Sunil K. Karna
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(a) Professional Preparation

- Ph.D. National Central University, Department of Physics, Taiwan, 2011
- M.Sc. Tribhuvan University, Department of Physics, Nepal, 2003
- B.Sc. Tribhuvan University, Department of Physics, Nepal, 1999

(b) Appointments

- 08/ 2020- Present *Assistant Professor-Research*, 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
- 08/ 2014- 02/2017 *Research Scientist*, Novel Materials Development Laboratory at Center for Condensed Matter Sciences, National Taiwan University, Taiwan.
- 08/ 2011- 07/2014: *Postdoctoral Research Associate*, Department of Physics, National Central University, Taiwan.
- 11/ 2003 - 06/2007 *Lecturer*, Department of Physics, Amrit Science Campus, Tribhuvan University, Kathmandu, Nepal.

(c) Synergetic activities

- Membership: American Physical Society (2017 - present)
- Reviewer: peer-reviewed journals: Physical Review Letters (PRL), Physical Review B (PRB), and Nano Energy
- Reviewer: Neutron experiment proposals reviewer for Oak Ridge National Laboratory (ORNL), USA
- Reviewer: Neutron experiment proposals reviewer for Australian Science and Technology Orgnization (ANSTO), Australia

(d) Skills and abilities

I. 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) ($Mn_{1/3}NbS_2$, $Fe_{1/3}NbS_2$, 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 ($Na_2Ni_2TeO_6$ single crystals grown using this method)

☐ Thin-Film Deposition
- Thermal evaporation method

II. 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-NbS_2 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 (LTEM).
- Experience in analyzing the HRTEM and LTEM data using Image J software.

III. 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

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

- MagLab, Tallahassee, Florida; Cell 8 and Cell 12 up to 35 T
- MagLab, Los Alamos; Cell 2 up to 65 T
- MagLab, Tallahassee, Florida; 18/20T, superconductor, general purpose (SCM-2) (Scheduled the experiment dates: 4/13/2020-4/19/2020)

V. 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)

(e) Publications

1. **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 Letters* 2020 (Under Review).
2. **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 " Field dependent of magnetic structure and metamagnetism in non-centrosymmetric helimagnet ScFeGe". *Phys. Rev. B* 2020 (Under Review). https://arxiv.org/abs/2009.14387
3. **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 $Mn_{1/3}NbS_2$" *Phys. Rev. B* **100**, 184413 (2019). (*Highlighted in the PRB webpage*). (https://journals.aps.org/prb/kaleidoscope/prb/100/18/184413).
4. Y. C. Chung, **Sunil K. Karna**, F. C. Chou, H. L. Liu "Electronic structure and lattice dynamics of $Li_2Ni(WO_4)_2$" *Chin. J. Phys.* **60**, 473 (2019).
5. 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).
6. 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).
7. 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)
8. J.-H. Chen, A. U. Saleheen , **Sunil K. Karna**, D. P. Young , N.Ali , S.Stadler "Tuning Martensitic Transitions in $(MnNiSi)_{0.65}(Fe_2Ge)_{0.35}$ Through Heat Treatment and Hydrostatic Pressure" *J. Appl. Phys.* **124**, 203903 (2018).
9. I. Panneer Muthuselvam, R. Sankar, G. Narsinga Rao, **Sunil K. Karna** and F. C. Chou "Ferromagnetic nature in low-dimensional S = 1 antiferromagnetic $Li_2Ni(WO_4)_2$ nanoparticles" *J. Magn. Magn. Mater.* **449**, 83-87 (2018).

10. **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 $Na_2Ni_2TeO_6$ with a Ni honeycomb lattice" *Phys. Rev. B* **95**, 104408 (2017).
11. 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).
12. 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 $Li_2Ni(WO_4)_2$ of spin 1" *J. Phys.: Condens. Matter* **27**,456001 (2015).
13. **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 $Li_2Ni(WO_4)_2$". *Phys. Rev. B* **92**, 014413 (2015).
14. **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 $Fe_{1.16}Te_{0.6}Se_{0.4}$", *J. Phys. Soc. Jpn*. 84, 094713 (2015).
15. R. Sankar, M. Neupane, S.-Y. Xu, J. Butler, I. Zejikovic, 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).
16. 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 $Fe_{1.12}Te_{1-x}Se_x$ by electronic charge redistribution". *Scientific Reports* **5**, 10951 (2015).
17. 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 $Pb_{1-x}Sn_xSe$" *Appl. Phys. Lett.* 106, 122101 (2015).
18. 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 $Na_2Ni_2TeO_6$ with a honeycomb layer and $Na_2Cu_2TeO_6$ with Cu spin dimmers". *CrystEngComm* **16**, 10791 (2014).
19. **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 $Fe_{1+y}Te_{0.5}Se_{0.5}$". *J. Phys. Soc. Jpn.* **83**, 074709 (2014).
20. 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).

21. **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 $BiOCu_{0.96}Se$" *Dalton Trans.* 42, 15581 (2013)**.**

22. 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).

23. 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).

24. **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).

25. 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).

26. **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).

27. **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).

28. **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).

29. 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).

30. 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).

31. 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).

32. 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).

33. 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 $HoLaMn_2O_5$," *J. Phys.: Condens. Matter* **22**, 246002 (2010).

(f) Conference presentations

1. *Observation of a mesoscopic magnetic modulation in chiral $Mn_{1/3}NbS_2$*, ORNL user meeting 2019, June 4-5, 2019. (Poster)
2. *Long wavelength modulation in chiral helimagnet $Mn_{1/3}NbS_2$.* APS March Meeting, March 4-9, 2019 Boston, Massachusetts. (Oral)
3. *Observation of long wavelength modulation near metamagnetic transition in non-centrosymmetric helimagnet ScFeGe.* 9th American Conference on Neutron Scattering (ACNS 2018), June 24-28, 2018, College Park, Maryland, USA. (Oral)
4. *Magnetic structures and metamagnetic transition of non-centrosymmetric helimagnet ScFeGe.* APS March Meeting, March 5–9, 2018 Los Angeles, California. (Oral)
5. *Magnetic structures and metamagnetic transition of non-centrosymmetric helimagnet ScFeGe.* Joint Nanoscience and Neutron Scattering User Meeting, Oak Ridge, TN, July 31-August 4, 2017. (Oral)
6. *The hidden chirality and diffusion path of Na layer in the honeycomb lattice of $Na_2Ni_2TeO_6$,* 8th International Conference on Highly Frustrated Magnetism 2016 (HFM 2016), Taipei, Taiwan. September 7-11, 2016. (Oral)
7. *Atomic and magnetic ordering orderings in the honeycomb lattice of $Na_2Ni_2TeO_6$,* 8th American Conference on Neutron Scattering 2016 (ACNS 2016), Queen Marry, Long beach, California, USA, July 10-14, 2016. (Oral)
8. *Structural and physical properties of the layered oxyselenide $BiOCu_{0.96}Se$,* ANOSA conference, Japan (2011) (Poster)
9. *Interplay between crystalline and magnetic structure in $BiOCu_{0.94}S$,* The international workshop on Neutron Applications on Strongly Correlated Electron Systems NASCES11, Tokai, Japan (February 2011) (Oral)
10. *Superconductivity of In nanoparticles modulated by In_2O_3 shell*, General Meeting of Chinese Physical Society (CPS), National Cheng Kung University NCKU, Taiwan (Feb 2010) (Oral)
11. *Magnetic Ordering of Fe in Na-intercalated FeOCl*, International Conference on Neutron and X-ray Scattering ICNX, Malaysia (June 2009) (Oral)
12. *Enhanced Magnetization in Pb Nanoparticles*, Taiwan International Conference on Superconductivity, Taiwan (2008) (Poster).

(g) 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.

(h) Invited talks

1. "*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.
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.