

SangEun Han

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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

“Gross-Neveu-Yukawa $SO(2)$ and $SO(3)$ tensorial criticality”

SangEun Han, SHOURYYA RAYOP, AND IGOR F. HERBUT

Accepted for publication in Phys. Rev. B. arXiv:2411.16842 [cond-mat.str-el] [hep-th] [cond-mat.stat-mech]

“Gross-Neveu-Yukawa theory of $SO(2N) \rightarrow SO(N) \times SO(N)$ spontaneous symmetry breaking”

SangEun Han AND IGOR F. HERBUT

Phys. Rev. B **110**, 125131 (2024). arXiv:2406.01681 [cond-mat.str-el] [hep-th] [cond-mat.stat-mech]

“Spontaneous breaking of the $SO(2N)$ symmetry in the Gross-Neveu model”

SangEun Han AND IGOR F. HERBUT

Phys. Rev. D **109**, 096026 (2024). arXiv:2403.09627 [hep-th] [cond-mat.str-el] [cond-mat.stat-mech]

“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

“Fermi Surface Bosonization of Non-Fermi Liquids”

SangEun Han, FÉLIX DESROCHERS, AND YONG BAEK KIM

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

Presentation

ORAL PRESENTATION

Informal Theory Seminar at Institute for Solid State Physics (Invited)

Quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction

Kashiwa, Japan

Feb. 5, 2025

Condensed Matter Physics Seminar at Korea Institute for Advanced Study (Invited)

Quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction

Seoul, S. Korea

Jan. 20, 2025

CTP Seminar at Seoul National University (Invited)

Quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction

Seoul, S. Korea

Jan. 17, 2025

Condensed Matter Group Seminar at Hanyang University (Invited)

Quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction

Seoul, S. Korea

Jan. 9, 2025

Physics Seminar at KAIST (Invited)

Quantum impurity model for two-stage multipolar ordering and Fermi surface reconstruction

Daejeon, S. Korea

Jan. 8, 2025

APS March Meeting 2024

Bosonization of Non-Fermi Liquids

Minneapolis, USA

Mar. 4, 2024

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

Condensed Matter Seminar at University of Cincinnati (Invited, Zoom)

Microscopic theory of multi-stage Fermi surface reconstruction in higher-rank moment quantum materials

Cincinnati, USA

May 10, 2023

APS March Meeting 2023

Microscopic theory of multi-stage Fermi surface reconstruction in heavy fermion systems with quartet multipolar local moments

Las Vegas, USA

Mar. 8, 2023

2022 CAP Congress

Realization of fractonic quantum phases in the breathing pyrochlore lattice

Hamilton, Canada

Jun. 8, 2022

APS March Meeting 2022

Realization of fractonic quantum phases in the breathing pyrochlore lattice

Chicago, USA

Mar. 17, 2022

APS March Meeting 2020 (Virtual APS March Meeting)

Quantum criticalities with lattice vibrations

Denver, USA

Mar. 3, 2020

12th BK21+ Young Physicists Workshop

Emergence of Supersymmetry from spin-lattice coupling

Daejeon, S. Korea

Feb. 4, 2019

KAIST-Weizmann Workshop on Quantum Condensed Matter Physics (Invited)

Emergence of Supersymmetry from spin-lattice coupling

Rehovot, Israel

Dec. 5, 2019

2019 KPS Fall Meeting

Quantum criticalities with lattice vibrations

Gwangju, S. Korea

Oct. 25, 2019

APS March Meeting 2019

Emergent Anisotropic Non-Fermi Liquid

Boston, USA

Mar. 4, 2019

11th BK21+ Young Physicists Workshop

Emergent Anisotropic Non-Fermi Liquid

Pohang, S. Korea

Feb. 15, 2019

2018 KPS Spring Meeting

Emergent Anisotropic Non-Fermi Liquid

Daejeon, S. Korea

Apr. 26, 2018

APS March Meeting 2018

Long-range Coulomb Interaction effects on Topological Phase Transitions between Semi-metals and Insulators

Los Angeles, USA

Mar. 7, 2018

2017 KPS Spring Meeting

Topological Phase Transitions in Dirac semi-metals of distorted spinels

Daejeon, S. Korea

Apr. 21, 2017

APS March Meeting 2017 Topological Phase Transitions in Dirac semi-metals of distorted spinels	<i>New Orleans, USA</i> <i>Mar. 14, 2017</i>
POSTER PRESENTATION	
International Conference on Strongly Correlated Electron Systems 2023 (SCES 2023) 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>
Quantum Matter Workshop 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>
2020 Theory Winter School Emergence of supersymmetry from spin-lattice coupling	<i>Tallahassee, USA</i> <i>Jan. 6-10, 2020</i>
IBSPCS-KIAS International Workshop Frustrated Magnetism Stability of Quantum Criticalities	<i>Daejeon, S. Korea</i> <i>Oct. 14-18, 2019</i>
The 2nd Workshop on Spin-orbit Coupled Topological States Stability of Quantum Criticalities	<i>Pohang, S. Korea</i> <i>Sep. 19-21, 2019</i>
KIAS workshop on Topology and Correlation in quantum materials Emergent Anisotropic Non-Fermi Liquid at a Topological Phase Transition in Three Dimensions	<i>Busan, S. Korea</i> <i>May 29-31, 2019</i>
The 19th JAPAN-KOREA-TAIWAN SYMPOSIUM ON STRONGLY CORRELATED ELECTRON SYSTEMS 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>
The 1st Workshop on Spin-Orbit Coupled Topological States 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>
Advanced School and Workshop on Correlations in Electron Systems – from Quantum Criticality to Topology - 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>
International Workshop on “New Paradigms in Quantum Matter 2018” 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>
KIAS workshop on Topology and Correlation 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>
10th BK21+ Young Physicists Workshop 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>
The 19th International Conference on Recent Progress in Many-Body Theories 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>
2016 Quantum Materials Symposium Topological Phase Transitions in Line-nodal Superconductors	<i>Incheon, S. Korea</i> <i>Feb. 22-26, 2016</i>

Teaching experiences

Teaching Assistants in

- PH504 Graduate Quantum Mechanics 2 at KAIST
- PH503 Graduate Quantum Mechanics 1at KAIST
- PH496 Colloquium & PH990 Seminar at KAIST
- PH503 Graduate Quantum Mechanics 1 at KAIST
- PH302 Undergraduate Quantum Mechanics 2 at KAIST
- PH301 Undergraduate Quantum Mechanics 1 at KAIST
- PH654 Quantum Field Theory 2 at KAIST
- PH142 General Physics 2 at KAIST
- PH141 General Physics 1 at KAIST

March 2013 - December 2017
September 2017 - December 2017
March 2017 - June 2017
September 2016 - December 2016
March 2016 - June 2016
September 2015 - December 2015
March 2015 - June 2015
March 2014 - June 2014
September 2013 - December 2013
March 2013 - June 2013

References

Prof. Eun-Gook Moon

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291 Daehak-ro, Yuseong-gu, Daejeon 34141, Republic of Korea
Email: egmoon@kaist.ac.kr

Prof. Yong Baek Kim

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60 St. George Street, University of Toronto, Toronto, Ontario M5S 1A7, Canada
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Prof. Igor F. Herbut

DEPARTMENT OF PHYSICS, SIMON FRASER UNIVERSITY (SFU)
Department of Physics, Simon Fraser University, 8888 University Drive, Burnaby, British Columbia V5A 1S6, Canada
Email: iherbut@sfu.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, KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY (KAIST)
291 Daehak-ro, Yuseong-gu, Daejeon 34141, Republic of Korea
Email: gilyoungcho@kaist.ac.kr