Chaebin Kim

Postdoctoral Researcher, School of Physics, Georgia Institute of Technology

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Contact information

Address: School of Physics, 837 State Street, Atlanta, GA 30332, USA
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Research Interest

Qauntum magnetism

- Geometrical frustration in triangular, kagome, pyrochlore lattice
- Exchange frustration from bond-dependent exchange anisotropy (Kitaev interaction)
- Quantum-to-Classical spin crossover
- Long-range entanglement between spins

Spin dynamics

- Exotic spin dynamics in quantum magnets
  (spontaneous magnon decay, quasi-particle fractionalization, etc)
- Finite temperature spin dynamics

Neutron scattering

- Measuring elementary excitations using inelastic neutron scattering
- Magnetic structure analysis using neutron diffraction

Employment

School of Physics, Georgia Institute of Technology (GT) — *Atlanta, GA, USA*
Postdoctoral Researcher — *Mar. 2024 - Current*

- *Advisor: Martin Mourigal*

Department of Physics and Astronomy, Seoul National University — *Seoul, Republic of Korea*
Postdoctoral Researcher — *Sep. 2023 – Feb. 2024*

- *Advisor: Je-Geun Park*

Department of Physics and Astronomy, Seoul National University — *Seoul, Republic of Korea*
Graduate Student — *Mar. 2018 – Aug. 2023*

- *Advisor: Je-Geun Park*

Education

Department of Physics and Astronomy, Seoul National University — *Seoul, Republic of Korea*
Ph.D. in Physics — *Mar. 2018 – Aug. 2023*

- *Thesis: Spin dynamics of Kitaev candidates in cobalt compounds*
- *Advisor: Je-Geun Park*

Department of Physics, Yonsei University — *Seoul, Republic of Korea*
B.S. in Physics — *Mar. 2013 – Feb. 2018*

Skills and Technique

Color indicates expert level skills

Material Synthesis

- Polycrystalline samples (Solid-state reaction, High-pressure synthesis)
- Single crystal growth with Flux method, **Chemical Vapor Transport**, Bridgman method

Material Characterization

- Polycrystalline X-ray diffraction and Crystal structure analysis (FullProf)
- Electrical / Magnetic / Thermal properties of materials using MPMS-XL, MPMS3, and PPMS

Neutron scattering experiment

- Polycrystalline neutron diffraction and structure analysis (FullProf)
- **Polycrystalline/Single-crystal inelastic neutron scattering and analysis** (Horace, Mantid, Dave)

X-ray scattering experiment

- XANES at PAL-2A & PAL-3A in Pohang, Republic of Korea
- Resonant X-ray Scattering at PAL-3A & PAL-XFEL in Pohang, Republic of Korea

Computational & Theoretical Technique

- Programming Language: Matlab, Python, Julia
- **Semi-classical spin dynamics and classical Monte-Carlo simulation** using SU(N)NY.jl
- **Linear Spin-Wave Theory** using SU(N)NY.jl and SpinW
- **Exact Diagonalization (ED)** using QuSpin
- Multiplet state calculation using Quanty

Awards and Honors

Duk Joo Kim Young Scientist Award *2024*
Korean Physical Society

Excellent Dissertation Awards *2023*
Seoul National University

Best Poster Awards *2023*
International Conference on Strongly Correlated Electron System (SCES)

Brain Korea 21 (BK21) doctoral scholarship *2022, 2023*
Seoul National University

Publications

Profiles : [Google Scholar], [Orcid], [Research Gate]

Citations : Google Scholar: **423**, $h = 10$

[#] *indicates my first (or co-first) contribution*
* *indicates equal contributions*
† *indicates corresponding author(s) (if not the senior author)*

Submitted and Preparing Journal Articles

[20] **C. Kim**[*†] and M. Mourigal[†]. "Emulation of quantum correlations by classical dynamics in a spin-1/2 Heisenberg chain". *In preparation* (2024).

[19] **C. Kim**[*], O. Vilella[*], Y. Lee[*], P. Park, Y. An, W. Cho, M. B. Stone, A. I. Kolesnikov, S. Asai, S. Itoh, T. Masuda, S. Matin, S. Kim, S.-J. Kim, M. Mourigal[†], and J.-G. Park[†]. "Possible higher-order skyrmion crystal in van der Waals Kitaev triangular antiferromagnet NiI_2". *In preparation* (2024).

[18] X.-G. Zhou[*], H. Li[*], **C. Kim**[*], A. Matsuo, K. Mehlawat, K. Matsui, Z. Yang, A. Miyata, G. Su, K. Kindo, J.-G. Park, Y. Kohama, W. Li, and H. Y. Matsuda. "Emergent quantum disordered phase in $Na_2Co_2TeO_6$ under intermediate magnetic field along c axis". *Submitted* (2024). DOI: 10.48550/arXiv.2408.01957.

[17] P. Park, W. Cho, **C. Kim**, Y. An, K. Iida, R. Kajimoto, S. Matin, S.-S. Zhang, C. D. Batista, and J.-G. Park. "Contrasting dynamical properties of single-Q and triple-Q magnetic orderings in a triangular lattice antiferromagnet". *Submitted* (2024). DOI: 10.48550/arXiv:2410.02180.

Published and Accepted Journal Articles

[16] Y. Lee*, **C. Kim***, S. Son, J. Cui, G. Park, K.-X. Zhang, S. Oh, H. Cheong, A. Kleibert, and J.-G. Park. "Imaging Thermally Fluctuating Néel Vectors in van der Waals Antiferromagnet $NiPS_3$". *Nano Letters* **24**, 6043–6065 (2024). DOI: 10.1021/acs.nanolett.4c00804.

[15] P. Park, W. Cho, **C. Kim**, Y. An, M. Avdeev, K. Iida, R. Kajimoto, and J.-G. Park. "Composition dependence of bulk properties in the Co-intercalated transition metal dichalcogenide $Co_{1/3}TaS_2$". *Physical Review B* **109**, L060403 (2024). DOI: 10.1103/PhysRevB.109.L060403.

[14] P. Park, W. Cho, **C. Kim**, Y. An, Y.-G. Kang, M. Avdeev, R. Sibille, K. Iida, R. Kajimoto, K. H. Lee, W. Ju, E.-J. Cho, H.-J. Noh, M. J. Han, S.-S. Zhang, C. D. Batista, and J.-G. Park. "Tetrahedral triple-Q magnetic ordering and large spontaneous Hall conductivity in the metallic triangular antiferromagnet $Co_{1/3}TaS_2$". *Nature Communications* **14**, 8346 (2023). DOI: 10.1038/s41467-023-43853-4.

[13] **C. Kim***, S. Kim*, P. Park, T. Kim, J. Jeong, S. Ohira-Kawamura, N. Murai, K. Nakajima, A. Chernyshev, M. Mourigal, and J.-G. Park. "Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnet". *Nature Physics* **19**, 1624–1629 (2023). DOI: 10.1038/s41567-023-02180-7.

[12] J. H. Kim, T. S. Jung, Y. Lee, **C. Kim**, J.-G. Park, and J. H. Kim. "Terahertz evidence of electromagnon excitations in the multiferroic van der Waals insulator NiI_2". *Physical Review B* **108**, 064414 (2023). DOI: 10.1103/PhysRevB.108.064414.

[11] Y. An, P. Park, **C. Kim**, K. Zhang, H. Kim, M. Avdeev, J. Kim, M.-J. Han, H.-J. Noh, S. Seong, J.-S. Kang, H.-D. Kim, and J.-G. Park. "Bulk properties of the chiral metallic triangular antiferromagnets $Ni_{1/3}NbS_2$ and $Ni_{1/3}TaS_2$". *Physical Review B* **108**, 054418 (2023). DOI: 10.1103/PhysRevB.108.054418.

[10] A. Wildes, B. Fåk, U. Hansen, M. Enderle, J. Stewart, L. Testa, H. Rønnow, **C. Kim**, and J.-G. Park. "Spin wave spectra of single crystal $CoPS_3$". *Physical Review B* **107**, 054438 (2023). DOI: 10.1103/PhysRevB.107.054438.

[9] Y. Lee*, S. Son*, **C. Kim***, S. Kang, J. Shen, M. Kenzelmann, B. Delley, T. Savchenko, S. Parchenko, W. Na, K.-Y. Choi, W. Kim, H. Cheong, P. M. Derlet, A. Kleibert†, and J.-G. Park†. "Giant magnetic anisotropy in the atomically thin van der Waals antiferromagnet $FePS_3$". *Advanced Electronic Materials* **9**, 2200650 (2023). DOI: 10.1002/aelm.202200650.

[8] H. Yang*, **C. Kim***, Y. Choi, J. H. Lee, G. Lin, J. Ma, M. Kratochvílová, P. Proschek, E.-G. Moon, K. H. Lee, Y. S. Oh, and J.-G. Park. "Significant thermal Hall effect in the 3d cobalt Kitaev system $Na_2Co_2TeO_6$". *Physical Review B* **106**, L081116 (2022). DOI: 10.1103/PhysRevB.106.L081116.

[7] S. Son, Y. Lee, J. H. Kim, B. H. Kim, **C. Kim**, W. Na, H. Ju, S. Park, A. Nag, K.-J. Zhou, Y.-W. Son, H. Kim, W.-S. Noh, J.-H. Park, J. S. Lee, H. Cheong, J. H. Kim, and J.-G. Park. "Multiferroic-Enabled Magnetic-Excitons in 2D Quantum-Entangled Van der Waals Antiferromagnet NiI_2". *Advanced Materials* **34**, 2109144 (2022). DOI: 10.1002/adma.202109144.

[6] **C. Kim***, H.-S. Kim†, and J.-G. Park†. "[**Review**] Spin-orbital entangled state and realization of Kitaev physics in 3d cobalt compounds: a progress report". *Journal of Physics: Condensed Matter* **34**, 023001 (2021). DOI: 10.1088/1361-648X/ac2d5d.

[5] **C. Kim***, J. Jeong, G. Lin, P. Park, T. Masuda, S. Asai, S. Itoh, H.-S. Kim, H. Zhou, J. Ma, and J.-G. Park†. "Antiferromagnetic Kitaev interaction in $J_{\text{eff}}= 1/2$ cobalt honeycomb materials $Na_3Co_2SbO_6$ and $Na_2Co_2TeO_6$". *Journal of Physics: Condensed Matter* **34**, 045802 (2021). DOI: 10.1088/1361-648X/ac2644.

[4] G. Lin, J. Jeong, **C. Kim**, Y. Wang, Q. Huang, T. Masuda, S. Asai, S. Itoh, G. Günther, M. Russina, Z. Lu, J. Sheng, L. Wang, J. Wang, G. Wang, Q. Ren, C. Xi, W. Tong, L. Ling, Z. Liu, L. Wu, J. Mei, Z. Qu, H. Zhou, X. Wang, J.-G. Park, Y. Wan, and J. Ma. "Field-induced

quantum spin disordered state in spin-1/2 honeycomb magnet $Na_2Co_2TeO_6$". *Nature communications* **12**, 5559 (2021). DOI: 10.1038/s41467-021-25567-7.

[3] H. Cho, C. H. Kim, Y. Lee, K. Komatsu, B.-G. Cho, D.-Y. Cho, T. Kim, **C. Kim**, Y. Kim, T. Y. Koo, Y. Noda, H. Kagi, D. I. Khomskii, D. Seoung, and J.-G. Park. "Pressure-induced transition from J_{eff}= 1/2 to S= 1/2 states in $CuAl_2O_4$". *Physical Review B* **103**, L081101 (2021). DOI: 10.1103/PhysRevB.103.L081101.

[2] S. Yun, K. H. Lee, **C. Kim**, J. Park, M.-G. Kim, D.-Y. Cho, D. Khomskii, and J.-G. Park. "Effects of Mn-substitution on the valence bond solid in Li_2RuO_3". *Physical Review B* **103**, 035151 (2021). DOI: 10.1103/PhysRevB.103.035151.

[1] **C. Kim**[*], J. Jeong, P. Park, T. Masuda, S. Asai, S. Itoh, H.-S. Kim, A. Wildes, and J.-G. Park[†]. "Spin waves in the two-dimensional honeycomb lattice XXZ-type van der Waals antiferromagnet $CoPS_3$". *Physical Review B* **102**, 184429 (2020). DOI: 10.1103/PhysRevB.102.184429.

Conference, Seminars, and Workshops

Invited talks

[13] "Emulation of quantum effects by classical dynamics in quantum spin chain". Analyzing Magnetic Neutron Scattering Data with Sunny.jl, Oak Ridge National Laboratory (ORNL), Oak Ridge (TN), USA. Sept. 2024.

[12] "Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnet". APS March Meeting, Minneapolis (MN), USA. Mar. 2024.

[11] "Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnet". Quantum Materials Symposium 2024, Youngpyeong, Republic of Korea. Mar. 2024.

[10] "Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnet". 2023 KMS Winter conference, Busan, Republic of Korea. Mar. 2023.

Contributed talks

[9] "Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnet". APS March Meeting, Las Vegas (NV), USA. Mar. 2023.

[8] "Antiferromagnetic Kitaev interaction in $J_{\text{eff}} = 1/2$ cobalt honeycomb materials $Na_3Co_2Sb_2O_6$ and $Na_2Co_2Sb_2O_6$". The 15$^{\text{th}}$ Asia Pacific Physics Conference, (Online). Mar. 2022.

[7] "Antiferromagnetic Kitaev interaction in $J_{\text{eff}} = 1/2$ cobalt honeycomb materials $Na_3Co_2Sb_2O_6$ and $Na_2Co_2Sb_2O_6$". APS March Meeting, Chicago (IL), USA, (Online). Mar. 2022.

Contributed posters

[6] "Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnetic". Analyzing Neutron Spectroscopy Data with (Linear) Spin-Wave Theory, Oak Ridge National Laboratory (ORNL), Oak Ridge (TN), USA. Mar. 2023.

[5] "Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnetic". International Conference on Strongly Correlated Electron System (SCES), Incheon, Republic of Korea. Mar. 2023.

[4] "Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnetic". 13$^{\text{th}}$ APCTP-IACS-KIAS Joint Conference on Emergent Phenomena in Novel Oxide Materials and Low Dimensional Systems, Pohang, Republic of Korea. Mar. 2023.

[3] "Antiferromagnetic Kitaev interaction in $J_{\text{eff}} = 1/2$ cobalt honeycomb materials $Na_3Co_2Sb_2O_6$ and $Na_2Co_2Sb_2O_6$". International Conference on Strongly Correlated Electron System, Brazil (Online). Mar. 2021.

[2] "Spin waves in the two-dimensional honeycomb lattice XXZ-type van der Waals antiferromagnet $CoPS_3$ (Poster)". APCTP-KIAS Quantum Materials Symposium, Republic of Korea (Online). Mar. 2021.

[1] "Spin waves in the two-dimensional honeycomb lattice XXZ-type van der Waals antiferromagnet $CoPS_3$ (Poster)". The 4^{th} Neutron, Muon School, and MIRAI PhD School 2019, J-PARC, Japan. Mar. 2021.

Teaching Experience

Research Assistant *Jul. 2018 - July. 2020*
Department of Physics and Astronomy, Seoul National University *Seoul, Republic of Korea*

- *Advisor: Je-Geun Park*

Chief Resident Assistant *Sep. 2017 - Feb. 2018*
Residential College, Yonsei University *Incheon, Republic of Korea*

Resident Assistant *Feb. 2017 - Aug. 2017*
Residential College, Yonsei University *Incheon, Republic of Korea*

Professional Activities

Journal Referee:
Physical Review Letters, Physical Review B, Physical Review Materials *2024-Current*

Session Chair
APS March Meeting, Minneapolis (MN), USA *2024*

- Quantum Spin Liquids V: Kagome and Dirac Systems

Personal Skills

Language(s): Korean (Native), English (Fluent)

Communication skills: Good communication skills gained through my experience as a resident assistant

Training courses Attended:

- Analyzing Magnetic Neutron Scattering Data with Sunny.jl, ORNL (2024)
- Analyzing Neutron Spectroscopy Data with (Linear) Spin-Wave Theory, ORNL (2023)
- Modeling and Fitting Crystals Fields with Neutron Scattering, ORNL, Virtual (2022)
- The $11^{\mathbf{th}}$ PAL Summer School, Pohang, Korea (2019)
- The $7^{\mathbf{th}}$ Powder Crystallography Tutorial, Pohang, Korea (2019)
- The $4^{\mathbf{th}}$ Neutron and Muon School & MIRAI PhD school 2019, J-PARC, Japan (2019)
- The $9^{\mathbf{th}}$ Summer School of Condensed Matter Physics, Korea (2018)