

RANGANATHAN GOPALAKRISHNAN

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Faculty page: <http://www.memphis.edu/me/faculty/gopalakrishnan.php>

Google Scholar: <https://scholar.google.com/citations?user=tOrZ9j4AAAAAJ&hl=en&oi=ao>

Teaching videos: <https://www.youtube.com/channel/UCDVmZHHXN5U5JJGMzWmgEsQ>

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A. PROFESSIONAL PREPARATION

| | | | |
|--|------------------------|------------------------|---|
| National Institute of Technology, Tiruchirappalli | Tiruchirappalli, India | Mechanical Engineering | Bachelor of Technology (2004 – 2008). |
| University of Minnesota – Twin Cities <i>Co-advisors: Prof. Christopher Hogan and Prof. Peter McMurry</i> | Minneapolis, MN | Mechanical Engineering | Ph. D. (September 2008 – August 2013) |
| California Institute of Technology <i>Supervisor: Prof. Richard Flagan</i> | Pasadena, CA | Chemical Engineering | Postdoctoral training (Sep. 2013–Sep. 2014) |
| University of California – Berkeley <i>Supervisor: Prof. David Graves</i> | Berkeley, CA | Chemical Engineering | Postdoctoral training (Oct. 2014 – July 2015) |

B. PROFESSIONAL APPOINTMENTS

| | | | |
|-----------------------------------|--|--|---------------------------|
| August 15, 2022 – present | Associate Professor | Mechanical Engineering | The University of Memphis |
| February 26, 2024 – present | Associate Professor | Biomedical Engineering | The University of Memphis |
| August 15, 2016 – August 12, 2022 | Assistant Professor | Mechanical Engineering | The University of Memphis |
| July 1 – 20, 2018 | Visiting Academic Fellow/Professor with Salary | Laboratoire des Sciences des Procédés et des Matériaux | University Paris XIII |
| August 2015 – July 2016 | Lecturer | Mechanical Engineering | The University of Iowa |

C. HONORS

- 2021 and 2023:** Top 20 finalists for University of Memphis Alumni Teaching Award.
- 2022:** Herff College of Engineering Faculty Research Award, University of Memphis
- Sep 2021 – August 2023:** R. Eugene Smith Professorship, University of Memphis
- Sep 2020 – Aug 2022:** UMRF Ventures Assistant Professorship, University of Memphis
- 2020:** Early Career Award, US Dept of Energy <https://science.osti.gov/early-career>
- 2014:** Honorable mention in the Best Dissertation Competition, University of Minnesota
- Fall 2012 and Spring 2013:** Doctoral Dissertation Fellowship, University of Minnesota

D. RESEARCH SUPPORT

Summary of awarded support

| | Total | Active |
|-----------------------------|--------------------|--------------------|
| Federal agencies (research) | \$1,859,854 | \$1,660,181 |
| Federal agencies (service) | \$50,000 | - |
| Other sources (consulting) | \$10,264 | - |
| Total | \$1,920,118 | \$1,660,181 |

Ongoing funded projects

1. US Army Research Office - Sciences of Extreme Materials Branch
 - Award #W911NF-23-2-0013
 - Theoretical and experimental investigation of grain charging, coagulation, and heating in dense non-thermal dusty plasmas for large scale materials synthesis
 - **\$750,689**, December 15, 2022 – December 14, 2025
 - **Role:** PI (co-PI: Prof. Truell Hyde, Baylor University)
 - **Share:** \$387,799 (52% of total project cost)
 - **Publicly released project abstract:** soon
2. Department of Energy Office of Science – Fusion Energy Sciences
 - Award #DE-SC0021146
 - Thermodynamics and Transport Models of Strongly Coupled Dusty Plasma Matter (**FY 2020 EARLY CAREER award**)
 - **\$750,695**, September 1, 2020 – August 31, 2025
 - **Role:** PI (no co-PIs)
 - **Publicly released project abstract:**
<https://pamspublic.science.energy.gov/WebPAMSEExternal/Interface/Common/ViewPublicAbstract.aspx?rv=81050aaf-d943-419a-b14d-e911370cf527&rtc=24>
3. Department of Energy Office of Science – Fusion Energy Sciences
 - Award #DE-SC0023416
 - Experiments to validate thermodynamic and transport models of strongly coupled dusty plasma matter at Magnetized Plasma Research Laboratory, Auburn University
 - **\$107,528**, September 1, 2022 – August 31, 2024
 - **Role:** PI (no co-PIs)
 - **Publicly released project abstract:**
<https://pamspublic.science.energy.gov/webPAMSEExternal/Interface/Common/ViewPublicAbstract.aspx?rv=fa7e0a58-acf2-45f5-87de-8dd47eccc18&rtc=24>
4. Department of Energy Office of Science – Basic Energy Sciences
 - Award #DE-SC0021206
 - Langevin Dynamics modeling of gas-phase ion-ion recombination
 - **\$363,782**, September 1, 2020 – August 31, 2024
 - **Role:** PI (no co-PIs)

- **Publicly released project abstract:**
<https://pamspublic.science.energy.gov/WebPAMSEExternal/Interface/Common/ViewPublicAbstract.aspx?rv=412be1ad-8af3-4d68-ab51-53fc44ee8975&rtc=24>
5. Department of Energy Office of Science – Biological and Environmental Sciences
 - Award #DE-SC0023267
 - Building partnerships for development of sustainable energy systems with atmospheric measurements
 - **\$149,892**, September 1, 2022 – February 29, 2024
 - **Role:** co-PI (PI: Prof. Daniel Foti, University of Memphis)
 - **Share:** \$49,964 (33% of total project cost)
 - **Publicly released project abstract:**
<https://pamspublic.science.energy.gov/WebPAMSEExternal/Interface/Common/ViewPublicAbstract.aspx?rv=97113085-5acf-45c1-a5c1-0fb4a71a1d6d&rtc=24&PRoleId=10>

Completed projects

1. National Science Foundation Division of Physics
 - Award #1903432
 - An effective potential approach to the modeling of concentrated dusty plasmas
 - **\$199,673**, July 1, 2019 – June 30, 2023
 - **Role:** PI (no co-PIs)
 - **Publicly released project abstract:**
https://nsf.gov/awardsearch/showAward?AWD_ID=1903432
 - **Final outcomes report:**
https://www.nsf.gov/awardsearch/showAward?AWD_ID=1903432#2
2. Jet Propulsion Laboratory – California Institute of Technology
 - PK-4 data organization for NASA Physical Sciences Informatics
 - **\$50,000**, March 1, 2022 – December 31, 2022
 - **Role:** PI (no co-PIs)
3. University of Minnesota Board of Regents
 - Fabrication of ultrasonic aerosol generators
 - **\$8,054**, May 1, 2019 – August 31, 2019
 - **Role:** PI (no co-PIs)
4. Consulting for All World Project Management Inc.
 - Provided consultation on indoor air quality monitoring
 - **\$2,210**, August 1, 2021 – August 31, 2021
 - **Role:** PI (no co-PIs)

E. TEACHING (F: Fall, S: Spring, Su: Summer, F08 = Fall 2008)

The University of Memphis (Assistant Professor, F16 – S22; Associate Professor, F22 onwards)

- MECH 2311 Thermodynamics I (F19, S20)
- MECH 3331 Fluid Mechanics (F18, S20, F20)
- MECH 3335 Fluid Mechanics Lab (S20, F20, S21, F21, S22, F22)
- MECH 3341 Numerical and Statistical Methods (F18, F19, F23)
- MECH 4309/6309 Gas Dynamics (F16)
- MECH 4327/6327 Particle Science and Engineering (S17, S21, F24)
- MECH 7302/8302: Theory of Continuous Media (S22, S24)
- MECH 7341/8341 Engineering Analysis I (F17, F22, F24)
- MECH 7342/8342 Engineering Analysis II (S18, S23)
- MECH 7378/8378 Introduction to Computational Fluid Dynamics (S18)

The University of Iowa (as Lecturer, F15 & S16)

- S16: ME 3052 Mechanical Systems
- S16: ME 4080 Experimental Engineering
- S16: ME 4086 Mechanical Engineering Design Project
- F15: ME 3351 Engineering Instrumentation
- F15: ME 4080 Experimental Engineering

University of Minnesota – Twin Cities (as Graduate Teaching Assistant, F09 – S12)

- ME 4031W: Basic Mechanical Measurements Laboratory
Instructor: Prof. Peter H. McMurry, Terms: F09, F10, S11, F11, S12
- ME 3332: Thermal Sciences II
Instructor: Prof. Christopher J. Hogan Jr., Term: S10

F. STUDENT MENTORING (F: Fall, S: Spring, Su: Summer, F08 = Fall 2008)

PhD graduates

1. Spring 2020: Rayhan Ahmed
2. Spring 2021: Li Li
3. Summer 2022: Vikram Suresh

MS graduates

1. Spring 2018: Ewe Jiun Chng
2. Spring 2018: Lekhnath Pokharel
3. Spring 2019: Harjindar Singh Chahl
4. Spring 2019: Prashant Parajuli
5. Fall 2021: Andrei Fendley
6. Summer 2023: Zhibo Liu
7. Spring 2024: Venkata Madugula

| <u>Current PhD Advisees</u> | <u>Undergraduate Research Assistants</u> | <u>High School students in research</u> |
|------------------------------------|---|--|
| Mrittika Roy (F21 – present) | Joshua Redmond Go Felipe (F19) | Logan |
| Ravi Kumar (F21 – present) | Zhibo Liu (S20 – S21) | Wymore (S23 |
| Dinil Jose (F23 - present) | Zach Perry (F20 – Su22) | – Su23) |
| Vedant Singh (F23 - present) | Davis Ballard (F22 – S22) | |
| Alhasan Hadidi (F23 - present) | | |

G. SCHOLARLY PRODUCTS

i. Peer reviewed journal articles (* - graduate advisees of Dr. Gopalakrishnan)

| Journal | # Publications |
|---|----------------|
| Journal of Aerosol Science | 9 |
| Aerosol Science and Technology | 5 |
| Journal of Chemical Physics | 3 |
| Physical Review E | 2 |
| Journal of Physics D: Applied Physics | 2 |
| Physics of Plasmas | 2 |
| Thin Solid Films | 1 |
| Powder Technology | 1 |
| Reviews of Scientific Instruments | 1 |
| Career total (as of May 13, 2024) | 26 |
| Google Scholar® Citation total (as of May 13, 2024) | 925 |
| Publications as PI (excluding collaborations and co-authorships) | 13 |

- Kumar, R., Liu, Z., Thakur, S. C., Thomas Jr., E. J., and **R. Gopalakrishnan**, Producing two-dimensional dust clouds and clusters using a movable electrode for complex plasma and fundamental physics experiments. *Rev. Sci. Instrum.* **95**, 053503 (2024).
- J. Beckers, J. Berndt, D. Block, M. Bonitz, P. J. Bruggeman, L. Couëdel, G. L. Delzanno, Y. Feng, **R. Gopalakrishnan**, F. Greiner, P. Hartmann et al., Physics and applications of dusty plasmas: The Perspectives 2023. *Physics of Plasmas* **30** (2023) 120601.
<https://doi.org/10.1063/5.0168088>
- Madugula*, V., Suresh*, V., Liu*, Z., Ballard*, D., Wymore*, L., and **R. Gopalakrishnan**, Self-consistent calculations of the electric charge, ion drag force, and the drift velocity of spherical grains using Langevin dynamics and comparisons against canonical experiments. *Physics of Plasmas* **30** (2023) 123703.
<https://doi.org/10.1063/5.0164245>
- Liu*, Z., Roy*, M., DeYonker, N. J., and **Gopalakrishnan, R.**, Neutral gas pressure dependence of ion–ion mutual neutralization rate constants using Landau–Zener theory coupled with trajectory simulations. *Journal of Chemical Physics* **159** (2023) 114111.
<https://doi.org/10.1063/5.0168609>
- Suresh*, V., Liu*, Z., Perry, Z. and **Gopalakrishnan, R.**, Modeling Particle-Particle Binary Coagulation Rate Constants for Spherical Aerosol Particles at High Volume Fractions Using Langevin Dynamics Simulations. *Journal of Aerosol Science* **164**: 106001.
<https://doi.org/10.1016/j.jaerosci.2022.106001>
Selected to feature in the cover page of the Volume 164 August 2022 issue.
- Suresh*[#], V., Li*[#], L., Redmond Go Felipe, J. and **Gopalakrishnan, R.**, Modeling nanoparticle charge distribution in the afterglow of non-thermal plasmas and comparison with measurements *Journal of Physics D: Applied Physics* **54**, 275205 (2021).
<https://doi.org/10.1088/1361-6463/abf70c>
- Li*, L. and **Gopalakrishnan, R.** (2021), An experimentally validated model of diffusion charging of arbitrary shaped aerosol particles. *Journal of Aerosol Science* **151**: 105678.
<https://doi.org/10.1016/j.jaerosci.2020.105678>

8. Suresh*, V. and **Gopalakrishnan, R.** (**invited article**), Tutorial: Langevin Dynamics methods for aerosol particle trajectory simulations and collision rate constant modeling. *Journal of Aerosol Science* 155: 105476.
<https://doi.org/10.1016/j.jaerosci.2021.105746>
9. Li*, L., Chahl*, H. S. and **Gopalakrishnan, R.** (2020), Comparison of the predictions of Langevin Dynamics-based diffusion charging collision kernel models with canonical experiments, *J. Aerosol. Sci.* 140, 105481.
<https://doi.org/10.1016/j.jaerosci.2019.105481>
10. Ahmed*, R., Suresh*, V., Li*. L. and **Gopalakrishnan, R.** (2020), Scalable generation of high concentration aerosol in the size range of 0.1–10 μm from commercial powders using ultrasonic dispersion, *Powder Technology* 376, 52.
<https://doi.org/10.1016/j.powtec.2020.08.009>
11. Ahmed*, R., & **Gopalakrishnan, R.** (2019), Computational study of electrostatic focusing of aerosol nanoparticles using an Einzel lens, *Journal of Aerosol Science*, 105443 (2019).
<https://doi.org/10.1016/j.jaerosci.2019.105443>
12. Chng*, E. J., Watson, A. B., Suresh*, V., Fujiwara, T., Bumgardner, J. D., & **Gopalakrishnan, R.** (2019), Adhesion of electrosprayed chitosan coatings using silane surface chemistry, *Thin Solid Films*, 137454.
<https://doi.org/10.1016/j.tsf.2019.137454>
13. Chahl*, H. S. and **Gopalakrishnan, R.**, (2019) High potential, near free molecular regime Coulombic collisions in aerosols and dusty plasmas, *Aerosol Science and Technology*, 53(8): 933-957.
<https://doi.org/10.1080/02786826.2019.1614522>
14. Pokharel*, L., Parajuli*, P., Li*, L., Chng*, E. J., and **Gopalakrishnan, R.**, (2019) An ultrasonic feeding mechanism for continuous aerosol generation from cohesive powders. *Aerosol Science and Technology*, 53(3): 321-331.
<https://doi.org/10.1080/02786826.2018.1559920>
15. Wong, C.-S., **Gopalakrishnan, R.**, and Goree, J. A., (2019) Fluctuation-theorem method of measuring a particle's mass without knowing its shape or density, *Journal of Aerosol Science*, 129: 116-123.
<https://doi.org/10.1016/j.jaerosci.2018.12.009>
16. Wong, C.-S., Goree, J. A., & **Gopalakrishnan, R.**, (2018) Experimental demonstration that a free-falling aerosol particle obeys a fluctuation theorem, *Physical Review E (Rapid Communication)*, 97: 050601(R).
<https://doi.org/10.1103/PhysRevE.97.050601>
17. **Gopalakrishnan, R.**, Kawamura, E., Lichtenberg, A. J., Lieberman, M. A., & Graves, D. B., (2016) Solvated electrons at the atmospheric pressure plasma-water anodic interface *J. Phys. D: Appl. Phys.*, 49: 295205.
<https://doi.org/10.1088/0022-3727/49/29/295205>
Selected by the Editorial Board of J. Phys. D: Appl. Phys. as Highlights of 2016.
18. **Gopalakrishnan, R.**, McMurry, P. H., & Hogan, C. J., (2015). The Bipolar Diffusion Charging of Nanoparticles: A Review and Development of Approaches for Non-Spherical Particles. *Aerosol Science and Technology*, 49(12): 1181-1194.
<https://doi.org/10.1080/02786826.2015.1109053>

19. **Gopalakrishnan, R.**, McMurry, P. H., & Hogan, C. J. (2015), The electrical mobilities and scalar friction factors of modest-to-high aspect ratio particles in the transition regime. *Journal of Aerosol Science*, 82: 24-39.
<https://doi.org/10.1016/j.jaerosci.2015.01.001>
20. **Gopalakrishnan, R.**, Thajudeen, T., Ouyang, H. & Hogan, C. J. (2013), The unipolar diffusion charging of arbitrary shaped aerosol particles. *Journal of Aerosol Science*, 64: 60-80.
<https://doi.org/10.1016/j.jaerosci.2013.06.002>
21. **Gopalakrishnan, R.**, Meredith, M. J., Larriba, C. & Hogan, C. J. (2013), Brownian dynamics determination of the bipolar steady charge distribution on sphere and non-spheres in the transition regime. *Journal of Aerosol Science*, 63: 126-145.
<https://doi.org/10.1016/j.jaerosci.2013.04.007>
22. Thajudeen, T., **Gopalakrishnan, R.** & Hogan, C. J. (2012), The collision rate of non-spherical particles and aggregates for all diffusive Knudsen numbers. *Aerosol Science and Technology*, 46(11): 1174-1186.
<https://doi.org/10.1080/02786826.2012.701353>
23. Ouyang, H., **Gopalakrishnan, R.** & Hogan, C. J. (2012), Nanoparticle collisions and growth in the gas phase in the presence of singular attractive potentials. *Journal of Chemical Physics*, 137: 064316.
<https://doi.org/10.1063/1.4742064>
24. **Gopalakrishnan, R.**, & Hogan, C. J. (2012), Coulomb-influenced collisions in aerosols and dusty plasmas. *Phys. Rev. E*, 85: 026410.
<https://doi.org/10.1103/PhysRevE.85.026410>
25. **Gopalakrishnan, R.**, Thajudeen, T. & Hogan, C. J. (2011), Collision limited reaction rates for arbitrarily shaped particles across the entire diffusive Knudsen number range. *Journal of Chemical Physics*, 135: 054302.
<https://doi.org/10.1063/1.3617251>
26. **Gopalakrishnan, R.**, & Hogan, C. J. (2011), Determination of the transition regime collision kernel from mean first passage times. *Aerosol Science and Technology*, 45: 1499-1509.
<https://doi.org/10.1080/02786826.2011.601775>

ii. **Patents**

1. **Ranganathan Gopalakrishnan**, Lekhnath Pokharel, Rayhan Ahmed, Ewe Jiun Chng, Jason Scott Presley, “SYSTEMS AND METHODS FOR DISPERSION OF DRY POWDERS”, US Patent Number 11,358,112 <https://patents.google.com/patent/US11358112B2/en>

iii. **Invited Presentations by Dr. Gopalakrishnan**

1. “Langevin dynamics modeling of gas-phase ion-ion recombination rates”, 1st Symposium on Nonequilibrium Multiphase Systems, Saint Louis, MO USA December 7-8, 2018, Hosted at Washington University in Saint Louis by the Center for Aerosol Science and Engineering.
2. “Evaluation of the Adhesion of Electrospayed and Solution-Cast Chitosan Coatings on Titanium Surfaces”, Session D2-TuA2, Abstract #292 at the International Conference on Metallurgical Coatings and Thin Films 2019, May 19 – 24, 2019, San Diego, CA, USA.
3. Abstract 3I-A-04: Modeling nanoparticle charge distribution in the afterglow of non-thermal plasmas and comparison with measurements, 48th International Conference on Plasma Science, September 12 – 16, 2021, Virtual Conference.

4. “Modeling grain level and grain phase level transport processes in dusty plasmas”, International Online Seminar on Dusty Plasmas, February 23, 2022.
5. Abstract 8CO.1: Modeling Coagulation, Aggregation and Gelation in High Volume Fraction Aerosols using Langevin Dynamics Simulations, American Association for Aerosol Research Conference, October 2 – 7 2022, Raleigh, NC.
6. Tutorial Session-4: Tutorial on Langevin Dynamics trajectory simulations, American Association for Aerosol Research Conference, October 2 – 7 2022, Raleigh, NC.
7. “Understanding particle behavior in gas-phase systems for engineering applications”, Aerosol Science Research Webinars, January 18th, 2024, Engineering and Physical Sciences Research Council, University of Bristol, UK.

H. SERVICE (F: Fall, S: Spring, Su: Summer, F08 = Fall 2008)

- i. Service to the Department of Mechanical Engineering, The University of Memphis
 - o *Graduate Program Coordinator* (Su21 – Sp24). Responsibilities include
 - Manage the graduate program that is ~40 strong as of August 2023
 - Review and issue decisions on applications for graduate studies
 - Advise graduate students on career development
 - Lead the Graduate Curriculum Process Team deliberations
 - Organize the PhD Qualifying Examination
 - o *Chair*, Instructor Search Committee (S21)
 - o *Member*, Undergraduate Curriculum Process Team (Aug 2016 – Nov 2018), Graduate Curriculum Process Team (Nov 2018 – present), Tenure-track Faculty Search Committees (F17, S18, S22), Instructor Search Committee (Su20), Tenured Faculty Search Committee (S22)
- ii. Service to the Herff College of Engineering, The University of Memphis
 - o *Member*, Biomedical Engineering PhD Qualifying Exam Committee (S17 – S20)
 - o *Member*, R1 Research Areas Task Force (F22, S23)
- iii. Service to The University of Memphis
 - o *Member*, Herff College of Engineering Dean Search Committee (S22)
- iv. Peer reviewer for various journals.
- v. Currently serving a three-year term as a member of the Early Career Editorial Board for the Journal of Aerosol Science until June 2024.
- vi. Served as co-guest editor for Frontiers in Physics Research Topic on “Particle Interaction With Afterglow Plasma and Non-Quasi-Neutral Plasma”
- vii. Reviewed grant proposals for US National Science Foundation, US Department of Energy Office of Science, US Army Research Office, MagNetUS Frontier Plasma Science
- viii. Service to the American Association for Aerosol Research (AAAR):
 - o Session Chair of “Aerosol Physics” session at AAAR conferences 2015 (Minneapolis, MN) and 2020 (Virtual Conference).
 - o Session Chair of “Aerosol Modeling” session at the International Aerosol Conference 2018 (St. Louis, MO).
 - o Tutorial Speaker on “Langevin Dynamics trajectory simulations” at AAAR conference 2022 (Raleigh, NC).
- ix. Service to IEEE: Session Chair of “Computational Physics” session at the 48th International Conference on Plasma Science 2021 (Virtual Conference).

I. MENTIONS IN THE MEDIA

- ***UofM's Gopalakrishnan Receives \$750,000 U.S. DOE EARLY CAREER Award***, published on July 2, 2020. <https://www.memphis.edu/mediaroom/releases/2020/july/ranga.php>
- ***Movers & Shakers***, published on July 8, 2020 in the Daily Memphian. <https://dailymemphian.com/section/businessmovers-and-shakers/article/15298/movers-shakers>
- ***Research gains fuel U of M hopes for Carnegie R1 status***, published on August 31, 2020 in the Daily Memphian. <https://dailymemphian.com/section/metroeducation/article/16502/carnegie-r1-research-park-u-of-m>
- ***UofM's Gopalakrishnan receives \$363,782 DOE award for studying chemical recombination of gas-phase ions***, published on September 3, 2020 <https://www.memphis.edu/mediaroom/releases/2020/september/gopalakrishnandoeaward.php>
- ***U of M edges closer to R1 status, feels confident about chances in 2021***, published on September 10, 2020 in the Memphis Business Journal. <https://www.bizjournals.com/memphis/news/2020/09/10/university-of-memphis-r1-status.html>
- ***U of M professor part of international effort to harness clean, abundant energy source***, published on September 28, 2020 in the Memphis Business Journal. <https://www.bizjournals.com/memphis/news/2020/09/28/ranganathan-gopalakrishnan-university-of-memphis.html>
- ***MIT Fusion Startup Gears Up for Reactor Design and Construction***, published on October 9, 2020 in Engineering News-Record <https://www.enr.com/articles/50293-mit-fusion-startup-gears-up-for-reactor-design-and-construction>
- ***Fusion Test Produces More Power Than It Takes In***, published on September 8, 2021 in Engineering News Record <https://www.enr.com/articles/52374-fusion-test-produces-more-power-than-it-takes-in>