Huibo Cao, Ph.D.

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Education and Training

2002-2007 Ph.D. in Condensed Matter Physics, Institute of Physics, CAS, Beijing, China
1998-2002 B.S. in Physics, Shanxi University, Taiyuan, China

Professional Experience

2010-present Research staff, Oak Ridge National Laboratory, USA
2009-2010 Postdoctoral Fellow, Oak Ridge National Laboratory, USA
2007-2009 Postdoctoral Fellow, Laboratoire Léon Brillouin, CEA-Saclay, France

Research

Currently Dr. Cao is a senior research staff at ORNL. He serves as the Point-of-Contact of a HFIR beamline DEMAND and is also the Principal Investigator (PI) of a quantum material research group. His interest and expertise lie in the study of magnetism, with a focus on emergent quantum states and structural/magnetic symmetry characterization in a range of materials. He began his research career investigating macroscopic quantum tunneling in single molecular magnets during his Ph.D. studies. During his first postdoctoral appointment in Laboratoire Léon Brillouin, France, his research interest moved to geometrically frustrated magnets that host various emergent quantum states. Following a one-year postdoctoral position at ORNL, he became research staff working on various quantum materials including low-dimensional, frustrated, topological, multiferroic, and superconducting materials. In 2018, Dr. Cao received the U.S. Department of Energy (DOE) Early Career Award on "Local Site Magnetic Susceptibility for Quantum Materials by Polarized Neutron Diffraction" and started his Quantum Material research group. His group has developed polarized neutron diffraction as a local probe of magnetic response at a crystallographic site to characterize magnetic quantum materials beyond magnetic ordered states. Dr. Cao's interest is also extended to AI-assisted instrument automation and data interpretation and is working with talented mathematicians to explore new routes to efficiently exploring quantum materials. Throughout his career, Dr. Cao has authored and co-authored over 200 publications and mentored 7 postdoctoral fellows and 6 short-term students. Dr. Cao's group warmly welcomes highly motivated students and postdocs who are passionate about quantum material research, neutron scattering science, and AI-assisted sciences relevant to these fields.

Professional activities

- In-depth expertise in the use of neutron scattering to study magnetism in condensed matter physics and materials.
- Lead instrument scientist of HB-3A DEMAND at High Flux Isotope Reactor since 2010.
- Point-of-Contact (one of two) for proposing a Second Target Station instrument, PIONEER (2020-2021).
- Member of the Instrument Science Advisory Team of PIONEER at the Second Target Station since 2021.
- Author and co-author 210 refereed journal articles.
- h-index of 43 and citations of 6803 (GoogleScholar).
- Presented over 20 invited lectures on university/institute seminars, conferences, workshops.
- Organized 17 symposiums or workshops with a focus on magnetism since 2010.
- Chair of the Neutron Special Interest Group in 2014, American Crystallographic Association
- Taught experiments and lectures for 13 years for "National School on Neutron and X-ray Scattering", Oak Ridge National Laboratory/ Argonne National Laboratory.
- Memberships, American Physical Society, Neutron Scattering Society of America, American Crystallographic Association, and AAAS (American Association for the Advancement of Science).

Reviewing activities

- Reviewer for Physical Review journals, Nature Communications, Journal of Physics, Applied Physics Letters, Journal of Applied Physics, Journal of Magnetism and Magnetic Materials, and Computational Materials Science.
- Reviewer for the neutron scattering proposals for NIST Center for Neutron Research
- Reviewer for the funding proposals

Mentorship experiences

Dr. Cao has mentored and is currently mentoring and managing a group of postdoctoral fellows and students, who are mainly supported by my ECA grant. The current and past group members are listed as follow.

- Dr. Madalynn Marshall, Postdoctoral Fellow, formerly a PhD student in Rutgers University, joined the group in February 2022.
- Dr. Qianli(Kyle) Ma, Postdoctoral Fellow, formerly a PhD student in McMaster University in Canada, joined the group in September 2022.
- Dr. Yiqing Hao, Postdoctoral Fellow, formerly a PhD student in Fudan University in China, joined the group in August 2022.
- Dr. Erxi Feng, Postdoctoral Fellow (2019-2022), formerly a PhD student graduated from the neutron scattering facility FRMII in Germany, currently an instrument scientist at Chinese Spallation Neutron Source.
- Dr. Lei Ding, Postdoctoral Fellow (2019-2021), formerly a postdoctoral fellow from the time-of-flight neutron scattering facility ISIS in UK, currently in the Institut Néel, France.
- Dr. Xiaojian Bai, Postdoctoral Fellow (2020-2022), formerly a PhD student in Georgia Institute of Technology, currently an assistant professor in Louisianan State University.
- Madalynn Marshall, a DOE SCGSR award winner (2019) from Louisiana State University, joined the group in January 2019 for 9 months. Currently a postdoc in my group.
- Leah Zimmer, a SULI (Science Undergraduate Laboratory Internship) student (2021 summer). Currently a graduate student at the University of Washington
- Courtney Baier, a HERE (Higher Education Research Experiences) student, July 15, 2019 - July 30, 2020. Currently a graduate student at a university.
- Emil Klahn, a visiting exchange student from Jacob Overgaard's group at Aarhus University in Denmark, working on single molecular magnets by polarized neutron diffraction, January – May 2019.
- Xin Gui, a visiting student (2018) for 2 months from Weiwei Xie's group at Louisiana State University. Currently an assistant professor in University of Pittsburg.
- Dr. Yan Wu, Postdoctoral Fellow (2016-2019), graduated from Louisiana State University. She began neutron scattering research with me in July 2016. After three-year postdoctoral research, she gained experience in neutron scattering and high-pressure studies and has recently joined our division as an instrument scientist at HB-2C WAND^2 and HB-3A DEMAND in 2019.

Honors & Awards:

2019 "**Beam Line Scientist Award**" from SHUG for Excellence in Beam Line Science recognizes beam line scientists who have made significant scientific contributions in their area of research or instrumentation development and have participated in the growth and enrichment of the user community.

2018 **DOE** Office of Science **Early Career Award** on "Local Site Magnetic Susceptibility for Quantum Materials by Polarized Neutron Diffraction".

Invited presentations and symposium/workshop organizer

- Invited speaker, "Magnetic ordering and topological defects "seen" by neutrons", Quantum Material seminar over Coffee, Oak Ridge National Laboratory, Feb. 1, 2023.
- Invited speaker, "Topological magnetic defects in frustrated magnets", University of Michigan, Ann Arbor, Michigan, Dec 6, 2022.
- Invited speaker, "Local magnetic probe for quantum magnets", Michigan State University, East Lansing, Michigan, Dec 7, 2022
- Invited to speak on "Local Site Magnetic Susceptibility for Quantum Materials" at the DOE's PIs meeting, December 15-17, 2021
- Invited colloquium speaker on "Quantum material characterization by neutrons", at the University of Tennessee - Knoxville, Apr. 6, 2021
- Invited colloquium speaker on "Field-tunable toroidal moment in a chiral-lattice magnet", Physics Department at the University of Tennessee - Knoxville, Mar 1, 2021
- Invited speaker on "Local Site Magnetic Susceptibility on Quantum Materials by Polarized Neutron Diffraction" 2020 MRS Virtual Spring/Fall Meeting, Nov.29, 2020
- Invited online CM seminar speaker at the University of Tennessee - Knoxville, on "Multiferroic reentrance in a molecular magnet", Nov.4, 2020

- Invited online CM Seminar speaker at Rutgers University on “Unveiling quantum materials with neutrons”, Apr. 28, 2020
- Invited to speak on “Anisotropic Magnetism in Quantum Materials” to the Neutron Advisory Board, Sept.2, 2020
- Invited colloquium speaker on “Neutron scattering studies on quantum materials” at the University of Arkansas, Fayetteville, AR. Oct.4, 2019
- Invited to attend and present at the DOE BES PIs’ meeting (7/1-4,2019 Washington, DC)
- Invited speaker on “Complex spin orbital orders in vanadates” APS March meeting 2018, Los Angeles, CA, March 5-9, 2018
- Invited speaker on Polarized neutron diffraction for Quantum Materials at UT-Battelle Science and Technology Committee (10/ 25, 2018, Oak Ridge)
- Invited LaCNS Seminar Speaker “Giant spin-lattice coupling in a paraelectric antiferromagnet $EuTiO_3$ studied by neutron scattering” at Louisiana State University October 30, 2018.
- Invited to speak on “Workshop on single-crystal neutron diffraction under pressure” at Ames Laboratory, May 30, 2018
- Invited to speak on “2018 Quantum Materials Young Investigators Workshop”, Oak Ridge, Tennessee, June 7-8, 2018
- Organizer and invited speaker for “Polarized Neutron Diffraction and Spectroscopy: Applications to Quantum Materials” workshop. ORNL, Oak Ridge, TN, USA. Sept. 26-29, 2022
- Organizer and invited speaker for “Polarized Neutron Diffraction and Spectroscopy: Applications to Quantum Materials” workshop. ORNL, Oak Ridge, TN, USA. Sept. 17-19, 2019
- Invited Lecturer “7th School on Representational Analysis and Magnetic Structures (RAMS)” University of Maryland, June 20-23, 2018.

- Invited speaker on Polarized Single-Crystal Diffraction, Polarized Neutron Capabilities at ORNL workshop, in conjunction with 2017 Joint Nanoscience and Neutron Scattering User Meeting, ORNL, Aug 3, 2017
- Invited speaker on the ACA workshop "Magnetic Structure Analysis by Unpolarized Neutron Diffraction Techniques" July 22, 2016, Denver, Colorado
- Invited speaker on "Magnetic Structure Determination from Neutron Diffraction Data Workshop", May 23-26, 2016, Florida State University, Tallahassee, Florida.
- Organizer for "Symmetry and Superspace Approach to Modulated Crystal Structures" Workshop. Oak Ridge, TN, USA. Oct. 23-24, 2019
- Organizer and tutorial/invited speaker (2012-2022), "Magnetic structure determination workshop" alternate between ORNL and NIST.

Full list of publications

1. Sandeep Gupta, Hanna Nielsen, Andreas Thiel, Emil Klahn, Erxi Feng, Huibo Cao, Thomas Hansen, Eddy Lelièvre-Berna, Arsen Goukassov, Iurii Kibalin, Sebastian Dechert, Serhiy Demeshko, Jacob Overgaard, Franc Meyer, "Benchmarking the local magnetic anisotropy of a robust cobalt(II) single-ion magnet by powder and single crystal polarized neutron diffraction – A comprehensive study", *Journal of the American Chemical Society Au*, 3, 2, 429-440 (2023).
2. Hasitha W Suriya Arachchige, William R Meier, Madalynn Marshall, Takahiro Matsuoka, Rui Xue, Michael A McGuire, Raphael P Hermann, Huibo Cao, David Mandrus, "Charge density wave in kagome lattice intermetallic ScV_6Sn_6", *Physical Review Letters,* 129 216402 (2022).
3. Jin-Ke Bao, Huibo Cao, Matthew J Krogstad, Keith M Taddei, Chenfei Shi, Shixun Cao, Saul H Lapidus, Sander van Smaalen, Duck Young Chung, Mercouri G Kanatzidis, Stephan Rosenkranz, Omar Chmaissem, "Spin and charge density waves in the quasi-one-dimensional KMn_6Bi_5", *Physical Review B (lett),* 106, L201111 (2022).
4. Brianna R Billingsley, Madalynn Marshall, Zhixue Shu, Huibo Cao, Tai Kong, "Single crystal synthesis and magnetic properties of a Shastry-Sutherland lattice compound $BaNd_2ZnS_5$", *Phys. Rev. Materials* 6,104403 (2022).
5. Nathan C Harms, Takahiro Matsuoka, Subhasis Samanta, Amanda J Clune, Kevin A Smith, Amanda V Haglund, Erxi Feng, Huibo Cao, Jesse S Smith, David G Mandrus, Heung-Sik Kim, Zhenxian Liu,

Janice L Musfeldt, "Symmetry progression and possible polar metallicity in $NiPS_3$ under pressure", *npj 2D Materials and Applications* 6, 40, (2022).

6. Yaohua Liu, Huibo Cao, Stephan Rosenkranz, Matthew Frost, Thomas Huegle, Jiao YY Lin, Peter Torres, Alexandru Stoica, Bryan C Chakoumakos, "PIONEER, a high-resolution single-crystal polarized neutron diffractometer", *AIP Review of Scientific Instruments*, 93, 073901 (2022)
7. Tiema Qian, Yueh-Ting Yao, Chaowei Hu, Erxi Feng, Huibo Cao, Igor I Mazin, Tay-Rong Chang, Ni Ni, "Magnetic dilution effect and topological phase transitions in ($Mn_{1-x}Pb_x$) Bi_2Te_4" *Physical Review B, 106, 045121 (2022).*
8. Tao Hong, Tao Ying, Qing Huang, Sachith E Dissanayake, Yiming Qiu, Mark M Turnbull, Andrey A Podlesnyak, Yan Wu, Huibo Cao, Yaohua Liu, Izuru Umehara, Jun Gouchi, Yoshiya Uwatoko, Masaaki Matsuda, David A Tennant, Gia-Wei Chern, Kai P Schmidt, Stefan Wessel, "Evidence for pressure induced unconventional quantum criticality in the coupled spin ladder antiferromagnet $C_9H_{18}N_2CuBr_4$", *Nature Communications* 13, 3073 (2022).
9. Jing Zhou, Guy Quirion, Jeffrey A Quilliam, Huibo Cao, Feng Ye, Matthew B Stone, Qing Huang, Haidong Zhou, Jinguang Cheng, Xiaojian Bai, Martin Mourigal, Yuan Wan, Zhiling Dun, "Anticollinear order and degeneracy lifting in square lattice antiferromagnet $LaSrCrO_4$", *Phys. Rev. B* 105, L180411 (2022).
10. Joanna Blawat, Madalynn Marshall, John Singleton, Erxi Feng, Huibo Cao, Weiwei Xie, Rongying Jin, "Unusual Electrical and Magnetic Properties in Layered $EuZn_2As_2$", *Advanced Quantum Technologies* 5, 2200012 (2022).
11. Qiang Zhang, Jinyu Liu, Huibo Cao, Adam Phelan, David Graf, JF DiTusa, D Alan Tennant, Zhiqiang Mao, "Toward tunable quantum transport and novel magnetic states in $Eu_{1-x}Sr_xMn_{1-z}Sb_2$ ($z< 0.05$)", *NPG Asia Materials* 14, 22 (2022).
12. Qing Huang, R Rawl, WW Xie, ES Chou, VS Zapf, XX Ding, C Mauws, CR Wiebe, EX Feng, HB Cao, W Tian, J Ma, Y Qiu, N Butch, HD Zhou, "Non-magnetic ion site disorder effects on the quantum magnetism of a spin-1/2 equilateral triangular lattice antiferromagnet", *J. Phys.: Condens. Matter* 34, 205401 (2022).
13. Sai Mu, Kiranmayi D Dixit, Xiaoping Wang, Douglas L Abernathy, Huibo Cao, Stephen E Nagler, Jiaqiang Yan, Paula Lampen-Kelley, David Mandrus, Carlos A Polanco, Liangbo Liang, Gábor B Halász, Yongqiang Cheng, Arnab Banerjee, Tom Berlijn, "Role of the third dimension in searching for Majorana fermions in alpha-$RuCl_3$ via phonons", *Phys. Rev. Research* 4, 013067 (2022).
14. Xianghan Xu, Fei-Ting Huang, Alemayehu S Admasu, Jaewook Kim, Kefeng Wang, Erxi Feng, Huibo Cao, Sang-Wook Cheong, "Bilayer Square Lattice $Tb_2SrAl_2O_7$ with Structural Z8 Vortices and Magnetic Frustration", *Chem. Mater.* 34, 3, 1225 (2022).
15. Yaofeng Xie, Lebing Chen, Tong Chen, Qi Wang, Qiangwei Yin, J Ross Stewart, Matthew B Stone, Luke L Daemen, Erxi Feng, Huibo Cao, Hechang Lei, Zhiping Yin, Allan H MacDonald, Pengcheng

Dai, “Spin excitations in metallic kagome lattice FeSn and CoSn”, *Communications Physics* 4, 240 (2021)

16. Yiqing Hao, Yiqing Gu, Yimeng Gu, Erxi Feng, Huibo Cao, Songxue Chi, Hua Wu, Jun Zhao, “Magnetic Order and Its Interplay with Structure Phase Transition in van der Waals Ferromagnet VI_3”, *Chinese Phys. Lett.* 38 096101 (2021)
17. Kenta Kimura, Naoki Yagi, Shunsuke Hasegawa, Masato Hagihala, Atsushi Miyake, Masashi Tokunaga, Huibo Cao, Takatsugu Masuda, Tsuyoshi Kimura, “Coexistence of Magnetoelectric and Antiferroelectric-like Orders in $Mn_3Ta_2O_8$”, *Inorg. Chem.* 60, 20, 15078 (2021).
18. Lei Ding, Xianghan Xu, Harald O Jeschke, Xiaojian Bai, Erxi Feng, Admasu Solomon Alemayehu, Jaewook Kim, Fei-Ting Huang, Qiang Zhang, Xiaxin Ding, Neil Harrison, Vivien Zapf, Daniel Khomskii, Igor I Mazin, Sang-Wook Cheong, Huibo Cao, “Field-tunable toroidal moment in a chiral-lattice magnet”, *Nature Communications* 12, 5339 (2021)
19. Xin Gui, Erxi Feng, Huibo Cao, Robert J Cava, “Ferromagnetic Cr_4PtGa_{17}: A Half-Heusler-Type Compound with a Breathing Pyrochlore Lattice”, *J. Am. Chem. Soc.* 143(35), 14342 (2021)
20. N. Li, Q. Huang, A. Brassington, X. Y. Yue, W. J. Chu, S. K. Guang, X. H. Zhou, P. Gao, E. X. Feng, H. B. Cao, E. S. Choi, Y. Sun, Q. J. Li, X. Zhao, H. D. Zhou, and X. F. Sun, “Quantum spin state transitions in the spin-1 equilateral triangular lattice antiferromagnet $Na_2BaNi(PO_4)_2$”, *Phys. Rev. B* 104, 104403 (2021)
21. Lei Ding, Chaowei Hu, Erxi Feng, Chenyang Jiang, Iurii A. Kibalin, Arsen Gukasov, MiaoFang Chi, Ni Ni, and Huibo Cao, “Neutron diffraction study of magnetism in van der Waals layered $MnBi_{2n}Te_{3n+1}$”, *Journal of Physics D: Applied Physics,* invited submission, 54 (17), 174003 (2021).
22. Xiaojian Bai, Randy S. Fishman, Gabriele Sala, Daniel M. Pajerowski, V. Ovidiu Garlea, Tao Hong, Minseong Lee, Jaime A. Fernandez-Baca, Huibo Cao, Wei Tian, “Magnetic Excitations of the Hybrid Multiferroic $(ND_4)_2FeCl_5D_2O$”, Physical Review B 103 (22), 224411 (2021).
23. Madalynn Marshall, Ivo Pletikosić, Mohammad Yahyavi, Hung-Ju Tien, Tay-Rong Chang, Huibo Cao, Weiwei Xie, Magnetic and electronic structures of antiferromagnetic topological material candidate $EuMg_2Bi_2$. *Journal of Applied Physics*, invited submission, 129 (3), 035106 (2021).
24. Z. Dun, Marcus Daum, Raju Baral, Henry E. Fischer, Huibo Cao, Yaohua Liu, Matthew B. Stone, Jose A. Rodriguez-Rivera, Eun Sang Choi, Qing Huang, Haidong Zhou, Martin Mourigal, Benjamin Frandsen, “Neutron scattering investigation of proposed Kosterlitz-Thouless transitions in the triangular-lattice Ising antiferromagnet $TmMgGaO_4$”, *Physical Review B* 103 (6), 064424 (2021).
25. Hu C., Lien S., Feng E., Mackey S., Tien H.J., Mazin I.I., Cao H.B., Chang T.R., Ni N., "Tuning magnetism and band topology through antisite defects in Sb-doped $MnBi_4Te_7$", *Physical Review B,* 104, 054422 (2021).

26. Qianheng Du, Lijun Wu, Huibo Cao, Chang-Jong Kang, C. S. Nelson, Lucian Pascut, Rongwei Hu, T. Besara, T. Siegrist, K. Haule, G. Kotliar, I. Zaliznyak, Yimei Zhu and C. Petrovic, "Defect-induced colossal thermopower in $FeSb_2$", *npj Quantum Materials,* 6 (1), 1-7 (2021).

27. Sunil K. Karna, D. Tristant, J. K. Hebert, G. Cao, R. Chapai, W. A. Phelan, Q. Zhang, Y. Wu, C. Dhital, Y. Li, H. B. Cao, W. Tian, C. R. Dela Cruz, A. A. Aczel, O. Zaharko, A. Khasanov, M. A. McGuire, A. Roy, W. Xie, D. A. Browne I. Vekhter, V. Meunier, W. A. Shelton, P. W. Adams, P. T. Sprunger, D. P. Young, R. Jin, J. F. DiTusa, Helical magnetic order and Fermi surface nesting in non-centrosymmetric ScFeGe. *Physical Review B*, 103 (1), 014443 (2021).

28. Shalini Tripathi, Shefali Vaidya, Naushad Ahmed, Emil Andreasen Klahn, Emil Damgaard-Møller, Huibo Cao, Gopalan Rajaraman, Jacob Overgaard, Maheswaran Shanmugam, "Structural property in stabilizing axial magnetic anisotropy in octahedral Co(II) complexes", *Cell Reports Physical Science* 2 (4), 100404 (2021).

29. Jianwei Huang, Zhicai Wang, Hongsheng Pang, Han Wu, Huibo Cao, Sung-Kwan Mo, Avinash Rustagi, A. F. Kemper, R. J. Birgeneau, Meng Wang, and Ming Yi, "Flatband-Induced Itinerant Ferromagnetism in $RbCo_2Se_2$", *Physical Review B* 103 (16), 165105 (2021).

30. P.-L. Dai, Gaoning Zhang, Yaofeng Xie, Chunruo Duan, Yonghao Gao, Zihao Zhu, Erxi Feng, Chien-Lung Huang, Huibo Cao, Andrey Podlesnyak, Garrett E. Granroth, David Voneshen, Shun Wang, Guotai Tan, Emilia Morosan, Xia Wang, Lei Shu, Gang Chen, Yanfeng Guo, Xingye Lu, Pengcheng Dai, "Spinon Fermi surface spin liquid in a triangular lattice antiferromagnet $NaYbSe_2$", *Physical Review X* 11 (2), 021044 (2021).

31. X. Ye, J. Zhao, H. Das, D. Sheptyakov, J. Yang, Y. Sakai, H. Hojo, Z. Liu, L. Zhou, L. Cao, T. Nishikubo, S, Wakazaki, C. Dong, X. Wang, Z. Hu, H.-J. Lin, C.-T. Chen, C. Sahle, A. Efiminko, H.B. Cao, S. Calder, K. Mibu, M. Kenzelmann, L.H. Tjeng, R. Yu, M. Azuma, C. Jin, and Y. Long, "Observation of novel charge ordering and spin reorientation in perovskite oxide $PbFeO_3$", *Nature communications* 12, 1917 (2021).

32. J.Y. Liu, J.B. Yu, J.L. Ning, L.X. Miao, A. Kleyser, L.J. Min, Y.L. Zhu, H.M. Yi, T. Pillsbury, Y. B. Zhang, Y. Wang, J. Hu, H.B. Cao, F. Balakirev, F. Weickert, M. Jaime, K. Yang, J.W. Sun, N. Alem, V. Gopalan, C.Z. Chang, N. Samarth, J. Jain, C.X. Liu, R.D. Mcdonald and Z.Q. Mao "Spin-valley locking and bulk quantum Hall effect in a noncentrosymmetric Dirac semimetal $BaMnSb_2$", *Nature Communications* 12, 4062 (2021).

33. Aashish Sapkota, TC Sterling, PM Lozano, Yangmu Li, Huibo Cao, VO Garlea, D Reznik, Qiang Li, IA Zaliznyak, GD Gu, JM Tranquada, "Reinvestigation of crystal symmetry and fluctuations in La_2CuO_4", *Physical Review B* 104 (1), 014304 (2021).

34. Xin Gui, Madalynn Marshall, Ranuri S Dissanayaka Mudiyanselage, Ryan A Klein, Qiang Chen, Qiang Zhang, William Shelton, Haidong Zhou, Craig M Brown, Huibo Cao, Martha Greenblatt, Weiwei Xie, "Spin Reorientation in Antiferromagnetic Layered $FePt_5P$", *ACS Applied Electronic Materials* 3, 8, 3501–3508 (2021).

35. J.K. Clark, C. Pak, H. Cao, M. Shatruk, "Helimagnetism in $MnBi_2Se_4$ Driven by Spin-Frustrating Interactions Between Antiferromagnetic Chains", *Crystals* 11 (3), 242 (2021).

36. L. Ding, M. Lee, T. Hong, Z. L. Dun, R. Sinclair, S. X. Chi, H. K. Agrawal, E. S. Choi, B. C. Chakoumakos, H. D. Zhou, H. B. Cao, "Noncollinear magnetic structure and magnetoelectric coupling in buckled honeycomb $Co_4Nb_2O_9$: A single-crystal neutron diffraction study", *Physical Review B* 102, 174443 (2020).

37. Lei Ding, Minseong Lee, Eun Sang Choi, Jing Zhang, Yan Wu, Ryan Sinclair, Bryan C. Chakoumakos, Yisheng Chai, Haidong Zhou, and Huibo Cao, "Large spin-driven dielectric response and magnetoelectric coupling in the buckled honeycomb $Fe_4Nb_2O_9$" *Phys. Rev. Materials* 4, 084403 (2020)

38. Lei Ding, Chaowei Hu, Feng Ye, Erxi Feng, Ni Ni, Huibo Cao, "Crystal and magnetic structures of magnetic topological insulators $MnBi_2Te_4$ and $MnBi_4Te_7$", *Physical Review B* 101, 020412(R) (2020).

39. J. Xing, E. Feng, Y. Liu, E. Emmanouilidou, C. Hu, J. Liu, D. Graf, A.P. Ramirez, G. Chen, H.B. Cao, N. Ni, "Néel-type antiferromagnetic order and magnetic field–temperature phase diagram in the spin-1/2 rare-earth honeycomb compound $YbCl_3$", *Physical Review B,* 102, 014427 (2020).

40. Jie Xing, Huibo Cao, Arpita Paul, Chaowei Hu, Hsin-Hua Wang, Yongkang Luo, Raj Chaklashiya, Stuart Brown, Turan Birol, and Ni Ni, "Anisotropic properties, charge ordering, and ferrimagnetic structures in the strongly correlated β–V_2PO_5 single crystal", *Physical Review Materials,* 4, 094414 (2020).

41. Chaowei Hu, Lei Ding, Kyle N. Gordon, Barun Ghosh, Haoxiang Li, Shang-Wei Lian, A. Garrison Linn, Hung-Ju Tien, Cheng-Yi Huang, P. V. Sreenivasa Reddy, Bahadur Singh, Amit Agarwal, Arun Bansil, Su-Yang Xu, Hsin Lin, Huibo Cao, Tay-Rong Chang, Dan Dessau, Ni Ni, "Realization of an intrinsic ferromagnetic topological state in $MnBi_8Te_{13}$", *Science Advances,* 6, eaba4275 (2020).

42. Chaowei Hu, Xiaoqing Zhou, Pengfei Liu, Jinyu Liu, Peipei Hao, Eve Emmanouilidou, Hongyi Sun, Yuntian Liu, Harlan Brawer, Arthur P. Ramirez, Huibo Cao, Qihang Liu, Dan Dessau, Ni Ni, "A van der Waals antiferromagnetic topological insulator with weak interlayer magnetic coupling", *Nature communications* 11, 97 (2020)

43. B. Shen, C. Hu, H.B. Cao, X. Gui, E. Emmanouilidou, W. Xie, N. Ni, "Structural distortion and incommensurate noncollinear magnetism in $EuAg_4As_2$", *Physical Review Materials,* 4, 064419 (2020).

44. C.L. Sarkis, M.J. Tarne, J.R. Neilson, H.B. Cao, E. Coldren, M.P. Gelfand, and K.A. Ross, "Partial Antiferromagnetic Helical Order in Single Crystal $Fe_3PO_4O_3$", *Physical Review B,* 101, 184417 (2020).

45. T. Hiroto, T. Sato, H.B. Cao, T. Hawai, T. Yokoo, S. Itoh, R. Tamura "Noncoplanar ferrimagnetism and local crystalline-electric-field anisotropy in the quasicrystal approximant $Au_{70}Si_{17}Tb_{13}$" *Journal Physics: Condensed Matter* 32 415802 (2020) https://iopscience.iop.org/article/10.1088/1361-648X/ab997d

46. Andrew May, Huibo Cao, and Stuart Calder, “Magnetic properties of ferrimagnetic $Mn_3Si_2Se_6$”, *Journal of Magnetism and Magnetic Materials,* 511, 166936 (2020).

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50. S.X. Chi, F. Ye, G. Cao, H.B. Cao, J.A. Fernandez-Baca, "Competition of three-dimensional magnetic phases in $Ca_2Ru_{1-x}Fe_xO_4$: A structural perspective", *Physical Review B,* 102, 014452 (2020).

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