

# SangEun Han

Department of Physics, 60 St. George Street, University of Toronto, Toronto, Ontario M5S 1A7, Canada

✉ sehan@sfu.ca | 🏠 sehan.org | 🎓 SangEun Han | 📞 0000-0003-3141-1964

## Education

### KAIST (Korea Advanced Institute of Science and Technology)

DOCTOR OF PHILOSOPHY IN PHYSICS, AUGUST 2020

Advisor: Prof. Eun-Gook Moon

Thesis: *Renormalization group study on Strongly correlated system*

Daejeon, S.Korea

March 2013 - August 2020

### KAIST (Korea Advanced Institute of Science and Technology)

BACHELOR OF SCIENCE, MAGNA CUM LAUDE, FEBRUARY, 2013

Double major in Physics and Mathematical Sciences

Daejeon, S.Korea

February 2010 - February 2013

### Hankuk University of Foreign Studies

IN DEPARTMENT OF PHYSICS

Seoul, S.Korea

March 2006 - January 2008

## Academic Affiliation

### Department of Physics, Simon Fraser University

Postdoctoral Fellow

September 2023 - Present

### Department of Physics, University of Toronto

Postdoctoral Fellow

November 2020 - August 2023

### School of Computational Sciences, KIAS (Korea Institute for Advanced Study)

Visiting Scholar

August 2020 - October 2020

### Department of Physics, KAIST (Korea Advanced Institute of Science and Technology)

Candidate of Integrated Master's and Ph.D Program

March 2013 - August 2020

## Honors

### AWARDS

2018 **Outstanding Poster Award**, Workshop on Spin-orbit Coupled Topological states

October 2018

2018 **Pre-doctoral Fellow of Physics at KAIST**, Department of Physics, KAIST

August 2018

2014 **Spring Outstanding Teaching Assistant Awards**, Department of Physics, KAIST

September 2014

2011 **Presidential Design Award**, Fall Semester's Freshmen Design Course Award, KAIST

February 2012

### SCHOLARSHIPS

2014 - 2015 **Scholarship**, Center for Theoretical Physics, Institute for Basic Science

March 2014 - May 2015

2006 - 2008 **Scholarship**, Hankuk University of Foreign Studies

2006 Fall - 2008 Spring

## Services

### Reviewer

of Nature Communications

August 2022 - Present

### Referee

of Physics Review Research

January 2020 - Present

### Referee

of Physics Review Letters

April 2019 - Present

### Referee

of Physics Review B

September 2018 - Present

## Publication list

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### **“Quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction”**

**SangEun Han**, DANIEL J. SCHULTZ, AND YONG BAEK KIM

Phys. Rev. B **108**, L060401 (2023). arXiv:2207.07661 [cond-mat.str-el]

### **“Complex fixed points of the non-Hermitian Kondo model in a Luttinger liquid”**

**SangEun Han**, DANIEL J. SCHULTZ, AND YONG BAEK KIM

Phys. Rev. B **107**, 155155 (2023). arXiv:2302.07883 [cond-mat.str-el]

### **“Non-Fermi liquid behavior and quantum criticality in cubic heavy fermion systems with non-Kramers multipolar local moments”**

**SangEun Han**, DANIEL J. SCHULTZ, AND YONG BAEK KIM

Phys. Rev. B **106**, 155155 (2022). arXiv:2206.02808 [cond-mat.str-el]

### **“Non-Fermi liquid induced by Bose metal with protected subsystem symmetries”**

**SangEun Han** AND YONG BAEK KIM

Phys. Rev. B **106**, L081106 (2022). arXiv:2102.05052 [cond-mat.str-el]

### **“Realization of fractonic quantum phases in the breathing pyrochlore lattice”**

**SangEun Han**, ADARSH S. PATRI, AND YONG BAEK KIM

Phys. Rev. B **105**, 235120 (2022). arXiv:2109.03835 [cond-mat.str-el]

### **“Lattice vibration as a knob on exotic quantum criticality”**

**SangEun Han**, JUNHYUN LEE, AND EUN-GOOK MOON

Phys. Rev. B **103**, 014435 (2021). arXiv:1911.01435 [cond-mat.str-el]

### **“Emergent Anisotropic Non-Fermi Liquid at a Topological Phase Transition in Three Dimensions”**

**SangEun Han**, CHANGHEE LEE, HONGKI MIN, AND EUN-GOOK MOON

Phys. Rev. Lett. **122**, 187601 (2019). arXiv:1809.10691 [cond-mat.str-el]

### **“Quantum Criticality with Infinite Anisotropy in Topological Phase Transitions between Dirac and Weyl Semi-metals”**

**SangEun Han**, GIL YOUNG CHO, AND EUN-GOOK MOON

Phys. Rev. B **98**, 085149 (2018). arXiv:1804.01547 [cond-mat.str-el]

### **“Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators”**

**SangEun Han** AND EUN-GOOK MOON

Phys. Rev. B **97**, 241101(R) (2018). arXiv:1802.05727 [cond-mat.str-el]

### **“Topological Phase Transitions in Line-nodal Superconductors”**

**SangEun Han**, GIL YOUNG CHO, AND EUN-GOOK MOON

Phys. Rev. B **95**, 094502 (2017). arXiv:1601.00975 [cond-mat.str-el]

### **“Explaining the Lepton Non-universality at the LHCb and CMS from an Unified Framework”**

SANJOY BISWAS, DEBTOSH CHOWDHURY, **SangEun Han**, AND SEUNG J. LEE

JHEP **02**, 142 (2015). arXiv:1409.0882 [hep-ph]

## MANUSCRIPTS UNDER REVIEW

### **“Bosonization of Non-Fermi Liquids”**

**SangEun Han**, FÉLIX DESROCHERS, AND YONG BAEK KIM

arXiv:2306.14955 [cond-mat.str-el] [hep-th]

## Presentation

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### ORAL PRESENTATION

#### **ASG Mini-workshop**

Theory of a quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction

Daejeon, S. Korea

June 21, 2023

#### **Condensed Matter Seminar at Simon Fraser University (Invited)**

Theory of a quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction

Burnaby, Canada

May 25, 2023

<b>Condensed Matter Seminar at University of Cincinnati (Invited, Zoom)</b> Microscopic theory of multi-stage Fermi surface reconstruction in higher-rank moment quantum materials	<i>Cincinnati, USA</i> <i>May 10, 2023</i>
<b>APS March Meeting 2023</b> Microscopic theory of multi-stage Fermi surface reconstruction in heavy fermion systems with quartet multipolar local moments	<i>Las Vegas, USA</i> <i>Mar. 8, 2023</i>
<b>2022 CAP Congress</b> Realization of fractonic quantum phases in the breathing pyrochlore lattice	<i>Hamilton, Canada</i> <i>Jun. 8, 2022</i>
<b>APS March Meeting 2022</b> Realization of fractonic quantum phases in the breathing pyrochlore lattice	<i>Chicago, USA</i> <i>Mar. 17, 2022</i>
<b>APS March Meeting 2020 (Virtual APS March Meeting)</b> Quantum criticalities with lattice vibrations	<i>Denver, USA</i> <i>Mar. 3, 2020</i>
<b>12th BK21+ Young Physicists Workshop</b> Emergence of Supersymmetry from spin-lattice coupling	<i>Daejeon, S. Korea</i> <i>Feb. 4, 2019</i>
<b>KAIST-Weizmann Workshop on Quantum Condensed Matter Physics (Invited)</b> Emergence of Supersymmetry from spin-lattice coupling	<i>Rehovot, Israel</i> <i>Dec. 5, 2019</i>
<b>2019 KPS Fall Meeting</b> Quantum criticalities with lattice vibrations	<i>Gwangju, S. Korea</i> <i>Oct. 25, 2019</i>
<b>APS March Meeting 2019</b> Emergent Anisotropic Non-Fermi Liquid	<i>Boston, USA</i> <i>Mar. 4, 2019</i>
<b>11th BK21+ Young Physicists Workshop</b> Emergent Anisotropic Non-Fermi Liquid	<i>Pohang, S. Korea</i> <i>Feb. 15, 2019</i>
<b>2018 KPS Spring Meeting</b> Emergent Anisotropic Non-Fermi Liquid	<i>Daejeon, S. Korea</i> <i>Apr. 26, 2018</i>
<b>APS March Meeting 2018</b> Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators	<i>Los Angeles, USA</i> <i>Mar. 7, 2018</i>
<b>2017 KPS Spring Meeting</b> Topological Phase Transitions in Dirac semi-metals of distorted spinels	<i>Daejeon, S. Korea</i> <i>Apr. 21, 2017</i>
<b>APS March Meeting 2017</b> Topological Phase Transitions in Dirac semi-metals of distorted spinels	<i>New Orleans, USA</i> <i>Mar. 14, 2017</i>
<b>POSTER PRESENTATION</b>	
<b>International Conference on Strongly Correlated Electron Systems 2023 (SCES 2023)</b> Theory of a quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction	<i>Songdo, S. Korea</i> <i>Jul. 3-7, 2023</i>
<b>Quantum Matter Workshop</b> Microscopic theory of multi-stage Fermi surface reconstruction in heavy fermion systems with quartet multipolar local moments	<i>Waterloo, Canada</i> <i>Nov. 14-16, 2022</i>
<b>2020 Theory Winter School</b> Emergence of supersymmetry from spin-lattice coupling	<i>Tallahassee, USA</i> <i>Jan. 6-10, 2020</i>
<b>IBSPCS-KIAS International Workshop Frustrated Magnetism</b> Stability of Quantum Criticalities	<i>Daejeon, S. Korea</i> <i>Oct. 14-18, 2019</i>
<b>The 2<sup>nd</sup> Workshop on Spin-orbit Coupled Topological States</b> Stability of Quantum Criticalities	<i>Pohang, S. Korea</i> <i>Sep. 19-21, 2019</i>
<b>KIAS workshop on Topology and Correlation in quantum materials</b> Emergent Anisotropic Non-Fermi Liquid at a Topological Phase Transition in Three Dimensions	<i>Busan, S. Korea</i> <i>May 29-31, 2019</i>

<b>The 19th JAPAN-KOREA-TAIWAN SYMPOSIUM ON STRONGLY CORRELATED ELECTRON SYSTEMS</b> Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators / Emergent Anisotropic Non-Fermi Liquid	<i>Tokyo, Japan</i> <i>Jan. 11-13, 2019</i>
<b>The 1<sup>st</sup> Workshop on Spin-Orbit Coupled Topological States</b> Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators / Emergent Anisotropic Non-Fermi Liquid • <i>Outstanding Poster Award</i>	<i>Pohang, S. Korea</i> <i>Oct. 1-5, 2018</i>
<b>Advanced School and Workshop on Correlations in Electron Systems – from Quantum Criticality to Topology -</b> Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators / Emergent Anisotropic Non-Fermi Liquid	<i>Trieste, Italy</i> <i>Aug. 6-17, 2018</i>
<b>International Workshop on “New Paradigms in Quantum Matter 2018”</b> Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators / Emergent Anisotropic Non-Fermi Liquid	<i>Beijing, China</i> <i>Jun. 24-Jul. 7, 2018</i>
<b>KIAS workshop on Topology and Correlation</b> Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators	<i>Seoul, S. Korea</i> <i>Jun. 7-8, 2018</i>
<b>10th BK21+ Young Physicists Workshop</b> Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators	<i>Seoul, S. Korea</i> <i>Feb. 8-9, 2018</i>
<b>The 19th International Conference on Recent Progress in Many-Body Theories</b> Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators	<i>Pohang, S. Korea</i> <i>Jun. 25-30, 2017</i>
<b>2016 Quantum Materials Symposium</b> Topological Phase Transitions in Line-nodal Superconductors	<i>Incheon, S. Korea</i> <i>Feb. 22-26, 2016</i>

## Teaching experiences

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### Teaching Assistants in

• PH504 Graduate Quantum Mechanics 2 at KAIST	<i>March 2013 - December 2017</i>
• PH503 Graduate Quantum Mechanics 1 at KAIST	September 2017 - December 2017
• PH496 Colloquium & PH990 Seminar at KAIST	March 2017 - June 2017
• PH503 Graduate Quantum Mechanics 1 at KAIST	September 2016 - December 2016
• PH302 Undergraduate Quantum Mechanics 2 at KAIST	March 2016 - June 2016
• PH301 Undergraduate Quantum Mechanics 1 at KAIST	September 2015 - December 2015
• PH654 Quantum Field Theory 2 at KAIST	March 2015 - June 2015
• PH142 General Physics 2 at KAIST	March 2014 - June 2014
• PH141 General Physics 1 at KAIST	September 2013 - December 2013
	March 2013 - June 2013

## References

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### Prof. Eun-Gook Moon

DEPARTMENT OF PHYSICS, KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY (KAIST)  
291 Daehak-ro, Yuseong-gu, Daejeon 34141, Republic of Korea  
Email: egmoon@kaist.ac.kr

### Prof. Yong Baek Kim

DEPARTMENT OF PHYSICS, UNIVERSITY OF TORONTO (U OF T)  
60 St. George Street, University of Toronto, Toronto, Ontario M5S 1A7, Canada  
Email: ybkim@physics.utoronto.ca

### Prof. Hongki Min

DEPARTMENT OF PHYSICS AND ASTRONOMY, SEOUL NATIONAL UNIVERSITY  
1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea  
Email: hmin@snu.ac.kr

**Prof. Gil Young Cho**

DEPARTMENT OF PHYSICS, POHANG UNIVERSITY OF SCIENCE AND TECHNOLOGY (POSTECH)

77 Cheongam-ro, Nam-gu, Pohang 37673, Republic of Korea

Email: gilyoungcho@postech.ac.kr