George Yumnam, PhD

Materials Science & Technology Division,
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EDUCATION

Ph.D. in Physics ..... (Aug 2017 – Dec 2022)

UNIVERSITY OF MISSOURI, COLUMBIA

Thesis: *Magnetic Charge Correlation and Quantum Disorder in Honeycomb Spin Ice Systems*

M.Sc. in Materials Science ..... (Aug 2016 – June 2017)

INDIAN INSTITUTE OF SCIENCE, BANGALORE

Thesis: *Unravelling the Role of Ionicity in Thermal Transport of van der Waals Materials*

B.Sc. in Materials Science ..... (Aug 2012 – June 2016)

INDIAN INSTITUTE OF SCIENCE, BANGALORE

Thesis: *Identifying efficient thermoelectric materials via first principle high throughput screening*

RESEARCH EXPERIENCE

Postdoctoral Research Associate ..... (Dec 2022 – present)

OAK RIDGE NATIONAL LABORATORY, OAK RIDGE *(ORNL)*

Advisors: Dr. Raphaël P. Hermann & Dr. Michael E. Manley

- Discovered Doping based Tunable Magnon-CEF hybridization via neutron scattering
- Elucidated the origin of spin-reorientation and magnon gap opening in Li-doped MnTe
- Implemented total scattering techniques for average and local structure of doped systems
- Mössbauer Spectral studies of Fe, Eu, Sb & Sn based compounds
- Spinwave calculations of complex interactions beyond the SU(2) approximation

† *The work at ORNL was supported by Basic Energy Science, Department of Energy, USA*

Graduate Research Assistant ..... (Aug 2017 – Nov 2022)

UNIVERSITY OF MISSOURI, COLUMBIA *(MIZZOU)*

Advisors: Prof. Deepak K. Singh & Dr. Valeria Lauter

- Demonstrated current induced spin-reconfiguration in Artificial Honeycomb lattices (AHL)
- Quantified and elucidated the static and dynamic properties of Magnetic diodes in AHL
- Synthesized $\alpha-Na_2RuO_3$ and $\beta-CoAsSe$ via solid-state methods
- Conceptualized and Initiated a new project on the synthesis of CVD-grown superconducting films
- Fabricated an array of magnetic diode and transistor for low-powered electronics
- Designed a numerical framework for calculating and fitting PNR/SANS based on DWBA method

‡ *The work at Mizzou was supported by Research/Teaching assistantships and multiple scholarships*

Masters Research Fellow .....(Aug 2016 – July 2017)

INDIAN INSTITUTE OF SCIENCE, BANGALORE *(IISc)*

Advisor: Prof. Abhishek K. Singh

· Implemented Bayesian Optimization for Machine-learning prediction of thermal conductivity (κ_{latt})

· Elucidated bonds hybridization strength as the origin of drastic κ_{latt} differences in (Mo/W)X_2

· Conceptualized & initiated a project on band-valley convergence study of $A^{II}B^{IV}C_2^V$ Chalcopyrites

† *Work at IISc was supported by the Department of Science & Technology (India), INSPIRE fellowship*

Undergraduate Research Student .....(Aug 2014 – June 2016)

INDIAN INSTITUTE OF SCIENCE, BANGALORE *(IISc)*

Advisor: Prof. Abhishek K. Singh

· Comprehensive investigation of transition metal dichalcogenide thermoelectrics via DFT

· Initiated/developed tool for estimating electronic relaxation time via deformation potential theory

· Developed numerical framework for lattice thermal conductivity calculation

† *Work at IISc was supported by the Department of Science & Technology (India), INSPIRE fellowship*

RESEARCH GRANTS

Contributions to Ongoing Funded Research .....(Aug, 2024 – present)

| ***Neutron Scattering Studies of Hybrid Excitations*** — PI: Dr. Raphaël P. Hermann
| (Awarded by Department of Energy, Basic Energy Science) — co-PI: Dr. Michael E. Manley
| — co-PI: Dr. Lucas Lindsay
| My contributions: Lead the section on "*Understanding multicaloric and thermomagnetic transport properties emerge from spin-lattice coupling*" which consists of the following broad research topics:

· Impact of ferroic frustration on multicaloric function in magnetic shape memory alloys

· Spin-lattice coupling and piezomagnetism in complex antiferromagnets

· Magnon-polaron dynamics in materials featuring anomalous Nernst effect

RESEARCH INTERESTS

- Investigations into the interplay between spin, lattice, and electronic degrees of freedom in magnetic materials, leveraging advanced neutron and X-ray scattering methods, and computational modeling.
- Emergent mechanisms of magnon-phonon coupling, spin reorientation, and frustrated magnetism.
- Synergystic study of pure and doped complex systems for enhanced functionalities.
- Precise control of spin-lattice interactions to develop energy-efficient platforms for spintronics and magnonics based information processing and quantum technologies.

HONORS AND AWARDS

⋆ **APS GERA 2025 Travel Fund Recipient** (2025)

⋆ **Gordon Research Seminar & Conference on Neutron Scattering**, Outstanding Poster Award (2023)

⋆ **Graduate Professional Council, Mizzou** Travel Award (2022)

⋆ **James L. and Dora D. Fergason Fund for Excellence in Physics Scholarship** (2020)

⋆ **Newell S. Gingrich Physics Scholarship** (2019)

⋆ **O. M. Stewart Scholarship** (2018)

⋆ **Graduate Professional Council, Mizzou**, 35^{th} RCAF – Best Researcher in Physical Science (2018)

⋆ **Kyoto University**, Invitation for Research Collaboration and Exchange (2017)

⋆ **18^{th} International Workshop on Computational Physics**, Selected for sponsored invitation (2017)

⋆ **INSPIRE Fellowship, Department of Science and Technology, India** (2012–2017)

⋆ **National Talent Search Examination** Recipient (1000 selected of ∼1 million paticipants) (2009)

PUBLICATIONS († – equal contributions)

[19] Andrew F. May, **George Yumnam**, Raphael P. Hermann, Stuart Calder, Benjamin M. Lefler, Steven J. May, Zachary E. Brubaker, Matthew Brahlek, Xiaodong Xu, Dmitry Ovchinnikov, and Michael A. McGuire (Mar. 2025). "Cleavable quaternary oxychlorides with high magnetic ordering temperatures". In: ***Phys. Rev. Mater.*** 9 (3), p. 034002

[18] Juliane Weber, Brittany Moseley, Ke Yuan, Barbara R Evans, Vitalii Starchenko, Elena Tajuelo Rodriguez, Dong Youn Chung, Matthew G Boebinger, Michael A McGuire, **George Yumnam**, et al. (2024). "Influence of Dissolved Iron in Solution on MgO Hydroxylation and Carbonation". In: ***The Journal of Physical Chemistry C*** 129.1, pp. 194–204

[17] **George Yumnam**, Duncan H Moseley, Joseph AM Paddison, Christiana Z Suggs, Emma Zappala, David S Parker, Garrett E Granroth, Gerald D Morris, Md Mobarak Hossain Polash, Daryoosh Vashaee, et al. (2024). "Magnon gap tuning in lithium-doped MnTe". In: ***Physical Review B*** 109.21, p. 214434

[16] T Seddik, B Rezini, K Djelid, Bakhtiar Ul Haq, Se-Hun Kim, M Batouche, Shah Fahad, A Djelloul, and **George Yumnam** (2023). "Electronic, optical, and thermoelectric properties of multifunctional zintl compound BaAg2Te2 for energy conversion". In: ***Physica B: Condensed Matter*** 668, p. 415209

[15] **George Yumnam**, Moudip Nandi, Pousali Ghosh, Amjed Abdullah, Mahmoud Almasri, Erik Henriksen, and Deepak K Singh (2023). "Field and temperature tuning of magnetic diode in permalloy honeycomb lattice". In: ***Materials Today Advances*** 18, p. 100386

[14] Jiasen Guo, Vitalii Dugaev, Arthur Ernst, **George Yumnam**, Pousali Ghosh, and Deepak Kumar Singh (2022). "Topological monopole's gauge field-induced anomalous Hall effect in artificial honeycomb lattice". In: ***Natural Sciences*** 2.4, e20210083

[13] **George Yumnam**, Jiasen Guo, Yiyao Chen, Ashutosh Dahal, Pousali Ghosh, Quinn Cunningham, Jong Keum, Valeria Lauter, Amjed Abdullah, Mahmoud Almasri, et al. (2022). "Magnetic charge and geometry confluence for ultra-low forward voltage diode in artificial honeycomb lattice". In: ***Materials Today Physics*** 22, p. 100574

[12] **George Yumnam**, Jiasen Guo, and Deepak K Singh (2021). "Various facets of magnetic charge correlation: Micromagnetic and distorted-wave Born approximation simulations study". In: ***Physical Review B*** 104.13, p. 134429

[11] Yiyao Chen, **George Yumnam**†, Jiasen Guo, Laura Stingaciu, Piotr Zolnierczuk, Valeria Lauter, and Deepak K Singh (2021). "Magnetic charge's relaxation propelled electricity in two-dimensional magnetic honeycomb lattice". In: ***Iscience*** 24.3, p. 102206

[10] **George Yumnam**, Yiyao Chen, Jiasen Guo, Jong Keum, Valeria Lauter, and Deepak Kumar Singh (2021). "Quantum disordered state of magnetic charges in nanoengineered honeycomb lattice". In: ***Advanced Science*** 8.6, p. 2004103

[9] Jiasen Guo, **George Yumnam**, Ashutosh Dahal, Yiyao Chen, Valeria Lauter, and Deepak K Singh (2021). "Local Spin Ice Order Induced Planar Hall Effect in Nd–Sn Artificial Honeycomb Lattice". In: ***Advanced Electronic Materials*** 7.9, p. 2100079

[8] **George Yumnam**, Jiasen Guo, Yiyao Chen, Valeria Lauter, and Deepak K. Singh (2020). "Nonconventional magnetic phenomena in neodymium thin film". In: ***Phys. Rev. Research*** 2.4, p. 043018

[7] Yiyao Chen, **George Yumnam**, A Dahal, JA Rodriguez-Rivera, Guangyong Xu, TW Heitmann, and DK Singh (2020). "Magnetic order and instability in newly synthesized CoSeAs marcasite". In: ***Physical Review Research*** 2.2, p. 023168

[6] KC Bhamu, Enamul Haque, CS Praveen, Nandha Kumar, **George Yumnam**, Md Anwar Hossain, and Gautam Sharma (2021). "Improving the optical and thermoelectric properties of Cs 2 InAgCl 6 with heavy substitutional doping: a DFT insight". In: ***RSC advances*** 11.10, pp. 5521–5528

[5] **George Yumnam**, Yiyao Chen, Yang Zhao, Arumugam Thamizhavel, Sudesh K Dhar, and Deepak K Singh (2019). "Microscopic nature of magnetic ground state in CeAuSb2". In: ***physica status solidi (RRL)–Rapid Research Letters*** 13.10, p. 1900304

[4] Rinkle Juneja, **George Yumnam**†, Swanti Satsangi, and Abhishek K Singh (2019). "Coupling the high-throughput property map to machine learning for predicting lattice thermal conductivity". In: ***Chemistry of Materials*** 31.14, pp. 5145–5151

[3] Madhubanti Mukherjee, **George Yumnam**, and Abhishek K Singh (2018). "High thermoelectric figure of merit via tunable valley convergence coupled low thermal conductivity in AIIBIVC2V chalcopyrites". In: ***The Journal of Physical Chemistry C*** 122.51, pp. 29150–29157

[2] **George Yumnam**, Tribhuwan Pandey, and Abhishek Kumar Singh (2018). "Interplay of structural and bonding characters in thermal conductivity and born-effective charge of transition metal dichalcogenides". In: ***The Journal of Physical Chemistry C*** 122.5, pp. 2521–2527

[1] **George Yumnam**, Tribhuwan Pandey, and Abhishek K Singh (2015). "High temperature thermoelectric properties of Zr and Hf based transition metal dichalcogenides: A first principles study". In: ***The Journal of Chemical Physics*** 143.23

MANUSCRIPT IN PREPARATION/REVIEW († – equal contributions)

[9] **George Yumnam**, Parul Raghuvanshi, *et al.* (in review at *npj Quantum Materials*) "Constraints on magnetism and correlations in RuO_2 from lattice dynamics and Mössbauer spectroscopy" (DOI: https://doi.org/10.21203/rs.3.rs-6572669/v1)

[8] Edison P. Carlisle, **George Yumnam**, Stuart Calder, *et. al.* (in review at *npj Quantum Materials*) "Tuning the magnetic properties of altermagnetic MnTe through pressure"

[7] Raphaël P. Hermann, **George Yumnam**, *et. al.* (in review at *Physica Status Solidi A*) "A Mössbauer Spectroscopy Investigation of Nickel-Zinc Ferrites Synthesized by a Self-Combustion Method for Soft Magnetic Core Applications"

[6] Pousali Ghosh, **George Yumnam**†, Jiasen Guo†, *et al.* (in review at Phys. Rev. B) "Magnetic charge liquid state in honeycomb spin ice"

[5] **George Yumnam**, Matthew Brahlek, Benjamin Frandsen, Raphaël P. Hermann, (in preparation) "Manganese Telluride (MnTe): From Classical Magnetism to Altermagnetism and Emerging Applications" (Review Article)

[4] **George Yumnam**, David Dahlbom, Duncan Moseley, *et al* (in preparation) "Controlling Unconventional Magnon–Crystal-field Hybridization via Doping up to the Percolation Threshold"

[3] **George Yumnam**, Eleanor Clements, Bing Li, *et al* (in preparation) "Neutron Scattering Evidence of Strong Paramagnon–Magnon Hybridization Inducing Large Chiral Altermagnon Splitting"

[2] **George Yumnam**, Ajay Kumar, Yaroslav Mudryk, Douglas Abernathy, Michael E. Manley, Raphaël P. Hermann. (in preparation) "Temperature dependent magnetic hysteresis due to crystal field and magnon hybridization in antiferromagnetic terbium silicide"

[1] Mohammad Islam, **George Yumnam**, Susan Kauzlarich, Raphaël P. Hermann (in preparation) "Magnetism and Mössbauer study of $Eu_{14}MAs_{11}$ (M = Cd, Zn, Mg)"

PROFESSIONAL SERVICE

- Peer Reviewer for Research in Magnetism (2023–present)
  - · *Phys. Rev. B*,
  - · *Adv. Funct. Mater.*,
  - · *Commun. Phys*,
  - · *Adv. Mater. Interfaces*,
  - · J. Appl. Crystallogr., etc.
- **Oak Ridge Postdoctoral Research Associate (ORPA)**: Chair of Research Activities (2023–2024)
  - · Co-organized the National Postdoc Appreciation Week in ORNL
  - · Organized the 12^{th} Oak Ridge Postdoctoral Research symposium, July–2024
  - · Chaired and Organized *ten* ORPA Research Seminars and Colloquium
- **Neutron Scattering Seminar Series**: Organizer (2023–2024)
  - · Chaired and Organized Monthly Seminars on Neutron Scattering: Science and Instrumentation

PRESENTATIONS AND CONFERENCES

- ***BES MSE Quantum Materials and Soft Matter Seminar Series***, MSTD/ORNL .....(Jan, 2025)
  · (***Invited talk***) "Probing Altermagnetism: Bridging Theory with Experiments"
- ***Roadmap to Altermagnetism***, New Jersey Institute of Technology .....(Jan, 2025)
  · (***Invited talk***) "Interplay of anisotropic paramagnons and phonons in altermagnetic MnTe"
- ***9^{th} North American Mössbauer International Symposium***, ORNL .....(2024)
  · (poster) "Strongly coupled magnon-crystal-field spectra as an origin for strong magnetoelasticity"
- ***American Conference on Neutron Scattering***, Knoxville .....(2024)
  · (talk) "Magnetic Disorder driven Magnon softening in TbSb"
- ***APS March Meeting***, Minneapolis .....(2024)
  · (talk) "Antiferromagnetic magnon gap opening and spin-reorientation in Li-doped MnTe"

- ***SNS & HFIR User Group Meeting and Seminar***, Oak Ridge ..... (2023)
  · (poster) "Magnon softening in Y-doped TbSb"
- ***Gordon Research Conference & Seminar*** on **Neutron Scattering**, Ventura ..... (June, 2023)
  · (***Invited talk***) "Doping-induced Magnetic Anisotropy and Spin Reorientation in MnTe"
  · (poster) "Magnetic Anisotropy driven Magnon Gap opening in MnTe"
- ***APS March Meeting***, Las Vegas ..... (2023)
  · (talk) "Field and temperature tuning of magnetic diode in permalloy honeycomb lattice"
- ***American Conference on Neutron Scattering***, Boulder ..... (2022)
  · (Poster) "Quantum Disordered State of Magnetic Charges in Nanoengineered Honeycomb Lattice"
- ***APS March Meeting***, Chicago ..... (2022)
  · (talk) "Magnetic charge's relaxation propelled electricity in a 2-D magnetic honeycomb lattice"
- ***APS March Meeting***, Denver (*virtual due to COVID-19*) ..... (2020)
  · (talk) "Cooperative liquid-like paramagnetic state in nanoengineered honeycomb lattice"
- ***35th Annual Research & Creative Activities Forum***, Graduate Professional Council, Mizzou ..... (2018)
  · (talk) "Interplay of Structural and Bonding Characters in Thermal Conductivity and Born-Effective Charge of Transition Metal Dichalcogenides"
  ⋆ *Won 1st place in Physical Science Category, Mizzou – College of Arts and Science*
- ***18th International Workshop on Computational Physics and Materials Science: Total Energy and Force Methods***, International Centre for Theoretical Physics, Trieste ..... (Jan, 2017)
  · (poster) "Electronic and thermal transport properties of bulk and monolayer TMDs"
  ⋆ *Selected for fully sponsored Travel Award among 30 international attendees*
- ***Asian Consortium on Computational Materials Science***, SRM University, Chennai ..... (2016)
  · (poster) "High temperature thermoelectric properties of Zr and Hf based Transition Metal Dichalcogenides: A first principles study"
- ***28th Annual Symposium, Department of Materials Engineering***, IISc ..... (2016)
  · (poster) "High temperature thermoelectric properties of Zr/Hf based TMDs via DFT"

SCIENTIFIC WORKSHOPS

- *Northeast Quantum Forum: Quantum Magnets and Magnetotransports*, New Hampshire ..... (2024)
  (poster:) Strongly coupled magnon-crystal field as an origin for strong magnetoelasticity in TbSb
- *Magnetic Structure Refinement Workshop*, Kennesaw ..... (2024)
- *Polarized Neutron Diffraction and Spectroscopy: Applications to Quantum Materials*, Knoxville . (2024)
- *Inelastic neutron scattering analysis software: Inspired, Shiver, Sunny*, Knoxville ..... (2024)
- *Methods for modelling transport and dynamics in quantum magnets*, Los Alamos ..... (2024)
- *APS March Meeting Tutorial: T4. Quantum Computing Platforms*, Minneapolis ..... (2024)
- *5th US Total Scattering School*, ORNL ..... (2023)
- *21st National School on Neutron and X-Ray Scattering*, ORNL & Argonne (highly selective) ..... (2019)
- *Advanced Workshop on High-Performance & High-Throughput Materials Simulations using Quantum ESPRESSO*, ICTP, Trieste (Among 30 fully-funded participants selected internationally) ..... (2017)

- *IWPSD International Workshop on Physics of Semiconductor devices*, IISc ..... (2015)

PROFESSIONAL SOCIETIES

- American Physical Society (APS – GMAG, DCMP) – Member (2017–present)
- The Minerals, Metals and Materials Society (TMS) – Member (2022–present)
- American Neutron Scattering Society (ACNS) – Member (2018–present)
- SNS & HFIR User Group (SHUG) – Member (2018–present)
- Graduate Professional Council (GPC), Mizzou – Member (2017–2022)
- Physics & Astronomy Graduate Students Association (PAGSA), Mizzou – Member (2017–2022)
- IISc Student Council – Member (2012–2017)

TEACHING EXPERIENCE

- **Introduction to Modern Physics and Quantum Mechanics**, Teaching Assistant .....(Fall 2017)
- **Introduction to Thermodynamics and Statistical Mechanics**, Teaching Assistant .....(Spring 2019)
- **College Physics I – Intro Classical Mechanics**, Laboratory Instructor .....(Fall 2018)
- **College Physics II – Intro Electromagnetism**, Laboratory Instructor .....(Spring 2019)
- **College Physics I – Intro Classical Mechanics**, Recitation Instructor .....(Fall 2021)
- **College Physics II – Intro Electromagnetism**, Recitation Instructor .....(Spring 2022)
- **Introduction to Electromagnetism and Electrodynamics**, Teaching Assistant ..... (Spring 2022)

 # As a teaching Assistant or Instructor, we perform proctoring, open office-hours, tutoring and grading
⋆ As Instructor, we also design teaching plan for Experiments/Weekly Revision & Recitation Problems

REFERENCES

- Dr. Raphaël P. Hermann (✉ hermannrp@ornl.gov) .....Sr. Scientist, ORNL
  Postdoc Advisor (2022–)
- Dr. Michael E. Manley (✉ manleyme@ornl.gov) .....Sr. Scientist, ORNL
  Postdoc co-Advisor (2022–)
- Prof. Deepak K. Singh (✉ singhdk@missouri.edu) .....Assoc. Prof., Mizzou
  Ph.D. Advisor (2017–22)
- Dr. Valeria Lauter (✉ lauterv@ornl.gov) .....Sr. R&D Scientist, ORNL
  Ph.D. co-Advisor (2017–22)
- Prof. Abhishek K. Singh (✉ abhishek@iisc.ac.in) .....Professor, IISc
  UG Advisor (2014–17)