Nashwan Sabti

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Work Experience

Horizon Postdoctoral Research Fellow in Physics *Johns Hopkins University, USA*

Research field: Cosmology and Particle physics – Advisor: Prof. Marc Kamionkowski *2022 - present*

In my current postdoctoral position, I am deeply immersed in the development of software and theoretical frameworks to explore fundamental physics. My work spans three main areas: Firstly, I specialize in building a high-performance Bayesian analysis pipeline tailored to investigate properties of the young Universe using high-redshift galaxy data sets. Secondly, I am studying the potential applications of atomic quantum systems in the context of fundamental physics searches. Lastly, I leverage state-of-the-art coding and deep-learning techniques to address pressing questions in physics, ranging from writing GPU-accelerated gravity simulations in `Python-JAX` to removing foreground noise in astrophysical observations in `Pytorch`.

Education

PhD in Theoretical Physics *King's College London, UK*

Research field: Cosmology and Particle physics – Advisor: Dr. Diego Blas *2018 - 2022*

During my PhD, I have covered a variety of directions: I have constrained particle physics and cosmological models with early Universe probes, measured the clustering and growth of matter with high-redshift galaxies, and probed new physics using systems in the local Universe and terrestrial experiments. I have authored 13 articles and presented my work at international conferences, workshops, journal clubs and seminar series. During my PhD, I have also developed two cosmological codes, organized a workshop and a journal club, worked as a teaching assistant, and supervised MSc students. 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

Organisational Experience

JHU Physics and Astronomy Seminar Series *Johns Hopkins University*

Organizer *Feb 2023 - present*

Organizer of the joint physics and astronomy seminar series at JHU.

Latest Advances in the Physics of BBN and Neutrino Decoupling *King's College London/TUM*

Co-organizer *April 2021*

Co-organized a 2-day online workshop on our current understanding of the physics of Big Bang Nucleosynthesis and neutrino decoupling. Speakers from both theoretical and experimental fields were invited to give a talk. See also this Indico link.

PhD Seminar Series *King's College London*

Co-organizer *Feb 2021 - May 2021*

Co-organized a local PhD seminar series, where PhD students could talk about their work and train their presentation skills.

Computing Skills

Expert: `Python`, `Mathematica`, LaTeX
Basic: `Pytorch`, `JAX`, `C++`
Scientific software: `CLASS`, `MontePython`, `PRIMAT`, `Resonance-DM`, `Sterile-DM`, `CalcHEP`
Developer: `pyBBN`, `GALLUMI`

Teaching and Service Experience

Referee for Journals
Referee
Astrophysical Journal, Physical Review

Supervision of PhD Students *Johns Hopkins University*
Supervisor *2022 - present*
Supervising PhD students on research projects involving 21-cm physics.

Supervision of MSc Students *King's College London*
Supervisor *Oct 2020 - Apr 2021*
Co-supervised two MSc students on a project entailing the impact of warm dark matter on structure formation.

Teaching Undergraduate Courses *King's College London*
Teaching assistant *2018 - 2020*
1st year labs, 3rd year particle physics.

Mentoring A-level Student *King's College London*
Supervisor *May 2019 - Sep 2019*
Mentored an A-level student in producing an academic piece of work as part of the Realising Opportunities programme.

Development and Supervision of Research Project for Secondary School Students *Leiden University*
Supervisor *Dec 2016*
Supervised pupils on a project that involved calculation of the mass of the black hole in the centre of the Milky Way using orbits of stars nearby Sgr A*.

Imaging and Analysis of Astrophysical Data *Leiden University*
Project lead *May 2015*
Project involved imaging and photometric analysis of the Cosmic Horseshoe gravitational lensing system using the Isaac Newton Telescope at the Roque de los Muchachos Observatory in La Palma with the goal of estimating the dark matter abundance within the lens.

Awards and Certificates

Hendrik Casimir Prize *Dec 2017*
Awarded by the Casimir Research School for best performance during the Master's program in physics.

Young Talent Encouragement Award *Nov 2014*
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*
- **Dr. Julian B. Muñoz** – Department of Astronomy, The University of Texas at Austin, Austin, Texas, USA, *julianbmunoz@utexas.edu*

- **Dr. Diego Blas** – Departament de Física, Universitat Autònoma de Barcelona, Institut de Fisica d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology, Bellaterra, Spain, *dblas@ifae.es*
- **Prof. Malcolm Fairbairn** – Department of Physics, King's College London, London, UK, *malcolm.fairbairn@kcl.ac.uk*

Publications

Published

1. J. B. Muñoz, J. Mirocha, S. Furlanetto, and N. Sabti, *Breaking degeneracies in the first galaxies with clustering*, MNRAS L. Vol. 526 Iss. 1 pp L47-L55 [2306.09403].
2. N. Sabti, 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].
3. J. Alvey, M. Escudero and N. Sabti, *What can CMB observations tell us about the neutrino distribution function?*, JCAP 02 (2022) 037 [2111.12726].
4. J. Alvey, M. Escudero, N. Sabti and T. Schwetz, *Cosmic Neutrino Background Detection In Large-Neutrino-Mass Cosmologies*, Phys. Rev. D 105, 063501 [2111.14870].
5. N. Sabti, J. B. Muñoz and D. Blas, *GALLUMI: A Galaxy Luminosity Function Pipeline for Cosmology and Astrophysics*, Phys. Rev. D 105, 043518 [2110.13168].
6. N. Sabti, 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].
7. A. Boyarsky, M. Ovchynnikov, N. Sabti and V. Syvolap, *When FIMPs Decay into Neutrinos: The $N_{\rm eff}$ Story*, Phys. Rev. D 104, 035006 [2103.09831].
8. J. Alvey, N. Sabti, 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].
9. N. Sabti, J. B. Muñoz and D. Blas, *First Constraints on Small-Scale Non-Gaussianity from UV Galaxy Luminosity Functions*, JCAP 01 (2021) 010 [2009.01245].
10. N. Sabti, A. Magalich and A. Filimonova, *An Extended Analysis of Heavy Neutral Leptons during Big Bang Nucleosynthesis*, JCAP 11 (2020) 056 [2006.07387].
11. J. Alvey, N. Sabti, 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].
12. N. Sabti, 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

13. N. Sabti, J. B. Muñoz, and M. Kamionkowski, *Insights from HST into Ultra-Massive Galaxies and Early-Universe Cosmology*, [2305.07049].
14. S. C. Hotinli, N. Sabti, J. North, and M. Kamionkowski, *Unveiling Neutrino Halos with CMB Lensing*, [2306.15715].

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'.

Presentations

Talks

1. GRAPPA University of Amsterdam, 04/21/2023
   – *The GALLUMI ecosystem: A unified framework for cosmology with high-redshift galaxies*
2. Cosmic DAWN Center Copenhagen, 04/17/2023
   – *Cosmology with the high-redshift UV galaxy luminosity function*
3. Johns Hopkins lunch seminar, 05/12/2022
   – *What will it take to detect the Cosmic Neutrino Background?*
4. Harvard Physics seminar, 04/11/2022
   – *The GALLUMI ecosystem: A unified framework for cosmology with high-redshift galaxies*
5. Harvard-Smithsonian Center for Astrophysics, 03/11/2022
   – *The GALLUMI ecosystem: A unified framework for cosmology with high-redshift galaxies*
6. Cosmological Probes of New Physics Univeristy of Maryland, 16/09/2022
   – *New Roads to the Small-Scale Universe: Measurements of the Clustering of Matter with the High-Redshift UV Galaxy Luminosity Function*
7. Circle University meeting, 08/06/2022
   – *What will it take to detect the Cosmic Neutrino Background?*
8. Seminar at IFAE and UAB, 17/05/2022
   – *What will it take to detect the Cosmic Neutrino Background?*
9. Cosmolunch at Princeton IAS, 07/03/2022
   – *New Roads to the Small-Scale Universe: Measurements of the Clustering of Matter with the High-Redshift UV Galaxy Luminosity Function*
10. Cosmo/Astro coffee at Princeton University/IAS, 07/03/2022
    – *Cosmology with UV Galaxy Luminosity Functions*
11. Sazerac - learning the high-redshift Universe, 02/02/2022
    – *GALLUMI: A Galaxy Luminosity Function Pipeline for Cosmology and Astrophysics*
12. Seminar at ICCUB, Barcelona, 18/11/2021
    – *New Roads to the Small-Scale Universe: Measurements of the Clustering of Matter with the High-Redshift UV Galaxy Luminosity Function*
13. Seminar at Universitá degli Studi di Padova, 11/11/2021
    – *New Roads to the Small-Scale Universe: Measurements of the Clustering of Matter with the High-Redshift UV Galaxy Luminosity Function*
14. Seminar at SNS, Pisa, 10/11/2021
    – *New Roads to the Small-Scale Universe: Measurements of the Clustering of Matter with the High-Redshift UV Galaxy Luminosity Function*
15. BSM Pandemic, 9/11/2021
    – *New Roads to the Small-Scale Universe: Measurements of the Clustering of Matter with the High-Redshift UV Galaxy Luminosity Function*
16. Seminar at IFPU in Trieste, 27/10/2021
    – *Astrophysical Probes of Dark Matter*
17. Seminar at Perimeter Institute, 19/10/2021
    – *Cosmological and Astrophysical Probes of Sterile Neutrinos*

18. 2021 Meeting of the Division of Particles and Fields of the American Physical Society (DPF21), Florida State University, 13/07/2021
    – *When FIMPs Decay into Neutrinos: The $N_{\rm eff}$ Story*
19. PPC 2021: XIV International Workshop on Interconnections between Particle Physics and Cosmology, University of Oklahoma, 15/05/2021
    – *Cosmology with UV Luminosity Functions*
20. First EuCAPT Annual Symposium, 06/05/2021
    – *Cosmology with UV Luminosity Functions*
21. MPA Cosmology Seminar, MPA Garching, 30/03/2021
    – *Probing Small-Scale Non-Gaussianity with UV Luminosity Functions*
22. High-z Galaxy Evolution Meeting, Harvard-CfA, 08/02/2021
    – *Cosmology with UV Luminosity Functions*
23. KCL PhD Seminar Series, 08/02/2021
    – *How do FIMPs that can decay into neutrinos affect $N_{\rm eff}$?*
24. London Cosmology Discussion Meeting, 21/01/2021
    – *What BBN can tell us about thermal dark sectors*
25. CTA Dark Matter Journal Club, 12/11/2020
    – *New Constraints on the Mass of Fermionic Dark Matter from Dwarf Spheroidal Galaxies*
26. UK Cosmology, University of Sheffield, 22/09/2020
    – *Probing Small-Scale Non-Gaussianity with UV Galaxy Luminosity Functions*

Posters

1. COSMO 2021, University of Illinois, 02-06/08/2021
   – *When FIMPs Decay into Neutrinos: The $N_{\rm eff}$ Story*
2. Weak Interactions and Neutrinos 2021, University of Minnesota. 07-12/06/2021
   – *When FIMPs Decay into Neutrinos: The $N_{\rm eff}$ Story*
3. RAS Early Career Poster Exhibition 2020, 14-28/09/2020
   – *First Constraints on Small-Scale Non-Gaussianity from UV Galaxy Luminosity Functions*