Kuldeep Suthar

Curriculum Vitae

School of Physical Sciences
Central University of Rajasthan
NH-8, Bandarsindari, Ajmer-305817, India
✉ *kuldeep.suthar@curaj.ac.in*

Education

2011 – 2016 **Ph.D. in Physics**, Physical Research Laboratory, India,
Dissertation title: "*Binary Mixtures of Ultracold Quantum Gases in Optical Lattices*",
Advisor: Prof. Angom Dilip Kumar Singh.

2008 – 2010 **M.Sc. in Physics**, Mohanlal Sukhadia University, Rajasthan, India [Gold Medalist].

Academic Experience

02/2023 – present **Assistant Professor**, Department of Physics, Central University of Rajasthan, India.

04/2021 – 01/2023 **Postdoctoral Research Associate**, Institute of Atomic and Molecular Sciences, Academia Sinica, Taiwan.

02/2019 – 08/2020 **Postdoctoral Research Assistant**, Institute of Theoretical Physics, Jagiellonian University, Poland.

12/2016 – 12/2018 **Postdoctoral Fellow**, Theoretical Physics Division, Physical Research Laboratory, India.

Professional Services

Guest Editor: Axioms, Multidisciplinary Digital Publishing Institute (MDPI), Switzerland

Editor: American Journal of Modern Physics, Science Publishing Group, USA

Referee: Physical Review Letters, Physical Review Research, Physical Review B, Physical Review A, Physics Letters A, Journal of Physics Communications, Physica Scripta, Journal of Physics B, New Journal of Physics

Research Interests

Research Areas: Theoretical Condensed Matter Physics, Computational Quantum Many-Body Physics, Ultracold Atoms, Strongly Correlated Systems, Thermalization and Many-Body Localization, Non-Hermitian Systems

Ultracold atomic gases, Strongly correlated quantum many-body systems, Ultracold dipolar gases, Artificial gauge field, Ultracold quantum mixtures, Spin-orbit coupling, Finite-temperature effects, Non-equilibrium quantum dynamics, Topological phases of matter, Disordered systems, Thermalization and many-body localization, and Non-Hermitian physics

Research Skills

My research can be summarized as a theoretical investigation of many-body systems supported by numerical simulations. Rich expertise in theoretical modeling and numerical simulation of strongly-

correlated quantum many-body and ultracold atomic systems. Computational techniques range from large scale state-of-the-art *exact diagonalization, Lanczos algorithm, cluster Gutzwiller approach, and Gutzwiller mean-field theory*. To harness the computation capabilities of large scale computer clusters, parallel techniques are used in simulations. As part of my PhD thesis, I developed a computational tool to solve *Bose-Hubbard models* in weakly-interacting limits and implemented the *Hartree-Fock-Bogoliubov formalism* to compute collective modes. Experience in extended *Gross-Pitaevskii simulations* and *Fast Fourier transforms*.

Research Highlights

- Characterization of staggered superfluidity of strongly-correlated dipolar bosons in a two-dimensional optical lattices.
- First theoretical study to unveil the interplay of two localization mechanisms (many-body localization and non-Hermitian skin effect) of disordered many-body non-Hermitian systems.
- Identification of the parameter space of finite-momentum superfluidity of spin-orbit coupled bosons in square lattice.
- Investigated the role of artificial gauge fields on the stability of many-body localization, supersolid phases, and Bose glass state. The influence of trapping potential on quantum Hall state is revealed.
- Predictions on the emergence of an additional Nambu-Goldstone mode at phase separation and thermal fluctuations driven miscibility of interacting bosonic mixtures in square lattice.

Awards & Fellowships

01/2023 **Oral Presentation Award**, Awarded by 2023 Annual Meeting of the Physical Society of Taiwan, National Cheng Kung University, Tainan, Taiwan.

04/2021 **Postdoctoral Research Fellowship**, Awarded by Institute of Atomic and Molecular Sciences, Academia Sinica, Taiwan.

01/2019 **Postdoctoral Research Fellowship**, Awarded by Jagiellonian University in Krakow, funded by National Science Center NCN OPUS11 2016/21/B/ST2/01086, Poland.

12/2016 **Postdoctoral Research Fellowship**, Awarded by Physical Research Laboratory, Unit of Department of Space, India.

03/2014 **Runner Up Poster Presentation Award**, Researchers' Ferret Confab (REFECO)-2014, Indian Institute of Technology Gandhinagar, India.

05/2012 **National Eligibility Test (NET) in Physical Sciences**, Human Resource Development Group, Council of Scientific and Industrial Research, India.

12/2011 **University Gold Medal for first rank in M.Sc.**, Mohanlal Sukhadia University, Rajasthan, India.

08/2011 **Junior Research Fellowship**, Awarded by Physical Research Laboratory, Unit of Department of Space, India.

03/2011 All India **Graduate Aptitude Test in Engineering (GATE)** in Physics, Ministry of Human Resource Development, India.

10/2009 **Assistantship for securing the second position in the M.Sc. project**, Awarded under MHRD UGC-BSR scheme for DRS departments by Mohanlal Sukhadia University, Rajasthan, India.

List of Publications

Peer-reviewed publications in journals

K. Suthar* and K.-K. Ng,
Staggered quantum phases of dipolar bosons at finite temperatures,
Phys. Rev. A **106**, 063313 (2022) [$*$ $\Rightarrow$ Corresponding author].

K. Suthar*, Y.-C. Wang, Y.-P. Huang, H.H. Jen, and J.-S. You,
Non-Hermitian Many-Body Localization with open boundaries,
Phys. Rev. B **106**, 064208 (2022) [$*$ $\Rightarrow$ Corresponding author].

K. Suthar*, P. Kaur, S. Gautam, and D. Angom,
Spin-orbit-coupling-driven superfluid states in optical lattices at zero and finite temperatures,
Phys. Rev. A **104**, 043320 (2021) [$*$ $\Rightarrow$ Corresponding author].

K. Suthar, R. Kraus, H. Sable, D. Angom, G. Morigi, and J. Zakrzewski,
Staggered superfluid phases of dipolar bosons in two-dimensional square lattices,
Phys. Rev. B **102**, 214503 (2020).

R. Bai, D. Gaur, H. Sable, S. Bandyopadhyay, **K. Suthar**, and D. Angom,
Segregated quantum phases of dipolar bosonic mixtures in two-dimensional optical lattices,
Phys. Rev. A **102**, 043309 (2020).

K. Suthar, H. Sable, R. Bai, S. Bandyopadhyay, S. Pal, and D. Angom,
Supersolid phase of the extended Bose-Hubbard model with an artificial gauge field,
Phys. Rev. A **102**, 013320 (2020).

K. Suthar, P. Sierant, and J. Zakrzewski,
Many-body localization with synthetic gauge fields in disordered Hubbard chains,
Phys. Rev. B **101**, 134203 (2020).

S. Bandyopadhyay, R. Bai, S. Pal, **K. Suthar**, R. Nath, and D. Angom,
Quantum phases of canted dipolar bosons in a two-dimensional square optical lattice,
Phys. Rev. A **100**, 053623 (2019).

S. Pal, R. Bai, S. Bandyopadhyay, **K. Suthar**, and D. Angom,
Enhancement of the Bose glass phase in the presence of an artificial gauge field,
Phys. Rev. A **99**, 053610 (2019),
Figure 6(c) appeared on the Kaleidoscope of the journal.

R. Bai, S. Bandyopadhyay, S. Pal, **K. Suthar**, and D. Angom,
Bosonic quantum Hall states in single-layer two-dimensional optical lattices,
Phys. Rev. A **98**, 023606 (2018),
Figure 10(a) appeared on the Kaleidoscope of the journal.

K. Suthar and D. Angom,
Characteristic temperature for the immiscible-miscible transition of binary condensates in optical lattices,
Phys. Rev. A **95**, 043602 (2017).

K. Suthar and D. Angom,
Optical-lattice-influenced geometry of quasi-two-dimensional binary condensates and quasiparticle spectra,
Phys. Rev. A **93**, 063608 (2016),
Figure 10(e) appeared on the Kaleidoscope of the journal.

K. Suthar, A. Roy, and D. Angom,
Fluctuation-driven topological transition of binary condensates in optical lattices,
Phys. Rev. A **91**, 043615 (2015).

K. Suthar, A. Roy, and D. Angom,
Acoustic radiation from vortex-barrier interaction in atomic Bose-Einstein condensate,
J. Phys. B : At. Mol. Opt. Phys. **47**, 135301 (2014),
Figure 2 appeared on the cover page of the journal, July 2014.

Preprints (under consideration in journals)

Y.-C. Wang*, **K. Suthar***, H.H. Jen, Y.-T. Hsu, and J.-S. You,
Non-Hermitian skin effects on many-body localized and thermal phases,
arXiv:2210.12998, (under consideration in Phys. Rev. Lett.) [$*$ $\Rightarrow$ Equal contributions].

Peer-reviewed conference proceedings/book-chapter

R. Bai, S. Bandyopadhyay, S. Pal, **K. Suthar**, and D. Angom,
Quantum Hall states for $\alpha = 1/3$ in optical lattices,
Springer Proceedings in Physics **230**, 211 (2019).

S. Gautam, **K. Suthar**, and D. Angom,
Vortex reconnections between coreless vortices in binary condensates,
AIP Conf. Proc. **1582**, 46 (2014).

Membership of Professional Societies

Member of Indian Society of Atomic and Molecular Physics (ISAMP), India

American Physical Society (APS), USA

Taiwan Physical Society (TPS), Taiwan

Teaching Experience

I have teaching experience of following courses at Central University of Rajasthan:

02/2023 – 03/2023 **Nuclear and Particle Physics**, MSc (III Semester).

02/2023 – 03/2023 **Nuclear and Particle Physics**, Integrated MSc-BEd (III Semester).

02/2023 – 04/2023 **Atomic and Nuclear Physics**, Integrated MSc (VI Semester).

02/2023 – 04/2023 **Physics Laboratory I**, Integrated MSc (I Semester).

Faculty Development/Orientation Programme Attended

04/2023 One-month Faculty Induction Programme, Teaching Learning Center, Ramanujan College, University of Delhi.

Invited Talks/Seminars (Oral Presentations)

01/2023 2023 Annual Meeting of the Physical Society of Taiwan, National Cheng Kung University, Tainan, Taiwan.

11/2022 IAMS Young Fellow Workshop, Academia Sinica, Taiwan.

09/2022 NCTS Atomic, Molecular, and Optical (AMO) Physics Summer School, Sun Moon Lake Teachers' Hotel, Taiwan.

08/2022 LOCALISATION - 2022, Hokkaido University, Sapporo, Japan.

06/2022 53rd Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), Orlando, USA.

04/2022 Ultracold Atoms Japan, Okinawa Institute of Science and Technology, Japan.

03/2022 APS March Meeting - 2022, American Physical Society, Chicago, USA.

01/2022 2022 Annual Meeting of the Physical Society of Taiwan, National Taiwan Normal University, Taiwan.

01/2022 NCTS Atomic, Molecular, and Optical (AMO) Physics Winter School, Heng-Chun City, Pingtung County, Taiwan.

11/2021 IAMS Young Fellow Workshop, Academia Sinica, Taiwan.

07/2021 NCTS international workshop on emergent quantum many-body phenomena, Taiwan.

01/2021 IAMS Institute Seminar, Academia Sinica, Taiwan.

02/2020 Theoretical Quantum Physics Group Seminar, Saarland University, Germany.

2019,'17,'15,'13 Divisional Seminar, Theoretical Physics Division, Physical Research Laboratory, India.

2017,'16,'15,'14 Young Physicists' Meet, Physical Research Laboratory, India.

Flash Talks

04/2021 Korrelationstage - 2021, virtual workshop, Max Planck Institute for the Physics of Complex Systems (MPIPKS), Dresden, Germany.

12/2020 735th WE-Heraeus-Seminar Exploring Quantum Many-Body Physics with Ultracold Atoms and Molecules, Technical University Kaiserslautern, Bad Honnef, Germany.

08/2020 LOCALISATION - 2020, Hokkaido University, Sapporo, Japan.

Poster Presentations

07/2022 27th International Conference on Atomic Physics (ICAP), University of Toronto, Canada.

10/2021 Ergodicity Breaking and Anomalous Transport in Quantum Many-Body Systems, Max Planck Institute for the Physics of Complex Systems (MPIPKS), Dresden, Germany.

10/2021 Probing Complex Quantum Dynamics through Out-of-time-ordered Correlators, Max Planck Institute for the Physics of Complex Systems (MPIPKS), Dresden, Germany.

03/2021 Abdus Salam International Centre for Theoretical Physics (ICTP) Conference on Time Crystals, Trieste, Italy.

07/2020 Munich Conference on Quantum Science and Technology, Cluster of Excellence Munich Center for Quantum Science and Technology (MCQST), Germany.

10/2018 Max-Planck-Society-IISER partner group kick-off Workshop on Dynamics of Ultracold Systems with Embedded Highly-excited Rydberg Atoms, IISER Bhopal, India.

03/2018 Recent Trends in Cold and Ultracold Matter, Indian Institute of Technology (IIT) Guwahati, India.

11/2017 Conference on Frontiers in Two-Dimensional Quantum Systems, Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy.

03/2014 Researchers' Ferret Confab'14 (REFECO'14), Indian Institute of Technology (IIT) Gandhinagar, India.

02/2014 School and Workshop on Physics of Cold Atoms, Harish-Chandra Research Institute, Allahabad, India.

12/2012 Winter School on Ultracold atoms titled "Ultracold atoms for fundamental science and enabling technologies", IISER Pune and MUARC (UK) held at Goa, India.

Workshops/Conferences/Schools Attended

08/2022 Quantum Transport with Ultracold Atoms, Max Planck Institute for the Physics of Complex Systems (MPIPKS), Dresden, Germany.

08/2022 NCTS Summer school for physics and tensor-network methods in correlated systems, National Tsing-Hua University, Taiwan.

07/2021 ICFO-Weizmann School on the frontiers of light - New approaches to atom-light interactions, Barcelona (Spain) & Rehovot (Israel).

06/2021 WE-Heraeus-Seminar on "Collective Effects and Non-Equilibrium Quantum Dynamics", ETH Zürich, at Bad Honnef, Germany.

05/2021 Atomtronics@AbuDhabi 2021, Technology Innovation Institute, UAE.

11/2020 Young Researchers Workshop on "Quantum Fluctuations in Ultracold Gases", Leibniz University, Hannover and Ludwig Maximilian University of Munich, Germany.

09/2020 Online summer school Topology and Interactions in Optical Lattices, Goethe University, Frankfurt, Germany.

09/2019 Workshop on Time Crystals and Related Phenomena, Jagiellonian University in Kraków, Poland.

07/2019 Workshop on Quantum Mixtures and celebration of the 70th anniversary of Sandro Stringari, CNR-INO BEC Center, Trento, Italy.

03/2018 PRL Conference on Condensed Matter Physics-2018, Physical Research Laboratory, India.

01/2017 21st National Conference on Atomic and Molecular Physics (NCAMP-XXI), Physical Research Laboratory, India.

04/2016 PRL Conference on Condensed Matter Physics-2016, Physical Research Laboratory, India.

07/2015	Vikram-100 HPC Training jointly conducted by Intel and IBM, Physical Research Laboratory, India.
10/2014	ICTS School and Discussion Meeting on Frontiers in Light-Matter Interactions (ICTS-LMI), Indian Association for the Cultivation of Science, Kolkata, India.
04/2013	4th RRI School on Statistical Physics, Raman Research Institute, Bangalore, India.
11/2009	Eighteenth National Symposium on Radiation Physics (NSRP-18), Mohanlal Sukhadia University, Udaipur, India.
10/2009	Workshop on Nanostructured Materials (WNM-09), Mohanlal Sukhadia University, Udaipur, India.
10/2009	IUAC Acquaintance Programme On Accelerator Based Research, Mohanlal Sukhadia University, Udaipur, India.

Computer Skills

Programming languages	C++, FORTRAN 90, Parallel programming, Mathematica, experience of using Makefile
Applications	LaTeX, Microsoft word, LibreOffice, TikZ
Scientific libraries	LAPACK, ARPACK, FFTW, Armadillo
Plotting packages	Xmgrace, Gnuplot, Matlab, Python
Operating systems	Unix/Linux and Microsoft Windows
HPC	Working experience on High Performance Computing (HPC) Clusters : Vikram-100 (PRL, India), PL-Grid infrastructure (Jagiellonian University, Poland) and HPC (IAMS-AS, Taiwan).

Declaration: I hereby declare that the above informations are correct to the best of my knowledge and belief.

Date : April 20, 2023
Place: Ajmer

Kuldeep Suthar