

# Yu Saito

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## Contact Information

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## Research Interests

### Condensed Matter Physics:

2D materials, van der Waals heterostructures, Quantum transport, Functional devices, Materials Informatics (Bayesian optimization, Feature selection)

## Education

### Doctor of Philosophy in Engineering

Expected March 2018

Department of Applied Physics, The University of Tokyo  
Advisor: Prof. Yoshihiro Iwasa

### Master of Engineering (with Distinguished Master's Thesis Award)

March 2015

Department of Applied Physics, The University of Tokyo

### Bachelor of Engineering (with Distinguished Bachelor's Thesis Award)

March 2013

Department of Applied Physics, The University of Tokyo

## Professional Experience

### Research Fellow

April 2015 – present

Department of Applied Physics, The University of Tokyo — Tokyo, Japan

Mentor: Prof. Yoshihiro Iwasa

Experimental research on condensed matter physics (esp. 2D materials)

- ▷ Quantum phase transitions and vortex dynamics in ion-gated 2D crystalline superconductors
- ▷ Exotic phenomena in 2D noncentrosymmetric superconductors
- ▷ Electric and thermoelectric transport in novel 2D materials

Grants from Grant-in-Aid for JSPS Research Fellow (DC1, No.JP15J07681)

## Teaching Experience

### Teaching Assistant

October 2013 – March 2015

Department of Applied Physics, The University of Tokyo — Tokyo, Japan

- ▷ Statistical Thermodynamics
- ▷ Physical Mathematics

### Supervision of Students

- ▷ Two undergraduate students and two master students at the University of Tokyo

## Skills

### Experimental skills

- ▷ Nanofabrication Techniques: Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM), Photo-lithography, E-beam lithography, E-beam deposition, Basic semiconductor process, Fabrication of van der Waals heterostructure
- ▷ Low-Temperature Transport Measurements: general cryogenic electrical measurement, techniques (esp. operation of PPMS) combined with AC lock-in amplifier, dilution refrigerator
- ▷ Electronics Techniques: low noise DC and AC measurements on electronic devices using analytic tools.

### Computer skills

- ▷ Software
  - Pattern designs using AutoCAD
  - Data visualization with Igor Pro and tableau etc.
- ▷ Programming – Languages: C/C++, Python
  - Optimization, machine learning and statics.
  - Basic numerical calculations.

## Honors and Awards

- ▷ Silver medal at Kaggle competition "Santa's uncertain bags"
  - 13th place out of 600+ teams (Top 2%)
- ▷ Tanaka Shouji Award (Distinguished Master's Thesis Award) in 2015
  - Top 10% of the graduating class (50+ students) at the department
- ▷ Distinguished Bachelor's Thesis Award in 2013
  - Top 10% of the graduating class (60+ students) at the department

## Grants

1. **Grant-in-Aid for JSPS Research Fellow (DC1)**      April 2015 – March 2018  
(No.JP15J07681)  
from Japan Society for the Promotion of Science (Research fund of JPY3400000)

## Services

### Reviewer Experience

- ▷ Nature Communications, Scientific Reports, Nano Letters, Chemistry of Materials, ACS Applied Materials & Interfaces, Physical Review B, Nanoscale

### Outreach Activity

- ▷ Seminars and talks at Asaka high school in Fukushima, Japan, 2012-2014
- ▷ Press releases of the contents published in (Science 2015, Nature Physics 2016, Science Advances 2017)

## Professional Memberships

- ▷ The Physical Society of Japan
- ▷ American Physical Society

List of Publications ([Google Scholar Citations](#), [Researcher ID](#))

Review Articles (refereed)

1. **Highly crystalline 2D superconductors**  
Y. Saito, T. Nojima and Y. Iwasa  
Nature Reviews Materials **2**, 16094 (2016).  
DOI: [10.1038/natrevmats.2016.94](https://doi.org/10.1038/natrevmats.2016.94)
2. **Gate-induced superconductivity in two-dimensional atomic crystals**  
Y. Saito, T. Nojima and Y. Iwasa  
Superconductor Science and Technology (SUST) **29**, 093001 (2016).  
DOI: [10.1088/0953-2048/29/9/093001](https://doi.org/10.1088/0953-2048/29/9/093001)

Original Papers (refereed)

1. **Nonreciprocal charge transport in noncentrosymmetric superconductors**  
R. Wakatsuki\*, Y. Saito\*, S. Hoshino, Y. M. Itahashi, T. Ideue, M. Ezawa, Y. Iwasa and N. Nagaosa  
(\*equal contribution)  
Science Advances **3**, e1602390 (2017).  
DOI: [10.1126/sciadv.1602390](https://doi.org/10.1126/sciadv.1602390)  
See also [UTokyo Research](#)
2. **Gate-tuned thermoelectric power in black phosphorus**  
Y. Saito\*, T. Iizuka\*, T. Koretsune, R. Arita, S. Shimizu and Y. Iwasa  
(\*equal contribution)  
Nano Letters **16**, 4819-4824 (2016).  
DOI: [10.1021/acs.nanolett.6b00999](https://doi.org/10.1021/acs.nanolett.6b00999)
3. **Gate-optimized thermoelectric power factor in ultrathin WSe<sub>2</sub> single crystals**  
M. Yoshida, T. Iizuka, Y. Saito, M. Onga, R. Suzuki, Y. J. Zhang, Y. Iwasa and S. Shimizu  
Nano Letters **16**, 2061-2065 (2016).  
DOI: [10.1021/acs.nanolett.6b00075](https://doi.org/10.1021/acs.nanolett.6b00075)
4. **Superconductivity protected by spin-valley locking in ion-gated MoS<sub>2</sub>**  
Y. Saito, Y. Nakamura, M. S. Bahrany, Y. Kohama, J. T. Ye, Y. Kasahara, Y. Nakagawa, M. Onga, M. Tokunaga, T. Nojima, Y. Yanase and Y. Iwasa  
Nature Physics **12**, 144-149 (2016).  
DOI: [10.1038/nphys3580](https://doi.org/10.1038/nphys3580)  
See also "[Perspective](#)" in Science, "[News and Views](#)" in Nature Physics and [UTokyo Research](#)  
Top 1% highly cited paper in the Web of Science (2016/5-6)
5. **Metallic ground state in an ion-gated two-dimensional superconductor**  
Y. Saito, Y. Kasahara, J. T. Ye, Y. Iwasa and T. Nojima  
Science **350**, 409-413 (2015).  
DOI: [10.1126/science.1259440](https://doi.org/10.1126/science.1259440)  
See also [UTokyo Research](#)
6. **Superconductivity series in transition metal dichalcogenides by ionic gating**  
W. Shi, J. T. Ye, Y. J. Zhang, R. Suzuki, M. Yoshida, J. Miyazaki, N. Inoue, Y. Saito and Y. Iwasa  
Scientific Reports **5**, 12534 (2015).  
DOI: [10.1038/srep12534](https://doi.org/10.1038/srep12534)
7. **Ambipolar insulator-to-metal transition in black phosphorus by ionic-liquid gating**  
Y. Saito and Y. Iwasa

ACS Nano **9**, 3192-3198 (2015).

DOI: [10.1021/acsnano.5b00497](https://doi.org/10.1021/acsnano.5b00497)

Top 1% highly cited paper in the Web of Science (2016/1-2)

#### Japanese Articles (refereed)

1. **2D superconducting state maintained in 50 Tesla magnetic fields**  
Y. Saito, Y. Iwasa, Y. Kohama and M. Tokunaga  
BUSSEIKEN DAYORI **56**(3), 20-22 (2016).
2. **Electric-double-layer transistor and two-dimensional superconductivity**  
Y. Saito, T. Nojima and Y. Iwasa  
KOTBA (Solid State Physics) **51**, 775-788 (2016).

#### List of Invited Talks

1. **2D crystalline superconductors with broken inversion symmetry.**  
28th International Conference on Low Temperature Physics (LT28), Gothenburg, Sweden, August 11th, 2017
2. **2D crystalline superconductors based on transition metal dichalcogenides.**  
EMN Lyon meeting on 2D materials, Lyon, France, August 8th, 2017
3. **Highly crystalline 2D superconductors.**  
CEMS Topical Meeting on Emergent 2D Materials 2017, Tokyo, Japan, July 21th, 2017
4. **Highly crystalline 2D superconductors.**  
YITP Workshop: Cutting-edge of superconductivity, Kyoto, Japan, June 19th, 2017
5. **Highly crystalline 2D superconductors protected by spin-valley locking.**  
IEEE International Magnetism Conference INTERMAG Europe 2017, Dublin, Ireland, April 28th, 2017
6. **2D superconductors without inversion symmetry.**  
CEMS Topical Meeting on Emergent Superconductivity under Extreme Condition, Tokyo, Japan, January 17th, 2017
7. **Highly-crystalline 2D superconductors and beyond.**  
29th International Symposium on Superconductivity (ISS 2015), Tokyo, Japan, December 15th, 2016
8. **Ion-gated interface superconductivity in two-dimensional layered materials.**  
NORDITA program : Physics of Interfaces and Layered Structures (PILS 2015), Stockholm, Sweden, September 11th, 2015

#### List of Presentations

(First/presenting author only)

##### International Conferences

(Oral)

1. **Ion-gated 2D crystalline superconductors with broken inversion symmetry**  
Y. Saito, Y. Itahashi, T. Ideue and Y. Iwasa  
XXVI International Materials Research Congress 2017: Inorganic Analogues to Graphene, SA.5-0007, Cancun, Mexico, August 24th, 2017
2. **Nonreciprocal transport in superconducting MoS<sub>2</sub>**  
Y. Saito, R. Wakatsuki, S. Hoshino, T. Ideue, M. Ezawa, Y. Iwasa and N. Nagaosa  
American Physical Society (APS) March Meeting 2017, L31-00010, New Orleans, LA, USA, March 2017

3. **Griffiths singularity of quantum phase transition in ion-gated ZrNCl**  
Y. Saito, T. Nojima and Y. Iwasa  
 American Physical Society (APS) March Meeting 2016, S15-00003, Baltimore, MD, USA, March 2016
4. **Metallic ground state in an ion-gate two-dimensional superconductor.**  
 Y. Iwasa, Y. Saito Y. Kasahara, J. T. Ye and T. Nojima (as a presenter)  
 American Physical Society (APS) March Meeting 2015, Q20-00011, San Antonio, TX, USA, March 2015
5. **Large upper critical field in ion-gated MoS<sub>2</sub> superconductivity.**  
Y. Saito, Y. Kohama, J. T. Ye, Y. Kasahara, M. Tokunaga and Y. Iwasa  
 American Physical Society (APS) March Meeting 2015, G11-00011, San Antonio, TX, USA, March 2015
6. **Two-dimensionality in electric-field-induced superconductivity.**  
Y. Saito, J. T. Ye, Y. J. Zhang, Y. Kasahara, T. Nojima and Y. Iwasa  
 American Physical Society (APS) March Meeting 2014, T52-00008, Denver, CO, USA, March 2014

(Poster)

1. **Electric and thermoelectric properties in ion-gated black phosphorus**  
Y. Saito, T. Iizuka, T. Koretsune, R. Arita and Y. Iwasa  
 XXVI International Materials Research Congress 2017: Inorganic Analogues to Graphene, P010, Cancun, Mexico, August 23th, 2017
2. **Cooper pairing protected by spin-valley locking in two-dimensional superconductivity on MoS<sub>2</sub>**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, J. T. Ye, Y. Kasahara, M. Tokunaga, T. Nojima, Y. Yanase and Y. Iwasa  
 American Physical Society (APS) March Meeting 2016, T1-00037, Baltimore, MD, USA, March 2016
3. **Quantum creep in a highly crystalline two-dimensional superconductor.**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, J. T. Ye, Y. Kasahara, M. Tokunaga, T. Nojima, Y. Yanase and Y. Iwasa  
 American Physical Society (APS) March Meeting 2016, T1-00206, Baltimore, MD, USA, March 2016
4. **Exotic superconducting states in ion-gated two-dimensional materials.**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, Y. Kasahara, M. Tokunaga, T. Nojima, Y. Yanase and Y. Iwasa  
 The 11th International Conference on Materials and Mechanism of Superconductivity (M2S), J005, Geneva, Switzerland, August 2015
5. **Interface superconductivity protected by valley-spin polarization in gate-tuned MoS<sub>2</sub>.**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, Y. Kasahara, M. Tokunaga, T. Nojima, Y. Yanase and Y. Iwasa  
 EP2DS21/MSS-17 Joint conference: 21st International Conference on Electronic Properties of Two-Dimensional Systems/17th International Conference on Modulated Semiconductor Structures, Th-PE-LN5, Sendai, Japan, July 2015
6. **Ambipolar insulator-to-metal transition and electric-field-control thermoelectric properties in black phosphorus**  
Y. Saito, T. Iizuka and Y. Iwasa  
 NT15 The 16th International Conference on the Science and Application of Nanotubes, P110, Nagoya, Japan, June 2015
7. **Asymmetric capacitance and ambipolar metal insulator transition in black phosphorus.**

Y. Saito, and Y. Iwasa

American Physical Society (APS) March Meeting 2015, H1-00234, San Antonio, TX, USA, March 2015

## International Workshops/Symposiums

(Poster)

1. **Enhanced upper critical field and nonreciprocal transport in superconducting MoS<sub>2</sub>.**  
Y. Saito, R. Wakatsuki, S. Hoshino, T. Ideue, M. Ezawa, Y. Iwasa and N. Nagaosa  
CEMS-QPEC Symposium on Emergent Quantum Materials, Tokyo, Japan, January 2017
2. **Quantum Griffiths singularity and associated quantum metal in highly-crystalline two-dimensional superconductors.**  
Y. Saito, T. Nojima and Y. Iwasa  
FET2016, International Workshop on Field-Effect Transistors and Functional Interfaces, Minneapolis, MN, USA, August 2016
3. **Noncentrosymmetric quasi-single-layer superconductivity in electrolyte-gated MoS<sub>2</sub>.**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, Y. Kasahara, M. Tokunaga, T. Nojima, Y. Yanase and Y. Iwasa  
CEMS International Symposium on Supramolecular Chemistry and Functional Materials 2016, P-05, Tokyo, Japan, January 2016
4. **Two-dimensional superconductivity protected by spin-valley locking in ion-gated MoS<sub>2</sub>**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, Y. Kasahara, M. Tokunaga, T. Nojima, Y. Yanase and Y. Iwasa  
CEMS Topical Meeting on Emergent 2D Materials, P-01, Wako, Japan, December 2015
5. **Electron transport in ion-gated black phosphorus.**  
Y. Saito, T. Iizuka, T. Koretsune, R. Arita and Y. Iwasa  
CEMS Topical Meeting on Emergent 2D Materials, P-02, Wako, Japan, December 2015
6. **Exotic phenomena in ion-gated two-dimensional superconductors.**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, Y. Kasahara, M. Tokunaga, T. Nojima, Y. Yanase and Y. Iwasa  
PILS 2015, Physics of Interfaces and Layered Structures, Stockholm, Sweden, August 2015
7. **Exploratory novel properties and materials of electric-field-induced superconductors.**  
Y. Saito, J. T. Ye, Y. Kasahara, T. Nojima and Y. Iwasa  
FET2014, International Workshop on Field-Effect Transistors and Functional Interfaces, Poster10, Kashiwa, Japan, October 2014
8. **Two dimensional superconducting phase in gate induced superconductivity with quantum dynamics.**  
Y. Saito, T. Nojima and Y. Iwasa  
The 6th Indo-Japan Seminar Physics and Design of Multi-Functional Correlated Materials, P28, Tokyo, Japan, March 2014
9. **Two-dimensionality in electric-field-induced superconductivity.**  
Y. Saito, J. T. Ye, Y. J. Zhang, Y. Kasahara, T. Nojima and Y. Iwasa  
FIRST International Symposium on “ Topological Quantum Technology ”, P23, Tokyo, Japan, January 2014

10. **Two-dimensionality in electric-field-induced superconductivity.**  
Y. Saito, J. T. Ye, Y. J. Zhang, Y. Kasahara, T. Nojima and Y. Iwasa  
RIKEN-APW joint workshop “Highlights in condensed matter physics”, P29, Wako,  
Japan, January 2014

#### Domestic Conferences (in Japanese)

(Oral)

1. **Quantum phase transition in highly-crystalline 2D superconductors**  
Y. Saito, T.Nojima and Y. Iwasa  
JSPS 2017 Autumn Meeting, 24aA29-3, Iwate, September 2017
2. **Quantum phase transition in highly-crystalline 2D superconductors**  
Y. Saito, T.Nojima and Y. Iwasa  
24th Vortex physics domestic conference, 27p1-3, Akita, November 2016
3. **Nonreciprocal superconducting current in ion-gated MoS<sub>2</sub>**  
Y. Saito, T.Ideue and Y. Iwasa  
JSPS 2016 Autumn Meeting, 14aBH-3, Ishikawa, September 2016
4. **Quantum Griffiths Phase in ion-gated ZrNCl**  
Y. Saito, T.Nojima and Y. Iwasa  
JSPS 2016 Autumn Meeting, 13aAC-8, Ishikawa, September 2016
5. **Ambipolar insulator-to-metal transition in black phosphorus**  
Y. Saito and Y. Iwasa  
JSPS 2015 Autumn Meeting, 14aBH-3, Osaka, September 2014
6. **Large upper critical field in ion-gated MoS<sub>2</sub>**  
Y. Saito, Y. Kohama, J. T. Ye, Y. Kasahara, M. Tokunaga, T. Nojima and Y. Iwasa  
JSPS 70th Annual Meeting, 21aAA-5, Tokyo, March 2015
7. **Two-dimensional vortex dynamic in ion-gated**  
Y. Saito, J. T. Ye, Y. Kasahara, T. Nojima and Y. Iwasa  
JSPS 69th Annual Meeting, 27aCA-4, Kanagawa, March 2014
8. **Two-dimensionality in electric-field-induced superconductivity**  
Y. Saito, J. T. Ye, Y. Kasahara, T. Nojima and Y. Iwasa  
JSPS 2013 Autumn Meeting, 25pEA-8, Tokushima, September 2013

(Poster)

1. **Ratchet effect and nonlinear-Hall effect in 2D noncentrosymmetric superconductors**  
Y. Saito, Y. Itahashi, T. Ideue, and Y. Iwasa  
YITP Workshop: Cutting-edge of superconductivity, Kyoto, Japan, June 20th, 2017
2. **Quantum phase in gate-induced superconductivity**  
Y. Saito, T. Nojima and N. Nagaosa  
YITP Workshop: Cutting-edge of superconductivity, Kyoto, Japan, June 20th, 2017
3. **Enhanced upper critical field and nonreciprocal transport in superconducting MoS<sub>2</sub>**  
Y. Saito, R. Wakatsuki, S. Hoshino, T. Ideue, M. Ezawa, Y. Iwasa and N. Nagaosa  
The 8th Research Meeting in Cryogenic Research Center, Tokyo, February 2017
4. **Superconductivity in ion-gated two-dimensional materials**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, Y. Kasahara, M. Tokunaga,  
T. Nojima, Y. Yanase and Y. Iwasa  
The 7th Research Meeting in Cryogenic Research Center, Tokyo, February 2016
5. **Exotic properties of superconductivity in ion-gated two-dimensional materials**  
Y. Saito, Y. Nakamura, M. S. Bahramy, Y. Kohama, Y. Kasahara, M. Tokunaga,

T. Nojima, Y. Yanase and Y. Iwasa  
JSPS 2015 Autumn Meeting, 14aBH-3, Osaka, September 2014

6. **Two-dimensionality in electric-field-induced superconductivity**

**Y. Saito**

2013 Summer School for Students Researching Condensed Matter Physics, P-01,  
Shiga, August 2013

**References**

**Yoshihiro Iwasa**

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