

Takumi Kuwahara

Assistant Professor

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Research Interests

Dark matter and dark sectors · CP violation · Quark flavor physics · Lepton flavor physics · Supersymmetric models · Grand unified theories · Composite particles · Inflation · Quantum corrections

Employment

Assistant Professor Sep. 2025–Present
Center for Theoretical Physics and College of Physics, Jilin University Changchun, China

Postdoctoral Fellow Sep. 2021–Aug. 2025
Center for High-Energy Physics, Peking University Beijing, China
One-year gap due to COVID-19.

Postdoctoral Fellow Sep. 2017–Aug. 2020
Center for Theoretical Physics of the Universe, Institute for Basic Science Daejeon, Republic of Korea

Postdoctoral Fellow Apr. 2017–Aug. 2017
High Energy Physics Theory Group, University of Tokyo Tokyo, Japan

Education

Ph.D. in Physics March 2017
Nagoya University Nagoya, Japan
Thesis: *Next-Leading Order Corrections for Proton Decay in Supersymmetric Unification*
Supervisor: Junji Hisano

M.S. in Physics March 2014
Nagoya University Nagoya, Japan
Thesis: *Proton Decay in SUSY SU(5) GUTs Revisited after Discovery of the Higgs Boson*
Supervisor: Junji Hisano

B.S. in Physics March 2012
Tokyo University of Science Tokyo, Japan

Grants and Fellowships

Research Grant Jan. 2023–Present
National Natural Science Foundation of China (RFIS-I) China
The Research Fund for International Young Scientists; funding amount: 200,000 RMB/year per project.

Research Fellow Apr. 2016–Aug. 2018
Japan Society for the Promotion of Science (JSPS) Japan

Research Assistant
Department of Physics, Nagoya University
Supervisor: Junji Hisano

Jul. 2014–Mar. 2015
Nagoya, Japan

Teaching

Co-instructor
Basic Experiments on Physics, Aichi Medical University

Fall semesters 2013–2015
Japan

Teaching Assistant
Mathematics for Physics (G30: for students studying abroad), Nagoya University

Fall semester 2015
Nagoya, Japan

Teaching Assistant
Mathematics for Physics, Nagoya University

Fall semester 2013
Nagoya, Japan

Awards

Overseas Dispatching for Young Scientists, Nagoya University

March 2016

Exemption from Refund of a Scholar Loan (JASSO)

March 2016

Exemption from Refund of a Scholar Loan (JASSO)

March 2014

Publications

In particle physics, alphabetical authorship is common in many collaborations.

Preprints

1. **Takumi Kuwahara** with J-C. Wang, S-R. Yuan. “*Direct Detection and Cosmological Constraints of Dark Matter with Dark Dipoles.*” Preprint. [arXiv:2602.06861](#); [INSPIRE](#)
2. **Takumi Kuwahara** with Y. Uchida. “*Composite Asymmetric Dark Matter from Primordial Black Holes.*” Preprint. [arXiv:2511.16354](#); [INSPIRE](#)

Peer-Reviewed Publications

1. **Takumi Kuwahara** with A. Kamada and K. Watanabe. “*Revisiting Q-ball Interactions with Matters.*” JHEP 01 (2026) 146. [arXiv:2507.10900](#); [INSPIRE](#)
2. **Takumi Kuwahara** with S. Das, A. Kamada, K. Murase, and D. Song. “*Composite asymmetric dark matter with a dark photon portal: Multimessenger tests.*” Phys. Rev. D 112 (2025) 1, 015027. [arXiv:2412.15641](#); [INSPIRE](#)
3. **Takumi Kuwahara** with A. Kamada, S. Matsumoto, Yu Watanabe, and Yuki Watanabe. “*Mediator Decay through mixing with Degenerate Spectrum.*” JHEP 01 (2025) 043. [arXiv:2404.06793](#); [INSPIRE](#)
4. **Takumi Kuwahara** with A. Kamada and A. Patel. “*Quantum Theory of Dark Matter Scattering.*” JHEP 11 (2023) 105. [arXiv:2303.17961](#); [INSPIRE](#)
5. **Takumi Kuwahara** with S-R. Yuan. “*Dark Vector Mesons at LHC Forward Detector Searches.*” JHEP 06 (2023) 208. [arXiv:2303.03736](#); [INSPIRE](#)
6. **Takumi Kuwahara** with A. Kamada and S. Kobayashi. “*Perturbative Unitarity of Strongly Interacting Massive Particle Models.*” JHEP 02 (2023) 217. [arXiv:2210.01393](#); [INSPIRE](#)
7. **Takumi Kuwahara** with A. Kamada. “*LHC lifetime frontier and visible decay searches in composite asymmetric dark matter models.*” JHEP 03 (2022) 176. [arXiv:2112.012022](#); [INSPIRE](#)
8. **Takumi Kuwahara** with A. Kamada. “*Lessons from $T^{\sim\{\mu\}}_{\sim\{\mu\}}$ on inflation models: two-loop renormalization of η in the scalar QED.*” Phys. Rev. D 103 (2021) 11, 116001. [arXiv:1909.04229](#); [INSPIRE](#)
9. **Takumi Kuwahara** with A. Kamada, H. J. Kim. “*Maximally self-interacting dark matter: models and predictions.*” JHEP 12 (2020) 202. [arXiv:2007.15522](#); [INSPIRE](#)
10. **Takumi Kuwahara** with A. Kamada. “*Lessons from $T^{\sim\{\mu\}}_{\sim\{\mu\}}$ on inflation models: two-scalar theory and Yukawa theory.*” Phys. Rev. D 101 (2020) 9, 096012. [arXiv:1909.04228](#); [INSPIRE](#)
11. **Takumi Kuwahara** with M. Ibe, A. Kamada, S. Kobayashi, W. Nakano. “*Baryon-Dark Matter Coincidence in Mirrored Unification.*” Phys. Rev. D 100, 075022 (2019). [arXiv:1907.03404](#); [INSPIRE](#)
12. **Takumi Kuwahara** with W. Kuramoto, R. Nagai. “*Renormalization Effects on Electric Dipole Moments in Electroweakly Interacting Massive Particle Models.*” Phys. Rev. D 99, 095024 (2019). [arXiv:1902.05360](#); [INSPIRE](#)
13. **Takumi Kuwahara** with J. L. Evans, K. Kadota. “*Revisiting Flavor and CP Violation in Supersymmetric $SU(5)$ with Right-Handed Neutrinos.*” Phys. Rev. D 98 (2018) 075030. [arXiv:1807.08234](#); [INSPIRE](#)
14. **Takumi Kuwahara** with J. Hisano, Y. Omura, T. Sato. “*Two-loop Anomalous Dimensions for Four-Fermi Operators in Supersymmetric Theories.*” Nucl. Phys. B922 (2017) 77-93. [arXiv:1703.08329](#); [INSPIRE](#)
15. **Takumi Kuwahara** with J. Hisano, W. Kuramoto. “*Light Stop, Heavy Higgs, and Heavy Gluino in Supersymmetric Standard Models with Extra Matters.*” PTEP 2017 no.3, 033B10. [arXiv:1611.07670](#); [INSPIRE](#)
16. **Takumi Kuwahara** with B. Bajc, J. Hisano, Y. Omura. “*Threshold Corrections to Dimension-six Proton Decay Operators in Non-minimal SUSY $SU(5)$ GUTs.*” Nucl. Phys. B910 (2016) 1-22. [arXiv:1603.03568](#); [INSPIRE](#)

INSPIRE

17. **Takumi Kuwahara** with J. Hisano, D. Kobayashi, W. Kuramoto. “*Nucleon Electric Dipole Moments in High-Scale Supersymmetric Models.*” JHEP 1511 (2015) 085. [arXiv:1507.05836](#); [INSPIRE](#)
18. **Takumi Kuwahara** with J. Hisano, Y. Omura. “*Threshold Corrections to Baryon Number Violating Operators in Supersymmetric $SU(5)$ GUTs.*” Nucl. Phys. B898 (2015) 1-29. [arXiv:1503.08561](#); [INSPIRE](#)
19. **Takumi Kuwahara** with J. Hisano, D. Kobayashi, N. Nagata. “*Decoupling Can Revive Minimal Supersymmetric $SU(5)$.*” JHEP 1307 (2013) 038. [arXiv:1304.3651](#); [INSPIRE](#)
20. **Takumi Kuwahara** with J. Hisano, N. Nagata. “*Grand Unification in High-scale Supersymmetry.*” Phys. Lett. B723 (2013) 324-329. [arXiv:1304.0343](#); [INSPIRE](#)
21. **Takumi Kuwahara** with M. Ibe, A. Kamada, S. Kobayashi, W. Nakano. “*Ultraviolet Completion of a Composite Asymmetric Dark Matter Model with a Dark Photon Portal.*” JHEP 1903 (2019) 173. [arXiv:1811.10232](#); [INSPIRE](#)

Conference Talks

- “*Composite Asymmetric Dark Matter from Primordial Black Holes.*” Sichuan University and IBS CTPU-CGA joint workshop on frontier of theoretical particle physics and gravity, Sichuan University, May. 24 - 27, 2026.
- “*Direct Detection of Composite Asymmetric Dark Matter.*” The 4th Topics of Particle, Astro and Cosmo Frontiers (TOPAC 2026), University of Electronic Science and Technology of China, Apr. 17 - 20, 2026.
- “*Matter-genesis via Heavy particle decay from Primordial Black Holes.*” The 3rd Workshop on Grand Unified Theories: Phenomenology and Cosmology (GUTPC 2026), HIAS, Apr. 9 - 13, 2026.
- “*Composite Asymmetric Dark Matter from Primordial Black Holes.*” KEK Theory Meeting on Particle Physics Phenomenology (KEK-PH 2026 Winter), KEK, Feb. 16 - 19, 2026.
- “*Revisiting Q-ball Dark Matter: A Closer Look at Interaction with Matter.*” 3rd Topics of Particle, Astro and Cosmo Frontiers (TOPAC 2025), Sun-Yat Sen University, June 7 - June 9, 2025.
- “*Dark Matter Decay in Dark Unification.*” The 2nd Workshop on Grand Unified Theories: Phenomenology and Cosmology (GUTPC 2025), HIAS, Apr 17 - 22, 2025.
- “*Composite asymmetric dark matter with a dark photon portal: Multi-Messenger tests.*” KEK Theory Meeting on Particle Physics Phenomenology, KEK, Feb 17 - Feb 21, 2025.
- “*Mediator Decay through Mixing with Degenerate Spectrum.*” The 3rd International Workshop on BSM Frontier: Where to Next?, Beihang University, Aug 19 - Aug 22, 2024.
- “*Composite asymmetric dark matter with a dark photon portal: Multimessenger tests.*” The 28th International Summer Institute on Phenomenology of Elementary Particle Physics and Cosmology (SI2024), Linyi University, Aug 3 - Aug 7, 2024.
- “*Confining Dark Sector and Long-lived Particle Searches.*” The 14th Workshop of the Long-Lived Particle Community (LLP 2024), University of Tokyo, July 1 - July 5, 2024.
- “*Quantum Theory of Dark Matter Scattering.*” 2nd Topics of Particle, Astro and Cosmo Frontiers (TOPAC 2024), SouthEast University, May 30 - June 2, 2024.
- “*Unification and Composite Asymmetric Dark Matter.*” The Workshop on Grand Unified Theory, Phenomenology and Cosmology (GUTPC), HIAS, Apr 8 - 12, 2024.
- “*Dark Hadrons at LHC Lifetime Frontier.*” KEK Theory Meeting on Particle Physics Phenomenology, KEK, Nov 7 - 10, 2023.
- “*Dark Hadrons at LHC Lifetime Frontier.*” CTPU Workshop on Particle Physics and Cosmology, Daejeon, South Korea, Oct 20 - 25, 2023 (**Invited talk**).
- “*Dark Hadrons at LHC Lifetime Frontier.*” 27th International Summer Institute on Phenomenology of Elementary Particle Physics and Cosmology (Summer Institute 2023), Nantou, Taiwan, Aug 21 - 25, 2023.

- “*LHC lifetime frontier and visible decay searches in composite asymmetric dark matter models.*” IBS and KMI Joint Workshop 2022, online, Aug 3 - 5, 2022 (**Invited talk**).
- “*Dark Hadrons at Lifetime Frontier Experiments.*” TDLI-PKU BSM Workshop 2022: Electroweak Lights the Way, online, Aug 1 - 3, 2022.
- “*Baryon-Dark Matter Coincidence in Mirrored Unification.*” KEK Theory Meeting on Particle Physics Phenomenology (KEK-PH2020), KEK, Feb 18 - 21, 2020.
- “*Electric Dipole Moments in Electroweakly Interacting Massive Particle Models.*” International Joint Workshop on the Standard Model and Beyond (KEK-KIAS-NCTS-ITP CAS Joint Workshop), Beijing, China, Oct 14 - 17, 2019.
- “*Baryon-Dark Matter Coincidence and Composite Asymmetric Dark Matter.*” New Physics Beyond the Standard Model, Beijing, China, Oct 9 - 12, 2019.
- “*UV Completions of Composite Asymmetric Dark Matter Model with Dark Photon Portal.*” Summer Institute 2019, Gangneung, Republic of Korea, Aug 18 - 23, 2019.
- “*Renormalization Effects on Electric Dipole Moments in Electroweakly Interacting Massive Particle Models.*” FPCP 2019, University of Victoria, Canada, May 6 - 10, 2019.
- “*Revisiting Flavor and CP Violation in Supersymmetric SU(5) with Right-Handed Neutrinos.*” KEK Theory Meeting (KEK-PH 2018 Winter), Tsukuba, Dec 4 - 7, 2018.
- “*Revisiting Flavor and CP Violation in Supersymmetric SU(5) with Right-Handed Neutrinos.*” SUSY 2018, Barcelona, Spain, July 23 - July 27, 2018.
- “*Two-loop Anomalous Dimensions for Four-Fermi Operators in Supersymmetric Theories.*” Dark Side of the Universe, IBS CTPU, South Korea, July 10 - July 14, 2017.
- “*Proton Decay in SUSY GUTs.*” ECT* Baryon over Antibaryon, ECT*, Italy, July 25 - July 29, 2016 (**Invited talk**).
- “*GUT Scale Threshold Effects on Proton Decay.*” SUSY 2016, Melbourne, Australia, July 4 - July 8, 2016.
- “*Threshold Corrections to Dimension-Six Proton Decay Operators in SUSY SU(5).*” CETUP* Workshop on Neutrino Physics/Unification Session, Lead-Deadwood, South Dakota, USA, June 20 - July 1, 2016.
- “*GUT Scale Threshold Effect on Proton Decay.*” Flavors of New Physics, Ibaraki (IQBRC/KEK Tokai Campus), Mar. 9 - Mar. 10, 2015.
- “*Decoupling Can Revive Minimal Supersymmetric SU(5).*” KEK Theory Meeting (KEK-PH2013 Fall), Tsukuba, KEK, Japan, 30 Sep - 3 Oct, 2013.

Seminar Talks

- “*Phenomenology of Composite Asymmetric Dark Matter Models.*” Nagoya University, Nagoya University, 5 Feb. 2026.
- “*Phenomenology of Composite Asymmetric Dark Matter (Japanese).*” Ibaraki University, Ibaraki University, 26 Jan. 2026.
- “*Phenomenology of Composite Asymmetric Dark Matter with a Dark Photon Portal.*” South China Normal University, South China Normal University, 23 June 2025.
- “*Phenomenology of Composite Asymmetric Dark Matter.*” Chiba University, Chiba University, 14 May 2025.
- “*Revisiting Q-ball Dark Matter: A Closer Look at Interaction with Matter.*” Tokyo Metropolitan University, Tokyo Metropolitan University, 12 May 2025.
- “*Phenomenology of Confining Dark Sector: Through a Dark Photon Portal.*” Jilin University, Jilin University, 6 Jan. 2025.
- “*Phenomenology of Composite Asymmetric Dark Matter with a Dark Photon Portal.*” Toyama University, Toyama University, 10 Oct. 2024.
- “*Dark Vector Mesons at LHC Forward Detector Searches.*” Kanazawa University, Kanazawa University, 8

Oct. 2024.

- “*Phenomenology of Composite Asymmetric Dark Matter with a Dark Photon Portal.*” Yokohama National University, Yokohama National University, 7 Oct. 2024.
- “*Phenomenology of Composite Asymmetric Dark Matter with a Dark Photon Portal.*” Kyushu University, Kyushu University, 27 Sep. 2024.
- “*Mediator decay through mixing with Degenerate Spectrum.*” Hangzhou Institute for Advanced Study, UCAS, Hangzhou Institute for Advanced Study, UCAS, 16 Apr. 2024.
- “*Quantum Theory of Dark Matter Scattering (Lecture and Seminar).*” Yonsei University, Yonsei University, 18–19 Oct. 2023.
- “*Quantum Theory of Dark Matter Scattering.*” Sichuan University, Sichuan University, 25 Sep. 2023.
- “*Quantum Theory of Dark Matter Scattering.*” Nagoya University, Nagoya University, 8 May 2023.
- “*Dark Hadrons at the LHC Lifetime Frontier.*” Jinan University, Guangzhou campus, Jinan University, Guangzhou campus, 18 Apr. 2023.
- “*Quantum Theory of Dark Matter Scattering.*” Sun-Yat-Sen University, Guangzhou campus, Sun-Yat-Sen University, Guangzhou campus, 17 Apr. 2023.
- “*Quantum Theory of Dark Matter Scattering.*” Sun-Yat-Sen University, Zhuhai campus, Sun-Yat-Sen University, Zhuhai campus, 15 Apr. 2023.
- “*Unitarizing Dark Pion SIMPs.*” Sun-Yat-Sen University, Zhuhai campus, Sun-Yat-Sen University, Zhuhai campus, 12 Apr. 2023.
- “*Dark QCD and Asymmetric Dark Matter.*” Center for High-Energy Physics, Peking University, Center for High-Energy Physics, Peking University, 29 Sep. 2021 (**Welcome Seminar**).
- “*Maximally self-interacting dark matter: A composite asymmetric dark matter scenario.*” E-ken, Nagoya University, E-ken, Nagoya University, 7 Oct. 2020.
- “*Maximally self-interacting dark matter: A composite asymmetric dark matter scenario.*” Center for High-Energy Physics, Peking University, Center for High-Energy Physics, Peking University, 23 Sep. 2020.
- “*Supersymmetric Standard Models with Extra Matters.*” Center for Theoretical Physics of Universe, Institute for Basic Science, Center for Theoretical Physics of Universe, Institute for Basic Science, 13 Oct. 2017 (**Welcome Seminar**).
- “*Next-Leading Order Corrections to Four-Fermi Operators in Supersymmetric Theories.*” University of Tokyo, Hongo group, University of Tokyo, Hongo group, 1 May. 2017 (**Welcome Seminar**).
- “*Threshold Corrections to Dimension-Six Proton Decay Operators in SUSY SU(5) GUTs.*” Osaka University, Osaka University, 1 Nov. 2016.
- “*Nucleon Electric Dipole Moments in High-Scale Supersymmetric Models.*” Jožef Stefan Institute, Jožef Stefan Institute, 10 Mar. 2016 (**Informal Seminar**).
- “*Threshold Corrections to Baryon Number Violating Operators in Supersymmetric SU(5) GUTs.*” Tohoku University, Tohoku University, 5 Nov. 2015.