

EMPLOYMENT

Pennsylvania State University Assistant Research Professor	University Park, PA 2022–present
Pennsylvania State University Postdoctoral Scholar	University Park, PA 2021–2022

EDUCATION

The University of Tokyo Ph.D. in Physics, Advisor: Prof.Kipp Cannon	Tokyo, Japan 2018–2021
The University of Tokyo M.S. in Physics, Advisor: Prof.Kipp Cannon	Tokyo, Japan 2016–2018
The University of Tokyo B.S. in Applied Physics, Advisor: Prof.Norikatsu Mio	Tokyo, Japan 2011–2016

RESEARCH EXPERIENCE

Pennsylvania State University – Development of a low-latency gravitational-wave (GW) search pipeline, GstLAL – Bayesian parameter estimation for targeted anisotropic GW background	University Park, PA 2021–present
Research Center for the Early Universe, The University of Tokyo <i>M.S./Ph.D. Research, supervised by Prof.Kipp Cannon</i> – Fast evaluation of trigger consistency between multiple detectors using GstLAL – Searches for ultra-light bosons using stochastic GW background	Tokyo, Japan 2016–2021
LIGO Lab, California Institute of Technology <i>LIGO visitor program, hosted by Prof.Alan Weinstein</i> – Development and event follow-up for online analysis of a GW detection pipeline, GstLAL – Joint study on GW search for the ultra-light boson particle through superradiant instability	Pasadena, CA Summer 2019
Laboratoire d'Annecyde Physiquesdes Particules <i>Visiting research, supervised by Dr.Tania Regimbau</i> – Mock data study for the detection of stochastic GW background from anisotropically distributed compact binary coalescence (CBC).	Annecy, France Fall 2018
University of Minnesota <i>Visiting research, supervised by Prof.Vuk Mandic</i> – Development of a search pipeline for GW background from ultra-light scalar fields.	Minneapolis, MN Spring 2018
The University of Tokyo <i>B.S. Research, supervised by Prof.Norikatsu Mio</i> – Evaluating optical properties and frequency stability of the reference cavity KAGRA.	Tokyo, Japan 2015–2016
LIGO Livingston Observatory, California Institute of Technology <i>LIGO SURF program, supervised by Dr.Valery Frolov</i> – Constructing the theoretical model of the optical loss inside the arm cavities of the Advanced LIGO.	Livingston, LA Summer 2014

SCHOLARSHIPS AND AWARDS

- **Best Poster Award**, Gravitational Wave Orchestra 2022
- **Best Presentation Award**, The 7th KAGRA International Workshop 2020
- **Japan Society for the Promotion of Science DC1 fellowship** 2018–2021
- **LIGO Visitor Program**, California Institute of Technology 2019
- **Overseas Challenge Program for Young Researchers**, JSPS 2019
- **GRASP Scholarship**, The University of Tokyo 2018
- **SURF Program**, California Institute of Technology 2014
- **Best Project Award**, Cosmic/Particle Spring school 2014

RESEARCH TALKS

INVITED TALKS, SEMINARS, COLLOQUIA, SYMPOSIUM

- Pannelist** *Panel discussion for gravitational waves and multi-messenger astronomy* 2023
New Evolution of MultiMessenger Astrophysics, Penn State State College, USA
- Invited** *Observation of neutron stars during LIGO-Virgo-KAGRA's observing runs* 2022
APS April meeting New York, USA
- Invited** *Modeling and searching for a stochastic GW background from ultralight bosons* 2021
GW Physics and Astronomy: Genesis, The Fourth Annual Area Symposium Japan (online)
- Seminar** *Low-latency detection of the GWs from compact binary coalescences* 2022
ISAS seminar, ISM astronomy seminar, JGW seminar Japan
- Seminar** *Gravitational waves from neutron star-black hole coalescences* 2021
LIGO-Virgo-KAGRA Collaboration webinar
- Seminar** *First observations of black hole and neutron star mergers* 2021
Fundamental Theory Seminar, Penn State Pennsylvania, USA
- Seminar** *First search for stochastic GW backgrounds from ultra-light bosons* 2018
The CGCA seminar, University of Wisconsin Milwaukee Wisconsin, USA
- Seminar** *Application of a low-latency whitening filter to CBC GW searches* 2016
RESCEU joint seminar, The University of Tokyo Tokyo, Japan

SELECTED CONTRIBUTED TALKS

- The improvement of GstLAL's ranking statistics toward the fourth observing run* 2023
APS April meeting Minnesota, USA
- First observations of black hole and neutron star mergers* 2021
The 8th KAGRA International Workshop Korea (online)
- Modeling and searching for a stochastic GW background from ultralight bosons* 2021
Amaldi 14 Australia (online)
- Stochastic GW backgrounds from ultra-light vectors* 2019
The 29th Workshop on General Relativity and Gravitation in Japan Kobe, Japan
- Anisotropic GW background Mock data study* 2019
Gravitational Wave Physics and Astronomy Workshop Tokyo, Japan

<i>A first search for stochastic GW backgrounds from ultra-light scalars</i>	2018
Gravitational Wave Physics and Astronomy Workshop	Maryland, USA
<i>Application of a low-latency whitening filter to CBC GW searches</i>	2017
The Third KAGRA International Workshop	Taipei, Taiwan
<i>Search for anisotropic GW backgrounds from LIGO and Virgo's O3</i>	2021
Japan Physics Society Meeting	Japan (online)
<i>Towards a search for stochastic GW backgrounds from ultra-light bosons</i>	2018
Gravitational Wave Physics and Astronomy: Genesis	Chiba, Japan
<i>Application of a low-latency whitening filter to CBC GW searches</i>	2017
Japan Physics Society Meeting	Tochigi, Japan

TEACHING EXPERIENCE

- **Substitute Lecturer** at Pennsylvania State University Fall 2022
Electromagnetism
- **Teaching Assistant** at The University of Tokyo Fall 2016
Analytical mechanics

MENTORING EXPERIENCE

- **Soichiro Kuwahara** Ph.D student at The University of Tokyo
GPU-accelerated parameter estimation for anisotropic gravitational-wave backgrounds
- **Santiago Jaraba** Ph.D student at Universidad Aut'onoma de Madrid
Parameter estimation for anisotropic gravitational-wave backgrounds [1]
- **Deepali Agarwal** Ph.D student at Inter-University Centre for Astronomy and Astrophysics (IUCAA)
Parameter estimation for anisotropic gravitational-wave backgrounds [1]
- **Erik Floden** Ph.D student at University of Minnesota
Parameter estimation and spherical-harmonics searches of anisotropic gravitational-wave backgrounds [1], [2], [26]
- **Anarya Ray** Ph.D student at University of Wisconsin-Milwaukee
Improving background sampling procedure for GstLAL
- **Richard George** Ph.D student at The University of Texas at Austin
Improving SNR – ξ^2 signal model of GstLAL [3]
- **Andre Guimaraes** Ph.D student at Louisiana State University
Improving SNR – ξ^2 signal model of GstLAL [3]
- **Shio Sakon** Ph.D student at Pennsylvania State University
Optimization of GstLAL's template bank [4]
- **Shomik Adhicary** Ph.D student at Pennsylvania State University
Improving ranking statistics for gravitational-wave detection pipeline, GstLAL [3]
- **Prathamesh Joshi** Ph.D student at Pennsylvania State University
Implementation of contamination removal and bank- ξ^2 statistics in GstLAL [3], [5]
- **Takuya Tsutsui** Ph.D student at The University of Tokyo
Rapid localization of gravitational wave sources [6]

PROFESSIONAL SERVICE

- **Thesis committee**, Pennsylvania State University 2023–2023
- **Co-leader**, Working group of anisotropic stochastic background in LVK Collaboration 2022–present
- **Vice director**, Cosmic/Astrophysics Student Summer School in Japan 2019
- **Workshop Assistant**, Gravitational Wave Physics and Astronomy Workshop 2019

OUTREACH

- **KAGRA outreach group** 2020–2021
- **SCJSF&JABA forum talk** 2020
- **Japanese translation of GW190425’s science summary** 2019
- **GW education at a public school in Pasadena** 2019
- **RESCEU Open Lab** 2017, 2018
- **International Space Education Board Student Program** 2015, 2016

SHORT AUTHOR LIST PUBLICATIONS AND PREPRINTS

- [1] **L. Tsukada**, S. Jaraba, D. Agarwal, and E. Floden, “Bayesian parameter estimation for targeted anisotropic gravitational-wave background”, *Physical Review D*, vol. 107, no. 2, Jan. 2023.
- [2] E. Floden, V. Mandic, A. Matas, and **L. Tsukada**, “Angular resolution of the search for anisotropic stochastic gravitational-wave background with terrestrial gravitational-wave detectors”, *Physical Review D*, vol. 106, no. 2, Jul. 2022.
- [3] **L. Tsukada**, P. Joshi, S. Adhicary, R. George, A. Guimaraes, C. Hanna, R. Magee, A. Zimmerman, P. Baral, A. Baylor, K. Cannon, S. Caudill, B. Cousins, J. D. E. Creighton, B. Ewing, H. Fong, P. Godwin, R. Harada, Y.-J. Huang, R. Huxford, J. Kennington, S. Kuwahara, A. K. Y. Li, D. Meacher, C. Messick, S. Morisaki, D. Mukherjee, W. Niu, A. Pace, C. Posnansky, A. Ray, S. Sachdev, S. Sakon, D. Singh, R. Tapia, T. Tsutsui, K. Ueno, A. Viets, L. Wade, and M. Wade, “Improved ranking statistics of the gstlal inspiral search for compact binary coalescences”, *Physical Review D*, vol. 108, no. 4, Aug. 2023.
- [4] S. Sakon, **L. Tsukada**, H. Fong, C. Hanna, J. K. W. Niu, S. Adhicary, P. Baral, A. Baylor, K. Cannon, S. Caudill, B. Cousins, J. D. E. Creighton, B. Ewing, P. Godwin, R. Harada, Y.-J. Huang, R. Huxford, P. Joshi, S. Kuwahara, A. K. Y. Li, R. Magee, D. Meacher, C. Messick, S. Morisaki, D. Mukherjee, A. Pace, C. Posnansky, S. Sachdev, D. Singh, R. Tapia, T. Tsutsui, K. Ueno, A. Viets, L. Wade, M. Wade, and J. Wang, *Template bank for compact binary mergers in the fourth observing run of advanced ligo, advanced virgo, and kagra*, Nov. 2022. arXiv: 2211.16674 [gr-qc].
- [5] P. Joshi, **L. Tsukada**, and C. Hanna, *Background filter: A method for removing signal contamination during significance estimation of a gstlal analysis*, May 2023. arXiv: 2305.18233 [gr-qc].
- [6] T. Tsutsui, K. Cannon, and **L. Tsukada**, “High speed source localization in searches for gravitational waves from compact object collisions”, *Phys. Rev. D*, vol. 103, p. 043011, 4 Feb. 2021.
- [7] C. Hanna, J. Kennington, S. Sakon, S. Privitera, M. Fernandez, J. Wang, C. Messick, A. Pace, K. Cannon, P. Joshi, R. Huxford, S. Caudill, C. Chan, B. Cousins, J. D. E. Creighton, B. Ewing, H. Fong, P. Godwin, R. Magee, D. Meacher, S. Morisaki, D. Mukherjee, H. Ohta, S. Sachdev, D. Singh, R. Tapia, **L. Tsukada**, D. Tsuna, T. Tsutsui, K. Ueno, A. Viets, L. Wade, and M. Wade, “Binary tree approach to template placement for searches for gravitational waves from compact binary mergers”, *Physical Review D*, vol. 108, no. 4, 2023.
- [8] A. I. Renzini, A. Romero-Rodríguez, C. Talbot, M. Lalleman, S. Kandhasamy, K. Turbang, S. Biscoveanu, K. Martinovic, P. Meyers, **L. Tsukada**, K. Janssens, D. Davis, A. Matas, P. Charlton, G.-C. Liu, I. Dvorkin, S. Banagiri, S. Bose, T. Callister, F. D. Lillo, L. D’Onofrio, F. Garufi, G. Harry, J. Lawrence, V. Mandic, A. Macquet, I. Michaloliakos, S. Mitra, K. Pham, R. Poggiani, T. Regimbau, J. D. Romano, N. van Remortel, and H. Zhong, “Pygwb: A python-based library for gravitational-wave background searches”, *The Astrophysical Journal*, vol. 952, no. 1, p. 25, Jul. 2023.
- [9] **L. Tsukada**, *Extension of the bayesian searches for anisotropic stochastic gravitational-wave background with non-tensorial polarizations*, Aug. 2023. arXiv: 2308.09020 [astro-ph.IM].
- [10] S. Morisaki, R. Smith, **L. Tsukada**, S. Sachdev, S. Stevenson, C. Talbot, and A. Zimmerman, *Rapid localization and inference on compact binary coalescences with the advanced ligo-virgo-kagra gravitational-wave detector network*, Jul. 2023. arXiv: 2307.13380.
- [11] K. Cannon, S. Caudill, C. Chan, B. Cousins, J. D. Creighton, B. Ewing, H. Fong, P. Godwin, C. Hanna, S. Hooper, R. Huxford, R. Magee, D. Meacher, C. Messick, S. Morisaki, D. Mukherjee, H. Ohta, A. Pace, S. Privitera, I. de Ruiter, S. Sachdev, L. Singer, D. Singh, R. Tapia, **L. Tsukada**, D. Tsuna, T. Tsutsui, K. Ueno, A. Viets, L. Wade, and M. Wade, “Gstlal: A software framework for gravitational wave discovery”, *SoftwareX*, vol. 14, p. 100680, 2021, ISSN: 2352-7110.

- [12] A. Ray, W. Niu, S. Sakon, B. Ewing, J. D. E. Creighton, C. Hanna, S. Adhicary, P. Baral, A. Baylor, K. Cannon, S. Caudill, B. Cousins, H. Fong, R. N. George, P. Godwin, R. Harada, Y.-J. Huang, R. Huxford, P. Joshi, S. Kapadia, J. Kennington, S. Kuwahara, A. K. Y. Li, R. Magee, D. Meacher, C. Messick, S. Morisaki, D. Mukherjee, A. Pace, C. Posnansky, S. Sachdev, D. Singh, R. Tapia, **L. Tsukada**, T. Tsutsui, K. Ueno, A. Viets, L. Wade, and M. Wade, *When to point your telescopes: Gravitational wave trigger classification for real-time multi-messenger followup observations*, Jun. 2023. arXiv: 2306.07190 [gr-qc].
- [13] S. Sachdev, S. Caudill, H. Fong, R. K. L. Lo, C. Messick, D. Mukherjee, R. Magee, **L. Tsukada**, K. Blackburn, P. Brady, P. Brockill, K. Cannon, S. J. Chamberlin, D. Chatterjee, J. D. E. Creighton, P. Godwin, A. Gupta, C. Hanna, S. Kapadia, R. N. Lang, T. G. F. Li, D. Meacher, A. Pace, S. Privitera, L. Sadeghian, L. Wade, M. Wade, A. Weinstein, and S. L. Xiao, *The gstlal search analysis methods for compact binary mergers in advanced ligo's second and advanced virgo's first observing runs*, 2019. arXiv: 1901.08580 [gr-qc].
- [14] C. Messick, S. Sachdev, K. Cannon, S. Caudill, C. Chan, J. D. E. Creighton, R. Everett, B. Ewing, H. Fong, P. Godwin, C. Hanna, R. Huxford, S. Kapadia, A. K. Y. Li, R. K. L. Lo, R. Magee, D. Meacher, S. R. Mohite, D. Mukherjee, A. Nishizawa, H. Ohta, A. Pace, A. Reza, M. Shikauchi, L. Singer, D. Singh, J. R. SK, **L. Tsukada**, D. Tsuna, T. Tsutsui, K. Ueno, and A. Zimmerman, *Automating the inclusion of subthreshold signal-to-noise ratios for rapid gravitational-wave localization*, 2020. arXiv: 2011.02457 [astro-ph.IM].
- [15] P. Godwin, R. Essick, C. Hanna, K. Cannon, S. Caudill, C. Chan, J. D. E. Creighton, H. Fong, E. Katsavounidis, R. Magee, D. Meacher, C. Messick, S. Morisaki, D. Mukherjee, H. Ohta, A. Pace, I. de Ruiter, S. Sachdev, **L. Tsukada**, T. Tsutsui, K. Ueno, L. Wade, and M. Wade, *Incorporation of statistical data quality information into the gstlal search analysis*, 2020. arXiv: 2010.15282 [gr-qc].
- [16] B. Ewing, R. Huxford, D. Singh, **L. Tsukada**, C. Hanna, Y.-J. Huang, P. Joshi, A. K. Y. Li, R. Magee, C. Messick, A. Pace, A. Ray, S. Sachdev, S. Sakon, R. Tapia, S. Adhicary, P. Baral, A. Baylor, K. Cannon, S. Caudill, S. S. Chaudhary, M. W. Coughlin, B. Cousins, J. D. E. Creighton, R. Essick, H. Fong, R. N. George, P. Godwin, R. Harada, J. Kennington, S. Kuwahara, D. Meacher, S. Morisaki, D. Mukherjee, W. Niu, C. Posnansky, A. Toivonen, T. Tsutsui, K. Ueno, A. Viets, L. Wade, M. Wade, and G. Waratkar, *Performance of the low-latency gstlal inspiral search towards ligo, virgo, and kagra's fourth observing run*, May 2023. arXiv: 2305.05625 [gr-qc].
- [17] S. Banagiri, C. P. L. Berry, G. S. C. Davies, **L. Tsukada**, and Z. Doctor, *A unified p_{astro} for gravitational waves: Consistently combining information from multiple search pipelines*, Apr. 2023. arXiv: 2305.00071 [astro-ph.IM].
- [18] C. Hanna, P. Joshi, R. Huxford, K. Cannon, S. Caudill, C. Chan, B. Cousins, J. D. E. Creighton, B. Ewing, M. Fernandez, H. Fong, P. Godwin, R. Magee, D. Meacher, C. Messick, S. Morisaki, D. Mukherjee, H. Ohta, A. Pace, S. Privitera, S. Sachdev, S. Sakon, D. Singh, R. Tapia, **L. Tsukada**, D. Tsuna, T. Tsutsui, K. Ueno, A. Viets, L. Wade, M. Wade, and J. Wang, "Metric assisted stochastic sampling search for gravitational waves from binary black hole mergers", *Physical Review D*, vol. 106, no. 8, Oct. 2022.
- [19] D. Mukherjee, S. Caudill, R. Magee, C. Messick, S. Privitera, S. Sachdev, K. Blackburn, P. Brady, P. Brockill, K. Cannon, S. J. Chamberlin, D. Chatterjee, J. D. Creighton, H. Fong, P. Godwin, C. Hanna, S. Kapadia, R. N. Lang, T. G. Li, R. K. Lo, D. Meacher, A. Pace, L. Sadeghian, **L. Tsukada**, L. Wade, M. Wade, A. Weinstein, and L. Xiao, "Template bank for spinning compact binary mergers in the second observation run of advanced ligo and the first observation run of advanced virgo", *Physical Review D*, vol. 103, no. 8, 2021.
- [20] **L. Tsukada**, R. Brito, W. E. East, and N. Siemonsen, "Modeling and searching for a stochastic gravitational-wave background from ultralight vector bosons", *Phys. Rev. D*, vol. 103, p. 083005, 8 Apr. 2021.
- [21] **L. Tsukada**, K. Cannon, C. Hanna, D. Keppel, D. Meacher, and C. Messick, "Application of a zero-latency whitening filter to compact binary coalescence gravitational-wave searches", *Physical Review D*, vol. 97, no. 10, May 2018.

- [22] **L. Tsukada**, T. Callister, A. Matas, and P. Meyers, “First search for a stochastic gravitational-wave background from ultralight bosons”, *Physical Review D*, vol. 99, no. 10, May 2019.
- [23] C. Hanna, S. Caudill, C. Messick, A. Reza, S. Sachdev, **L. Tsukada**, K. Cannon, K. Blackburn, J. D. E. Creighton, H. Fong, P. Godwin, S. Kapadia, T. G. F. Li, R. Magee, D. Meacher, D. Mukherjee, A. Pace, S. Privitera, R. K. L. Lo, and L. Wade, “Fast evaluation of multidetector consistency for real-time gravitational wave searches”, *Physical Review D*, vol. 101, no. 2, 2020.
- [24] S. Sachdev, R. Magee, C. Hanna, K. Cannon, L. Singer, J. R. SK, D. Mukherjee, S. Caudill, C. Chan, J. D. E. Creighton, B. Ewing, H. Fong, P. Godwin, R. Huxford, S. Kapadia, A. K. Y. Li, R. K. L. Lo, D. Meacher, C. Messick, S. R. Mohite, A. Nishizawa, H. Ohta, A. Pace, A. Reza, B. S. Sathyaprakash, M. Shikauchi, D. Singh, **L. Tsukada**, D. Tsuna, T. Tsutsui, and K. Ueno, “An early-warning system for electromagnetic follow-up of gravitational-wave events”, *The Astrophysical Journal*, vol. 905, no. 2, p. L25, Dec. 2020.
- [25] C. Chan, K. Cannon, S. Caudill, H. Fong, P. Godwin, C. Hanna, S. Kapadia, R. Magee, D. Meacher, C. Messick, S. R. Mohite, S. Morisaki, D. Mukherjee, A. Nishizawa, H. Ohta, A. Pace, S. Sachdev, M. Shikauchi, L. Singer, **L. Tsukada**, D. Tsuna, T. Tsutsui, and K. Ueno, “Improving the background estimation technique in the gstlal inspiral pipeline with the time-reversed template bank”, Sep. 2020. eprint: 2009.03025.

COLLABORATION PUBLICATIONS (MAJOR CONTRIBUTION)

- [26] B. P. Abbott *et al.*, “Search for anisotropic gravitational-wave backgrounds using data from advanced ligo and advanced virgo’s first three observing runs”, *Phys. Rev. D*, vol. 104, p. 022005, 2 Jul. 2021.
- [27] B. P. Abbott *et al.*, “Gwtc-2: Compact binary coalescences observed by ligo and virgo during the first half of the third observing run”, *Physical Review X*, vol. 11, no. 2, 2021.
- [28] B. P. Abbott *et al.*, “Observation of gravitational waves from two neutron star–black hole coalescences”, *The Astrophysical Journal Letters*, vol. 915, no. 1, p. L5, Jun. 2021.