

Pyeongjae Park



Postdoctoral Researcher

Materials Science and Technology Division
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Education

- 2016.08 – 2022.08 **Ph.D. in Physics:** Seoul National University, Seoul, Korea
Thesis: “Spin dynamics and topological aspects of non-collinear metallic antiferromagnets”
Advisor: Prof. Je-Geun Park
- 2019.10 The 4th Neutron and Muon School: J-PARC, Japan
- 2012.03 – 2016.08 **BSc in Physics:** Yonsei University, Seoul, Korea
(High Honors at Graduation, Class Rank: 1st out of 43)

Work Experience

- 2023.04 – **Postdoctoral researcher:** Oak Ridge National Laboratory, USA
Advisor: Dr. Andrew Christianson
- 2022.09 – 2023.03 **Postdoctoral researcher:** Seoul National University, Seoul, Korea
Advisor: Prof. Je-Geun Park

Research Interests

- **Quantum magnetism in two-dimensional lattices**
 - Geometrically frustrated triangular/kagome lattice antiferromagnets
 - Exchange frustration in square, honeycomb, and triangular lattices

- **Topology in magnetic materials**
 - Topological phenomena in metallic antiferromagnets
 - Topological spin texture

- **Spin dynamics**

- Modeling finite-temperature spin dynamics
- Exotic spin dynamics in frustrated magnets and metallic magnets

■ Neutron scattering

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

Research Skills

■ Neutron scattering

- Powder/single-crystal neutron diffraction & Rietveld refinement (FullProf)
- **Powder/single-crystal inelastic neutron scattering (Particularly specialized)**
- Extensive experience in conducting neutron scattering experiments across 18 different beamlines at renowned facilities worldwide, including SNS (USA), HFIR (USA), J-PARC (Japan), ISIS (UK), PSI (Switzerland), and ANSTO (Australia)

■ Theoretical calculations

- **Static and dynamical properties of spin systems at finite temperatures (Su(n)ny)**
- Linear spin-wave theory (SpinW, Su(n)ny)
- Nonlinear spin-wave theory: Decay and renormalization of magnons
- Magnon-phonon hybridization

■ Sample synthesis

- Polycrystalline sample growth by solid-state reaction
- Single crystal growth using chemical vapor transport and flux methods

■ Bulk characterization

- Powder/single-crystal X-ray diffraction and Rietveld refinement (FullProf)
- (Magneto-)transport experiments (QD PPMS & Cryogenic Ltd.)
- Magnetic susceptibility measurement (MPMS-XL & MPMS3)

■ X-ray spectroscopy

- X-ray absorption spectroscopy
- Phonon spectroscopy using non-resonant inelastic X-ray scattering

Publication

(*: Co-first authors, †: Corresponding)

- 1.** **Magnetic excitations in non-collinear antiferromagnetic Weyl semimetal Mn_3Sn**
P. Park, J. Oh, K. Uhlířová, J. Jackson, A. Deák, L. Szunyogh, K.H. Lee, H. Cho, H-L Kim, H. C. Walker, D. Adroja, V. Sechovský, and J.-G. Park[†]

npj Quantum Materials 3, 63 (2018)

2. **Momentum-Dependent Magnon Lifetime in the Metallic Noncollinear Triangular Antiferromagnet CrB₂**
P. Park, K. Park, T. Kim, Y. Kousaka, K. H. Lee, T. G. Perring, J. Jeong, U. Stuhr, J. Akimitsu, M. Kenzelmann, and J.-G. Park[†]
Phys. Rev. Lett. 125, 027202 (2020)
3. **Spin-orbit coupling effects on spin-phonon coupling in Cd₂OS₂O₇**
 T. Kim, C. H. Kim, J. Jeong, P. Park, K. Park, K. H. Lee, J. C. Leiner, D. Ishikawa, A. Baron, Z. Hiroi, and J.-G. Park[†]
Phys. Rev. B 102, 201101(R) (2020)
4. **Spin waves in the two-dimensional honeycomb lattice XXZ-type van der Waals antiferromagnet CoPS₃**
 C. Kim, J. Jeong, P. Park, T. Masuda, S. Asai, S. Itoh, H.-S. Kim, A. Wildes, and J.-G. Park[†]
Phys. Rev. B 102, 184429 (2020)
5. **Spin texture induced by non-magnetic doping and spin dynamics in 2D triangular lattice antiferromagnet h-Y(Mn,Al)O₃**
P. Park^{*}, K. Park^{*}, J. Oh, K. H. Lee, J. C. Leiner, H. Sim, T. Kim, J. Jeong, K. C. Rule, K. Kamazawa, K. Iida, T. G. Perring, H. Woo, S.-W. Cheong, M. E. Zhitomirsky, A. L. Chernyshev, and J.-G. Park[†]
Nature Communications 12, 2306 (2021)
6. **Possible Persistence of Multiferroic Order down to Bilayer Limit of van der Waals Material NiI₂**
 H. Ju^{*}, Y. Lee^{*}, K.-T. Kim, I. H. Choi, C. J. Roh, S. Son, P. Park, J. H. Kim, T. S. Jung, J. H. Kim, K. H. Kim, J.-G. Park[†], and J. S. Lee[†]
Nano Letters 21, 5126-5132 (2021)
7. **Air-Stable and Layer-Dependent Ferromagnetism in Atomically Thin van der Waals CrPS₄**
 J. Son^{*}, S. Son^{*}, P. Park, M. Kim, Z. Tao, J. Oh, T. Lee, S. Lee, J. Kim, K. Zhang, K. Cho, T. Kamiyama, J. H. Lee, K. F. Mak, J. Shan, M. Kim, J.-G. Park[†], and J. Lee[†]
ACS Nano 15 (10), 16904-16912 (2021)
8. **Antiferromagnetic Kitaev interaction in J_{eff}= 1/2 cobalt honeycomb materials Na₃Co₂SbO₆ and Na₂Co₂TeO₆**
 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[†]
Journal of Physics: Condensed Matter 34, 045802 (2022)
9. **Field-tunable toroidal moment and anomalous Hall effect in noncollinear antiferromagnetic Weyl semimetal Co_{1/3}TaS₂**
P. Park, Y.-G. Kang, J. Kim, K. H. Lee, H.-J. Noh, M. J. Han, and J.-G. Park[†]
npj Quantum Materials 7, 42 (2022)
10. **Bulk properties of the chiral metallic triangular antiferromagnets Ni_{1/3}NbS₂ and Ni_{1/3}TaS₂**
 Y. Ahn, 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[†]
Phys. Rev. B 108, 054418 (2023)
11. **Spin wave Hamiltonian and anomalous scattering in NiPS₃**
 A. Scheie^{*†}, P. Park^{*†}, J. W. Villanova, G. E. Granroth, C. L. Sarkis, H. Zhang, M. B. Stone, J.-G. Park, S.

Okamoto, T. Berlijn, and D. A. Tennant
Phys. Rev. B 108, 104402 (2023) (Editors' suggestion)

12. **Bond-dependent anisotropy and magnon decay in cobalt-based Kitaev triangular antiferromagnet**
 C. Kim*, S. Kim*, **P. Park**, T. Kim, J. Jeong, S. Ohira-Kawamura, N. Murai, K. Nakajima, A. L. Chernyshev, M. Mourigal, S.-J. Kim and J.-G. Park[†]
Nature Physics 19 (31), 1624-1629 (2023)
13. **Rapid Suppression of Quantum Many-Body Magnetic Exciton in Doped van der Waals Antiferromagnet (Ni,Cd)PS₃**
 J. Kim*, W. Na*, J. Kim*, **P. Park**, K. Zhang, I. Hwang, Y.-W. Son, J. H. Kim[†], H. Cheong[†], and J.-G. Park[†]
Nano Letters 23 (22), 10189-10195 (2023)
14. **Tetrahedral triple-Q ordering and large spontaneous Hall conductivity in the metallic triangular antiferromagnet Co_{1/3}TaS₂**
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[†]
Nature Communications 14, 8346 (2023)
15. **Quantum magnetism in the frustrated square lattice oxyhalides YbBi₂IO₄ and YbBi₂ClO₄**
P. Park[†], G. Sala, Th. Proffen, M. B. Stone, A. D. Christianson, and A. F. May[†]
Phys. Rev. B 109, 014426 (2024) (Editors' suggestion)
16. **Composition dependence of bulk properties in the Co-intercalated transition-metal dichalcogenide Co_{1/3}TaS₂**
P. Park[†], W. Cho, C. Kim, Y. An, M. Avdeev, K. Iida, R. Kajimoto, and J.-G. Park[†]
Phys. Rev. B 109, L060403 (2024)
17. **Direct Observation and Analysis of Low-Energy Magnons with Raman Spectroscopy in Atomically Thin NiPS₃**
 W. Na*, **P. Park***, S. Oh*, J. Kim, A. Scheie, D. A. Tennant, H. C. Lee[†], J.-G. Park[†] and H. Cheong[†]
ACS Nano 18 (31), 20482-20492 (2024)
18. **Quantum and classical spin dynamics across temperature scales in the S = 1/2 Heisenberg antiferromagnet**
P. Park[†], G. Sala, D. M. Pajerowski, A. F. May, J. A. Kolopus, D. Dahlbom, M. B. Stone[†], G. B. Halász[†] and A. D. Christianson[†]
Phys. Rev. Research 6 (3), 033184 (2024) (Editors' suggestion)
19. **Anomalous continuum scattering and higher-order van Hove singularity in the strongly anisotropic S = 1/2 triangular lattice antiferromagnet**
P. Park[†], E. A. Ghioldi, A. F. May, J. A. Kolopus, A. A. Podlesnyak, J. A. M. Paddison, C. D. Batista, A. E. Trumper, L. O. Manuel, M. B. Stone[†], G. B. Halász[†] and A. D. Christianson[†]
Nature Communications 15, 7264 (2024)
20. **Electrical control of topological 3Q state in an intercalated van der Waals antiferromagnet**
 J. Kim, K. Zhang, **P. Park**, W. Cho, H. Kim and J.-G. Park[†]
 arXiv:2409.02710 (2024)

Conference Presentation

[Oral]

1. **Magnetic excitations in non-collinear antiferromagnetic Weyl semimetal Mn_3Sn**
International Conference on Magnetism (ICM) 2018, San Francisco, USA
2. **Magnetic Excitations and Q-dependent magnon lifetime in Non-collinear Metallic Antiferromagnet CrB_2**
APS March Meeting 2020, Denver, USA
- 3-4. **Spin texture induced by non-magnetic doping and spin dynamics in 2D triangular lattice antiferromagnet $\hbar\text{-Y}(\text{Mn,Al})\text{O}_3$**
International Conference on Strongly Correlated Electron Systems (SCES) 2020, Brazil & Online
APS March Meeting 2022, Chicago (Invited speaker)
5. **Field-tunable toroidal moment and anomalous Hall effect in noncollinear antiferromagnetic Weyl semimetal $\text{Co}_{1/3}\text{TaS}_2$**
The 9th International Workshop on 2D Materials (2022), Japan & Online
6. **Significant composition dependence of the anomalous Hall effect in the metallic triangular lattice antiferromagnet $\text{Co}_{1/3}\text{TaS}_2$**
APS March Meeting 2023, Las Vegas, USA
7. **Quantum fluctuations in the highly anisotropic $S = 1/2$ triangular lattice antiferromagnet**
APS March Meeting 2024, Minneapolis, USA
8. **Unraveling single-Q and triple-Q magnetic orders in the metallic triangular lattice antiferromagnet $\text{Co}_{1/3}\text{TaS}_2$**
Methods for Modeling Transport and Dynamics of Quantum Magnets (2024), Los Alamos, USA
(Invited speaker)
9. **Using the LLD option in $\text{Su}(n)_\text{ny}$ for quantum magnetism studies**
Analyzing Magnetic Neutron Scattering Data with Sunny.jl (2024), Oak Ridge, USA (Invited speaker)

[Poster]

1. **Magnetic excitations in non-collinear antiferromagnetic Weyl semimetal Mn_3Sn**
APTCP-KIAS Quantum Materials Symposium 2019, Yongpyong, Korea
- 2-5. **Magnetic excitations in non-collinear metallic antiferromagnet CrB_2**
11th International Conference on Magnetic and Superconducting Materials, Seoul, Korea (2019)
International Conference on Strongly Correlated Electron Systems (SCES) 2019, Okayama, Japan
The 20th Korea-Taiwan-Japan Symposium on SCES, Seoul, Korea (2020)
APTCP-KIAS Quantum Materials Symposium 2020, Yongpyong, Korea
6. **Spin texture induced by non-magnetic doping and spin dynamics in 2D triangular lattice antiferromagnet $\hbar\text{-Y}(\text{Mn,Al})\text{O}_3$**
APTCP-KIAS Quantum Materials Symposium 2021, Online
- 7-8. **Quantum fluctuations in the highly anisotropic $S = 1/2$ triangular lattice antiferromagnet**

Analyzing Neutron Spectroscopy Data with (Linear) Spin-Wave Theory, ORNL, USA (2023)

Quantum on the Quad, ORNL, USA (2023)

Honors & Awards

- 2022.08 **Best Ph.D. Thesis Award**
College of Natural Sciences, Seoul National University, Seoul, Korea
- 2021.09 **Brain Korea 21 doctoral Scholarship**
- 2020.09 **Brain Korea 21 doctoral Fellowship**
- 2020.02 **Best poster award**
APTCP-KIAS Quantum Materials Symposium 2020, Yongpyong, Korea
- 2020.01 **Best poster award**
The 20th Korea-Taiwan-Japan Symposium on Strongly Correlated Electron Systems, Seoul, Korea
- 2019.11 **Best presentation award**
The 4th Neutron and Muon School: J-PARC, Japan
- 2019.03 **Brain Korea 21 doctoral Scholarship**
- 2019.02 **Best poster award**
APTCP-KIAS Quantum Materials Symposium 2019, Yongpyong, Korea
- 2012-2016 **Recipient of the National Science & Technology Scholarship**
Korea Student Aid Foundation