

Sumit Kumar

Assistant Professor

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Research Interests

Quantum sensing and technologies · Cavity optomechanics · MEMS / NEMS · Superfluid optomechanics · Quantum fluids and solids · Quantum computing · Low-temperature physics · Superconducting devices · Machine learning and quantum devices · Cryogenic detectors

Education

Doctor of Philosophy (PhD) 2017 – 2021

Institut Néel, CNRS / Université Grenoble Alpes · Grenoble, France

Supervisors: Dr. Andrew Fefferman and Dr. Eddy Collin

Thesis: Low-temperature microwave optomechanics: Anomalous force noise and optomechanically induced transparency and absorption

Master of Technology (M.Tech.) 2015 – 2017

Centre for Nanoscience and Engineering · Indian Institute of Science (IISc) · Bengaluru, India

Bachelor of Technology (B.Tech.) — Engineering Physics 2010 – 2014

Indian Institute of Technology (IIT) Delhi · New Delhi, India

Best Major Project Thesis Award, Physics Department, 2014

Academic Positions

Assistant Professor 2025 – present

Department of Physics · IIT (ISM) Dhanbad, India

- Teaching undergraduate and postgraduate courses in physics; establishing experimental research lab in quantum sensing and nanomechanics.
- Exploring AI-driven methods for precision agriculture — applying quantum sensing and ML to develop smart monitoring systems for soil, crop health, and environmental parameters.
- Startup incubation — Co-founder, *Enthrophy*: developing cavity optomechanical accelerometers and reservoir computing architectures based on nanomechanical systems, leveraging the rich nonlinear dynamics of MEMS / NEMS devices as physical substrates

Postdoctoral Researcher 2023 – 2025

Royal Holloway, University of London · Egham, UK

Supervisor: Dr. Xavier Rojas

- Investigated non-linearities in fourth sound resonance in superfluid ^4He sonic crystal.
- Conducted analogue cosmological simulations using third sound in superfluid ^4He .
- Developed superfluid optomechanics platform for gravitational wave detection.

Postdoctoral Researcher 2021 – 2022

Royal Holloway, University of London · Egham, UK

Supervisor: Dr. Xavier Rojas

- Led experiments on superfluid ^4He cavity optomechanics using superconducting microwave cavities.
- Explored room-temperature microwave optomechanics using Si_3N_4 membranes.

Doctoral Researcher 2017 – 2021

Institut Néel, CNRS · Grenoble, France

Supervisors: Dr. Andrew Fefferman & Dr. Eddy Collin

- Conducted low-temperature cavity optomechanical experiments using Si₃N₄ nanostrings and Al drums.
- Gained expertise in nanofabrication, cryogenics (dilution refrigerator), automation, and RF measurements.

Research Intern

May – Jul 2013

LPS, École Normale Supérieure · Paris, France

Supervisor: Dr. Mokhtar Adda-Bedia

- Studied the inverse Leidenfrost effect — dynamics of self-propulsion of water droplets on liquid nitrogen.

Publications

In Preparation & Submitted

- S. Hibbit, **S. Kumar** et al., "A proposal for gravitational wave detection using superfluid ⁴He in a microwave re-entrant geometry". (in prep.)
- **S. Kumar** et al., "Superfluid optomechanics with third sound on ⁴He for analogue black hole simulations". (in prep.)
- **S. Kumar** et al., "Non-linearities in fourth sound of superfluid ⁴He sonic crystal resonator". (in prep.)
- S. Kumari, **S. Kumar** et al., "TWC-SRGAN: Lightweight super resolution network for improving brain tumor detection", *Evolutionary Intelligence*, Springer. (submitted, 2026)
- S. Kumari, **S. Kumar** et al., "Water Quality Intervention Levels using Deep Learning Models", *Scientific Reports*, Springer. (submitted, 2025)

Peer-Reviewed Journal Articles

1. **S. Kumar** et al., "Optomechanically Induced Transparency in a 3D Microwave Cavity Architecture at Ambient Temperature", *AIP Advances* 14.3.
2. I. Golokolenov, **S. Kumar** et al., "Nano-beam clamping revisited", *Journal of Applied Physics* 133.12, 124302.
3. **S. Kumar** et al., "A Novel Architecture for room temperature microwave optomechanical experiments", *Journal of Applied Physics* 133.9, 094501.
4. **S. Kumar** et al., "Microwave Optomechanically Induced Transparency and Absorption Between 250 and 450 mK", *Journal of Low Temperature Physics*, 1–11.
5. **S. Kumar** et al., "Microwave optomechanical measurement of non-metallized SiN strings at mK temperatures", *arXiv:2110.00228*.
6. D. Cattiaux, I. Golokolenov, **S. Kumar** et al., "A macroscopic object passively cooled into its quantum ground state of motion beyond single-mode cooling", *Nature Communications* 12, 6182.
7. I. Golokolenov, D. Cattiaux, **S. Kumar** et al., "Microwave single-tone optomechanics in the classical regime", *New Journal of Physics* 23, 053008.
8. D. Cattiaux, X. Zhou, **S. Kumar** et al., "Beyond linear coupling in microwave optomechanics", *Physical Review Research* 2, 033480.
9. D. Cattiaux, **S. Kumar**, X. Zhou, A. Fefferman, E. Collin, "Geometrical Nonlinearity of Circular Plates and Membranes", *Journal of Applied Physics* 128, 104501.
10. D. Schmoranzler, **S. Kumar** et al., "A 10 mK hermetic cell for eliminating parasitic heating in cryogen-free dilution refrigerators", *Cryogenics* 110, 103162.
11. D. Schmoranzler, **S. Kumar** et al., "Observations on thermal coupling of silicon oscillators in cryogen-free dilution refrigerators", *Journal of Low Temperature Physics* 196, 268.
12. M. Sreekanth, S. Ghosh, P. Biswas, **S. Kumar**, P. Srivastava, "Improved field emission from indium decorated multi-walled carbon nanotubes", *Applied Surface Science* 383, 84–89.
13. M. Adda-Bedia, **S. Kumar** et al., "Inverse Leidenfrost effect: Levitating drops on liquid nitrogen", *Langmuir* 32(17), 4179–4188.

Conference & Workshop Contributions

Special Sessions

- Special Session Organizer, *5th International Conference on Data Analysis and Management*, London Metropolitan University, London, UK. (Jun 2024)

Invited Talks & Keynotes

- Keynote speaker, ANRF Govt. of India sponsored workshop "Smart and Sustainable Systems: Application of IoT and ML for Environmental Solutions", Bennett University, Greater Noida, India. (Jan 2026)
- "AI & ML: Transforming Data Analytics for Global Impact on Sustainability", IEEE Smart World Congress Workshop, University of Calabria, Rende, Italy. (Sep 2026)
- "Nonlinearities in the fourth sound resonance of superfluid ^4He ", Quantum Fluids and Solids (QFS), Florida. (2024)
- "Superfluid Optomechanics using third sound in Superfluid ^4He ", QSimFP Workshop. (2022, 2024)
- "Superfluid Optomechanics using third sound in Superfluid ^4He ", IOP Low-Temperature Workshop, London. (2022)
- "Low temperature microwave optomechanics: Anomalous force noise and OMIT", Royal Holloway. (2021)
- "Anomalous spikes in the apparent vibration amplitude of nanomechanical strings", GDR MecaQ, Grenoble. (2020)
- "Probing individual two level system in amorphous NEMS", GdR MecaQ 3rd Annual Meeting, Paris. (2018)

Posters

- "Superfluid Optomechanics using third sound in Superfluid ^4He ", QTFP Meeting, Glasgow. (2025)
- "Electromechanically induced transparency and absorption", Quantum Fluids and Solids, Edmonton, Canada. (2019)
- "Probing individual two level system in amorphous NEMS", Atomic Tunneling Systems, Dresden, Germany. (2019)
- "Probing individual two level system in amorphous NEMS", Journées de la Matière Condensée, Grenoble. (2018)

Technical Skills & Expertise

Experimental

- Microwave and RF systems: signal generation, modulation, and analysis for quantum device characterisation.
- Cryogenics: dilution refrigerators (mK operation), helium-tight designs, ^4He / ^3He systems.
- Nanofabrication: e-beam lithography, e-beam evaporation, reactive ion etching, optical lithography.
- Quantum sensing and MEMS / NEMS characterisation; low-temperature cavity optomechanics; superfluid ^4He dynamics.

Computational

- Instrumentation & automation: Zurich Instruments (UHFLI, MFLI), spectrum analyzers, network analysers.
- Programming: Python (data analysis, automation), LabVIEW, MATLAB.
- Machine learning methods applied to quantum device optimisation and data analysis.

Awards & Honours

Best Major Project Thesis Award

Physics Department, IIT Delhi.

2014

Charpak Scholarship

Awarded by the French Embassy for research internship in France.

2013

Summer Schools & Training

Cryocourse

Aalto University, Helsinki.

2018

Foundations and Applications of Nanomechanics

ICTP Trieste, Italy.

2017

Collaborative Research, Editorial Work & Reviewing

Active research collaboration with **Dr. Sangeeta Kumari** (University of Malta) on AI / ML-driven approaches for next-generation wireless sensor networks and IoT systems, including:

- Book Reviewer — *AI-Driven Communication Systems: Pioneering IoT and Next-Gen Wireless Networks*, Springer, 2026.
- Book Co-Editor and Reviewer — *Future-Oriented AI-Powered Robotics and Systems*, Springer, 2026.
- Book Reviewer — *AI-Driven Diagnostics for 6G-Enabled Smart Healthcare*, Elsevier, 2025.
- Collaborative Project: Machine learning applications for smart sensing and IoT — bridging quantum sensing with AI-enabled network protocols.

References

Dr. Xavier Rojas

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University of London
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Dr. Andrew Fefferman

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CNRS, Grenoble
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Dr. Eddy Collin

Researcher, Institut Néel /
CNRS, Grenoble
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