

EMPLOYMENT

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

EDUCATION

The University of Tokyo Tokyo, Japan
Ph.D. in Physics, Advisor: Prof.Kipp Cannon 2018–2021
– Thesis title : Modeling and Searching for Stochastic Gravitational-waves Backgrounds from Ultralight Boson Particles

The University of Tokyo Tokyo, Japan
M.S. in Physics, Advisor: Prof.Kipp Cannon 2016–2018
– Thesis title : Towards a Search for Stochastic Gravitational-Wave Backgrounds from Ultra-light Bosons

The University of Tokyo Tokyo, Japan
B.S. in Applied Physics, Advisor: Prof.Norikatsu Mio 2011–2016
– Thesis title : Performance evaluation of the frequency reference cavity for KAGRA detector

RESEARCH EXPERIENCE

Pennsylvania State University University Park, PA
2021–present
– Development of a low-latency gravitational wave (GW) search pipeline, GstLAL
– Bayesian parameter estimation for targeted anisotropic GW background

Research Center for the Early Universe, The University of Tokyo Tokyo, Japan
M.S./Ph.D. Research, supervised by Prof.Kipp Cannon 2016–2021
– Fast evaluation of trigger consistency between multiple detectors using GstLAL
– Searches for ultra-light bosons using stochastic GW background

LIGO Lab, California Institute of Technology Pasadena, CA
LIGO visitor program, hosted by Prof.Alan Weinstein Summer 2019
– 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

Laboratoire d’Annecyde Physiquesdes Particules Annecy, France
Visiting research, supervised by Dr.Tania Regimbau Fall 2018
– Mock data study for the detection of stochastic GW background from anisotropically distributed compact binary coalescence.

University of Minnesota Minneapolis, MN
Visiting research, supervised by Prof.Vuk Mandic Spring 2018
– Development of a search pipeline for GW background from ultra-light scalar fields.

The University of Tokyo Tokyo, Japan
B.S. Research, supervised by Prof.Norikatsu Mio 2015–2016
– Evaluating optical properties and frequency stability of the reference cavity KAGRA.

- Constructing the theoretical model of the optical loss inside the arm cavities of the Advanced LIGO.

TEACHING EXPERIENCE

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

FELLOWSHIP 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, PANEL, SYMPOSIUM

- Overview and prospect of the GW transient search in the fourth observing run* 2024
The extreme Universe : CTA-Japan workshop Tokyo, Japan
- Toward unified Bayesian parameter inference of stochastic gravitational wave backgrounds* 2023
LIGO seminar, California Institute of Technology Pasadena, USA
- The improvement of GstLAL's ranking statistics toward the fourth observing run* 2023
Utrecht & UMass Dartmouth joint seminar USA (online)
- Overview and future prospect of LIGO-Virgo-KAGRA's fourth observing run* 2023
Astronomy Society of Japan Autumn meeting Nagoya, Japan
- Toward unified Bayesian parameter inference of stochastic gravitational wave backgrounds* 2023
C-lab seminar, Nagoya University Nagoya, Japan
- Panel for gravitational waves and multi-messenger astronomy* 2023
New Evolution of Multi-Messenger Astrophysics, Penn State State College, USA
- Observation of neutron stars during LIGO-Virgo-KAGRA's observing runs* 2022
APS April meeting New York, USA
- Modeling and searching for a stochastic GW background from ultralight bosons* 2021
GW Physics and Astronomy: Genesis, The Fourth Annual Area Symposium Japan (online)
- Low-latency detection of the GWs from compact binary coalescences* 2022
ISAS seminar, ISM astronomy seminar, JGW seminar Japan
- Gravitational waves from neutron star-black hole coalescences* 2021
LIGO-Virgo-KAGRA Collaboration webinar

<i>First observations of black hole and neutron star mergers</i> Fundamental Theory Seminar, Penn State	2021 Pennsylvania, USA
<i>First search for stochastic GW backgrounds from ultra-light bosons</i> The CGCA seminar, University of Wisconsin Milwaukee	2018 Wisconsin, USA
<i>Application of a low-latency whitening filter to CBC GW searches</i> RESCEU joint seminar, The University of Tokyo	2016 Tokyo, Japan

SELECTED CONTRIBUTED TALKS

<i>The improvement of GstLAL's ranking statistics toward the fourth observing run</i> APS April meeting	2023 Minnesota, USA
<i>First observations of black hole and neutron star mergers</i> The 8th KAGRA International Workshop	2021 Korea (online)
<i>Modeling and searching for a stochastic GW background from ultralight bosons</i> Amaldi 14	2021 Australia (online)
<i>Stochastic GW backgrounds from ultra-light vectors</i> The 29th Workshop on General Relativity and Gravitation in Japan	2019 Kobe, Japan
<i>Anisotropic GW background Mock data study</i> Gravitational Wave Physics and Astronomy Workshop	2019 Tokyo, Japan
<i>A first search for stochastic GW backgrounds from ultra-light scalars</i> Gravitational Wave Physics and Astronomy Workshop	2018 Maryland, USA
<i>Application of a low-latency whitening filter to CBC GW searches</i> The Third KAGRA International Workshop	2017 Taipei, Taiwan

MENTORING EXPERIENCE

- **Soichiro Kuwahara** Ph.D student at The University of Tokyo spring 2022 - present
GPU-accelerated parameter estimation for anisotropic gravitational-wave backgrounds
- **Santiago Jaraba** Ph.D student at Universidad Aut'onoma de Madrid spring 2022 - present
Parameter estimation for anisotropic gravitational-wave backgrounds [13]
- **Deepali Agarwal** Ph.D student at IUCAA spring 2022 - present
Parameter estimation for anisotropic gravitational-wave backgrounds [13]
- **Erik Floden** Ph.D student at University of Minnesota spring 2021 - present
Parameter estimation and spherical-harmonics searches of anisotropic gravitational-wave backgrounds [13], [16], [29]
- **Anarya Ray** Ph.D student at University of Wisconsin-Milwaukee spring 2022 - spring 2023
Improving background sampling procedure for GstLAL
- **Richard George** Ph.D student at The University of Texas at Austin spring 2022 - spring 2023
Improving SNR – ξ^2 signal model of GstLAL [9]
- **Andre Guimaraes** Ph.D student at Louisiana State University spring 2022 - spring 2023
Improving SNR – ξ^2 signal model of GstLAL [9]
- **Shio Sakon** Ph.D student at Pennsylvania State University spring 2022
Optimization of GstLAL's template bank [2]
- **Shomik Adhicary** Ph.D student at Pennsylvania State University spring 2022 - present
Improving ranking statistics for gravitational-wave detection pipeline, GstLAL [9]
- **Prathamesh Joshi** Ph.D student at Pennsylvania State University spring 2022 - present

Implementation of contamination removal and bank- ξ^2 statistics in GstLAL [7], [9]

- **Takuya Tsutsui** Ph.D student at The University of Tokyo 2019
Rapid localization of gravitational wave sources [20]

PROFESSIONAL SERVICE

- **Thesis committee** : Pennsylvania State University 2023–2023
- **Co-leader of anisotropic stochastic-background working group** : LVK Collaboration 2022–present
- **Referee** : Physical Review D, Physical Review Letter 2022–present
- **Advanced LIGO science summaries** : Writer and japanese translator 2021–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] B. Ewing, R. Huxford, D. Singh, **L. Tsukada**, *et al.*, “Performance of the low-latency gstlal inspiral search towards ligo, virgo, and kagra’s fourth observing run”, *Physical Review D*, vol. 109, no. 4, Feb. 2024.
- [2] S. Sakon, **L. Tsukada**, *et al.*, “Template bank for compact binary mergers in the fourth observing run of advanced ligo, advanced virgo, and kagra”, *Physical Review D*, vol. 109, no. 4, Feb. 2024.
- [3] S. Schmidt, S. Caudill, J. D. E. Creighton, R. Magee, **L. Tsukada**, *et al.*, *Searching for gravitational-wave signals from precessing black hole binaries with the gstlal pipeline*, 2024. arXiv: 2403.17186 [gr-qc].
- [4] 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”, *Phys. Rev. D*, vol. 108, p. 123 040, 12 Dec. 2023.
- [5] **L. Tsukada**, “Extension of the bayesian searches for anisotropic stochastic gravitational-wave background with nontensorial polarizations”, *Physical Review D*, vol. 108, no. 12, Dec. 2023.
- [6] S. Banagiri, C. P. L. Berry, G. S. C. Davies, **L. Tsukada**, and Z. Doctor, “Unified p_{astro} for gravitational waves: Consistently combining information from multiple search pipelines”, *Phys. Rev. D*, vol. 108, p. 083 043, 8 Oct. 2023.
- [7] P. Joshi, **L. Tsukada**, and C. Hanna, “Method for removing signal contamination during significance estimation of a gstlal analysis”, *Phys. Rev. D*, vol. 108, p. 084 032, 8 Oct. 2023.
- [8] S. S. Chaudhary, *et al.* including **L. Tsukada**, *Low-latency gravitational wave alert products and their performance in anticipation of the fourth ligo-virgo-kagra observing run*, Aug. 2023. arXiv: 2308.04545 [astro-ph.HE].
- [9] **L. Tsukada**, P. Joshi, *et al.*, “Improved ranking statistics of the gstlal inspiral search for compact binary coalescences”, *Physical Review D*, vol. 108, no. 4, Aug. 2023.
- [10] A. Renzini, *et al.* including **L. Tsukada**, “Pygwb: A python-based library for gravitational-wave background searches”, *The Astrophysical Journal*, vol. 952, no. 1, p. 25, Jul. 2023.
- [11] A. Ray, *et al.* including **L. Tsukada**, *When to point your telescopes: Gravitational wave trigger classification for real-time multi-messenger followup observations*, Jun. 2023. arXiv: 2306.07190 [gr-qc].
- [12] B. Ewing, R. Huxford, D. Singh, **L. Tsukada**, *et al.*, *Performance of the low-latency gstlal inspiral search towards ligo, virgo, and kagra’s fourth observing run*, May 2023. arXiv: 2305.05625 [gr-qc].
- [13] **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.
- [14] C. Hanna, *et al.* including **L. Tsukada**, “Binary tree approach to template placement for searches for gravitational waves from compact binary mergers”, *Physical Review D*, vol. 108, no. 4, 2023.
- [15] C. Hanna, *et al.* including **L. Tsukada**, “Metric assisted stochastic sampling search for gravitational waves from binary black hole mergers”, *Physical Review D*, vol. 106, no. 8, Oct. 2022.
- [16] 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.
- [17] K. Cannon, *et al.* including **L. Tsukada**, “Gstlal: A software framework for gravitational wave discovery”, *SoftwareX*, vol. 14, p. 100 680, Jun. 2021, ISSN: 2352-7110.
- [18] D. Mukherjee, *et al.* including **L. Tsukada**, “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, Apr. 2021.

- [19] **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. 083 005, 8 Apr. 2021.
- [20] 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. 043 011, 4 Feb. 2021.
- [21] S. Sachdev, *et al.* including **L. Tsukada**, “An early-warning system for electromagnetic follow-up of gravitational-wave events”, *The Astrophysical Journal*, vol. 905, no. 2, p. L25, Dec. 2020.
- [22] C. Messick, *et al.* including **L. Tsukada**, *Automating the inclusion of subthreshold signal-to-noise ratios for rapid gravitational-wave localization*, Nov. 2020. arXiv: 2011.02457 [astro-ph.IM].
- [23] P. Godwin, *et al.* including **L. Tsukada**, *Incorporation of statistical data quality information into the gstlal search analysis*, Oct. 2020. arXiv: 2010.15282 [gr-qc].
- [24] C. Chan, *et al.* including **L. Tsukada**, “Improving the background estimation technique in the gstlal inspiral pipeline with the time-reversed template bank”, Sep. 2020. eprint: 2009.03025.
- [25] C. Hanna, S. Caudill, C. Messick, A. Reza, S. Sachdev, **L. Tsukada**, *et al.*, “Fast evaluation of multidetector consistency for real-time gravitational wave searches”, *Physical Review D*, vol. 101, no. 2, Jan. 2020.
- [26] **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.
- [27] S. Sachdev, *et al.* including **L. Tsukada**, *The gstlal search analysis methods for compact binary mergers in advanced ligo’s second and advanced virgo’s first observing runs*, Jan. 2019. arXiv: 1901.08580 [gr-qc].
- [28] **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.

COLLABORATION PUBLICATIONS (MAJOR CONTRIBUTION)

- [29] 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. 022 005, 2 Jul. 2021.
- [30] 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, Jun. 2021.
- [31] 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.