

## EMPLOYMENT

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<b>Pennsylvania State University</b>	University Park, PA
Assistant Research Professor	2022–present
Postdoctoral Scholar	2021–2022

## EDUCATION

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<b>The University of Tokyo</b>	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	
<b>The University of Tokyo</b>	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	
<b>The University of Tokyo</b>	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

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<b>Pennsylvania State University</b>	University Park, PA
	2021–present
– Development of a low-latency gravitational wave (GW) search pipeline, GstLAL	
– Bayesian parameter estimation for targeted anisotropic GW background	
<b>Research Center for the Early Universe, The University of Tokyo</b>	Tokyo, Japan
<i>M.S./Ph.D. Research, supervised by Prof.Kipp Cannon</i>	2016–2021
– Fast evaluation of trigger consistency between multiple detectors using GstLAL	
– Searches for ultra-light bosons using stochastic GW background	
<b>LIGO Lab, California Institute of Technology</b>	Pasadena, CA
<i>LIGO visitor program, hosted by Prof.Alan Weinstein</i>	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	
<b>Laboratoire d’Annecyde Physiques des Particules</b>	Annecy, France
<i>Visiting research, supervised by Dr.Tania Regimbau</i>	Fall 2018
– Mock data study for the detection of stochastic GW background from anisotropically distributed compact binary coalescence.	
<b>University of Minnesota</b>	Minneapolis, MN
<i>Visiting research, supervised by Prof.Vuk Mandic</i>	Spring 2018
– Development of a search pipeline for GW background from ultra-light scalar fields.	
<b>The University of Tokyo</b>	Tokyo, Japan
<i>B.S. Research, supervised by Prof.Norikatsu Mio</i>	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>	2021
Fundamental Theory Seminar, Penn State	Pennsylvania, USA
<i>First search for stochastic GW backgrounds from ultra-light bosons</i>	2018
The CGCA seminar, University of Wisconsin Milwaukee	Wisconsin, USA
<i>Application of a low-latency whitening filter to CBC GW searches</i>	2016
RESCEU joint seminar, The University of Tokyo	Tokyo, Japan

## SELECTED CONTRIBUTED TALKS

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

## MENTORING EXPERIENCE

• <b>Soichiro Kuwahara</b> Ph.D student at The University of Tokyo	spring 2022 - present
<i>GPU-accelerated parameter estimation for anisotropic gravitational-wave backgrounds</i>	
• <b>Santiago Jaraba</b> Ph.D student at Universidad Aut'onoma de Madrid	spring 2022 - present
<i>Parameter estimation for anisotropic gravitational-wave backgrounds [12]</i>	
• <b>Deepali Agarwal</b> Ph.D student at IUCAA	spring 2022 - present
<i>Parameter estimation for anisotropic gravitational-wave backgrounds [12]</i>	
• <b>Erik Floden</b> Ph.D student at University of Minnesota	spring 2021 - present
<i>Parameter estimation and spherical-harmonics searches of anisotropic gravitational-wave backgrounds [12], [15], [28]</i>	
• <b>Anarya Ray</b> Ph.D student at University of Wisconsin-Milwaukee	spring 2022 - spring 2023
<i>Improving background sampling procedure for GstLAL</i>	
• <b>Richard George</b> Ph.D student at The University of Texas at Austin	spring 2022 - spring 2023
<i>Improving SNR – <math>\xi^2</math> signal model of GstLAL [8]</i>	
• <b>Andre Guimaraes</b> Ph.D student at Louisiana State University	spring 2022 - spring 2023
<i>Improving SNR – <math>\xi^2</math> signal model of GstLAL [8]</i>	
• <b>Shio Sakon</b> Ph.D student at Pennsylvania State University	spring 2022
<i>Optimization of GstLAL's template bank [2]</i>	
• <b>Shomik Adhicary</b> Ph.D student at Pennsylvania State University	spring 2022 - present
<i>Improving ranking statistics for gravitational-wave detection pipeline, GstLAL [8]</i>	
• <b>Prathamesh Joshi</b> Ph.D student at Pennsylvania State University	spring 2022 - present

*Implementation of contamination removal and bank- $\xi^2$  statistics in GstLAL [6], [8]*

- **Takuya Tsutsui** Ph.D student at The University of Tokyo 2019  
*Rapid localization of gravitational wave sources [19]*

## PROFESSIONAL SERVICE

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- **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

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- **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. 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.
- [4] **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.
- [5] S. Banagiri, C. P. L. Berry, G. S. C. Davies, **L. Tsukada**, and Z. Doctor, “Unified  $p_{\text{astro}}$  for gravitational waves: Consistently combining information from multiple search pipelines”, *Phys. Rev. D*, vol. 108, p. 083 043, 8 Oct. 2023.
- [6] 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.
- [7] 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].
- [8] **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.
- [9] 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.
- [10] 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].
- [11] 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].
- [12] **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.
- [13] 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.
- [14] 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.
- [15] 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.
- [16] 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.
- [17] 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.
- [18] **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.

- [19] 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.
- [20] 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.
- [21] 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].
- [22] 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].
- [23] 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.
- [24] 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.
- [25] **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.
- [26] 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].
- [27] **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)

- [28] 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.
- [29] 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.
- [30] 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.