SUNAO SUGIYAMA

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CONTACT INFORMATION

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RESEARCH INTERESTS

Theoretical and Observational cosmology: *large-scale structure of the Universe, gravitational weak/micro lensing, primordial black hole*

COLLABORATIONS

Subaru HSC weak lensing working group, member (2021-present, **co-chair** since 2024Nov)
Dark Enrgy Survey (DES), member (2024-present)

POSITIONS

Current

Postdoctoral researcher, Sep. 2023 – present
University of Pennsylvania, Philadelphia, the United States
Mentor: Prof. Bhuvnesh Jain

Past

JSPS Overseas Research Fellow, Sep. 2023 – Aug. 2025
University of Pennsylvania, Philadelphia, the United States

Postdoctoral researcher, Apr. 2023 – Aug. 2023
Kavli IPMU, Chiba, Japan
Mentor: Prof. Masahiro Takada, funded partially by beyond AI

JSPS Research Fellowships for Young Scientists, Apr. 2021 – Mar. 2023
Kavli IPMU, Chiba, Japan

Educations

University of Tokyo, Tokyo, Japan, Apr. 2020 – Mar. 2023
Ph.D. course in Physics
Dissertation: *"Joint cosmology analyses using gravitational weak lensing data from Subaru Hyper Suprime-Cam"*
Supervisor: Prof. Masahiro Takada

University of Tokyo, Tokyo, Japan, Apr. 2018 – Mar. 2020
M.S. in Physics
Dissertation: *"Validation of cosmological analysis based on perturbation theory for wide-field galaxy survey"*
Supervisor: Prof. Masahiro Takada

University of Tokyo, Tokyo, Japan, Apr. 2014 – Mar. 2018
B.A. in Physics

GRANT & AWARDS

Grant-in-Aid for JSPS Research Fellows (DC2), Japan Society for the Promotion of Science, Apr. 2021 – Mar. 2023

The School of Science Encouragement Award (Doctoral program), University of Tokyo, the School of Science, Mar. 2023

WINGS IGPEES, course completion, Sep. 2018 – Mar. 2023

TEACHING

Collaborative coding: git and github, CD3 symposium 2023, Kavli IPMU

Coadvised students: Rafael C. H. Gomes (a PhD student at UPenn since 2023), Noriaki Nakasawa (a master student at the University of Nagoya, 2022)

PROFESSIONAL ACTIVITIES

Society	The Astronomical Society of Japan (ASJ), 2018 – present The Physical Society of Japan (JPS), 2022 – present
Seminar/Workshop/Conference	IPMU weekly lunch seminar (co-organizer), 2019 – 2021 HSC weaklensing mini workshop (organizer), Aug. 2022 Sesto 2025 - Tracing Cosmic Evolution with Galaxy Clusters V (SOC), 2025
Referee	International Journal of Modern Physics D The Astrophysical Journal American Astronomical Society Journals Journal of Cosmology and Astroparticle Physics
Computing	Developer of `fft-extended-source`, `fastnc`, `dark emulator` as a part of Dark Quest Project I can work with C, C++, Python, HSC pipeline (for image analysis)
Accepted Observation	**PI** of Definitive search for PBH dark matter in the multiverse cosmology with HSC co-I of Survey of M31 eclipsing binaries: Toward a 1% distance measurement

PUBLIC ENGAGEMENT AND OUTREACH

Apperence on *Cosmic Front, Primordial Black Hole: the master key of the Universe (title in Japanese)* produced by NHK, 2021

Interviewed by Quanta Magazine on *Clashing Cosmic Numbers Challenge Our Best Theory of the Universe*, 2024

Interviewed by Asahi Shimbun on *Breakdown in the standard model of the Universe? An analysis using precise dark matter "map" (title in Japanese)*, 2024

PUBLICATIONS

The up-to-date list of publication availabele at ADS.

4. R. C. H. Gomes, **Sugiyama, S.**, B. Jain, et al. Dark Energy Survey Year 3 Results: Cosmological constraints from second and third-order shear statistics. *arXiv e-prints*, arXiv:2508.14018, August 2025:arXiv:2508.14018

5. R. C. H. Gomes, **Sugiyama, S.**, B. Jain, et al. Cosmology with second and third-order shear statistics for the Dark Energy Survey: Methods and simulated analysis. *arXiv e-prints*, arXiv:2503.03964, March 2025:arXiv:2503.03964

6. **Sugiyama, Sunao**, R. C. H. Gomes, and M. Jarvis. Fast modeling of the shear three-point correlation function. *arXiv e-prints*, arXiv:2407.01798, July 2024:arXiv:2407.01798

7. X. Li, T. Zhang, **Sugiyama, Sunao**, et al. Hyper Suprime-Cam Year 3 results: Cosmology from cosmic shear two-point correlation functions. Phys. Rev. D, 108(12):123518, December 2023:123518

8. H. Miyatake, **Sugiyama, Sunao**, M. Takada, et al. Hyper Suprime-Cam Year 3 results: Cosmology from galaxy clustering and weak lensing with HSC and SDSS using the emulator based halo model. Phys. Rev. D, 108(12):123517, December 2023:123517

9. **Sugiyama, Sunao**, H. Miyatake, S. More, et al. Hyper Suprime-Cam Year 3 results: Cosmology from galaxy clustering and weak lensing with HSC and SDSS using the minimal bias model. Phys. Rev. D, 108(12):123521, December 2023:123521

10. R. Dalal, X. Li, A. Nicola, et al. Hyper Suprime-Cam Year 3 results: Cosmology from cosmic shear power spectra. Phys. Rev. D, 108(12):123519, December 2023:123519

11. S. More, **Sugiyama, Sunao**, H. Miyatake, et al. Hyper Suprime-Cam Year 3 results: Measurements of clustering of SDSS-BOSS galaxies, galaxy-galaxy lensing, and cosmic shear. Phys. Rev. D, 108(12):123520, December 2023:123520

12. **Sugiyama, Sunao**, M. Takada, and A. Kusenko. Possible evidence of axion stars in HSC and OGLE microlensing events. *Physics Letters B*, 840:137891, May 2023:137891

13. H. Miyatake, **Sugiyama, Sunao**, M. Takada, et al. Cosmological inference from an emulator based halo model. II. Joint analysis of galaxy-galaxy weak lensing and galaxy clustering from HSC-Y1 and SDSS. Phys. Rev. D, 106(8):083520, October 2022:083520

14. H. Miyatake, Y. Kobayashi, M. Takada, et al. Cosmological inference from an emulator based halo model. I. Validation tests with HSC and SDSS mock catalogs. Phys. Rev. D, 106(8):083519, October 2022:083519

15. **Sugiyama, Sunao**. Fast Fourier Transformation Based Evaluation of Microlensing Magnification with Extended Source. ApJ, 937(2):63, October 2022:63

16. **Sugiyama, Sunao**, M. Takada, H. Miyatake, et al. HSC Year 1 cosmology results with the minimal bias method: HSC ×BOSS galaxy-galaxy weak lensing and BOSS galaxy clustering. Phys. Rev. D, 105(12):123537, June 2022:123537

17. **Sugiyama, Sunao**, V. Takhistov, E. Vitagliano, et al. Testing stochastic gravitational wave signals from primordial black holes with optical telescopes. *Physics Letters B*, 814:136097, March 2021:136097

18. *A. Kusenko, M. Sasaki, **Sugiyama, Sunao**, et al. Exploring Primordial Black Holes from the Multiverse with Optical Telescopes. Phys. Rev. Lett., 125(18):181304, October 2020:181304

19. **Sugiyama, Sunao**, M. Takada, Y. Kobayashi, et al. Validating a minimal galaxy bias method for cosmological parameter inference using HSC-SDSS mock catalogs. Phys. Rev. D, 102(8):083520, October 2020:083520

20. **Sugiyama, Sunao**, T. Kurita, and M. Takada. On the wave optics effect on primordial black hole constraints from optical microlensing search. MNRAS, 493(3):3632–3641, April 2020:3632–3641

21. H. Niikura, M. Takada, N. Yasuda, et al. Microlensing constraints on primordial black holes with Subaru/HSC Andromeda observations. *Nature Astronomy*, 3:524–534, April 2019:524–534

co-authored papers

22.

23.

24.

25. T. Zhang, **Sugiyama, Sunao**, S. More, et al. Modelling Galaxy Clustering and Tomographic Galaxy-Galaxy Lensing with HSC Y3 and SDSS using the Point-Mass Correction Model and Redshift Self-Calibration. *arXiv e-prints*, arXiv:2507.01377, July 2025:arXiv:2507.01377

26. T. Zhang, X. Li, **Sugiyama, Sunao**, et al. Cosmology and Source Redshift Constraints from Galaxy Clustering and Tomographic Weak Lensing with HSC Y3 and SDSS using the Point-Mass Correction Model. *arXiv e-prints*, arXiv:2507.01386, July 2025:arXiv:2507.01386

27. R. Terasawa, X. Li, M. Takada, et al. Exploring the baryonic effect signature in the Hyper Suprime-Cam Year 3 cosmic shear two-point correlations on small scales: The S8 tension remains present. Phys. Rev. D, 111(6):063509, March 2025:063509

28. K.-F. Chen, I. N. Chiu, M. Oguri, et al. Weak-Lensing Shear-Selected Galaxy Clusters from the Hyper Suprime-Cam Subaru Strategic Program: I. Cluster Catalog, Selection Function and Mass–Observable Relation. *The Open Journal of Astrophysics*, 8:2, January 2025:2

29. T. Sunayama, H. Miyatake, **Sugiyama, Sunao**, et al. Optical cluster cosmology with SDSS redMaPPer clusters and HSC-Y3 lensing measurements. Phys. Rev. D, 110(8):083511, October 2024:083511

30. I. N. Chiu, K.-F. Chen, M. Oguri, et al. Weak-Lensing Shear-Selected Galaxy Clusters from the Hyper Suprime-Cam Subaru Strategic Program: II. Cosmological Constraints from the Cluster Abundance. *The Open Journal of Astrophysics*, 7:90, October 2024:90

31. J. Shi, T. Sunayama, T. Kurita, et al. The intrinsic alignment of galaxy clusters and impact of projection effects. MNRAS, 528(2):1487–1499, February 2024:1487–1499

32. T. Zhang, X. Li, R. Dalal, et al. A general framework for removing point-spread function additive systematics in cosmological weak lensing analysis. MNRAS, 525(2):2441–2471, October 2023:2441–2471

33. Y. Park, T. Sunayama, M. Takada, et al. Cluster cosmology with anisotropic boosts: validation of a novel forward modelling analysis and application on SDSS redMaPPer clusters. MNRAS, 518(4):5171–5189, February 2023:5171–5189

Other Articles

1. S. Sugiyama, M. Takada, and H. Miyatake. Weak lensing cosmology with subaru hsc data. *ASJ EUREKA*, 117(1):304–314, May 2024:304–314

TALKS

Listing 21 selected talks out of 46 talks. See here for the full list of talks.

1. **Cosmology from a joint analysis of second and third order shear statistics**, KICP seminar, 2025, Oct., *Oral*

2. **Cosmology with third-order shear statistics Applications to HSC and DES**, Beyond-two-point Statistics Meet Survey Systematics, 2025, Sep., *Oral* (**Invited Talk**)

3. **Exploring Primordial Black Hole with Microlensing Data: Updates on Analysis Pipeline**, UPenn CfPC workshop, 2024, Nov., *Oral*
4. **Exploring Primordial Black Hole with Microlensing Data: Updates on Analysis Pipeline**, Focus week on primordial black holes 2024, 2024, Nov., *Oral* (**Invited Talk**)
5. **Cosmology with third-order shear statistics**, Roman F2F meeting, 2024, Oct., *Oral*
6. **Exploring Primordial Black Hole with Microlensing Data**, Pacific conference, 2024, Aug., *Oral* (**Invited Talk**)
7. **Cosmology from Subaru HSC weak lensing Year 3 data**, MIfA colloquium, 2024, May., *Oral* (**Invited Talk**)
8. **Cosmology from weak lensing three-point correlation function**, astro/cosmo seminar at CMU, 2024, Feb., *Oral*
9. **Cosmology from Subaru HSC weak lensing Year 3 data**, Subaru Users Meeting FY2023, 2024, Jan., *Oral*
10. **HSC Y3 weak lensing cosmology results**, CosmoPalooza, 2023, Oct., *Oral*
11. **HSC Year 3 Weak Lensing Cosmology Results**, HSC webinar, 2023, Apr., *Oral*
12. **HSC Y3 cosmology results**, CMB x LSS, 2023, Apr., *Oral* (**Invited Talk**)
13. **Collaborative coding: git and github**, CD3 Opening Symposium, 2023, Apr., *Oral*
14. **Revealing the nature of dark matter with gravitational lensing: weak and microlensing**, Colloqium at Osaka theoretical astrophysics group, 2022, Jul., *Oral* (**Invited Talk**)
15. **Exploring Primordial black hole with microlensing observation of Andromeda galaxy**, Subaru Users Meeting 2021, 2022, Jan., *Oral*
16. **Joint analysis of galaxy-galaxy lensing and clustering at large scales from Subaru HSC and SDSS data**, 2021 Autumn Annual Meeting of ASJ, 2021, Sep., *Oral*
17. **Exploring Dark Matter Candidates with Microlensing**, KEK theory seminar, 2021, Apr., *Oral*
18. **Testing stochastic gravitational wave signals by PBH microlensing**, 4th KEK-PH + KEK-Cosmo Joint Lectures and Workshop on "Gravitational Wave", 2020, Nov., *Oral* (**Invited Talk**)
19. **Observational constraint on PBH scenarios with HSC microlensing**, 9th workshop on observational cosmology, 2020, Nov., *Oral*
20. **Validation of PT-based method for cosmology analysis with wide field galaxy survey data**, Seminar at astro group of Hirosaki University, 2020, Feb., *Oral*
21. **Wave effect on PBH micro-lensing and constraintWave effect on PBH micro-lensing and constraint**, 7th workshop on observational cosmology, 2018, Dec., *Oral*

PRESS RELEASES

Primordial black holes and the search for dark matter from the multiverse, IPMU, 2020 Dec

How to see the invisible: Using dark matter distribution to test our cosmological model, IPMU, 2024 Apr