

# KARTHIK RAO

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## RESEARCH INTERESTS

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Design and synthesis of novel materials, crystal growth, strongly correlated electron systems, quantum spin liquids, high pressure floating zone

## EDUCATION

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**Rice University, Houston, TX**

August 2021 - Present

Ph.D. in Physics

Thesis Advisor: Prof. Emilia Morosan

**Texas A&M University, College Station, TX**

August 2017 - May 2021

B.S. in Physics, B.S. in Computer Science

Honors Minor in Mathematics, Minor in Cybersecurity

Cumulative GPA - 3.814

Magna Cum Laude, Undergraduate Research Scholar

University Honors Fellows, Honors in Physics

Thesis: *Particle Detector for Low-Energy Heavy Ions*

Thesis Advisor: Prof. Grigory Rogachev

## RELEVANT RESEARCH EXPERIENCE

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**Quantum Materials** - Rice University

August 2021 - Present

*Graduate Research Assistant*

Designed, synthesised, and characterized novel quantum materials with unconventional electronic and magnetic ground states, constructed the high pressure floating zone laser furnace at Rice University, maintained several of the lab's instruments including the Quantum Design PPMS DynaCool (with DR), Quantum Design MPMS3 (with iQHe3), and Bruker D8 Advance, and mentored undergraduate research assistants in the lab

**Atomic Force Microscopy** - National Institute of Standards and Technology May 2021 - July 2021

*Research Intern*

Performed COMSOL simulations on AFM probes to build a dataset of results using different probe shapes and to determine unknown probe shape from scanning results

## OTHER RESEARCH EXPERIENCE

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**Nuclear Astrophysics** - Texas A&M University

May 2019 - July 2021

**Deep Learning** - Texas A&M University

August 2020 - May 2021

**Quantum Light-Matter Interaction** - Texas A&M University

August 2019 - May 2021

**Superconducting Magnets** - Texas A&M University

May 2018 - January 2019

**Molecular Gyroscopes** - Texas A&M University

January 2018 - May 2018

## SKILLS

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Proficient in **material synthesis** techniques such as single crystal flux growths, chemical and physical vapor transport, high pressure laser floating zone, and polycrystalline arc-melting

Proficient in **material characterization** techniques such as crystallography, powder x-ray diffraction, Laue diffraction, elemental analysis, scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), magnetization and specific heat measurements, electrical transport

**Proficient** in L<sup>A</sup>T<sub>E</sub>X, C, C++, Java, MATLAB, OriginPro, Python, HTML, CSS, JavaScript  
**Experience** with R, Prolog, Assembly, Inventor, Verilog, VHDL, ROOT, LISE++, COMSOL  
**Familiar** with workshop machines such as mills, band-saws, lathes etc.  
Website Architect: [Personal Website](#), [Research Group Website](#)

## PUBLICATIONS

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1. K. S. Rao, "Particle Detector For Low-Energy Heavy Ions", *Explorations: The Texas A&M Undergraduate Journal*, vol. 12, pp. 74-78, Nov 2020

## PRESENTATIONS AND POSTERS

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1. Mar 07, 2024: *APS March Meeting*, Minneapolis, Minnesota, "New Quantum Spin Liquid Candidates Based on a Tm triangular lattice"
2. Jan 15, 2024: *7<sup>th</sup> Fundamentals of Quantum Materials Winter School*, College Park, Maryland, "Complex Magnetic Order and Room Temperature Ferromagnetism in Rare Earth Intermetallic"
3. Aug 04, 2023: *2023 Smalley-Curl Institute Summer Research Colloquium*, Houston, Texas, "Complex Magnetic Order and Room Temperature Ferromagnetism in Gd<sub>5</sub>Pb<sub>3</sub>"
4. Mar 13, 2023: *Workshop on Design Principles for Topological Quantum Materials*, Santa Barbara, California, "TmAgTe<sub>2</sub> and TmCuTe<sub>2</sub>: Quantum Spin Liquid Candidates"
5. Aug 06, 2021: *The 2021 Virtual SPS Intern Symposium*, "Profiling the Shape of Electrostatic Force Microscopy Probes Using Finite Element Simulations"
6. Apr 18, 2020: *1<sup>st</sup> APS Virtual April Meeting (Q2C, 2020 Vision: Frontiers in Physics)*, "Delay line PPAC for low-energy, heavy ions"
7. Feb 26, 2020: *3<sup>rd</sup> Undergraduate Research Scholars Symposium*, College Station, Texas, "Delay line PPAC for low-energy, heavy ions"
8. Mar 22, 2018: *21<sup>st</sup> Student Research Week (Bridging Disciplines, Engaging with Others)*, College Station, Texas, "Simulations of Rotational Barriers in Molecular Gyroscopes", presented by J. Joung, **K. S. Rao**, C. Woodall

## PROPOSALS

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1. 2023: Rapid proposal - "Crystal Electric Field (CEF) Effect in TmCuTe<sub>2</sub>", ISIS Neutron and Muon Source

## OTHER WORKS

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1. Nov 3, 2023: *Science in a Flash*, Houston, Texas, "Design and Synthesis of Novel Quantum Materials"
2. "Trust Your Gut", *the SPS Observer*, 57(2), pp. 20, Fall 2023

## WORK EXPERIENCE

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|--|------------------------------|
| <b>Teaching Assistant</b>  | January 2022 - December 2023 |
| TA for Elementary Physics Lab 2, Mechanics (with Lab), Undergraduate Quantum Mechanics   |                              |
| <b>Grader</b>  | August 2019 - May 2021       |
| Graded for physics classes such as Optics and Thermodynamics (Fall 2019), Quantum Mechanics 1 (Spring 2020, 2021), Quantum Mechanics 2 (Fall 2020) |                              |
| <b>Peer Mentor</b>   | August 2018 - December 2018  |
| Mentored incoming freshmen in College of Science through one-on-one weekly interactions and served   |                              |

as a sincere and positive source of support to help first-year physics students

**Student Technician**

August 2017 - December 2017

Assisted the TA for a freshman-level Physics class

## LEADERSHIP EXPERIENCE

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**junior Rice Center for Quantum Materials (jRCQM)**

August 2023 - Present

*jRCQM Organizer*

Led and managed a subcommittee of postdoctoral researchers and graduate students, bridging communication between the faculty committee and students' needs relevant to the Rice Center for Quantum Materials, and fostered a collaborative environment through the organization of weekly happy hour events with the theme of research progress discussions

**Physics and Astronomy Graduate Student Association (PAGSA)**

August 2023 - Present

*Physics and Astronomy Department Graduate Program Committee Representative*

Represent graduate students on the departmental Graduate Program Committee, along with organizing social and professional development events, working with administrators to plan events for prospective and incoming graduate students, and coordinate with other graduate student associations across Rice University and other universities to organize joint social events

**Nanotechnology NSF Research Experience for Teachers (RET)**

June 2023 - July 2023

*RET Mentor*

Mentored an elementary school teacher for six weeks and created a research project that aligned with their expectations and experience, and helped them create a scientific poster that they presented at the RET Symposium

**Physics and Astronomy Graduate Student Association (PAGSA)**

August 2022 - May 2023

*Diversity, Equity and Inclusion (DEI) Representative*

Represent graduate student voices on the Physics & Astronomy Department DEI Committee, report back on DEI committee progress and initiatives, and work with PAGSA and graduate students to implement graduate student level initiatives to improve the physics graduate community culture

**Society of Physics Students**

August 2018 - May 2021

*Treasurer*

Create and manage a budget of \$1000, analyze budgets and financial reports regularly, ensure the organizations funding activities is in compliance with the standards set by the University, develop ideas for fundraising and aid in Department of Physics and Astronomy outreach events

**Discover, Explore and Enjoy Physics (DEEP)**

August 2017 - May 2021

*Member*

Built demonstrations such as the plasma cutter, drawdio pencils, thermoelectric generator, fluid instability demonstration and so on, worked side-by-side with their peers and professors on research, concept, design, and fabrication of science demonstration experiments and presented these exhibits during the Festival, Shows, and other outreach program in teams of several students and faculty members

**Corps of Cadets**

August 2017 - May 2021

*Operations/Logistics Officer*

Train freshmen, sophomore and junior cadets on class structure, ensuring knowledge of rules, responsibilities, and duties expected of them as well as organize outfit events such as the annual Christmas party, family weekend events and more

**O. R. Simpson Honor Society**

August 2018 - May 2020

### *Test Bank Sergeant*

Offer free one-on-one tutoring for any cadet in need, take accountability at all mandatory tutoring events for the Corps of Cadets as well as update and maintain the test bank

## **OUTREACH, VOLUNTEERING AND COMMUNITY SERVICE**

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Houston Humane Society (2022), Big Event (2018, 2019, 2021), March to the Brazos (2018, 2019), Various community service events with the Corps of Cadets, Assisted department in New Student Conferences, Physics Festival (2018, 2019, 2021), DEEP Showcase (2018-2020), Various department outreach events over the academic year and summer breaks

## **AWARDS**

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**Robert L. Chuoke Award** - Dept. of Physics and Astronomy, Rice University 2022 - 2023  
Recognize second and third year graduate students who show the greatest promise in physics as evidenced by performance in course work and speedy progress in research.

**John B. Beckham Award** - College of Science, Texas A&M University 2020 - 2021  
Highest award in Texas A&M's College of Science with selection based upon achievement, integrity, and academic and extracurricular leadership

**Phi Kappa Phi Deans Excellence Award** - College of Science, Texas A&M University 2017 - 2018  
Recognize top first-year and sophomore students for their achievements and to help identify these students as potential candidates for future recognition in both campus award programs as well as for nomination to nationally-competitive awards

**Aggie Research Scholar** - Texas A&M University Spring 2018  
Fulfilled all requirements to be certified as an Aggie Research Scholar by working in a cross multi-disciplinary research team

**Dean's Honor Roll** - College of Science, Texas A&M University Fall 2017, Spring 2018, Spring 2020  
Distinction awarded to top 10% of students based on a grade point average of 3.75 to 4.00 and completion of 15 graded hours

**Outstanding Academic Freshman** - Corps of Cadets, Texas A&M University 2017 - 2018  
Awarded to one freshman cadet in the Corps of Cadets based on academic performance

**Academic Scholarships** - Texas A&M University 2017 - 2021  
Various academic scholarships from student organizations, departments, colleges and the University of varying amounts based upon academic achievement and extracurricular leadership

**Non-Resident Tuition Waiver** - Texas A&M University 2017 - 2021  
Awarded to eligible non-resident students who hold competitive scholarships of atleast \$4000 for the academic year for which they are enrolled, making them eligible to pay the fees and charges required of Texas residents without regard to the length of time the students have resided in Texas