Nashwan Sabti

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Summary

Postdoctoral researcher with a PhD in physics, passionate about advancing computational and theoretical frameworks for addressing challenging problems. Highly skilled in programming, engineering simulations, and analyzing data. Expert in Python, experienced with JAX, PyTorch, and machine learning, and with an 8+ years track record in high-performance computing.
Key metrics: Authored 16 articles with nearly 600 citations, developed 3 codes, supervised 3 PhD students and 2 MSc students, and presented research findings at 28 occasions.

Employment

Horizon Postdoctoral Research Fellow   *Johns Hopkins University, USA*
RESEARCH FIELD: COSMOLOGY AND ASTROPHYSICS – ADVISOR: PROF. MARC KAMIONKOWSKI   *2022 - present*
Deeply immersed in the development of frameworks in cosmology and astrophysics, spanning three main directions:
1) building a multi-probe high-performance Bayesian analysis pipeline tailored to investigate properties of the Universe with galaxy data sets, **2)** leveraging state-of-the-art coding and deep-learning techniques to write GPU-accelerated gravity simulations and optimize signal extraction in noisy astrophysical data, and **3)** studying the potential of atomic quantum systems in fundamental physics searches.

Education

PhD in Physics   *King's College London, UK*
RESEARCH FIELD: COSMOLOGY AND PARTICLE PHYSICS – ADVISOR: DR. DIEGO BLAS   *2018 - 2022*
Research in fundamental physics, with an emphasis on utilizing cosmological, astrophysical, and laboratory probes to constrain particle physics and cosmological models. Thesis can be found here.

Master of Science in Theoretical Physics   *Leiden University, Netherlands*
THESIS: "HEAVY NEUTRAL LEPTONS DURING THE BIG BANG NUCLEOSYNTHESIS EPOCH"   *2016 - 2018*
GPA: 9.0/10 (Cum Laude)

Double Bachelor of Science in Physics and Astronomy   *Leiden University, Netherlands*
THESIS: "CONSTRAINING COSMOLOGICAL PARAMETERS USING THE CLASS CODE"   *2013 - 2016*
GPA: 9.0/10 (Cum Laude) in both degrees

Programming

Languages:

- `Python`: Extensive decade-long expertise in writing analysis pipelines and packages, utilizing key libraries such as `NumPy`, `SciPy`, `Numba`, `emcee`, `Matplotlib`, `PyTorch`, and `JAX`.
- `Mathematica`: 5+ years proficiency in writing scientific software and crosslinking with `Python`.
- `C++`: Experience in writing `C++` code and wrapping within `Python` to accelerate simulations.

Software:

- Developer: `pyBBN` (package in `Python`, `C++`, and `Fortran` to model the early Universe), `GALLUMI` (Bayesian analysis pipeline in `Python` to model galaxies), `Cheetah` (GPU-accelerated gravity simulation in `JAX`)
- User: `CLASS`, `CAMB`, `MontePython`, `PRIMAT`, `Resonance-DM`, `Sterile-DM`, `CalcHEP`

Machine learning: Experience in designing, training, and evaluating tailored neural network architectures for supervised and unsupervised learning on astrophysical data. Architectures include multilayer perceptrons, convolutional neural networks, normalizing flows, autoencoders, diffusion models, and transformers.

HPC: 8+ years expertise in high-performance computing using both CPU and GPU platforms, including experience with tier-1 supercomputers. Proficient in `SLURM` workload manager and other HPC-specific software tools.

Professional Experience

Referee for Science Journals
The Astrophysical Journal, Physical Review.

Supervision and Teaching
Supervising PhD and MSc students in their research and teaching undergraduate courses.

Seminars and Colloquiums
Organizer of the joint physics and astronomy seminar series at JHU and committee member for STScI colloquiums.

Extracurricular
Project lead for imaging analysis of the Cosmic Horseshoe lensing system using the Isaac Newton Telescope in La Palma.

Outreach
Mentoring of A-level students in the UK as part of the Realising Opportunities program.

Awards and Certificates

Hendrik Casimir Prize
Awarded by the Casimir Research School for best performance during the Master's program in physics.

Young Talent Encouragement Award
Awarded by the Royal Holland Society of Sciences and Humanities for best performance during the first year of the Bachelor's program in physics.

Languages

Fluent: English, Dutch
Intermediate: Arabic
Basic: Russian

References

- **Prof. Marc Kamionkowski** – Bloomberg Center for Physics and Astronomy, Johns Hopkins University, Baltimore, Maryland, USA, *kamion@jhu.edu*

- **Prof. Julian B. Muñoz** – Department of Astronomy, The University of Texas at Austin, Austin, Texas, USA, *julianbmunoz@utexas.edu*

Publications

Published

1. S. C. Hotinli, <u>N. Sabti</u>, J. North, and M. Kamionkowski, *Unveiling Neutrino Halos with CMB Lensing*, Phys. Rev. D 108, 103504 [2306.15715].

2. J. B. Muñoz, J. Mirocha, S. Furlanetto, and <u>N. Sabti</u>, *Breaking degeneracies in the first galaxies with clustering*, MN-RAS L. Vol. 526 Iss. 1 pp L47-L55 [2306.09403].

3. <u>N. Sabti</u>, J. B. Muñoz and D. Blas, *New Roads to the Small-Scale Universe: Measurements of the Clustering of Matter with the High-Redshift UV Galaxy Luminosity Function*, ApJL 928 L20 [2110.13161].

4. J. Alvey, M. Escudero and <u>N. Sabti</u>, *What can CMB observations tell us about the neutrino distribution function?*, JCAP 02 (2022) 037 [2111.12726].

5. J. Alvey, M. Escudero, <u>N. Sabti</u> and T. Schwetz, *Cosmic Neutrino Background Detection In Large-Neutrino-Mass Cosmologies*, Phys. Rev. D 105, 063501 [2111.14870].

6. <u>N. Sabti</u>, J. B. Muñoz and D. Blas, *GALLUMI: A Galaxy Luminosity Function Pipeline for Cosmology and Astrophysics*, Phys. Rev. D 105, 043518 [2110.13168].

7. <u>N. Sabti</u>, J. Alvey, M. Escudero, M. Fairbairn and D. Blas, *Implications of LUNA for BBN and CMB constraints on MeV-scale Thermal Dark Sectors*, JCAP 08 (2021) A01 [2107.11232].

8. A. Boyarsky, M. Ovchynnikov, <u>N. Sabti</u> and V. Syvolap, *When FIMPs Decay into Neutrinos: The N_{eff} Story*, Phys. Rev. D 104, 035006 [2103.09831].

9. J. Alvey, <u>N. Sabti</u>, V. Tiki, D. Blas, K. Bondarenko, A. Boyarsky, M. Escudero, M. Fairbairn, M. Orkney and J. I. Read, *New Constraints on the Mass of Fermionic Dark Matter from Dwarf Spheroidal Galaxies*, MNRAS 501 (2021) 1, pp. 1188-1201 [2010.03572].

10. <u>N. Sabti</u>, J. B. Muñoz and D. Blas, *First Constraints on Small-Scale Non-Gaussianity from UV Galaxy Luminosity Functions*, JCAP 01 (2021) 010 [2009.01245].

11. <u>N. Sabti</u>, A. Magalich and A. Filimonova, *An Extended Analysis of Heavy Neutral Leptons during Big Bang Nucleosynthesis*, JCAP 11 (2020) 056 [2006.07387].

12. J. Alvey, <u>N. Sabti</u>, M. Escudero and M. Fairbairn, *Improved BBN Constraints on the Variation of the Gravitational Constant*, Eur. Phys. J.C80.2 (2020), p. 148 [1910.10730].

13. <u>N. Sabti</u>, J. Alvey, M. Escudero, M. Fairbairn and D. Blas, *Refined Bounds on MeV-scale Thermal Dark Sectors from BBN and the CMB*, JCAP 01 (2020) 004 [1910.01649].

Submitted to journal

14. <u>N. Sabti</u>, J. B. Muñoz, and M. Kamionkowski, *Insights from HST into Ultra-Massive Galaxies and Early-Universe Cosmology*, [2305.07049] (accepted for publication in Physical Review Letters).

White papers

15. *EuCAPT White Paper: Opportunities and Challenges for Theoretical Astroparticle Physics in the Next Decade*, [2110.10074]. Contributed to the section 'Astroparticle observables for dark matter'.

16. *Snowmass2021 Cosmic Frontier White Paper: Dark Matter Physics from Halo Measurements*, [2203.07354]. Contributed to the section 'Ultraviolet luminosity function probes of dark matter'.