Gaurav Shukla

Ph. D. in Physics
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Personal Statement

I completed my Ph. D. in Physics at Banaras Hindu University, specializing in quantum optics, quantum metrology, and nonlinear optics. My research focused on enhancing the sensitivity of interferometric measurements using quantum states of light and various measurement techniques. I have worked with leading research groups at the *University of Hamburg* and *Max Planck Institute for the Science of Light*, gaining expertise in theoretical aspects and a foundational understanding of experimental interferometry. I am committed to advancing quantum technologies and mentoring the next generation of scientists.

Research Experience

- **University of Hamburg, Hamburg, Germany** *Aug 1, 2023 – Jan 31, 2024*
  (*International Visiting Fellow in the Research Group of Dr. Frank Schlawin*)
  Under the *International Student Visiting Program*, I worked with Dr. Frank Schlawin's theory group, focusing on the theoretical investigation of two-photon absorption (TPA) processes using quantum light sources [arXiv:2506.07384].

- **Max Planck Institute for the Science of Light, Erlangen, Germany** *Dec 1–22, 2019 & Jan 7–Feb 14, 2022*
  (*Visiting Researcher in the Laboratory of Prof. Mari Chekhova*)
  As part of an Indo-German collaborative project, I worked with Prof. Mari Chekhova's experimental group, contributing to the theoretical aspect of the research. This work resulted in the theoretical proposal of a novel detection scheme [*Optics Express* **29**, 95–104 (2021)].

Education

- **Ph. D. in Physics (Theory)** *July 2025*
  Banaras Hindu University, Varanasi-221005, India
- **Master of Science (Physics)** *Percentage: 78.85*
  University of Allahabad, Prayagraj-211002, India 2018
- **Bachelor of Science (Physics, Mathematics)** *Percentage: 64.72*
  VBS Purvanchal University (TDPG College), Jaunpur-222003, India 2016

Key publications

- **G. Shukla**, S. Panahiyan, D. K. Mishra, and F. Schlawin, *"Enhancing Measurement Precision of Non-Degenerate Two-Photon Absorption"*, arXiv:2506.07384.
- D. Yadav, **G. Shukla**, P. Sharma, and D. K. Mishra, *"Quantum-enhanced super-sensitivity of Mach-Zehnder interferometer using squeezed Kerr state"*, APL Quantum **1 (1)** 016104 (2024).
- **G. Shukla**, K. M. Mishra, A. K. Pandey, T. Kumar, H. Pandey and D. K. Mishra, *"Improvement in phase-sensitivity of a Mach-Zehnder interferometer with the superposition of Schrödinger's cat-like state with vacuum state as an input under parity measurement"*, Opt. Quant. Electron. **55**, 460 (2023).
- **G. Shukla**, K. K. Mishra, D. Yadav, R. K. Pandey, and D. K. Mishra, *"Quantum-enhanced super-sensitivity of a Mach–Zehnder interferometer with superposition of Schrödinger's cat-like state and Fock state as inputs using a two-channel detection"*, J. Opt. Soc. Am. B **39**, 59-68 (2022).
- **G. Shukla**, D. Salykina, G. Frascella, D. K. Mishra, M. V. Chekhova, and F. Ya. Khalili, *"Broadening the high sensitivity range of squeezing-assisted interferometers by means of two-channel detection"*, Opt. Express **29**, 95-104 (2021).

PUBLICATIONS

- **G. Shukla**, S. Panahiyan, D. K. Mishra, and F. Schlawin, *"Enhancing Measurement Precision of Non-Degenerate Two-Photon Absorption"*, arXiv:2506.07384.

- A. Kumar, **G. Shukla**, and D. K. Mishra, *"Comparative study of squeezing-assisted Mach–Zehnder interferometer under homodyne, product detection and first-order correlation measurements"*, Quantum Inf Process **24**, 142 (2025).

- T. Kumar, **G. Shukla**, and D. K. Mishra, *"Enhancement in Sensitivity of Coherent Anti-Stokes Raman Spectroscopy via SU(1,1) Interferometry"*, Appl. Phys. B **131**, 25 (2025).

- P. Sharma, A. K. Pandey, **G. Shukla**, and D. K. Mishra, *"Enhancement in phase sensitivity of SU(1,1) interferometer with Kerr state seeding"*, Optics Communications, **573**, 131028 (2024).

- D. Yadav, **G. Shukla**, P. Sharma, and D. K. Mishra, *"Quantum-enhanced super-sensitivity of Mach-Zehnder interferometer using squeezed Kerr state"*, APL Quantum **1 (1)** 016104 (2024).

- **G. Shukla**, D. Yadav, A. Kumar, and D. K. Mishra, *"Quantum sub-phase sensitivity of a Mach-Zehnder interferometer with the superposition of Schrödinger's cat-like state with vacuum state as an input under product detection measurement"*, Physics Open **18**, 100200 (2024).

- **G. Shukla**, K. M. Mishra, A. K. Pandey, T. Kumar, H. Pandey and D. K. Mishra, *"Improvement in phase-sensitivity of a Mach-Zehnder interferometer with the superposition of Schrödinger's cat-like state with vacuum state as an input under parity measurement"*, Opt. Quant. Electron. **55**, 460 (2023).

- **G. Shukla**, K. K. Mishra, D. Yadav, R. K. Pandey, and D. K. Mishra, *"Quantum-enhanced super-sensitivity of a Mach–Zehnder interferometer with superposition of Schrödinger's cat-like state and Fock state as inputs using a two-channel detection"*, J. Opt. Soc. Am. B **39**, 59-68 (2022).

- **G. Shukla**, D. Salykina, G. Frascella, D. K. Mishra, M. V. Chekhova, and F. Ya. Khalili, *"Broadening the high sensitivity range of squeezing-assisted interferometers by means of two-channel detection"*, Opt. Express **29**, 95-104 (2021).

- D. Yadav, K. K. Mishra, **G. Shukla**, and D. K. Mishra, *"Enhancement of amplitude-squared squeezing of light with the SU(3) multiport beam splitters"*, Opt. Quant. Electron. **53**, 133 (2021).

- K. K. Mishra, D. Yadav, **G. Shukla**, and D. K. Mishra, *"Non-classicalities exhibited by the superposition of Schrödinger's cat state with the vacuum of the optical field"*, Physica Scripta **96**, 045102 (2021).

- K. K. Mishra, **G. Shukla**, D. Yadav, and D. K. Mishra, *"Generation of sum- and difference-squeezing by the beam splitter having third-order nonlinear material"*, Opt. Quant. Electron. **52**, 186 (2020).

Technical Skills

Mathematica: Experienced in symbolic computation, quantum optics simulations, and visualization. Used primarily for theoretical modeling with 'Quantum' package.

MATLAB: Experienced in plotting mathematical functions and visualizing theoretical results. Primarily used for generating 2D and 3D plots to support analytical work in quantum optics and related areas

LaTeX: Skills in scientific writing and document preparation, including journal articles, presentations, and thesis formatting.

Academic Mentoring

Assisted over five master's students in their dissertation projects, focusing on topics in theoretical quantum optics, quantum metrology, and related areas.

Achievements & Awards

- **International Visiting Student Fellowship – IoE, BHU (2023)**

Selected for a prestigious six-month international research fellowship under the Institutes of Eminence (IoE) global outreach program. The fellowship provided financial support for research at the University of Hamburg, Germany.

- **First Prize – Scientific Poster Presentation**

Awarded First Prize in the poster competition held during the 7^{th} Institute Day Celebration, Institute of Science, Banaras Hindu University, Varanasi, on December 14, 2022.

- **Research Incentive Awards – Institutes of Eminence (IoE), BHU**

Received monetary incentives in August 2022 and April 2024 for publishing research articles in Q1/Q2 peer-reviewed journals. The awards were granted under the IoE Research Promotion Scheme of Banaras Hindu University.

- **GATE – Graduate Aptitude Test in Engineering (2019)**
  Qualified GATE-2019 in Physics with a score of 387. The examination was conducted by the Indian Institute of Technology (IIT) Madras, India.

Interests and Hobbies

- Enjoy exploring gadgets and new technologies
- Interested in music across genres
- Enjoy watching films and web series
- Passionate about gardening and nature care

Strengths

- Focused and dedicated toward research goals
- Persistent in solving problems with patience
- Good listener and supportive team member

References

1. Prof. Devendra Kumar Mishra (Ph. D. supervisor)
Department of Physics, Institute of Science, Banaras Hindu University, Varanasi-221005, India
Email: kndmishra@gmail.com

2. Dr. Frank Schlawin (Collaborator)
Young Investigator Group Leader, Centre for Ultrafast Imaging, University of Hamburg, Germany
Email: frank.schlawin@uni-hamburg.de

3. Prof. Dr. Maria Chekhova (Collaborator)
Group leader, Quantum Radiation, Max Planck Institute for the Science of Light, Erlangen, Germany
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4. Prof. Farit Ya. Khalili (Collaborator)
Russian Quantum Center, Skolkovo IC, Bolshoy Bulvar, Moscow, Russia
Email: farit.khalili@gmail.com