

# SUNAO SUGIYAMA

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## CONTACT INFORMATION

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## RESEARCH INTERESTS

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

## COLLABORATIONS

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

## POSITIONS

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<b>Current</b>	<b>Postdoctoral researcher,</b> University of Pennsylvania, Philadelphia, the United States Mentor: Prof. Bhuvnesh Jain	Sep. 2023 – present
<b>Past</b>	<b>JSPS Overseas Research Fellow,</b> University of Pennsylvania, Philadelphia, the United States <b>Postdoctoral researcher,</b> Kavli IPMU, Chiba, Japan Mentor: Prof. Masahiro Takada <b>Project Researcher,</b> Beyond AI, Tokyo, Japan <b>JSPS Research Fellowships for Young Scientists,</b> Kavli IPMU, Chiba, Japan	Sep. 2023 – Aug. 2025 Apr. 2023 – Aug. 2023 Apr. 2023 – Aug. 2023 Apr. 2021 – Mar. 2023
<b>Educations</b>	<b>University of Tokyo, Tokyo, Japan,</b> Ph.D. course in Physics Dissertation: “ <i>Joint cosmology analyses using gravitational weak lensing data from Subaru Hyper Suprime-Cam</i> ” Supervisor: Prof. Masahiro Takada <b>University of Tokyo, Tokyo, Japan,</b> M.S. in Physics Dissertation: “ <i>Validation of cosmological analysis based on perturbation theory for wide-field galaxy survey</i> ” Supervisor: Prof. Masahiro Takada <b>University of Tokyo, Tokyo, Japan,</b> B.A. in Physics	Apr. 2020 – Mar. 2023 Apr. 2018 – Mar. 2020 Apr. 2014 – Mar. 2018

## GRANT & AWARDS

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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

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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

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<b>Society</b>	The Astronomical Society of Japan (ASJ), 2018 – present The Physical Society of Japan (JPS), 2022 – present
<b>Seminar/Workshop/Conference</b>	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
<b>Referee</b>	International Journal of Modern Physics D The Astrophysical Journal American Astronomical Society Journals Journal of Cosmology and Astroparticle Physics
<b>Computing</b>	Developer of <b>fft-extended-source</b> , <b>fastnc</b> , <b>dark emulator</b> as a part of <b>Dark Quest Project</b> I can work with C, C++, Python, <b>HSC pipeline</b> (for image analysis)
<b>Accepted Observation</b>	PI of <b>Definitive search for PBH dark matter in the multiverse cosmology with HSC</b> co-PI of <b>Survey of M31 eclipsing binaries: Toward a 1% distance measurement</b>

## PUBLIC ENGAGEMENT AND OUTREACH

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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

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The up-to-date list of publication available at [ADS](#).

\* = Author list alphabetized

### ***First-author papers or co-authored papers with significant contributions***

1. **Sugiyama, Sunao** and M. Park. Data Compression with Noise Suppression for Inference under Noisy Covariance. *arXiv e-prints*, arXiv:2508.14021, **August 2025:arXiv:2508.14021**
2. **Sugiyama, Sunao**, R. C. H. Gomes, and B. Jain. Cosmology from a joint analysis of second and third order shear statistics with Subaru Hyper Suprime-Cam Year 3 data. *arXiv e-prints*, arXiv:2508.14019, **August 2025:arXiv:2508.14019**
3. 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**
4. 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**
5. **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**
6. 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**
7. 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**
8. 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**
9. 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**
10. **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**
11. **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**
12. 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**
13. 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**
14. **Sugiyama, Sunao**. Fast Fourier Transformation Based Evaluation of Microlensing Magnification with Extended Source. *ApJ*, 937(2):63, **October 2022:63**

15. **Sugiyama, Sunao**, M. Takada, H. Miyatake, et al. HSC Year 1 cosmology results with the minimal bias method: HSC  $\times$ BOSS galaxy-galaxy weak lensing and BOSS galaxy clustering. *Phys. Rev. D*, 105(12):123537, **June 2022:123537**
16. **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**
17. \*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**
18. **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**
19. **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**
20. 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*

21. 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**
22. 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**
23. R. Terasawa, M. Takada, T. Kurita, and **Sugiyama, Sunao**. Late-time suppression of structure growth as a solution for the  $S_8$  tension. *arXiv e-prints*, arXiv:2505.09176, **May 2025:arXiv:2505.09176**
24. 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  $S_8$  tension remains present. *Phys. Rev. D*, 111(6):063509, **March 2025:063509**
25. R. Terasawa, M. Takada, **Sugiyama, Sunao**, and T. Kurita. Testing small-scale modifications in the primordial power spectrum with Subaru HSC cosmic shear, primary CMB and CMB lensing. *arXiv e-prints*, arXiv:2503.20396, **March 2025:arXiv:2503.20396**
26. 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**
27. 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**
28. 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**
29. 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**
30. 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**

31. 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

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Listing 21 selected talks out of 44 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**, **MIIfA 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**, **Colloquium 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 constraint**  
**Wave effect on PBH micro-lensing and constraint**, 7th workshop on observational cosmology, 2018, Dec., *Oral*

## PRESS RELEASES

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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