

# 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

## MAJOR INVOLVEMENT IN LARGE PROJECTS

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Subaru HSC weak lensing working group, member (2021-present)

## POSITIONS & EDUCATION

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**University of Pennsylvania, Philadelphia, the United States** September 2023 – Now  
Postdoctoral researcher  
Mentor: Prof. Bhuvnesh Jain

**Kavli IPMU, Chiba, Japan** April 2023 – August 2023  
Postdoctoral researcher  
Mentor: Prof. Masahiro Takada

**Beyond AI** April 2023 – August 2023  
Researcher

**University of Tokyo, Tokyo, Japan** April 2020 – March 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** April 2018 – March 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** April 2014 – March 2018  
B.A. in Physics

## AWARDS AND FELLOWSHIP

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**Overseas Research Fellowships**, Japan Society for the Promotion of Science, Sep. 2023 – Now

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

**Research Fellowships for Young Scientists (Doctoral Course Students, DC2)**, Japan Society for the Promotion of Science, Apr. 2021 – Mar. 2023

**International Graduate Program for Excellence in Earth-Space Science (IGPEES)**, World-leading Innovative Graduate Study Program (WINGS), Sep. 2018 – Mar. 2023

## GRANTS

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Grant-in-Aid for JSPS Research Fellows (DC2)

## OBSERVATIONS

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**PI**, Definitive search for PBH dark matter in the multiverse cosmology with HSC ([Subaru website](#))

## PROFESSIONAL SOCIETY

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The Astronomical Society of Japan (ASJ), 2018 – present

The Physical Society of Japan (JPS), 2022 – present

## PUBLICATIONS

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For up-to-date list of my papers, please see [ADS](#).

\* = Author list alphabeticized

### *Major author*

1. 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. *arXiv e-prints*, arXiv:2304.00704, [April 2023:arXiv:2304.00704](#). doi: 10.48550/arXiv.2304.00704
2. 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. *arXiv e-prints*, arXiv:2304.00703, [April 2023:arXiv:2304.00703](#). doi: 10.48550/arXiv.2304.00703
3. X. Li, T. Zhang, **Sugiyama, Sunao**, et al. Hyper Suprime-Cam Year 3 Results: Cosmology from Cosmic Shear Two-point Correlation Functions. *arXiv e-prints*, arXiv:2304.00702, [April 2023:arXiv:2304.00702](#). doi: 10.48550/arXiv.2304.00702
4. R. Dalal, X. Li, A. Nicola, et al. Hyper Suprime-Cam Year 3 Results: Cosmology from Cosmic Shear Power Spectra. *arXiv e-prints*, arXiv:2304.00701, [April 2023:arXiv:2304.00701](#). doi: 10.48550/arXiv.2304.00701
5. **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. *arXiv e-prints*, arXiv:2304.00705, [April 2023:arXiv:2304.00705](#). doi: 10.48550/arXiv.2304.00705
6. **Sugiyama, Sunao**. Fast Fourier Transformation Based Evaluation of Microlensing Magnification with Extended Source. *ApJ*, 937(2):63, [October 2022:63](#). doi: 10.3847/1538-4357/ac8df1
7. 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](#). doi: 10.1103/PhysRevD.106.083520
8. 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](#). doi: 10.1103/PhysRevD.106.083519
9. **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](#). doi: 10.1103/PhysRevD.105.123537
10. **Sugiyama, Sunao**, M. Takada, and A. Kusenko. Possible evidence of QCD axion stars in HSC and OGLE microlensing events. *arXiv e-prints*, arXiv:2108.03063, [August 2021:arXiv:2108.03063](#)
11. **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](#). doi: 10.1016/j.physletb.2021.136097

12. \*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**. doi: 10.1103/PhysRevLett.125.181304
13. **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**. doi: 10.1103/PhysRevD.102.083520
14. **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**. doi: 10.1093/mnras/staa407
15. 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**. doi: 10.1038/s41550-019-0723-1

### *Contributing author*

16. 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**. doi: 10.1093/mnras/stac3410
17. T. Zhang, X. Li, R. Dalal, et al. A General Framework for Removing Point Spread Function Additive Systematics in Cosmological Weak Lensing Analysis. *arXiv e-prints*, arXiv:2212.03257, **December 2022:arXiv:2212.03257**

## SELECTED TALKS

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Listing 20 selected talks among 28 talks.

1. **Hyper Suprime-Cam Year 3 Results: Cosmology from Weak Lensing with HSC, Windows on the Universe**, 2023, Aug., *Oral (Invited Talk)*
2. **HSC Year 3 Weak Lensing Cosmology Results**, **HSC webinar**, 2023, Apr., *Oral*
3. **HSC Y3 cosmology results**, **CMB x LSS**, 2023, Apr., *Oral (Invited Talk)*
4. **Cosmology analysis with Subaru HSC Y3 data and SDSS data: cosmological parameter inference in  $\Lambda$ CDM model**, **2023 Spring Annual Meeting of ASJ**, 2023, Mar., *Oral*
5. **Cosmology analysis with Subaru HSC Y3 data and SDSS data: a joint analysis of cosmic shear + galaxy-galaxy lensing + galaxy clustering**, **2022 Autumn Annual Meeting of ASJ**, 2022, Sep., *Oral*
6. **Revealing the nature of dark matter with gravitational lensing: weak and microlensing**, **Colloquium at Osaka theoretical astrophysics group**, 2022, Jul., *Oral (Invited Talk)*
7. **HSC cosmology: Joint analysis of galaxy-galaxy lensing and clustering from Subaru HSC and SDSS data**, **77th Annual Meeting of JPS**, 2022, Mar., *Oral*
8. **Exploring Primordial black hole with microlensing observation of Andromeda galaxy**, **Subaru Users Meeting 2021**, 2022, Jan., *Oral*
9. **Joint analysis of galaxy-galaxy lensing and clustering at large scales from Subaru HSC and SDSS data**, **34th astro-theory Symposium**, 2021, Dec., *Oral*
10. **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*
11. **Exploring Dark Matter Candidates with Microlensing**, **KEK theory seminar**, 2021, Apr., *Oral*
12. **Constraining PBH with HSC microlensing**, IPMU phenomenology lunch journal club, 2020, Dec., *Oral*

13. **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**)
14. **Observational constraint on PBH scenarios with HSC microlensing**, [9th workshop on observational cosmology](#), 2020, Nov., *Oral*
15. **Developing a method of cosmological parameter inference from galaxy survey data by Subaru/HSC**, [Summer school for young researchers in astronomy/astrophysics](#), 2020, Aug., *Oral*
16. **Validating a minimal galaxy bias method for cosmological parameter inference using HSC-SDSS mock catalog**, Seminar at Daniel Eisenstein group@CfA, 2020, Aug., *Oral*
17. **Validation of PT-based method for cosmology analysis with wide field galaxy survey data**, Seminar at astro group of Hirotsuki University, 2020, Feb., *Oral*
18. **Validation of PT-based method for cosmology analysis of wide field galaxy survey data**, [2019 Autumn Annual Meeting of ASJ](#), 2019, Sep., *Oral*
19. **On the wave effect of PBH microlensing in the observation of the M31 stars**, [2019 Spring Annual Meeting of ASJ](#), 2019, Mar., *Oral*
20. **Wave effect on PBH micro-lensing and constraint**, [7th workshop on observational cosmology](#), 2018, Dec., *Oral*

## PEER REVIEWS

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Reviewer of International Journal of Modern Physics D

## PRESS RELEASES

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Primordial black holes and the search for dark matter from the multiverse ([IPMU website](#))

How to see the invisible: Using dark matter distribution to test our cosmological model ([IPMU website](#))

## PROGRAMMING SKILLS

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<b>Computing Language</b>	C, C++, Python, HSC pipeline (for image analysis)
<b>Code developed</b>	<a href="#">fft-extended-source</a>
<b>Software Maintenance</b>	<a href="#">dark emulator</a> as a part of <a href="#">Dark Quest Project</a>

## SEMINARS AND WORKSHOPS ORGANIZED

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IPMU weekly lunch seminar (co-organizer), 2019 – 2021

HSC weaklensing mini workshop, Aug. 2022