoral Researcher *Tel Aviv, Israel*

VISITING EXPERIENCE

Brown University 2018 - 2019
Long-term visitor (KITPC Travel Award) *Providence, USA*

Boston University 2018
Short-term visitor (three months) *Boston, USA*

Dartmouth College 2017 - 2018
Long-term visitor (KITPC Travel Award) *Hanover, USA*

EDUCATION

Virginia Tech 2013 - 2017
Ph.D. in Particle Physics, Advisor: Tatsu Takeuchi *Blacksburg, USA*

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

BSM Theory

· Pati-Salam extension from noncommutative geometry

AWARDS

· 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

PUBLICATIONS

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 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
UMass, Amherst
· Constraints on Non-Standard Neutrino Interactions from Borexino Phase-II

Signals of Dark Matter in its Natural Habitat Workshop 2019/02
TRIUMF
· 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
MIT
· 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 2018/03
McGill
· New Astrophysical Probes of Beyond SM Physics

Brown University 2017/12
· Gravitational Wave Cosmology & Particle Physics

New England Theoretical Cosmology and Gravity Workshop 2017/10
MIT
· The Limits of Dark Matter from Electroweak Symmetry Breaking

Duke Regional String Meeting 2015/10
Duke University
· Rethinking Gauge Theory through Connes' Noncommutative Geometry

SPOCK meeting 2015/08
University of Cincinnati
· 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`
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

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

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Tomer Volansky	School of Physics and Astronomy, Tel-Aviv University, Tel-Aviv 69978 Phone: +972-3-6407026 Email: tomerv@post.tau.ac.il