

Curriculum Vitae

Sunil K. Karna

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Prairie View A & M University

Department of Physics

RESEARCH EXPERIENCES AND INTERESTS

My expertise and interests are on exploration of novel quantum materials and techniques which will make a significant impact in the advancement of the modern technology. I investigate strongly correlated quantum materials which exhibit emergent phenomena such as complex magnetism, non-trivial topology, and frustrated spin systems. I generate the projects and perform the experiments independently as well as in collaboration with other groups. I have published the results in many peer reviewed journals. I have more than 8 years of experience in operating and maintaining various instruments such as Optical floating-zone furnace, Quantum design Physical Property Measurement System (PPMS), Magnetic Property Measurement System (MPMS), X-ray Diffraction (XRD), Scanning Electron Microscope (SEM), and Energy-dispersive X-ray Spectroscopy (EDX), Helium Gas Recovery System and Helium Liquefier. I have also performed data collection, manipulation, analysis, and organization and presentation of collected data in standard format using various types of software such as OriginLab, Excel, Python, MATLAB, Igor Pro, MathCad, ICSD database, High Score Plus and Power Point.

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Google scholar: https://scholar.google.com.tw/citations?user=So5I9_MAAAAJ&hl=en

EDUCATION

Ph.D. National Central University, Department of Physics, Taiwan, June 2011

M.Sc. Tribhuvan University, Department of Physics, Nepal, June 2003

B.Sc. Tribhuvan University, Department of Physics, Nepal, Dec 1999

PROFESSIONAL EMPLOYMENT

- 09/2022- Present *Assistant Professor*, Department of Physics & Chemistry, Prairie View A & M University, Prairie View, TX 77446, USA
- 08/ 2020- 08/2022 *Assistant Research Professor*, Department of Physics & Center for Materials Research, Norfolk State University, Norfolk, VA, USA
- 02/ 2017- 08/2020 *Postdoctoral Research Associate*, Department of Physics & Astronomy, Louisiana State University, Baton Rouge, LA, USA. Supervisor: Professor John F. DiTusa
- 08/ 2014- 02/2017 *Research Scientist*, Novel Materials Development Laboratory at Center for Condensed Matter Sciences, National Taiwan University, Taiwan. Supervisor: Professor Fang-Cheng Chou
- 08/ 2011- 07/2014: *Postdoctoral Research Associate*, Department of Physics, National Central University, Taiwan. Supervisor: Professor Wen-Hsien Li
- 11/ 2003 - 06/2007 *Lecturer*, Department of Physics, Amrit Science Campus, Tribhuvan University, Kathmandu, Nepal.

AWARDS

- 09/12 Gold Medal (*Nepal Vidya Bhusan 'A' Award*) from Government of Nepal
- 11/12 & 13 Best poster award received in a Workshop on Neutron Scattering organized by Taiwan Neutron Scattering Society (TWNSS).

MEMBERSHIP IN PROFESSIONAL SOCIETIES

- American Physical Society (2017 - present).
- National Society of Black Physicists (2021-present).

GRANTS AWARDED

1. “Acquisition of a Cryogen-Free Physical Properties Measurement System (PPMS DynaCool) for Quantum Materials Research and Education at NSU” as a *Co-PI* with PI D. Temple and Co-PIs L. Salary, H. Yoon, K. Santiago. Supported by the National Science Foundation (NSF) October 2021 - September 2023, \$741,571.

My contribution: Drafted this NSF-MRI proposal and arranged support letters from the collaborators in Hampton roads area.

2. “Acquisition of a Real-Time Laue Back Reflection X-Ray System and a Powder Pattern X-Ray System and a Powder Pattern X-Ray Diffraction System for Education and Research in Crystallography” as a *Co-PI* with PI D. Temple and Co-PIs L. Salary. Supported by the Department of Defense (DoD) through HBCU/MSI science program. May 2021 - May 2022, \$452,043.

My contribution: Drafted this proposal and arranged support letters from the past collaborators.

3. “CREST Center for Research and Education in Quantum-Leap Science and Technology” as a *Senior-personnel* with PI D. Temple and Co-PIs S.-S. Sun, N. Noginova, H. Yoon, and G. Miller. Supported by the National Science Foundation (NSF) September 2021 – August 2026, \$4,999,998.

My contribution: Proposed Quantum Materials Research of Thrust 1 (out of three thrusts), drafted Thrust 1 Quantum materials research part, and arranged support letters from the past collaborators.

REFEREED PUBLICATIONS

1. C.-W. Wang, **Sunil K. Karna**, S. Yano, C.-H. Lee, M. Avdeev, C. S. Lue, and C. N. Kuo, “Magnetic properties and noncollinear spin structure of the tin-rich stannide $\text{Ho}_5\text{Co}_6\text{Sn}_{18}$ ”. *Phys. Rev. B* **105**, 104429 (2022).
2. **Sunil K. Karna**, C.-W. Wang, R. Sankar, D. Temple, and M. Avdeev, “Commensurate and incommensurate magnetic structure of the moderately frustrated antiferromagnet $\text{Li}_2\text{M}(\text{WO}_4)_2$ with $M = \text{Co}, \text{Ni}$ ”. *Phys. Rev. B* **104**, 134435 (2021).
3. **Sunil K. Karna**, M. Marshall, W. Xie, L. DeBeer-Schmitt, D. P. Young, I. Vekhter, W. A. Shelton, A. Kovacs, M. Charilaou, and J. F. DiTusa “Annihilation and control of chiral domain walls with magnetic fields” *Nano Lett.* **21**, 1205-1212 (2021).

4. **Sunil K. Karna**, D. Tristant, J. K. Hebert, W. A. Phelan, G. Cao, F. Womack, R. Chapai, Y. Li, C. Dhital, Y. Wu, H. Cao, Q. Zhang, W. Tian, A. Aczel, C. R. Dela Cruz, O. Zaharko, A. Roy, A. Khasanov, D. P. Young, P. W. Adams, J. Singleton, I. Vekhtar, W. Shelton, V. Meunier, P. Sprunger, D. A. Browne, R. Jin, and J. F. DiTusa “Helical magnetic order and Fermi surface nesting in non-centrosymmetric ScFeGe”. *Phys. Rev. B* **103**, 014443 (2021).
5. Yun Chen Chung, **Sunil K. Karna**, Fan-Cheng Chou and Hsiang-Lin Liu “Electronic structure and lattice dynamics of Ba₂CuTeO₆ single crystals”. *RSC Adv.* **10**, 20067 (2020).
6. **Sunil K. Karna**, F. N. Womack, R. Chapai, D. P. Young, M. Marshall, W. Xie, D. Graf, Y. Wu, H. Cao, L. DeBeer-Schmitt, P. W. Adams, R. Jin and J. F. DiTusa “Consequences of magnetic ordering in chiral Mn_{1/3}NbS₂” *Phys. Rev. B* **100**, 184413 (2019). (*Highlighted in the PRB webpage*). (<https://journals.aps.org/prb/kaleidoscope/prb/100/18/184413>).
7. Y. C. Chung, **Sunil K. Karna**, F. C. Chou, H. L. Liu “Electronic structure and lattice dynamics of Li₂Ni(WO₄)₂” *Chin. J. Phys.* **60**, 473 (2019).
8. F. J. We, R. A. Mole, **Sunil K. Karna**, J. W. Shi, J. K. Sheu, and K. H. Lin, “Verification of complex acoustic mismatch model in sub-THz regime” *Appl. Phys. Lett.* **114**, 151106 (2019).
9. Yan Wu, Zhenhua Ning, Huibo Cao, Guixin Cao, K. A. Benavides, **S. Karna**, Gregory T. McCandless, R. Jin, Julia Y. Chan, W. A. Shelton and J. F. DiTusa “Spin density wave instability in a ferromagnet” *Scientific Reports* **8**, 5225 (2018).
10. G. J. Shu, S. C. Liou, **S. K. Karna**, R. Sankar, M. Hayashi, and F. C. Chou, “Dynamic surface electronic reconstruction as symmetry-protected topological orders in topological insulator Bi₂Se₃” *Phys. Rev. Materials* **2**, 044201 (2018)
11. J.-H. Chen, A. U. Saleheen , **Sunil K. Karna**, D. P. Young , N.Ali , S.Stadler “Tuning Martensitic Transitions in (MnNiSi)_{0.65}(Fe₂Ge)_{0.35} Through Heat Treatment and Hydrostatic Pressure” *J. Appl. Phys.* **124**, 203903 (2018).
12. I. Panneer Muthuselvam, R. Sankar, G. Narsinga Rao, **Sunil K. Karna** and F. C. Chou “Ferromagnetic nature in low-dimensional S = 1 antiferromagnetic Li₂Ni(WO₄)₂ nanoparticles” *J. Magn. Magn. Mater.* **449**, 83-87 (2018).
13. **Sunil K. Karna**, Y. Zhao, R. Sankar, M. Avdeev, K. Matan, G.-Y. Guo and F. C. Chou, “Sodium layer chiral distribution and spin structure of Na₂Ni₂TeO₆ with a Ni honeycomb lattice” *Phys. Rev. B* **95**, 104408 (2017).
14. R. Das, **Sunil Karna**, Y.-C.Lai and F.-C.Chou “Self-Adjusted Traveling Solvent Floating Zone Growth of Single Crystal CaFe₂O₄” *Cryst. Growth Des.* **16**, 499 (2016).
15. I. Panneer Muthuselvam, R. Sankar, A. V. Ushakov, W. T. Chen, G. Narsinga Rao, Sergey V. Streltsov, **Sunil K. Karna**, L. Zhao, M.-K. Wu and F. C. Chou “Successive spin orderings of tungstate-bridged Li₂Ni(WO₄)₂ of spin 1” *J. Phys.: Condens. Matter* **27**,456001 (2015).

16. **Sunil K. Karna**, C.-W. Wang, R. Sankar, M. Avdeev, A. Singh, I. Panneer Muthuselvam, V. N. Singh, G.-Y. Guo and F. C. Chou “Antiferromagnetic spin structure and negative thermal expansion of $\text{Li}_2\text{Ni}(\text{WO}_4)_2$ ”. *Phys. Rev. B* **92**, 014413 (2015).
17. **Sunil K. Karna**, C.-H. Lee, W.-H. Li, R. Sankar, F. C. Chou and M. Avdeev “Fe-excess Ions as Electronic Charge Suppliers for Zero Thermal Expansion in the Normal State of $\text{Fe}_{1.16}\text{Te}_{0.6}\text{Se}_{0.4}$ ”, *J. Phys. Soc. Jpn.* **84**, 094713 (2015).
18. R. Sankar, M. Neupane, S.-Y. Xu, J. Butler, I. Zejickovic, I. Panneer Muthuselvam, F.-T. Huang, S.-T. Guo, **Sunil K. Karna**, M.-W. Chu, W. L. Lee, M.-T. Lin, R. Jayavel, V. Madhavan, M. Z. Hasan, and F. C. Chou. “Large single crystal growth, transport property, and spectroscopic characterizations of three-dimensional Dirac semimetal Cd_3As_2 ” *Scientific Reports* **5**, 12966 (2015).
19. W.-H. Li, **Sunil K. Karna**, H. Han, C. Y. Li, C. H. Lee R. Sankar and F. C. Chou “Development of a ferromagnetic component in the superconducting state of Fe-excess $\text{Fe}_{1.12}\text{Te}_{1-x}\text{Se}_x$ by electronic charge redistribution”. *Scientific Reports* **5**, 10951 (2015).
20. G. J. Shu, S. C. Liou, **S. Karna**, R. Sankar, M. Hayashi, M.-W. Chu, and F. C. Chou. “Graphene-like conjugated π bond system in $\text{Pb}_{1-x}\text{Sn}_x\text{Se}$ ” *Appl. Phys. Lett.* **106**, 122101 (2015).
21. R. Sankar, I. Panneer Muthuselvam, G. J. Shu, W. T. Chen, **Sunil K. Karna**, R. Jayavel and F. C. Chou “Crystal growth and magnetic orderings of $\text{Na}_2\text{Ni}_2\text{TeO}_6$ with a honeycomb layer and $\text{Na}_2\text{Cu}_2\text{TeO}_6$ with Cu spin dimmers”. *CrystrEngComm* **16**, 10791 (2014).
22. **Sunil K. Karna**, H. Han, C. Y. Li, S. B. Li, C. H. Lee R. Sankar, F. C. Chou and W.-H. Li “Direct interplay between superconductivity and ferromagnetism in $\text{Fe}_{1+y}\text{Te}_{0.5}\text{Se}_{0.5}$ ”. *J. Phys. Soc. Jpn.* **83**, 074709 (2014).
23. C.-H. Lee, C.-Y. Li, **Sunil K. Karna**, E. Batsaikhan, S. -B. Liu, C. -H. Hang, Y.-Y. Chen and W.-H. Li “Remarkable enhancement of magnetization in the superconducting state of In/Ni nanoparticle composites by inhomogeneous spin anti-screening” *J. Nanopart. Res.* **16**, 2447 (2014).
24. **Sunil K. Karna**, C.-H. Hung, C.-M. Wu, C.-W. Wang, W.-H. Li, R. Sankar, F.C. Chou, and M. Avdeev “Large magnetoresistance and charge transfer between the conduction and magnetic electrons in layered oxyselenide $\text{BiOCu}_{0.96}\text{Se}$ ” *Dalton Trans.* **42**, 15581 (2013).
25. C. -H. Hang, C.-H. Lee, C.-K. Hsu, C.-Y. Li, **Sunil K. Karna**, C.-W. Wang, C.-M. Wu and W.-H. Li “Unusually large magnetic moments in the normal state and superconducting state of Sn nanoparticles” *J. Nanopart. Res.* **15**, 1905 (2013).
26. C.-Y. Li, **Sunil K. Karna**, C.-W. Wang, and W.-H. Li “Spin Polarization and Quantum Spins in Au Nanoparticles” *Int. J. Mol. Sci.* **14**, 17618-17642 (2013).

27. **Sunil K. Karna**, W.-H. Li, C.-M. Wu, C. W. Wang, R. Sankar and F. C. Chou “Magnetic-field-tunable negative thermal expansion in layered oxyselenide BiOCuSe”. *J. Phys. Soc. Jpn.* **82**, 094705 (2013).
28. C.-M Wu, **Sunil K. Karna**, S.-B Liu, C.-H. Lee, C.-W. Wang and W.-H. Li “Inverse magnetic proximity effects in superconducting In-Ni and Sn-Ni nanoparticle assemblies”. *J. Nanopart. Res.* **15**, 1691 (2013).
29. **Sunil K. Karna**, R. Sankar, C.-M. Wu, C.-W. Wang, Daniel Hsu, C.-J. Wang, F. C. Chou and W.-H. Li, “Spin, charge and lattice couplings in oxysulphide BiOCu_{0.94}S”, *J. Phys. Condens. Matter.* **24**, 266004 (2012).
30. **Sunil K. Karna**, R. Sankar, C.-M. Wu, C.-W. Wang, Daniel Hsu, C.-J. Wang, F. C. Chou and W.-H. Li, “Interplay between crystalline and magnetic structures in BiOCu_{0.94}S” *J. Phys. Soc. Jpn.* **80 SB011** (2011).
31. **Sunil K. Karna**, C.-Y. Li, C.-M. Wu, C.-K. Hsu, C.-W. Wang, and W.-H. Li, “Observation of large magnetic moments in icosahedral Pb nanoparticles,” *J. Phys. Chem. C* **115**, 8906 (2011).
32. C.-Y. Li, C.-M. Wu, **Sunil K. Karna**, C.-W. Wang, Daniel Hsu, C.-J. Wang, and W.-H. Li “Intrinsic magnetic moments of Gold Nanoparticles” *Phys. Rev. B* **83**, 174446 (2011).
33. S.-B. Liu, C.-T. Chen, C.-M. Wu, C.-W. Wang, C.-J. Wang, **Sunil K. Karna**, and W.-H. Li, “Suppression of superconductivity by interparticle interactions in Al nanoparticle assembly,” *J. Appl. Phys* **109**, 07E153 (2011).
34. C.-W. Wang, C.-M. Wu, **Sunil K. Karna**, C.-Y. Li, C.-K. Hsu, Carrisa H. C. Li and W.-H. Li “Electrically controllable metal-insulator-like transition in nanoparticle compacts” *J. Nanopart Res.* **13**, 3405 (2011).
35. I. Jarrige,¹ Y. Q. Cai, S. R. Shieh, H. Ishii, N. Hiraoka, **S. Karna**, and W.-H. Li, “Charge transfer in FeOCl intercalation compounds and its pressure dependence: An x-ray spectroscopic study,” *Phys. Rev. B* **82**, 165121 (2010).
36. C.-W. Wang, C.-M. Wu, C.-Y. Li, **Sunil K. Karna**, C.-K. Hsu, Carissa H C Li, W.-H. Li, C.-C. Yu, C.-P. Wu, H. Chou, and Jeffrey W Lynn, “Short range magnetic correlations induced by La substitution in HoLaMn₂O₅,” *J. Phys.: Condens. Matter* **22**, 246002 (2010).

INVITED TALKS

1. “Topological magnetic-spin textures in noncentrosymmetric magnets” at Department of Physics, Hampton University on Jan 21, 2021. (Virtual)
2. “Development of a ferromagnetic component in the superconducting state of Fe-excess Fe_{1.12}Te_{1-x}Se_x by electronic charge redistribution” at Department of Mechatronics Engineering, National Changhua University of Education (NCHE), Taiwan on Oct 16, 2014.

3. “Magnetic-field-tunable negative thermal expansion in layered oxyselenide BiOCuSe iso-structural to Fe-based superconductor” at Department of Physics, National Chung Hsing University (NCHU), Taiwan on May 3, 2013.

13 CONTRIBUTED TALKS at American Physical Society meetings, ORNL user’s meeting, American Conference on Neutron Scattering meetings, International Conference on Highly Frustrated Magnetism meeting, ANOSA meeting and the international workshop on Neutron Applications on Strongly Correlated Electron Systems meetings.

MENTORING of STUDENTS

- Graduate students: Jonathan Valenzuela (2020-2021), Orrin Clark Delgado (2021-2022).
- Undergraduate students: 4 undergraduate students in the crystal growth projects.

COURSES TEACHING

- PHY2326 University Physics II (Fall 2022)
- PHSC1315 Physical Science I (Fall 2022)

COURSES TAUGHT

- PHY653 Solid State Physics (Spring 2022) at Norfolk State University

SKILLS AND ABILITIES

A. Methods used for the material synthesis

- ❑ Polycrystalline sample
 - Solid state method, Arc-melting and Radio-frequency (RF) melting
 - High pressure material synthesis in Multi-Anvil (Apparatus) from Rockland Research Press, mostly used cubic-anvil cell up to 9 GPa.
 - Nanoparticles fabrication (Thermal evaporation method)
- ❑ Single crystal growth techniques
 - Optical floating zone (FZ) image furnace (CaFe_2O_4 , SrFeO_3 and ScFeGe single crystals are grown using FZ technique)
 - Chemical vapor transport (CVT) ($\text{Mn}_{1/3}\text{NbS}_2$, $\text{Fe}_{1/3}\text{NbS}_2$, etc single crystals are grown using CVT method)
 - Bridgeman growth (mostly $B20$ compounds such as CoSi , PdGa , PtGa , etc grown using this technique)
 - Flux-growth ($\text{Na}_2\text{Ni}_2\text{TeO}_6$ single crystals grown using this method)
- ❑ Thin-Film Deposition
 - Thermal evaporation method

B. Instruments used for characterization

- ❑ MPMS SQUID magnetometer:
 - Measure magnetization, *ac* and *dc* magnetic susceptibility.
 - Measure High-pressure magnetization using a Cu-Be pressure cell.

- Resistivity and Hall Effect measurements using standard lock-in techniques.
- ❑ Physical Property Measurement System (PPMS) :
 - Transport (Resistivity and Hall Effect) measurements.
 - Seebeck effect measurements
- ❑ X-ray diffractometer (Bruker D8 ADVANCE and PANalytical Empyrean multi-stage)
- ❑ Experience using FIB-SEM and TEM:
 - Characterized the transition metal intercalated-NbS₂ crystal using a focused-ion-beam scanning-electron microscope (FIB-SEM) and prepared the samples for High-resolution transmission electron microscopy (HRTEM) and Lorentz TEM
 - Experience in analyzing the HRTEM and LTEM data using Image J software.

C. Neutron experiments performed at the following facilities:

- Oak Ridge National Laboratory (ORNL), USA
- National Institute of Standards and Technology (NIST), USA
- Australian Nuclear Science and Technology Organization (ANSTO), Australia

D. Experiments performed at National High Magnetic Field Laboratory (NHFML)

- MagLab, Tallahassee, Florida; Cell 8, Cell 12 up to 35 T, Cell 14 (45 T)
- MagLab, Los Alamos; Cell 2 up to 65 T

E. Frequently used software in the research

- OriginLab (Data analysis and plotting), Matlab and Python
- TOPAS and GSAS (Crystal structures refinements and Electron density mapping.
- FullProf and JANA softwares for the Crystal and Magnetic structures refinements)
- Crystal Maker, Diamond, VESTA
- Image J software (for LTEM and TEM images analysis)

ATTENDED SCHOOLS AND WORKSHOPS

1. *Diffuse Scattering Workshop* organized by ORNL, June 5-7, 2019.
2. *3rd JHU Summer School on Materials Growth and Design: Exotic Magnetic States in Quantum Materials* organized by PARADIM, John Hopkins University, June 17-22, 2018.
3. *MagLab Summer School 2018*, Tallahassee, Florida, May 14-18, 2018.
4. *New Trends in Magnetic Structure Determination*, 12-16 Dec 2016 at ILL, Grenoble, France.
5. *FP School 2016- 9th ILL school on Neutron Diffraction Data Treatment using FullProf Suite*, 9-14 May 2016, Grenoble, France.
6. *Inelastic Neutron Scattering School* from Nov. 22-27, 2015 organized by ANSTO/AINSE at ANSTO, Sydney, Australia.
7. *Asia-Pacific Edition of HERCULES in Taiwan* from July 5th -24th held at NSRRC, Taiwan.

Referee Service

- Reviewer: peer-reviewed journals: Physical Review Letters (PRL), Physical Review B (PRB), and Nano Energy
- Guest Editor, Magnetochemistry Journal. Special Issue "Advances in Chiral Magnetism".
- Reviewer: Oak Ridge National Laboratory: neutron beam time request - science review.
- Reviewer: Australian Science and Technology Organization (ANSTO), Australia: neutron beam time request - science review.

PERSONAL REFERENCES BY REQUEST