

# So Chigusa

## Curriculum Vitae

77 Massachusetts Avenue, Cambridge, MA 02139 / (617)253-4800 / schigusa@mit.edu

### EDUCATION

- 2020 Ph.D. in Physics, Department of Physics, University of Tokyo
- 2017 M.S. in Physics, Department of Physics, University of Tokyo
- 2015 B.S. in Physics, Department of Physics, University of Tokyo

### PROFESSIONAL APPOINTMENTS

- 2024 Postdoctoral Fellow, Massachusetts Institute of Technology
- 2020 Postdoctoral Fellow, Lawrence Berkeley National Laboratory
- 2020 Postdoctoral Fellow, High Energy Accelerator Research Organization (KEK)

### AWARDS AND HONORS

- 2020 Best presentation award for young scientists for Unraveling the History of the Universe 2020
- 2019 Best Poster Award for HPNP 2019

### GRANTS AND FELLOWSHIPS

- 2020 Research Fellowships for Young Scientists (PD), JSPS (3100000 JPY)
- 2017 Research Fellowships for Young Scientists (DC1), JSPS (2800000 JPY)
- 2015 Program for Leading Graduate Schools, MEXT

### TEACHING EXPERIENCES

- 2015 Teaching Assistant for an undergraduate course “Quantum Mechanics II”, Department of Physics, University of Tokyo, Apr.–Sep.

### PUBLICATIONS

- [1] S. Chigusa, S. Girmohanta, Y. Nakai and Y. Zhang, *Interplay of ALP Couplings at a Muon Collider*, 2502.18912.
- [2] E.D. Herbschleb, S. Chigusa, R. Kawase, H. Kawashima, M. Hazumi, K. Nakayama et al., *Robust sensing via the standard deviation with a quantum sensor*, *APL Quantum* **1** (2024) 046106.

- [3] T. Sichanugrist, H. Fukuda, T. Moroi, K. Nakayama, S. Chigusa, N. Mizuochi et al., *Entanglement-enhanced AC magnetometry in the presence of Markovian noises*, 2410.21699.
- [4] S. Chigusa, M. Hazumi, E.D. Herbschleb, Y. Matsuzaki, N. Mizuochi and K. Nakayama, *Nuclear Spin Metrology with Nitrogen Vacancy Center in Diamond for Axion Dark Matter Detection*, 2407.07141.
- [5] C.W. Bauer, S. Chigusa and M. Yamazaki, *Quantum parton shower with kinematics*, *Phys. Rev. A* **109** (2024) 032432 [2310.19881].
- [6] S. Chigusa, A. Ito, K. Nakayama and V. Takhistov, *Effects of finite material size on axion-magnon conversion*, *JHEP* **01** (2024) 185 [2310.17704].
- [7] S. Chigusa, S. Girmohanta, Y. Nakai and Y. Zhang, *Aiming for tops of ALPs with a muon collider*, *JHEP* **01** (2024) 077 [2310.11018].
- [8] S. Chigusa, D. Kondo, H. Murayama, R. Okabe and H. Sudo, *Axion detection via superfluid  $^3\text{He}$  ferromagnetic phase and quantum measurement techniques*, *JHEP* **09** (2024) 191 [2309.09160].
- [9] S. Chigusa, T. Moroi, K. Nakayama and T. Sichanugrist, *Dark matter detection using nuclear magnetization in magnet with hyperfine interaction*, *Phys. Rev. D* **108** (2023) 095007 [2307.08577].
- [10] S. Chigusa, T. Moroi and Y. Shoji, *Stability of electroweak vacuum and supersymmetric contribution to muon  $g - 2$* , *JHEP* **11** (2023) 027 [2306.16596].
- [11] S. Chigusa, M. Hazumi, E.D. Herbschleb, N. Mizuochi and K. Nakayama, *Light Dark Matter Search with Nitrogen-Vacancy Centers in Diamonds*, 2302.12756.
- [12] S. Chigusa and M. Yamazaki, *Quantum simulations of dark sector showers*, *Phys. Lett. B* **834** (2022) 137466 [2204.12500].
- [13] S. Chigusa, T. Moroi and Y. Shoji, *Upper bound on the smuon mass from vacuum stability in the light of muon  $g-2$  anomaly*, *Phys. Lett. B* **831** (2022) 137163 [2203.08062].
- [14] S. Chigusa, S. Li, Y. Nakai, W. Zhang, Y. Zhang and J. Zheng, *Deeply learned preselection of Higgs dijet decays at future lepton colliders*, *Phys. Lett. B* **833** (2022) 137301 [2202.02534].

- [15] S. Chigusa, K. Hamaguchi, T. Moroi, A. Niki and K. Ono, *Studying squark mass spectrum through gluino decay at 100 TeV future hadron colliders*, *Phys. Lett. B* **817** (2021) 136332 [2102.07910].
- [16] S. Chigusa, T. Moroi and K. Nakayama, *Axion/hidden-photon dark matter conversion into condensed matter axion*, *JHEP* **08** (2021) 074 [2102.06179].
- [17] S. Chigusa, Y. Nakai and J. Zheng, *Implications of gravitational waves for supersymmetric grand unification*, *Phys. Rev. D* **104** (2021) 035031 [2011.04090].
- [18] S. Chigusa, T. Moroi and Y. Shoji, *Precise Calculation of the Decay Rate of False Vacuum with Multi-Field Bounce*, *JHEP* **11** (2020) 006 [2007.14124].
- [19] S. Chigusa, M. Endo and K. Kohri, *Constraints on electron-scattering interpretation of XENON1T excess*, *JCAP* **10** (2020) 035 [2007.01663].
- [20] S. Chigusa, T. Moroi and K. Nakayama, *Detecting light boson dark matter through conversion into a magnon*, *Phys. Rev. D* **101** (2020) 096013 [2001.10666].
- [21] S. Chigusa, *Probing Electroweakly Interacting Massive Particles with Drell-Yan Process at 100 TeV Colliders*, Ph.D. thesis, Tokyo U., 2020.
- [22] S. Chigusa, Y. Hosomi, T. Moroi and M. Saito, *Determining Wino Lifetime in Supersymmetric Model at Future 100 TeV pp Colliders*, *Phys. Lett. B* **803** (2020) 135260 [1912.00592].
- [23] S. Chigusa, T. Moroi and K. Nakayama, *Signals of Axion Like Dark Matter in Time Dependent Polarization of Light*, *Phys. Lett. B* **803** (2020) 135288 [1911.09850].
- [24] S. Chigusa, T. Moroi and Y. Shoji, *Bounce Configuration from Gradient Flow*, *Phys. Lett. B* **800** (2020) 135115 [1906.10829].
- [25] S. Chigusa, S. Kasuya and K. Nakayama, *Novel Flavon Stabilization with Trimaximal Neutrino Mixing*, *Phys. Rev. D* **100** (2019) 015030 [1905.11517].
- [26] T. Abe, S. Chigusa, Y. Ema and T. Moroi, *Indirect studies of electroweakly interacting particles at 100 TeV hadron colliders*, *Phys. Rev. D* **100** (2019) 055018 [1904.11162].
- [27] S. Asai, S. Chigusa, T. Kaji, T. Moroi, M. Saito, R. Sawada et al., *Studying gaugino masses in supersymmetric model at future 100 TeV pp collider*, *JHEP* **05** (2019) 179 [1901.10389].
- [28] S. Chigusa, Y. Ema and T. Moroi, *Probing electroweakly interacting massive particles with Drell–Yan process at 100 TeV hadron colliders*, *Phys. Lett. B* **789** (2019) 106 [1810.07349].

- [29] S. Chigusa, S. Kasuya and K. Nakayama, *Flavon Stabilization in Models with Discrete Flavor Symmetry*, *Phys. Lett. B* **788** (2019) 494 [1810.05791].
- [30] S. Chigusa and K. Nakayama, *Anomalous Discrete Flavor Symmetry and Domain Wall Problem*, *Phys. Lett. B* **788** (2019) 249 [1808.09601].
- [31] S. Chigusa, T. Moroi and Y. Shoji, *Decay Rate of Electroweak Vacuum in the Standard Model and Beyond*, *Phys. Rev. D* **97** (2018) 116012 [1803.03902].
- [32] S. Chigusa, T. Moroi and Y. Shoji, *State-of-the-Art Calculation of the Decay Rate of Electroweak Vacuum in the Standard Model*, *Phys. Rev. Lett.* **119** (2017) 211801 [1707.09301].
- [33] S. Chigusa and T. Moroi, *Bottom-Tau Unification in Supersymmetric  $SU(5)$  Models with Extra Matters*, *PTEP* **2017** (2017) 063B05 [1702.00790].
- [34] S. Chigusa and T. Moroi, *Bottom-tau unification in a supersymmetric model with anomaly-mediation*, *Phys. Rev. D* **94** (2016) 035016 [1604.02156].

## INVITED SEMINAR TALKS

- 2025 “ダイヤモンド中のNV中心を用いた軽い暗黒物質探索: 電子スピン、核スピン、共磁気測定”, Kobe University, Jan 8
- 2024 “Light Dark Matter Search with NV Centers: Electron Spin, Nuclear Spin, and Comagnetometry”, The University of Tokyo, Dec 23
- 2024 “Quantum simulation of parton shower with kinematics”, KIAS QUC-AIHEP, May 28
- 2024 “Light Dark Matter Search with NV Centers: Electron Spin, Nuclear Spin, and Comagnetometry”, University of Minnesota, Apr 19
- 2023 “Light DM Search with Nitrogen-Vacancy Centers in Diamonds”, UC Davis, Nov 13
- 2023 “Vacuum Decay @ NLO: from the SM to a BSM for the muon  $g-2$ ”, KEK IPNS Seminar, Sep 28
- 2023 “Estimating eV-Scale Background Rates for Dark Matter Direct Detection”, KEK Theory Seminar, Sep 26
- 2022 “Quantum Simulations of Dark Sector Showers”, The University of Tokyo, May 23
- 2021 “固体中の「アクシオン」を用いた軽いボソン暗黒物質の直接探索”, Toyama, Kanazawa University, Mar 1
- 2020 “Detecting Light Boson Dark Matter through Conversion into Magnon (Online)”, Nagoya University, Jun 22
- 2020 “Detecting Light Boson Dark Matter through Conversion into Magnon (Online)”, UC Berkeley, Jun 12
- 2020 “Detecting Light Boson Dark Matter through Conversion into Magnon (Online)”, Kyushu University, Jun 2
- 2020 “Detecting Light Boson Dark Matter through Conversion into Magnon (Online)”, IBS, May 20
- 2020 “Detecting Light Boson Dark Matter through Conversion into Magnon (Online)”, TDLI and INPAC, May 14
- 2019 “Flowing to the Bounce”, Tohoku University, Oct 24
- 2019 “Indirect Studies of Electroweakly Interacting Particles at 100 TeV Hadron Colliders”, Osaka University, Jul 23
- 2019 “Indirect Studies of Electroweakly Interacting Particles at 100 TeV Hadron Colliders”, University of Florida, May 16
- 2019 “Indirect Studies of Electroweakly Interacting Particles at 100 TeV Hadron Colliders”, Florida State University, May 10
- 2019 “Indirect Studies of Electroweakly Interacting Particles at 100 TeV Hadron Colliders”, KEK, Apr 9
- 2019 “Solutions to Domain Wall Problem in Models with Discrete Flavor Symmetry”, Hokkaido University, Jan 11
- 2018 “Probing Electroweakly Interacting Massive Particles with Drell-Yan Process at 100 TeV Hadron Colliders”, Nagoya University, Oct 16

## PRESENTATIONS AT INTERNATIONAL CONFERENCES

- 2025 “Light Dark Matter Search with NV Centers: Electron Spin, Nuclear Spin, and Comagnetometry (**Invited**)”, The Frontier of Particle Physics: Exploring Muons, Quantum Science and the Cosmos, YITP, Kyoto University, Jun 17
- 2025 “Searching for new particles at a 10 TeV wakefield collider (**Invited**)”, ALEGRO 2025, SLAC, Mar 4
- 2023 “Light Dark Matter Search with Nitrogen-Vacancy Centers in Diamonds (**Invited**)”, PNU-IBS workshop on Axion Physics : Search for axions, Busan, Korea, Dec 6
- 2023 “Light Dark Matter Search with Nitrogen-Vacancy Centers in Diamonds”, PASCOS 2023, UC Irvine, Jun 27
- 2023 “Topical theory talk: Vacuum stability (**Invited**)”, Workshop for Tera-Scale Physics and Beyond, Hakata, Jun 23
- 2023 “Axion detection with spin dynamics: magnons and axions (**Invited**)”, Joint IQ Initiative and PITT PACC Workshop: Axions, Fundamental and Synthetic, The University of Pittsburgh, Apr 6
- 2022 “Upper bound on the smuon mass from vacuum stability in the light of muon  $g-2$  anomaly”, PPC 2022, St. Louis, Jun 7
- 2022 “Axion/Hidden-Photon Dark Matter Conversion into Condensed Matter Axion (**Invited**)”, KEK IPNS-IMSS-QUP Joint workshop, Online, Feb 8
- 2021 “Direct detection of light bosonic dark matter using spin excitation”, COSMO’21, Online, Aug 3
- 2020 “Anomaly Mediation at Future Hadron Colliders”, KEK-PH 2020, Tsukuba, Aug 4
- 2020 “Flowing to the Bounce”, Berkeley Week, IPMU, Jan 14
- 2019 “Indirect Studies of Electroweakly Interacting Particles at 100 TeV Hadron Colliders”, SI 2019, Gangneung, Korea, Aug 20
- 2019 “Flowing to the Bounce”, NHWG26, Osaka, Aug 9
- 2019 “Indirect Studies of Electroweakly Interacting Particles at 100 TeV Hadron Colliders”, SUSY 2019, Texas, May 22
- 2019 “Indirect Studies of Electroweakly Interacting Particles at 100 TeV Hadron Colliders”, Pheno 2019, Pittsburgh, May 6
- 2018 “Flavon Stabilization in Models with Discrete Flavor Symmetry”, KEK-PH 2018 winter, Tsukuba, Dec 6
- 2018 “Decay Rate of the Electroweak Vacuum in the Standard Model and Beyond”, Planck 2018, Bonn, May 24
- 2017 “Bottom-Tau Unification in Supersymmetric Models”, New Physics Forum, IPMU, Feb 6
- 2016 “Bottom-Tau unification in Supersymmetric Model with Anomaly-Mediation”, SUSY 2016, Melbourne, Jul 5

(Poster)

- 2025 “Nuclear spin metrology with NV sensors for axion dark matter detection”, Enabling the discovery of QCD Axion Dark Matter at the GUT scale, Berkeley, May 7
- 2024 “Exploring supersymmetry through gauginos with FCC-hh”, FCC Week 2024, San Francisco, Jun 13
- 2022 “Roles of lattice defects in dark matter direct detection experiments”, QUPosium 2022, Tsukuba, Dec 13
- 2019 “Probing Electroweakly Interacting Massive Particles with Precision Measurements at 100 TeV Hadron Colliders”, HPNP2019, Osaka, Feb 21

## PRESENTATIONS AT DOMESTIC CONFERENCES

- 2023 “LHC Run 3 と高輝度 LHC で探る新物理模型 (**Symposium talk**)”, JPS 2023 Fall, Tohoku University, Sep 18
- 2023 “高エネルギー反応におけるパートンシャワーへの量子計算の応用 (**Symposium talk**)”, JPS 2023 Spring, Online, Mar 25
- 2021 “物性系を用いた軽い暗黒物質の直接探索 (**Invited**)”, PPP 2021, Online, Sep 9
- 2021 “スピン励起を用いた軽いボソン暗黒物質の直接探索 (**Invited**)”, KEK「素核宇・物性」連携研究会, Online, Mar 31
- 2020 “XENON1T 実験の結果を説明する模型への制限”, ダークマターの懇談会2020 online, Online, Sep 8
- 2020 “特徴的なシグナルを用いた暗黒物質模型の探索 (**Invited**)”, 新テラスケール研究会, Online, Aug 11
- 2020 “マグノンを用いた軽いボソン暗黒物質の直接探索”, Unraveling the History of the Universe 2020, Online, Jun 2
- 2019 “Flavon Stabilization without Domain Wall Problem in Discrete Flavor Symmetry Models”, Neutrino Oscillation and Flavor Physics, Nagoya, Jun 11
- 2018 “Zero Mode Problem in the Calculation of Decay Rate of the SM Electroweak vacuum”, JPS 2018, Shinshu, Sep 15
- 2016 “Bottom-Tau unification in Supersymmetric Model with Anomaly-Mediation”, JPS 2016, Miyazaki, Sep 21

(Poster)

- 2022 “レプトン加速器におけるヒッグス事象の機械学習を用いた事前選択”, PPP 2022, Online, Aug 29
- 2018 “Indirect Search of WIMP Dark Matter at Future 100 TeV Collider”, PPP 2018, Kyoto, Aug 9
- 2017 “Bottom Tau Unification in Supersymmetric Models”, PPP 2017, Kyoto, Aug 3

## **SERVICE TO PROFESSION**

Journal manuscript review work of the following journals

- Nature Communications
- Physical Review Letters
- Physical Review D
- Physics Letters B
- Journal of High Energy Physics
- Progress of Theoretical and Experimental Physics

## **SKILLS**

Languages: English – Fluent, Japanese – Native

Computer: c++, Mathematica, Python, LaTeX