QUANTUMPHASE

QuantumPhase Technology Pvt.Ltd.

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Research Profile

Experimental AMO physicist with research experience in optical atomic clocks, atom interferometry, quantum sensing, and ultracold atoms. Current work focuses on continuously operating optical lattice clocks, with earlier postdoctoral research on Bragg-based cold-atom gradiometry and laser architectures for atom interferometry. Research interests span precision metrology, quantum sensing, cold quantum gases, and quantum information.

Academic Appointments

Postdoctoral Researcher, Quantum Delta NL Project, Strontium BEC Group, University of Amsterdam, Netherlands — Feb 2022 - Present

Contract duration: up to four years.

- Research focus: construction of a continuously operating four-clock optical lattice system inside a single vacuum assembly, aimed at achieving unprecedented stability and enabling precision measurements such as isotope shifts.
- Also involved in the construction of a superradiant active clock.

Postdoctoral Researcher, Atom Interferometry and Inertial Sensing Group, LNE-SYRTE, Paris Observatory, France — May 2019 - Oct 2021

Contract duration: two and a half years.

- Constructed a state-of-the-art cold-atom gradiometer based on Bragg diffraction.
- Built a novel laser system capable of addressing several atom-interferometry schemes and demonstrated a new detection method for separating the output ports of a two-photon Bragg interferometer.

Education

M.Sc.-Ph.D., Indian Institute of Science Education and Research (IISER), Pune, India — 2011 - Apr 2019

- Dissertation: Ultracold atoms in 1D optical lattices: experiments towards quantum chaos and atom interferometry.
- Advisor: Dr. Umakant D. Rapol.
- Major conclusions: first-ever experimental demonstration of non-exponential decoherence; first-ever demonstration of diffraction of an atom laser.

B.Sc. in Science (Physics Honours), Ramakrishna Mission Vidyamandira, affiliated to the University of Calcutta, Kolkata, India — 2008 - 2011

Research Interests

- Atom interferometry, metrology, quantum sensing, and atomic clocks
- Bose-Einstein condensation of neutral alkali and alkaline-earth atoms
- Physics of cold quantum gases and atom optics
- Interactions of atoms with optical lattices
- Quantum information and quantum computing

Publications

Selected publications listed in reverse chronological order.

[1] Picosecond-range network time scale based on an ensemble of atomic clocks; Rodrigo Gonzalez Escudero, Sougandh Kannoth Mavila, Marc Weiss, Frank Cozijn, Kees Steinebach, Kjeld Eikema, Erik Dierikx, Yan Xie, Sander Klemann, Paul Klop, **Sumit Sarkar**, Nicolaas van Druten, Florian Schreck, Jeroen Koelemeij. Under review in Nature (2025).

[2] Terrestrial Very-Long-Baseline Atom Interferometry: summary of the second workshop; A. Abdalla et al. EPJ Quantum Technol. 12, 42 (2025).

[3] A decade of advancement of quantum sensing and metrology in India using cold atoms and ions; Pranab Dutta, S. Sagar Maurya, Kushal Patel, Korak Biswas, Jay Mangaonkar, **Sumit Sarkar**, Umakant D. Rapol. J. Indian Inst. Sci. 103, 609-632 (2023).

[4] Separating the output ports of a Bragg interferometer via velocity-selective transport; Raphael Piccon, **Sumit Sarkar**, J. Gomez Baptista, Sebastien Merlet, Franck Pereira dos Santos. Phys. Rev. A 106, 013303 (2022).

[5] A simple and robust architecture of a laser system for atom interferometry; **Sumit Sarkar**, Raphael Piccon, Sebastien Merlet, Franck Pereira dos Santos. Opt. Express 30, 33583-33596 (2022).

[6] Effects of finite momentum width on the reversal dynamics in a BEC-based atom-optics delta-kicked rotor; Jay Mangaonkar, Chetan Vishwakarma, S. Sagar Maurya, **Sumit Sarkar**, Jamie L. MacLennan, Pranab Dutta, Umakant D. Rapol. J. Phys. B: At. Mol. Opt. Phys. 53, 235502 (2020).

[7] Nonmonotonic diffusion rates in atom-optics Levy kicked rotor; Sanku Paul, **Sumit Sarkar**, Chetan Vishwakarma, Jay Mangaonkar, M. S. Santhanam, Umakant D. Rapol. Phys. Rev. E 100, 060201(R) (2019).

[8] A simple atomic beam oven with a metal thermal break; Chetan Vishwakarma, Jay Mangaonkar, Kushal Patel, Gunjan Verma, **Sumit Sarkar**, Umakant D. Rapol. Rev. Sci. Instrum. 90, 053106 (2019).

[9] Diffraction of a CW atom laser in the Raman-Nath regime; **Sumit Sarkar**, Jay Mangaonkar, Chetan Vishwakarma, Umakant D. Rapol. Phys. Rev. A 98, 043625 (2018).

[10] Non-exponential decoherence and subdiffusion in atom-optics kicked rotor; **Sumit Sarkar**, Sanku Paul, Chetan Vishwakarma, Sunil Kumar, Gunjan Verma, M. Sainath, Umakant D. Rapol, M. S. Santhanam. Phys. Rev. Lett. 118, 174101 (2017).

[11] Bose-Einstein condensation in an electro-pneumatically transformed quadrupole-Ioffe magnetic trap; Sunil Kumar, **Sumit Sarkar**, Gunjan Verma, Chetan Vishwakarma, Md Noaman, Umakant D. Rapol. New J. Phys. 17, 023062 (2015).

Teaching and Mentoring

Mentorship

- Feb 2025 - Present: Daily supervisor/mentor of a Master-Ph.D. student working on the optical lattice clock project at the University of Amsterdam.
- Feb 2023 - Present: Daily supervisor/mentor of a Ph.D. student working on the optical lattice clock project at the University of Amsterdam.
- Sep 2022 - Aug 2023: Mentored a student through a year-long Master's thesis at the University of Amsterdam focused on the design and construction of an ultra-stable reference cavity for a strontium clock laser.
- Apr 2022 - Jul 2022: Mentored two Bachelor students at the University of Amsterdam on a summer project to realize a rubidium 2D MOT.

- Aug 2019 - Oct 2019: Mentored a Bachelor student at Paris Observatory in partially building a laser system for atom interferometry.
- Aug 2019 - Present: Mentored several Bachelor students at Paris Observatory and the University of Amsterdam on lasers, Zeeman slowers, electronic circuits, Fabry-Perot resonators, and electro-optic modulators.

Teaching Assistantships

- Electronics I: Introductory undergraduate course on semiconductor devices, amplifiers, and BJTs. Conducted tutorials, delivered lectures, designed demonstration setups, and assisted with grading (Aug 2016 - Nov 2016).
- AMO Physics: Advanced undergraduate theory course in atomic, molecular, and optical physics. Conducted tutorials and assisted with grading (Jan 2016 - Apr 2016).
- Physics Lab II: Demonstrated experiments in spectroscopy, optics, and semiconductor physics; supervised practical sessions and conducted viva examinations (Jan 2015 - Apr 2015).
- Advanced Physics Lab IV: Demonstrated experiments in laser spectroscopy, optics, and electronics; supervised practical sessions and graded laboratory notebooks (Aug 2014 - Nov 2014).
- Quantum Mechanics: Introductory undergraduate theory course; conducted tutorials and assisted with grading (Jan 2014 - Apr 2014).

Academic Service

- Independent reviewer for more than ten manuscripts across Physical Review Research, Optics Express, Optics Letters, and Optics Continuum.

Awards and Fellowships

- Postdoctoral Grant from the European Space Agency (2023 - 2024).
- Qualified the CSIR Junior Research Fellowship (JRF) examination with an All India Rank of 119 (2018).
- INSPIRE Fellowship during the B.Sc. programme (2008 - 2011).
- Infosys Foundation Travel Award to attend an advanced school and workshop at the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy.

Technical and Computational Skills

- MATLAB
- 3D CAD design using CATIA and SOLIDWORKS
- Instrumentation interface and data acquisition using LabVIEW
- Instrument interface and control system using LabWindows/CVI
- Data analysis using Origin, Igor, and related scientific software