

## Mohamed Oudah

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Address: Stewart Blusson Quantum Matter Institute (SBQMI), 2355 E Mall, Vancouver, BC V6T 1Z4

### EDUCATION

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- PhD in Physics at the Kyoto University, Japan, Highest Honors (2015-2018)  
Thesis: “Discovery of Superconductivity in the Antiperovskite Oxide  $\text{Sr}_{3-x}\text{SnO}$ ” Supervisor: Yoshiteru Maeno
- MSc in Chemistry-Nanotechnology at the University of Waterloo, Canada (2013-2014)  
Thesis: “Optimization of Thermoelectric Chalcogenides” Supervisor: Holger Kleinke
- BAS in Chemical Engineering, University of Ottawa, Canada (2006-2012)  
Thesis: “Ammonia electro-oxidation on alloyed PtIr nanoparticles” Supervisor: Elena Baranova

### EMPLOYMENT & RESEARCH POSITIONS

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#### **Senior Scientist – SBQMI – University of British Columbia, 100% Research (January 2021-Current)**

Area of Focus: Growth and low temperature measurements of intermetallics and high-entropy oxides with topology, superconductivity and magnetism, and muon spin relaxation studies.

#### **SBQMI & UBC-MPI-UTokyo Fellow –University of British Columbia (June 2018 - January 2021)**

Advisors: Doug Bonn, George Sawatzky

Area of Focus: Single crystal growth and low temperature measurements of semimetallic superconductors

#### **Visiting Fellow – Max Planck Institute, Stuttgart (June-December 2018, July-August 2019)**

Advisors: Bernhard Keimer, Hidenori Takagi

Area of Focus: High-pressure synthesis of novel oxides and chalcogenides and crystal growth of oxides

#### **Visiting Fellow – Princeton University (May-July 2019)**

Advisors: Leslie Schoop

Area of Focus: Crystal growth and exploration of new topological square-net materials

#### **Physics PhD Candidate – Kyoto University (April 2015 – March 2018)**

Advisor: Yoshiteru Maeno

Area of Focus: Discovery of superconductivity in the antiperovskite oxides with topological semimetallicity

#### **Research Assistant – University of Waterloo (January 2013 – March 2015)**

Advisor: Holger Kleinke

Area of Focus: Improving the thermoelectric performance of copper chalcogenides for clean energy

#### **Research Intern – NTT BRL, Japan, 100% Research (September 2010 – September 2011)**

Advisor: Yasuyuki Kobayashi

Area of Focus: Characterization of freestanding III-V heterostructure thin-film

### AWARDS & FELLOWSHIPS

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- QuantEmX Exchange Award (2023)
- Best Poster Prize at Conference on Strongly Correlated Electron Systems (SCES), Amsterdam, 1st Place (2022)
- SBQMI & MPI-UBC-UTokyo Fellowship (2018-2021)
- MEXT Research Scholarship, Full Scholarship to Study in Japan (2015-2018)
- University of Waterloo Special Graduate Scholarship (2014)
- Andrew Moffitt Memorial Scholarship and University of Ottawa Engineering Scholarships (2009, 2012)
- Wilfrid Brisson Undergraduate Memorial Scholarship and McLimont Scholarship (2009)
- Ontario Professional Engineers Foundation for Education Scholarships (2009)
- Queen Elizabeth Aiming for the Top Scholarship (2006-2009)

## TEACHING & SUPERVISION

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- Leading and teaching seminars on X-ray diffraction and crystal structures at UBC for Quantum Pathways undergraduate students from underrepresented groups in physics (2020-2021)
- Supervision of six undergraduate and seven graduate students at UBC (2019-2024)
- Supervision of the research of international exchange students at Kyoto University (2017-2018)
- Teaching assistant for CHEM 120: Physical and Chemical Properties of Matter and CHEM 123: Chemical Reactions, Equilibria and Kinetics at University of Waterloo (2013-2014)

## ACADEMIC SERVICES

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- CIFAR Spring School on Quantum Materials Organizing Committee (June 2023)
- Session chair at Materials and Mechanisms of Superconductivity (M2S) Conference (July 2022)
- Organizer of seminar on high-entropy materials at University of British Columbia (2021-2023)
- Reviewer for publications in *Advanced Materials* & *APL Materials*
- Provided lab tours at SBQMI for funders from government and industry (2019-present)
- Presented results in press release at Kyoto University to local news papers (Oral-Japanese, 2016)

## INVITED TALKS

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- University of Hawai'i, USA (2025) Superconductivity in Non-Centrosymmetric Materials: Discovery in LaRhGe<sub>3</sub> and Normal-State Electron-Phonon Interactions
- TU Wien, Austria (2023) Discovery of Superconductivity and Electron-Phonon Drag in the Non-Centrosymmetric Semimetal LaRhGe<sub>3</sub>
- ETH, Switzerland (2022) - Discovery of Superconductivity in the Non-Centrosymmetric Semimetal LaRhGe<sub>3</sub>
- Aalto University, Finland (2021) - Unusual Sn State in the Superconducting Disordered Selenide
- Rice University, USA (2020) - Antimonides, Tellurides, and Square-Net Materials
- ETH Zurich, Switzerland (2019) - Exploration of Ag-Bi-O Phases Synthesized Under High Pressure
- Ringberg Meeting, MPI, Germany (2018) - Thermoelectric Properties of BaCu<sub>6-x</sub>(S,Se)Te<sub>6</sub>
- Hokkaido University, Japan (2017) - Superconductivity in the Antiperovskite Oxide Sr<sub>3-x</sub>SnO
- Yukawa Institute, Kyoto University (2016) - The Superconducting Antiperovskite Oxide Sr<sub>3-x</sub>SnO
- Waterloo Institute of Nanotechnology (2014) - Localized Cu-Ion Mobility in Thermoelectric Chalcogenides

## CONTRIBUTED TALKS

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- APS March Meeting - 2022, Magnetic Order in Ga-Substituted Spinel Type High Entropy Oxide (MnFeCrCoNi)<sub>3-x</sub>Ga<sub>x</sub>O<sub>4</sub>
- APS March Meeting - 2019, Boston, USA - Towards Topological States in Silver Bismuthates Synthesized under High-Pressure
- JPS Spring Meeting, Osaka, Japan (2017) - Dependence of the Properties of Superconducting Sr<sub>3-x</sub>SnO on Sr Deficiency
- JPS Fall Meeting, Kanazawa, Japan (2016) - Superconductivity in the antiperovskite oxide Sr<sub>3</sub>SnO

## POSTERS

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- CIFAR Meeting, Montreal, Canada (2023) - Discovery of Superconductivity and Electron-Phonon Drag in the Non-centrosymmetric Semimetal LaRhGe<sub>3</sub>
- Strongly Correlated Electron Systems (SCES), Amsterdam, Netherlands (2022) - Type-I Superconductivity in Non-centrosymmetric LaRhGe<sub>3</sub>
- MPI-UBC-UTokyo Meeting, Vancouver, Canada (2019) - Unusual Sn State in the Superconducting Entropy Stabilized Selenide Ag<sub>1-x</sub>Sn<sub>1+x</sub>Se<sub>2</sub>
- Spectroscopies in Novel Superconductors, Tokyo, Japan (2019) - Spectroscopy of Ag-Bi-O Phases Synthesized Under High Pressure

## LANGUAGES

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- Native in English and Arabic, fluent in Japanese

## PUBLICATIONS

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### SUBMITTED

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35. M. Roppongi, Y. Cai, K. Ogawa, S. Liu, G. Q. Zhao, **M. Oudah**, T. Fujii, K. Imamura, S. Fang, K. Ishihara, K. Hashimoto, K. Matsuura, Y. Mizukami, M. Pula, M. V. De Toro Sanchez, C. Young, I. Markovici, D. A. Bonn, T. Watanabe, A. Yamashita, Y. Mizuguchi, G. M. Luke, K. M. Kojima, Y. J. Uemura, and T. Shibauchi, “Topology meets time-reversal symmetry breaking in  $\text{FeSe}_{1-x}\text{Te}_x$  superconductors” Under review in *Nat. Comm.*, arXiv:2501.02818 (2024)
34. Y. Zhang, Y. Gao, A. Pulkkinen, X. Guo, J. Huang, Y. Guo, Z. Yue, J. S. Oh, A. Moon, **M. Oudah**, X.-J. Gao, A. Fedorov, S.-K. Mo, M. Hashimoto, D. Lu, A. Rajapitamahuni, E. Vescovo, J. Kono, A. M. Hallas, R. J. Birgeneau, L. Balicas, J. Min’ar, P. Hosur, K. T. Law, E. Morosan, M. Yi, “Kramers nodal lines in intercalated  $\text{TaS}_2$  superconductors” Under review in *Nat. Comm.*, (2024)
33. J. Bannies, M. Michiardi, H.-H. Kung, S. Godin, J.W. Simonson, **M. Oudah**, M. Zonno, S. Gorovikov, S. Zhdanovich, I.S. Elfimov, A. Damascelli, M.C. Aronson, “Electronically-driven switching of topology in  $\text{LaSbTe}$ ” Under review in *Nat. Mater.*, arXiv:2407.08798 (2024)

### PUBLISHED/ACCEPTED

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32. X.Y. Li, A. Nocera, K. Foyevtsova, G.A. Sawatzky, **M. Oudah**, N. Murai, M. Kofu, M. Matsuura, H. Tamatsukuri, M.C. Aronson, “Frustrated  $S=1/2$  Chains in One-Dimensional Correlated Metal  $\text{Ti}_4\text{MnBi}_2$ ” Accepted in *Nat. Mater.*, arXiv:2409.02880 (2024)
31. **M. Oudah**, D. Takegami, S. Kitao, J. L. Lado, A. Meléndez-Sans, D. S. Christovam, M. Yoshimura, K. D. Tsuei, G. McNally, M. Isobe, K. Küster, M Seto, B. Keimer, D. A. Bonn, H. Tjeng, G. Sawatzky, H. Takagi, “Charge-Entropy-Stabilized Selenide  $(\text{Ag},\text{Sn})\text{Se}$ ” Accepted in *Commu. Mater.* (2024)
30. S. Kitagawa, H. Matsudaira, K. Ishida, **M. Oudah**, “Highly Uniform Magnetic and Electronic Environment in Non-Centrosymmetric Superconductor  $\text{LaRhGe}_3$ ” *JPSJ*, 94, 025002 (2025)
29. **M. Oudah**, Y. Cai, M. V. De Toro Sanchez, J. Bannies, M. C. Aronson, K. M. Kojima, D. A. Bonn, “Critical Field Anisotropy and Muon Spin Relaxation Study of Superconducting Dirac-Semimetal  $\text{CaSb}_2$ ” *Phys. Rev. B*, 110, 134524 (2024)
28. **M. Oudah**, H. H. Kung, S. Sahu, N. Heinsdorf, A. Schulz, K. Philippi, M. V. De Toro Sanchez, Y. Cai, K. M. Kojima, A. P. Schnydr, H. Takagi, B. Keimer, D. A. Bonn, A. M. Hallas, “Discovery of Superconductivity and Electron-Phonon Drag in the Non-Centrosymmetric Semimetal  $\text{LaRhGe}_3$ ” *npj Quantum Mater.*, 9, 88 (2024)
27. **M. Oudah**, M. Kim, R. Dinnebier, G. McNally, K. Foyevtsova, D. A. Bonn, H. Takagi, “A New High-Pressure High-Temperature Phase of Silver Antimonate  $\text{AgSbO}_3$  with Strong Ag-O Hybridization” *Inorg. Chem.*, 63, 22379 (2024)
26. V King, S. Choi, D. Chen, B. Stuart, J. Kim, **M. Oudah**, J. Kim, B.J Kim, D. A. Bonn, S. A. Burke, “Using  $k$ -means to sort spectra: Electronic order mapping from scanning tunneling spectroscopy measurements” *Appl. Phys. Lett.*, 125, 181603 (2024)

25. P.-Y. Cheng, **M. Oudah**, T.-L. Hung, C.-E. Hsu, C.-C. Chang, J.-Y. Haung, T.-C. Liu, C.-M. Cheng, M.-N. Ou, W.-T. Chen, L.Z. Deng, C.-C. Lee, Y.-Y. Chen, C.-N. Kuo, C.-S. Lue, J. Machts, K. M. Kojima, A. M. Hallas, C.-L. Huang, “Physical properties and electronic structure of the two-gap superconductor  $V_2Ga_5$ ” *Phys. Rev. Res.*, 2405, 03499 (2024)
24. S. S. Aamlid, M. Kim, M. U. González-Rivas, **M. Oudah**, H. Takagi, and A. M. Hallas., “Effect of high pressure synthesis conditions on the formation of high entropy oxides” *Appl. Phys. Lett.*, 125, 021901 (2024)
23. G. Baker, T. W. Branch, J. S. Bobowski, J. Day, D. Valentinis, **M. Oudah**, P. McGuinness, S. Khim, P. Surówka, Y. Maeno, R. Moessner, J. Schmalian, A. Mackenzie, D. A. Bonn, “Non-Local Microwave Electrodynamics in Ultra-Pure  $PdCoO_2$ ” *Phys. Rev. X*, 14, 011018 (2024)
22. J. O. Ticknor, J. R. Adelman, A. Chatzichristos, M. H. Dehn, L. Egoriti, D. Fujimoto, V.L. Karner, Robert F. Kiefl, C. D. P. Levy, R. Li, R. M. L. McFadden, **M. Oudah**, G. D. Morris, M. Stachura, E. Thoeng, W. A. MacFarlane, “Ion-Implanted  $^8Li$  Nuclear Magnetic Resonance in Highly Oriented Pyrolytic Graphite”, *Phys. Rev. B*, 108, 195437 (2023)
21. J. Weng, H. Shin, S. Godin, **M. Oudah**, R. Sutarto, R. Pons, B.A. Davidson, K. Zou, “Ordered Deficient Perovskite  $La_{2/3}TiO_3$  Films Grown via Molecular Beam Epitaxy”, *J. Vac. Sci. Tech. A*, 41, 6 (2023)
20. S. S. Aamlid, G. H. J. Johnstone, S. Mugiraneza, **M. Oudah**, J. Rottler, A. M. Hallas, “Phase Stability of Entropy Stabilized Oxides with the  $\alpha$ - $PbO_2$  Structure”, *Commun. Mater.*, 4, 45(2023)
19. W. A. MacFarlane, **M. Oudah**, R. M. L. McFadden, D. Huang, A. C. Chatzichristos, D. Fujimoto, V. L. Karner, R. F. Kiefl, C. D. P. Levy, R. Li, I. McKenzie, G. D. Morris, M. R. Pearson, M. Stachura, J. O. Ticknor, E. Thoeng, H. Nakamura, H. Takagi, “ $^8Li$   $\beta$ -NMR Studies of Epitaxial Thin Films of the 3D Topological Dirac Semimetal  $Sr_3SnO$ ”, *J. Phys.: Conf. Ser.*, 2462, 012057 (2023)
18. S. S. Aamlid, **M. Oudah**, J. Rottler, A. M. Hallas, “Understanding the Role of Entropy in High Entropy Oxides”, *J. Am. Chem. Soc.* 145, 5991 (2023) [Review Article]
17. G. H. J. Johnstone, M. U. González-Rivas, K. M. Taddei, R. Sutarto, G. A. Sawatzky, R. J. Green, **M. Oudah**, A. M. Hallas, “Entropy Engineering and Tunable Magnetic Order in the Spinel High Entropy Oxide”, *J. Am. Chem. Soc.*, 144, 20590 (2022)
16. **M. Oudah\***, J. Bannies\* D. A. Bonn, M. C. Aronson, “Time-reversal symmetry breaking superconductivity in  $CaSb_2$ ”, *Phys. Rev. B*, 105, 184504 (2022)
15. M. Kim, G. M. McNally, H. Kim, **M. Oudah**, A. Gibbs, P. Manuel, R. Green, T. Takayama, U. Wedig, M. Isobe, R. K. Kremer, D. Bonn, B. Keimer, and H. Takagi, “Discovery of Superconductivity in  $(Ba,K)SbO_3$ ”, *Nat. Mater.*, 21, 627 (2022)
14. B. A. Stuart, S. Choi, J. Kim, L. Muechler, R. Queiroz, **M. Oudah**, L. M. Schoop, D. A. Bonn, S. A. Burke, “Quasiparticle Interference Observation of the Topologically Non-Trivial Drumhead Surface State in  $ZrSiTe$ ”, *Phys. Rev. B*, 105, L121111 (2022)
13. **M. Oudah**, M. Kim, K. Rabinovich, K. Foyevtsova, G. McNally, B. Kilic, K. Küster, R. J. Green, A. V. Boris, G. A. Sawatzky, A. Schnyder, D. A. Bonn, B. Keimer, H. Takagi, “Electronic Structure of the Bond Disproportionated Bismuthate  $Ag_2BiO_3$ ”, *Phys. Rev. Mater.*, 5, 064202(2021)
12. R. J Kirby, L. Muechler, S. Klemenz, C. Weinberg, A. Ferrenti, **M. Oudah**, D. Fausti, G. D. Scholes, L. M. Schoop, “Signature of an Ultrafast Photoinduced Lifshitz Transition in the Nodal-Line Semimetal  $ZrSiTe$ ” *Phys. Rev. B*, 103, 205138 (2021)

11. R. J. Kirby, A. Ferrenti, C. Weinberg, S. Klemenz, **M. Oudah**, S. Lei, C. P. Weber, D. Fausti, G. D. Scholes, L. M. Schoop, “Transient Drude Response Dominates Near-Infrared Pump–Probe Reflectivity in Nodal-Line Semimetals ZrSiS and **ZrSiSe**”, *J. Phys. Chem. Lett.*, 11, 15, 6105 (2020)
10. A. Ikeda, Z. Guguchia, **M. Oudah**, S. Koibuchi, S. Yonezawa, D. Das, T. Shiroka, H. Luetkens, Y. Maeno, “Penetration Depth and Gap Structure in the Antiperovskite Oxide Superconductor **Sr<sub>3-x</sub>SnO** revealed by  $\mu$ SR”, *Phys. Rev. B*, 101, 174503 (2020)
9. A. Ikeda, S. Koibuchi, S. Kitao, **M. Oudah**, S. Yonezawa, M. Seto, Y. Maeno, “Negative Ionic States of Tin in the Oxide Superconductor **Sr<sub>3-x</sub>SnO** Revealed by Mössbauer Spectroscopy”, *Phys. Rev. B*, 100, 245145 (2019)
8. **M. Oudah**, J.N. Hausmann, S. Kitao, A. Ikeda, S. Yonezawa, M. Seto, Y. Maeno, “Evolution of Superconductivity with Sr-Deficiency in Antiperovskite Oxide **Sr<sub>3-x</sub>SnO**”, *Sci. Rep.*, 9, 1831 (2019)
7. P. Jafarzadeh, **M. Oudah**, A. Assoud, N. Farahi, E. Müller, H. Kleinke, High thermoelectric performance of **Ba<sub>3</sub>Cu<sub>16-x</sub>(S,Te)<sub>11</sub>**”, *J. Mater. Chem. C*, 6, 13043 (2018)
6. S. Kitagawa, K. Ishida, **M. Oudah**, J.N. Hausmann, A. Ikeda, S. Yonezawa, Y. Maeno, “Normal-State Properties of the Antiperovskite Oxide **Sr<sub>3-x</sub>SnO** Revealed by  $^{119}\text{Sn}$ -NMR”, *Phys. Rev. B*, 98, 100503 (2018)
5. A. Ikeda, T. Fukumoto, **M. Oudah**, J.N. Hausmann, S. Yonezawa, S. Kobayashi, M. Sato, C. Tassel, F. Takeiri, H. Takatsu, H. Kageyama, Y. Maeno, “Theoretical Band Structure of the Superconducting Antiperovskite Oxide **Sr<sub>3-x</sub>SnO**”, *Physica B*, 536, 752 (2018)
4. J.N. Hausmann\*, **M. Oudah**\*, A. Ikeda, S. Yonezawa, Y. Maeno, “Controlled Synthesis of the Antiperovskite Oxide Superconductor **Sr<sub>3-x</sub>SnO**”, *Supercond. Sci. Technol.*, 31, 055012 (2018)
3. **M. Oudah**, A. Ikeda, J.N. Hausmann, S. Yonezawa, T. Fukumoto, S. Kobayashi, M. Sato, Y. Maeno, “Superconductivity in the Antiperovskite Dirac-Metal Oxide **Sr<sub>3-x</sub>SnO**”, *Nat. Comm.*, 7, 13617 (2016)
2. **M. Oudah**, K. M. Kleinke, H. Kleinke, “Thermoelectric Properties of the Quaternary Chalcogenides **BaCu<sub>5.9</sub>STe<sub>6</sub>** and **BaCu<sub>5.9</sub>STe<sub>6</sub>**”, *Inorg. Chem.*, 54, 845-849 (2015)
1. A. Allagui, **M. Oudah**, X. Tuae, S. Ntais, F. Almomani, E.A. Baranova, “Ammonia Electro-Oxidation on Alloyed PtIr Nanoparticles of Well-Defined Size”, *Int. J. Hydrog. Energy*, 38, 5, 2455-2463 (2013)

## REFERENCES

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- Prof. Doug Bonn ([bonn@phas.ubc.ca](mailto:bonn@phas.ubc.ca)),  
Superconductivity and crystal growth expert & supervisor at University of British Columbia
- Prof. Bernhard Keimer ([b.keimer@fkf.mpg.de](mailto:b.keimer@fkf.mpg.de)),  
Superconductivity, magnetism, and spectroscopy expert & host at Max Planck Institute of Solid State Research
- Prof. Holger Kleinke ([kleinke@uwaterloo.ca](mailto:kleinke@uwaterloo.ca)),  
Thermoelectrics and solid-state chemistry expert & supervisor at University of Waterloo