YOTA MAEDA

ALEXANDER VON HUMBOLDT FOUNDATION POSTDOCTORAL FELLOW
TECHNISCHE UNIVERSITÄT DARMSTADT

Education

Apr 2019- Mar 2023: Ph.D. course in Mathematics, Kyoto University in Japan (Early graduation)

Advisor: Tetsushi Ito.

Thesis: Birational geometry and compactifications of modular varieties and arithmetic of modular forms

Apr 2015- Mar 2019: Undergraduate course in Science, Kyoto University in Japan.

Employment

Apr 2025 - current: Tohoku University, Japan, visiting researcher

Mar 2025 - current: Technische Universität Darmstadt, Germany, Alexander von Humboldt Foundation Postdoctoral Fellow

Sep 2022 - Feb 2025: Quantum Computing Center, Keio University, Japan, researcher.

Apr 2021 - Feb 2025: Advanced Research Laboratory, Research Platform, Sony Group Corporation, Japan, researcher.

Others

Reviewer of zbMATH

Research Interests

His research interests lie widely in mathematical science. It ranges from arithmetic geometry (Shimura varieties, Kodaira dimensions and modular forms) to their application to quantum computing and machine learning. For details, see my interview.

Grants

- Mar 2025 - current: **Alexander von Humboldt Foundation Postdoctoral Fellowship**, "Birational geometry of moduli spaces, arithmetic of Shimura varieties and

their compactifications in terms of the construction and investigation of modular forms", total 84,000 EUR, acceptance rate 20-25%.

- Nov 2020 - Mar 2023: **Japan Science and Technology Agency, ACT-X**: JPMJAX200P (A solution to Kudla's modularity conjecture, a study of Shimura varieties and their applications to the post-quantum cryptography, total 5,850,000 yen, acceptance rate 13.3%, Youngest recipient).
- Apr 2021: **Japan Society for the Promotion of Science, Research Fellowship for Young Scientist DC1** (acceptance rate 20.4%, declined).

Personal

Japanese: mother tongue
English: fluent
Germany: ein wenig (A1)
Birthdate: March 11, 1997

E-mail address y.maeda.math@gmail.com

Skills

- Programming (C++, Python)
- Research experience on machine learning, cryptography and quantum computing

Academic Stay in Foreign Countries (Records from when registered in Japan)

- November, 2019 (3 weeks): University of Toronto, Canada
- May and September, 2022 (3 weeks & 2 weeks): Leibniz University Hannover, Germany
- September, 2022 (2 weeks): University of Bath, the UK
- January, 2023 (1 week): National University of Taiwan, Taiwan
- October, 2023 (2 weeks): Mathematisches Forschungsinstitut Oberwolfach, Germany
- January, 2024 (1 week): Taiwan
- February, 2024 (2 weeks): Vancouver
- September, 2024 (1 week): Montreal

Teaching Experience

- 2019-2021: Teaching Assistant at Kyoto University
- 2024: Lecturer at Sony

Outreach activities

JST CREST: Mathematics caravan, expanding Mathematics in Kyoto (2024)

Work

0. Thesis

[1] **Yota Maeda**,
Birational geometry and compactifications of modular varieties and arithmetic of modular forms,
Ph.D. thesis, Kyoto University (2023),
Kyoto University Repository

1. Publications

Journal articles.

[2] **Yota Maeda**,
The modularity of special cycles on orthogonal Shimura varieties over totally real fields under the Beilinson-Bloch conjecture,
Canad. Math. Bull. 64 (2021), no. 1, 39–53.
DOI:10.4153/S000843952000020X

[3] **Yota Maeda**,
Modularity of special cycles on unitary Shimura varieties over CM-fields,
Acta Arith. 204 (2022), no. 1, 1–18.
DOI:10.4064/aa210202-12-4

[4] **Yota Maeda**, Yuji Odaka,
Fano Shimura varieties with mostly branched cusps,
Springer Proceedings in Mathematics & Statistics (PROMS, Vol. 409), 2023, 633–664.
DOI:10.1007/978-3-031-17859-7

[5] **Yota Maeda**,
Irregular cusps of ball quotients,
Math. Nachr. (2023), 1–29.
DOI:10.1002/mana.202100639

[6] **Yota Maeda**,
Reflective obstructions of unitary modular varieties,
J. Algebra 647 (2024), 341–399.
DOI:10.1016/j.jalgebra.2024.02.031

[7] **Yota Maeda**,
Uniruledness of some low-dimensional ball quotients,
Geom. Dedicata 218 (2024), Article no. 3, 17 pages.
DOI:10.1007/s10711-023-00844-5

[8] Klaus Hulek, **Yota Maeda**,
Revisiting the moduli space of 8 points on $\mathbb{P}^1$,
Adv. Math. 463 (2025), 41 pages.
DOI:10.1016/j.aim.2025.110126

[9] **Yota Maeda**, Hideaki Kawaguchi, Hiroyuki Tezuka,
Estimation of mutual information via quantum kernel methods,
Quant. Mach. Intell. 7, Article 29 (2025), 20 pages.
DOI:10.1007/s42484-025-00263-7

[10] Yuta Kamba, **Yota Maeda**, Tristan Vaccon,
Geometric Generality of Transformer-Based Gröbner Basis Computation,
to appear in **Contemp. Math. AMS.**, 2025 (19 pages).
Paper

Proceedings with peer-reviewed conferences.

[11] Hiroshi Yano, **Yota Maeda**,
Generalization capacity of singular models in quantum state estimation,
Quantum Techniques in Machine Learning, (**QTML2024**).
Paper

[12] **Yota Maeda**, Ken Arai, Yu Tanaka, Yu Terada, Hiroshi Ueno, Hiroyuki Tezuka,
Quantum PC algorithm: data-efficient and nonlinear causal discovery,
IEEE Quantum Computing and Engineering (**IEEE QCE2024**).
DOI:10.1109/QCE60285.2024.10322

[13] Masakazu Yoshimura, Teruaki Hayashi, **Yota Maeda**,
MambaPEFT: Exploring Parameter-Efficient Fine-Tuning for Mamba,
International Conference on Learning Representations (**ICLR2025**).
Paper

Preprints.

[14] Klaus Hulek, **Yota Maeda**, Shigeyuki Kondō,
Compactifications of the Eisenstein ancestral Deligne-Mostow variety,
arXiv, 2024 (50 pages).
arXiv:2403.18345

[15] Hiroshi Yano*, **Yota Maeda***, Naoki Yamamoto,
Statistical inference for quantum singular models,
arXiv, 2024 (57 pages, equal contribution).
arXiv:2411.16396

[16] Klaus Hulek, **Yota Maeda**,
The Universe of Deligne-Mostow Varieties,
arXiv, 2025 (23 pages).
arXiv:2504.16235

[17] **Yota Maeda**, Kazuma Ohara,
Finiteness of Free Algebras of Modular Forms on Unitary Groups,
arXiv, 2025 (44 pages).
arXiv:2505.13698

[18] Shuji Horinaga, **Yota Maeda**, Takuya Yamauchi,
The Kodaira dimension of even-dimensional ball quotients,
arXiv, 2025 (48 pages).
arXiv:2507.22203

[19] **Yota Maeda**, Ken Arai, Yu Tanaka, Yu Terada, Hiroshi Ueno, Hiroyuki Tezuka,
Quantum-enhanced causal discovery for a small number of samples,
arXiv, 2025 (19 pages).
arXiv:2501.05007

Proceedings with no peer-reviewed conferences.

[20] **前田　洋太**,
The local Langlands conjecture for GL_n,
第 2 回数理新人セミナー報告集 (2019 年).

[21] **Yota Maeda**,
On the modularity of special cycles on orthogonal Shimura varieties,
RIMS 共同研究 (公開型)「保型形式と L 関数の解析的、幾何的 p 進的研究」講究録 (2020 年).

[22] **前田　洋太**,
On the modularity of special cycles on Shimura varieties,
第 3 回数理新人セミナー報告集 (2020 年).

[23] **Yota Maeda**,
Uniruledness of some unitary Shimura varieties,
代数幾何学シンポジウム報告集 (Kyoto University Research Information Repository (2020 年).

[24] **Yota Maeda**,
ユニタリ型志村多様体の小平次元について,
RIMS 共同研究 (公開型)「保型形式、保型表現、ガロア表現とその周辺」講究録 (2021 年).

[25] **前田　洋太**,
The Kodaira dimension of modular varieties,
第 4 回数理新人セミナー報告集 (2021 年).

2. Talks

Talks(International conferences, seminars，English).

[1] **Yota Maeda**,
On the modularity of special cycles on orthogonal Shimura varieties,
RIMS 共同研究 (公開型)「保型形式と L 関数の解析的, 幾何的, p 進的研究」(京都大学), 2020.1.21.

[2] **Yota Maeda**,
On the Kodaira dimension of unitary Shimura varieties,
Hannover Algebraic Geometry Seminar (Zoom meeting), 2020.11.26 (招待講演).

[3] **Yota Maeda**,
On the Kodaira dimension of unitary Shimura varieties,
RIMS 共同研究 (公開型)「保型形式, 保型表現, ガロア表現とその周辺」(Zoom meeting), 2021.1.28 (招待講演).

[4] **Yota Maeda**,
The Hirzebruch-Mumford volume of unitary groups and its application to the geometry of ball quotients,
Research Seminar Number Theory and Arithmetic Geometry (Leibniz University Hannover), 2022.5.27 (招待講演).

[5] **Yota Maeda**,
Deligne-Mostow theory and beyond,
East Asia Core Doctoral Forum in Mathematics (National Center for Theoretical Sciences, Taipei), 2023.1.9 (招待講演).

[6] **Yota Maeda**,
Deligne-Mostow theory and beyond,
International Seminar on Automorphic Forms (Zoom meeting), 2023.1.10 (招待講演).

[7] Hiroshi Yano, **Yota Maeda**,
A quantum widely applicable information criterion for quantum state estimation,
Joint Symposium on Quantum Computing 2024 at National Taiwan University, 2024.08.24 (招待講演).

[8] **Yota Maeda**, et al.,
Quantum PC algorithm: data-efficient and nonlinear causal discovery,
IEEE International Conference on Quantum Computing and Engineering, 2024.09.15.

[9] Hiroshi Yano, **Yota Maeda**,
Generalization capacity of singular models in quantum state estimation,
Quantum Techniques in Machine Learning (QTML2024), 2024.11.25.

[10] **Yota Maeda**,
Geometric Foundations for Transformer in Gröbner Basis Computation,
30th Applications of Computer Algebra (ACA 2025), 2025.07.14.

[11] **Yota Maeda**,
On the Kodaira dimension of even-dimensional ball quotients,
Algebraic geometry seminar at Heidelberg university, 2025.07.29（招待講演）.

[12] **Yota Maeda**,
Deep learning and algbraic geometry,
informal seminar at TU Ilmenau, 2025.08.05（招待講演）.

[13] **Yota Maeda**,
The Kodaira dimension of ball quotients via automorphic representation theory,
International Workshop on Automorphic Forms at SwissMAP, 2025.09.04.

[14] **Yota Maeda**,
On the Kodaira dimension of even-dimensional ball quotients,
Pure mathematics seminar at University of Nottingham, 2025.09.16（招待講演）.

Talks（Domestic conferences, seminars, Japanese）.

[15] **前田　洋太**,
The local Langlands conjecture for $\mathrm{GL_n}$,
第 2 回数理新人セミナー（京都大学）, 2019.2.11.

[16] **前田　洋太**,
直交型志村多様体上の特殊サイクルが生成する形式的べき級数の保型性について,
数論合同セミナー（京都大学）, 2019.10.25.

[17] **前田　洋太**,
On the modularity of special cycles on Shimura varieties,
第 3 回数理新人セミナー（名古屋大学）, 2020.2.9.

[18] **前田　洋太**,
On the singularities of unitary Shimura varieties and their applications to the Kodaira dimension,
第 19 回仙台広島整数論集会（Zoom meeting）, 2020.9.8.

[19] **前田　洋太**,
Uniruledness of some unitary Shimura varieties,
城崎代数幾何学シンポジウム 2020（Zoom meeting）, 2020.10.21.

[20] **前田　洋太**,
The Kodaira dimension of modular varieties,
第 4 回数理新人セミナー（Zoom meeting）, 2021.2.10.

[21] **前田　洋太**,
Fano Shimura varieties with mostly branched cusps,
Friday Tea Time Zoom Seminar（Zoom meeting）, 2021.7.9（招待講演）.

[22] **前田　洋太**,
Fano Shimura varieties and special modular forms,
九州代数的整数論 2021 夏 on Zoom（Zoom meeting）, 2021.9.27（招待講演）.

[23] **前田　洋太**,
Irregular cusps and Kodaira dimension of unitary modular varieties,
金沢整数論オータムワークショップ 2021（金沢大学）, 2021.10.19（招待講演）.

[24] **前田　洋太**,
Big line bundles on ball quotients,
仙台保型形式小集会（東北大学）, 2022.1.21（招待講演）.

[25] **前田　洋太**,
The Hirzebruch-Mumford volume of unitary groups and its application to birational types of ball quotients,
代数幾何学セミナー（名古屋大学）, 2022.5.12（招待講演）.

[26] **前田　洋太**,
ユニタリ群の体積とボール商の幾何について,
大阪大学整数論＆保型形式セミナー（大阪大学）, 2022.6.24（招待講演）.

[27] **前田　洋太**,
On the geometry of higher dimensional ball quotients,
第 21 回仙台広島整数論集会（東北大学）, 2022.7.12.

[28] **前田　洋太**,
Deligne-Mostow theory and beyond,
数学科談話会（東京理科大学）, 2022.12.21（招待講演）.

[29] **前田　洋太**,
Revisiting the moduli space of 8 points on $\mathbb{P}^1$,
仙台保型形式小集会（東北大学）, 2023.2.4（招待講演）.

[30] **前田　洋太**,
Modular interpretation of the moduli spaces of weighted pointed stable rational curves,
Number Theory Seminar（早稲田大学）, 2023.3.30（招待講演）.

[31] **前田　洋太**,
Modular interpretation of the moduli spaces of weighted pointed stable rational curves,
名古屋代数幾何セミナー（名古屋大学）, 2023.7.10（招待講演）.

[32] **前田　洋太**,
Extendability of the period maps on $M_{0,n}$,
津田整数論ワークショップ（津田塾大学）, 2023.11.18（招待講演）.

[33] **前田　洋太**,
Extendability of the period maps on $M_{0,n}$,
数論合同セミナー（京都大学）, 2023.12.1（招待講演）.

[34] **前田　洋太**,
Extendability of the period maps on $M_{0,n}$,
仙台保型形式小集会（東北大学）, 2024.2.3（招待講演）.

[35] **前田　洋太**,
Volume formulae for algebraic groups,
仙台保型形式小集会（東北大学）, 2025.2.9（招待講演）.

Presentations（Others）.

[36] **前田　洋太**,
モジュラー多様体とモジュラー形式〜整数論と代数幾何学の交わり〜,
京都大学学生談話会（Zoom meeting）, 2021 年 10 月 7 日（招待講演）.

[37] **前田　洋太**,
Eichler orders and the Deuring correspondence,
ラマヌジャン・グラフの整数論による耐量子計算機暗号へのアプローチ（九州大学 IMI）, 2021 年 12 月 14 日（招待講演）.

[38] **前田　洋太**,
Deligne-Mostow theory and beyond,
数学と諸分野の連携に向けた若手数学者交流会（AP 市ヶ谷，ポスター発表）, 2023 年 3 月 13–14 日（招待講演）.

[39] **前田　洋太**,
AI 成果発表,
第 6 回量子コンピュータ最前線, 2024 年 10 月 24 日（招待講演）,
参考.

[40] **前田　洋太**,
暗号と量子コンピュータの数理,
JST 数学キャラバン 2024, 2024 年 12 月 21 日（招待講演）,
JST 公式サイト.

[41] **Yota Maeda**,
The Kodaira Dimension of Ball Quotients via Automorphic Representation Theory,
Summer school on the Siegel-Weil formula, ポスター発表 (2025 年 9 月 29 日)

3. Patents

[1] DETERMINATION DEVICE AND DETERMINATION METHOD
[2] VERIFICATION DEVICE AND VERIFICATION METHOD
[3] INFORMATION PROCESSING METHOD, INFORMATION PROCESSING SYSTEM, AND PROGRAM