Anil Kumar, PhD

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EDUCATION

- **Kyung Hee University, South Korea.** Feb 2025
  Doctor of Philosophy (Ph.D.) in Physics
  Thesis: Advanced Strategies for Reducing Lattice Thermal Conductivity and Enhancing Thermoelectric Performance in Bi_2Te_3 and GeTe-based compounds.

- **National Institute of Technology (NIT) Manipur, India.** July 2019
  Master of Science (M.Sc.) in Physics
  Thesis: Synthesis and optical studies on zeolite and composite with magnetite.

- **Kumaun University Nainital, India.** June 2016
  Bachelor of Science (B.Sc.) in Physics, Chemistry, and Mathematics
  Project: Designing and Verification of Logic Gates.

RESEARCH INTERESTS

- Quantum Materials, Strongly Correlated Materials, Topological Materials, Thermoelectric Materials.
- Exploration of Unconventional Transport Phenomena and Electronic, Magnetic, and Thermal Transport Measurements.
- Thermoelectricity: Thermal Transport Phenomena, Enhancing the figure of merit (zT), and Applications.

RESEARCH EXPERIENCE

- **Postdoctoral Researcher, University of Notre Dame at Stavropoulos Center for Complex Quantum Matter** Nov 2026 - present
  Advisor: Dr. László Forró

- Have been working on the single crystal synthesis and transport measurements of quantum materials, particularly emerging magnetic states: Altermagnetism.

- **Postdoctoral Researcher, Texas Tech University** Jan 2025 - Oct 2026
  Advisor: Dr. Yun Suk Eo

  - Worked on the single crystal synthesis and characterization of strongly correlated materials.
  - Investigated transport phenomena such as the Anomalous Hall effect, Anisotropic resistivities (Montgomery Analysis), angle-dependent magnetoresistance, chiral-anomaly, spin-glass transitions, surface states, magnetic ordering, and hysteresis, etc.
  - Got extensive hands-on experience with transport measurement, including He-3, Lock-in amplifier for low noise measurements, VSM, Heat capacity, TTO on Quantum Design PPMS, and growing crystals using the Flux-growth method and Chemical Vapor Transport (CVT) methods, powder XRD, and facet identification.

- **Graduate Student, Kyung Hee University** Sep 2021 - Feb 2025
  Advisor: Dr. Jong-Soo Rhyee

  - Worked on synthesis and investigating polycrystal thermolectric materials.
  - Demonstrated mechanisms to reduce lattice thermal conductivity, including lattice mismatch, stacking fault, grain connectivity, and hierarchical phonon scattering.
  - Improved thermoelectric performance of compounds using methods like hot deformation, sintering, spray coating, ultrasonication, making nano-/micro-architecture, alloys & composite formation, creating Negative Thermal Expansion.

- **Master Student, National Institute of Technology (NIT) Manipur** May 2018 - May 2019
  Advisor: Dr. L. Herojit Singh

  - Worked on the synthesis and characterization of zeolite and its composite.
  - Had experience with wet chemical synthesis methods and measurement techniques like XRD, FT-IR spectroscopy, and UV-Visible spectroscopy.

- **Summer Intern, Tezpur University, India.** June 2018 - Aug 2018
  Advisor: Dr. Pritam Deb

  - Worked on the development and characterization of functional 2D nanostructures
  - Had experience with hydrothermal synthesis and structural characterization techniques like powder XRD, FE-SEM.

SKILLS AND EXPERTISE

- **Material Synthesis Techniques: Single crystal/polycrystal growth**
  Flux-growth method, Chemical Vapor Transport (CVT), Arc-melting, Ball milling, Vertical Bridgman method, melting, quenching, annealing, hydrothermal/solvothermal method, pyrolysis process, and co-precipitation method.

- **Material Characterization Equipments**
  Quantum Design PPMS 9 and 14T, He-3, Lock-in amplifier for low noise measurements, VSM, Heat capacity, TTO, thermogravimetric analyzer (TGA), ZEM-3, LFA, XRD, EBSD, Raman spectroscopy, FE-SEM, HR-TEM, FT-IR spectroscopy, UV-Visible spectroscopy, etc.

- **Software Skills**
  Origin Pro, LabVIEW, LaTeX writing, Panalytical's HighScore Plus, ImageJ, Jade, Maud, PlotDigitizer, MS Office, Peakfit, VESTA, Mendeley, etc.

- **Data Processing Software**
  Expertise in phase identification analysis using X'Pert HighScore Plus; analysis of micrographs obtained from FE-SEM and TEM using ImageJ software; and use of Wolfram Mathematica 13.0 for thermoelectric theoretical calculations (such as lattice thermal conductivity, effective mass, Lorenz number, majority/minority carrier conductivity, etc.).

PUBLICATIONS

Google Scholar profile: Anil Kumar

Published in peer-reviewed journals

1. S. Thoravat, **A Kumar** et al., Mechanically Robust Dicing-Free Thermoelectric Module Fabrication Using Anion-Cation co-Doped Bismuth Tellurides. Small 2026.. Small, 2026, 22:e74188.

2. P. Rawat, **A Kumar** et al., Ag Doping Effect in Electrical and Thermal Transport Properties of Type-I $Ba_8Al_{16}Si_{30}$ Clathrate Compounds. J. Therm. Anal. Calorim 2026, 1–10.

3. S. Mostufa ... **A Kumar** et al., Wet Ball Milling Synthesis of Iron Oxide Nanoparticles for Magnetic Hyperthermia in Ovarian Cancer. Adv. Mater. Technol. 2026, e70960.

4. **A Kumar** et al., Lattice Mismatch-Induced Thermal Conductivity Reduction in GeTe Bulk Alloys. ACS Appl. Mater. Interfaces 2025, 17, 45784–45795.

5. **A Kumar** et al., Improved Thermoelectric Performance in Bi-Sb-Te Composite with HEA Nanoparticles. Energy Mater. 2025, 5, 500109.

6. **A Kumar** et al., Enhanced Thermoelectric Properties of p-type Bi_2Te_3 Composites with Ag-TiO_2 Nanoparticles. J. Materiomics 2025, 11, 100929.

7. **A Kumar** et al., Stacking-Fault-Controlled Thermoelectric Performance in $(GeTe)_{1-x}(Bi_2Te_3)_x$. Mater. Chem. Phys. 2024, 322, 129532.

8. **A Kumar** et al., Hierarchical Phonon Scattering in p-type Bi_2Te_3 Composites with Ag-TiO_2. J. Alloys Compd. 2024, 979, 173503.

9. P. Rawat, **A Kumar** et al., Extrinsic Phase Mixing in Chalcogenide Nanocomposites. Curr. Appl. Phys. 2024, 60, 15–31.

10. P. Rawat$^{\#}$ and **A Kumar**$^{\#}$ ($^{\#}$equal contribution) et al., Hierarchical Phonon Scattering in Ag/TiO_2 Decorated Bi_2Te_3 Composites. ACS Appl. Mater. Interfaces 2023, 15, 58487–58496.

11. N. J. Singh ... **A Kumar** et al., Zeolite/Iron Oxide Nanocomposites for Congo Red Removal. J. Mater. Res. 2023, 38, 1149–1161.

PATENTS

- Jong-Soo Rhyee, **Anil Kumar**, Saurabh Thoravat, Jin Hee Kim. "High thermal conductive and high mechanical strength High entropy alloy and wide bandgap semiconductor composite substrates" **Application#: RPT-2024321-0000003, Date of Filing: 21.03.2024. Pending.**

PRESENTATIONS

Invited Talks

1. Understanding Altermagnetism: Probing One of Its Signatures in the Candidate GdAlSi Through Transport Measurements, Amity University, Department of Chemistry, Biochemistry and Forensic Sciences, Amity School of Applied Sciences, Manesar, Haryana, India. (October 06, 2026)

2. Insights into Anomalous Hall Conductivity Extraction in the Altermagnet Candidate GdAlSi Through Transport, Texas Tech University, Department of Physics Astronomy, Lubbock, TX, USA. (September 14, 2026)

Oral Presentations

1. **A Kumar**, D Pal, P Regmi, B Bouley, M Sanati, and YS Eo. Transport Properties of Weyl Semimetal and Altermagnet candidate GdAlSi. **APS Global Physics Summit 2026**, Denver, USA.

2. **A Kumar**, S Thoravat, P Rawat, H Jin, and JS Rhyee. Hierarchical phonon scattering from nano to macro scale in Bismuth Telluride bulk composites and cost-effective module structure. **24th Korea Thermophysical Society Academic Conference (KSTP) 2024**, Jinju, South Korea.

3. **A Kumar**, P Rawat, H Jin, and JS Rhyee. Hierarchical phonon scattering from nano to macro scale in Ag-nano/TiO_2-micro particle decorated p-type Bismuth Telluride bulk composites, **The Korean Institute of Metals and Materials (KIMM or KPS) 2023**, Jeju, South Korea.

Poster Presentations

1. **A Kumar**, D Pal, P Regmi, M Adnan, E Ji, B Bouley, M Sanati, L Miao, and YS Eo. Transport Properties of Weyl Semimetal and Altermagnet Candidate GdAlSi, **The Second Texas Quantum Summit 2026**, The University of Texas at Dallas, Dallas, USA.

2. **A Kumar**, P Regmi, D Pal, and YS Eo. Quantum Material Transport Studies at Texas Tech, **The First Texas Quantum Summit 2025**, College Station, USA.

3. **A Kumar**, S Thoravat, P Rawat, H Jin, and JS Rhyee. Hierarchical phonon scattering from nano to macro scale in Bismuth Telluride bulk composites and cost-effective module structure, **The 22nd International Nanotech Symposium (NANO KOREA) 2024**, Ilsan, South Korea.

MENTORING EXPERIENCE

- **Mentor for Muhammad Adnan (Graduate Student) and Leon (Undergraduate student)** Spring 2026-present
  Texas Tech University in Eo Research Group.
  Responsibilities: Crystal growths, sample preparation for electric/magnetic transport, and structural measurements. Transport and XRD measurements, including data analysis.

- **Mentor for Debapratim Pal (Graduate Student)** Fall 2025-present
  Texas Tech University in Eo Research Group.

Responsibilities: Crystal growths, sample preparation for electric/magnetic transport, and structural measurements. Transport and XRD measurements, including data analysis.

- **Mentor for Saurabh Thoravat (Graduate Student) and Woojin Jo (Undergraduate student)** Aug 2023 - Oct 2024
  Kyung Hee University in Prof. Rhyee's Lab.
  Responsibilities: Thermoelectric material synthesis, related sample preparation and measurements, data analysis, and technical writing.

AWARDS, HONORS & FELLOWSHIPS

- Brain Korea (BK) Fellow, South Korea. (2022-2024)
- President Scholarship (Foreigner), South Korea (2021-2023)
- SRFP fellow, conducted by the Indian Academy of Sciences (June-August 2018)
- Highly Competitive Joint Admission Test for M.Sc. (IIT-JAM) in Physics with All India rank 1182 conducted by Indian Institutes of Technology (IITs), India.(2017)

ENGLISH LANGUAGE PROFICIENCY

- **DUOLINGO Score (13th, Feb 2021):** 110/160 (Literacy: 110, Conversation: 95, Comprehension: 115, Production: 85)
- I completed my entire academic education, from undergraduate studies to my doctoral degree, with English as the medium of instruction.

PROFESSIONAL ACTIVITIES & RESPONSIBILITIES

- Energy Materials and Quantum Physics (EMQP) Lab manager at KHU, South Korea. (Jan 2024 – Oct 2024)
- Lab and Physics department representative at NIT Manipur, India. (2018-2019)
- Teaching as core faculty in Physics for National Eligibility Cum Entrance Test (NEET) and Indian Institute of Technology (IIT-JEE) aspirants at Rudrapur, Uttarakhand, India. (July – December 2019).
- Science Teacher at Govind Vidya Mandir Public School, Rudrapur, Uttarakhand, India. (July 2016 - May 2017).

REFERENCES

- (*Postdoc advisor*) **Dr. László Forró**, Marquez Chair Professor, Department of Physics & Astronomy and Director of Stavropoulos Center for Complex Quantum Matter, University of Notre Dame, Notre Dame, USA. Mobile: +1 (574) 252-1936, Email: lforro@nd.edu, Homepage
- (*Postdoc advisor*) **Dr. Yun Suk Eo**, Assistant Professor, Department of Physics & Astronomy, Texas Tech University, Lubbock, USA. Mobile: +1 (734) 353-0007, Email: yeo@ttu.edu, Homepage
- (*Ph.D. advisor*) **Dr. Jong-Soo Rhyee**, Professor, Department of Applied Physics, Kyung Hee University, International campus, South Korea. Office: +82-31-201-2415, Mobile: +82-10-8593-0608, Fax: +82-31-204-8122, Email: jsrhyee@khu.ac.kr, Homepage
- (*Postdoc collaborator*) **Dr. Mahdi Sanati**, Associate Professor, Department of Physics & Astronomy, Texas Tech University, Lubbock, USA. Mobile: +1 (806) 834-6169, Email: M.Sanati@ttu.edu, Homepage
- (*Postdoc collaborator*) **Dr. Wade DeGottardi**, Assistant Professor, Department of Physics & Astronomy, Texas Tech University, Lubbock, USA. Mobile: +1 (806) 742-3767, Email: wdegotta@ttu.edu, Homepage