Debayan Mitra, Ph.D.

Email: dm3710@columbia.edu

RESEARCH INTERESTS

My research interests span the areas of quantum mechanics, atomic, molecular and optical physics and condensed matter physics. I have a specific interest in ultracold-atoms and molecules, as a platform for quantum information, quantum simulation and quantum chemistry and its interface with solid-state physics and precision measurements.

EDUCATION

2018 **Ph.D. in Physics**, Princeton University, Princeton, NJ
Dissertation: Exploring attractively interacting fermions in 2D using a Quantum Gas Microscope
Faculty Mentor: Waseem Bakr, Associate Professor of Physics

2012 **Ingénieur Polytechnicien**, Promotion X2009, Ecole Polytechnique, Palaiseau, France

2009 **B.Sc. in Physics**, Presidency University, Kolkata, India

RESEARCH EXPERIENCE

2021- **Associate Research Scientist**, Department of Physics, Columbia University, New York, NY
Faculty Mentor: Tanya Zelevinsky, Professor of Physics

2018 **Postdoctoral Fellow**, Department of Physics, Harvard University, Cambridge, MA
Faculty Mentor: John Doyle, Professor of Physics

PUBLICATIONS

1. Q. Sun, et. al. "Probing the limits of optical cycling in a predissociative diatomic molecule," *Phys. Rev. Research* 5, 043070 (2023)
2. **D. Mitra**, et. al. "Quantum control of molecules for fundamental physics," *Phys. Rev. A* 105, 040101 (2022)
3. S. F. Vazquez-Carson, et. al. "Direct laser cooling of calcium monohydride molecules," *New J. Phys.* 24, 083006 (2022)
4. G-Z Zhu, et. al. "Functionalizing Aromatic Compounds with Optical Cycling Centers," *Nature Chemistry*, 14, 995–999 (2022)
5. **D. Mitra**, et. al. "Pathway Towards Optical Cycling and Laser Cooling of Functionalized Arenes," *J. Phys. Chem. Lett.* 13, 30, 7029–7035 (2022)
6. N. B. Vilas, et. al. "Magneto-Optical Trapping and Sub-Doppler Cooling of a Polyatomic Molecule," *Nature* 606, 70–74 (2022)
7. Z. Lasner, et. al. "Fast and High-Yield Loading of a D_2 MOT of Potassium from a Cryogenic Buffer Gas Beam," *Phys. Rev. A* 104, 063305 (2021)
8. **D. Mitra**, et. al. "Direct Laser Cooling of a Symmetric Top Molecule," *Science* 369, 6509 (2020)
9. L. Baum, et. al. "Establishing a highly closed cycling transition in a polyatomic molecule," *Phys. Rev. A.* 103, 043111 (2021)

10. L. Baum, et al. "1D Magneto-Optical Trap of Polyatomic Molecules," *Phys. Rev. Lett.* 124, 133201 (2020)
11. P. T. Brown, et. al. "Bad metallic transport in a cold atom Fermi-Hubbard system," *Science* 363, 6425 (2019)
12. E. Guardado-Sanchez, et. al. "Probing quench dynamics across a quantum phase transition into a 2D Ising antiferromagnet," *Phys. Rev. X* 8, 021069 (2018)
13. **D. Mitra,** et. al. "Quantum gas microscopy of an attractive Fermi–Hubbard system," *Nature Physics*, 14, 173–177 (2018)
14. P. T. Brown, et. al. "Spin-imbalance in a 2D Fermi-Hubbard system," *Science* 357, 6358 (2017)
15. **D. Mitra,** et. al. "Phase separation and pair condensation in a spin-imbalanced 2D Fermi gas," *Phys. Rev. Lett*. 117, 093601 (2016)

Covid-19 related work

B. Augenbraun, et. al. "Assessment and mitigation of aerosol airborne SARS-CoV-2 transmission in laboratory and office environments," *Journal of Occupational and Environmental Hygiene*, 17:10, 447-456 (2020)

PRESENTATIONS

Invited Talks

1. "The ultracold molecular frontier of physics," Indian Association for the Cultivation of Science, Kolkata, India, August 2023.
2. "Cooling the hydrogen atom without actually cooling it," Columbia Physics Colloquium, New York, March 2023.*
3. "Laser cooled molecules for precision measurements," Invited talk, FRIB Michigan State University, Lansing, January 2023.
4. "Laser cooling of CaH – mitigation and control of predissociation," ITAMP workshop on laser cooling of molecules, Cambridge, October 2022.*
5. "Laser cooling of polyatomic molecules," ICAP Hot Topics speaker, Toronto, July 2022.*
6. "Frontiers of direct laser cooling of molecules," virtual seminar at annual department meeting, TIFR, Mumbai, April 2022.
7. "Laser cooling of polyatomic molecules," Special seminar, Princeton University, Princeton, February 2022 and Pro-QM seminar, Columbia University, New York, March 2022
8. "Direct laser cooling of polyatomic molecules," virtual QFARM seminar, Stanford University, Palo Alto, January 2021.*
9. "A 1D MOT of polyatomic molecules," ITAMP seminar, Harvard & Smithsonian Center for Astrophysics, Cambridge, December 2019.
10. "Quantum Gas Microscopy of the Fermi-Hubbard Model in and out of equilibrium", Doyle Group, Harvard University, Cambridge, January 2018; Will Group, Columbia University, New York, December 2017.

* *Recorded talks*

Contributed Talks

1. Division of Atomic, Molecular and Optical Physics (DAMOP) 2022 "Optical cycling functionalization of aromatic molecules, towards laser cooling," Orlando, Florida, June 2022
2. DAMOP 2020 "Direct laser cooling polyatomic molecules," Virtual conference, June 2020.
3. DAMOP 2018 "Signatures of a massive collective mode of attractive fermions in an optical lattice: The η-mode," Ft. Lauderdale, Florida, May 2018.

4. DAMOP 2017 “Observation of charge density wave correlations in the attractive Fermi-Hubbard model,” Sacramento, California, June 2017.
5. DAMOP 2016 “Pair condensation in a spin-imbalanced 2D Fermi gas,” Providence, Rhode Island, May 2016.

TEACHING, ADVISING AND OUTREACH EXPERIENCE

Teaching Assistant, Princeton University, Princeton, NJ
Responsibilities included teaching lab sections, grading all assignments, and advising students
- Mechanics. (Fall 2013, 2014, and 2016).
- Introductory Physics. (Fall 2015).

Advising,
Advised and mentored 13 undergraduate students and 5 graduate students at Princeton, Harvard and Columbia University

Outreach,
Mentor to a SUSFDNY female high school student as part of Science in High School program

DEI,
- Served as co-chair of the Climate, Diversity and Inclusion (CDI) committee at the Columbia University department of Physics (2022-2023). Currently serving as member on the committee.
- Served as member of member of DEI committee at the Harvard University department of Physics (2019-2021)

AWARDS & HONORS

Prizes
- Grand Prix du stage de recherche (Grand prize for research internship), École Polytechnique, Palaiseau, France, 2012 for research performed at the IBM Almaden Research Center on the inverse spin-Hall effect.
- Gold Medal, National Graduate Physics Examination, India, 2008-09.

Teaching Awards
Department teaching award, Princeton University (2017)

PROFESSIONAL SERVICE

- Reviewer for Physical Review A, Journal of Physical Chemistry, Advanced Quantum Technologies and Nature Physics.
- Proposal reviewer for AFOSR.