Pratap Chandra Adak

Scientist,
Institute of Materials Research and Engineering (IMRE),
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Professional Appointments

Scientist	IMRE, A*STAR, Singapore.	November 2026–present
Postdoctoral Fellow	City College of New York, New York, NY, USA.	August 2022–October 2026
Teaching Fellow	World Science Foundation, New York, NY, USA.	January 2025–April 2025
Adjunct Lecturer	City College of New York, New York, NY, USA.	January 2024–May 2024

Education

PhD in Physics — Tata Institute of Fundamental Research, Mumbai, India — August 2016–July 2022
Thesis: Electronic transport in topological flat bands of twisted double bilayer graphene
Advisor: *Prof. Mandar M. Deshmukh*
Best Thesis Commendation in Physics, 2023 (Honourable Mention), TIFR, India

MSc in Physics — Indian Institute of Technology, Kanpur, India. — August 2014–July 2016
(CGPA: 9.6/10)

BSc in Physics — Ramakrishna Mission Residential College, Narendrapur, University of Calcutta, India. — August 2011–July 2014
(First class with 85.25% marks)

HS (12th) — Balipur Melatola High School, West Bengal Council of Higher Secondary Education (WBCHSE). — August 2009–July 2011
(First class with 90.6% marks)

10th — Balipur Melatala High School, West Bengal Board of Secondary Education (WBBSE). — 2004–2009
(First class with 90.38% marks)

Research Experience and Summary of PhD/Postdoctoral Work

Postdoctoral Fellow — August 2022–present
The City College of New York, New York, USA.
Advisor: Prof. Vinod M. Menon

- Explored light–matter interactions focusing on exciton–polaritons in layered van der Waals magnetic semiconductors using angle-resolved optical spectroscopy and microwave spectroscopy.
- Studied magnon-mediated excitonic interactions and their implications in nonlinear optics in CrSBr.
- Probed anisotropic propagation and confinement of self-hybridised exciton–polaritons in CrSBr.
- Developed microwave-to-optical transduction using exciton–magnon coupling, and enhanced the coupling using a hyperbolic cavity in the microwave regime.
- Contributed to the scientific development and preparation of a successful U.S. Department of Energy grant proposal on coherent exciton–magnon–photon interactions in van der Waals magnets.

PhD in Physics August 2016–July 2022

Tata Institute of Fundamental Research, Mumbai, India.

Advisor: Prof. Mandar M. Deshmukh

Thesis: **Electronic transport in topological flat bands of twisted double bilayer graphene**

- Studied tunable topological phases in twisted double bilayer graphene using low-temperature electron transport.
- Demonstrated nonlinear Hall effect from Berry curvature dipoles in time-reversal symmetric systems.
- Demonstrated electrically tunable Chern insulator and valley Hall states in moiré flat bands.

Publications

Google Scholar Profile | ORCID

Publication summary: 14 peer-reviewed publications, including 9 first/co-first-author publications; 2 invited review articles.

Peer-reviewed journal articles: *Co-first authors, †Corresponding author(s)

1. **P. C. Adak**†, I. McDaniel, S. Paul, C. Heuvel-Horwitz, B. Das, V. Kozlov, K. Mosina, A. Ramanathan, X. Roy, Z. Sofer, T. Zhong, A. Kamra, A. Thielens, A. Alù, V. M. Menon†, "Microwave-to-optical transduction using magnon–exciton coupling", *accepted in Nature Materials, arXiv*:2604.03441.
   Impact Factor: **38.0**; WoS/JCR Q: **Q1**; Role: **First and corresponding author**.
2. **P. C. Adak**†, F. Dirnberger, S. Acharya, A. Kamra, X. Xu, V. M. Menon†, "Excitons in van der Waals magnetic materials", *Nature Materials* **25**, 1492 (2026) **(Invited Review Article)**.
   Impact Factor: **38.0**; WoS/JCR Q: **Q1**; Role: **First and corresponding author.**
3. **P. C. Adak***†, S. Yu*, J. Abad-Arredondo*, B. Datta*, A. Cruz, S. Fischer, K. Mosina, Z. Sofer, A. I. Fernández-Domínguez, F. J. García-Vidal†, V. M. Menon†, "Directional flow of confined polaritons in CrSBr", *Advanced Materials* **38**, e12557 (2026).
   Impact Factor: **29.1**; WoS/JCR Q: **Q1**; Role: **Co-first and corresponding author.**
4. B. Datta*†, **P. C. Adak***†, S. Yu*, A. V. Dharmapalan, S. J. Hall, A. Vakulenko, F. Komissarenko, E. Kurganov, J. Quan, W. Wang, K. Mosina, Z. Sofer, D. Pashov, M. v. Schilfgaarde, S. Acharya, A. Kamra, M. Y. Sfeir, A. Alù, A. B. Khanikaev, V. M. Menon†, "Magnon-mediated exciton-exciton interaction in a van der Waals antiferromagnet", *Nature Materials* **24**, 1027 (2025).
   Impact Factor: **38.0**; WoS/JCR Q: **Q1**; Role: **Co-first and corresponding author.**
5. M. Cho, B. Datta, K. Han, S. B. Chand**, P. C. Adak**, S. Yu, F. Li, K. Watanabe, T. Taniguchi, J. Hone, J. Jung, G. Grosso, Y. D. Kim†, V. M. Menon†, "Moiré exciton polaron engineering via twisted hBN", *Nano Letters* **25**, 1381 (2024).
   Impact Factor: **9.1**; WoS/JCR Q: **Q1.**
6. **P. C. Adak***, S. Sinha*, A. Agarwal, M. M. Deshmukh†, "Tunable moiré materials for probing Berry physics and topology", *Nature Reviews Materials* **9**, 481 (2024) **(Invited Review Article).**
   Impact Factor: **83.3**; WoS/JCR Q: **Q1**; Role: **Co-first author.**
7. **P. C. Adak**†, S. Sinha, D. Giri, D. K. Mukherjee, Chandan, L. D. V. Sangani, Surat Layek, Ayshi Mukherjee, K. Watanabe, T. Taniguchi, H. A. Fertig, A. Kundu†, M. M. Deshmukh†, "Perpendicular electric field drives Chern transitions and layer polarization changes in Hofstadter bands", *Nature Communications* **13**, 7781 (2022).
   Impact Factor: **18.1**; WoS/JCR Q: **Q1**; Role: **First and corresponding author.**
8. A. Chakraborty*†, K. Das*†, S. Sinha, **P. C. Adak**, M. M. Deshmukh, A. Agarwal†, "Nonlinear anomalous Hall effects probe topological phase-transitions in twisted double bilayer graphene", *2D Materials* **9**, 045020 (2022).
   Impact Factor: **4.3**; WoS/JCR Q: **Q2.**
9. S. Sinha*†, **P. C. Adak***, A. Chakraborty, K. Das, K. Debnath, L. D. V. Sangani, K. Watanabe, T. Taniguchi, U. V. Waghmare, A. Agarwal†, M. M. Deshmukh†, "Berry curvature dipole senses

topological transition in a moiré superlattice", *Nature Physics* **18**, 765 (2022).
Impact Factor: **18.0**; WoS/JCR Q: **Q1**; Role: **Co-first author.**

10. L. N. Kapoor, S. Mandal[†], **P. C. Adak**, M. Patankar, S. Manni, A. Thamizhavel, M. M. Deshmukh[†], "Observation of standing spin-wave modes in a van der Waals magnetic material", *Advanced Materials*, 2005105 (2020).
Impact Factor: **29.1**; WoS/JCR Q: **Q1**.
11. S. Sinha*, **P. C. Adak***[†], R. S. Surya Kanthi, B. L. Chittari, L. D. V. Sangani, K. Watanabe, T. Taniguchi, J. Jung, M. M. Deshmukh[†], "Bulk valley transport and Berry curvature spreading at the edge of flat bands", *Nature Communications* **11**, 5548 (2020).
Impact Factor: **18.1**; WoS/JCR Q: **Q1**; Role: **Co-first and corresponding author.**
12. L. D. V. Sangani, R.S. Surya Kanthi, **P. C. Adak**, S. Sinha, A. H. Marchawala, T. Taniguchi, K. Watanabe, M. M. Deshmukh[†], "Facile deterministic cutting of 2D materials for twistronics using a tapered fibre scalpel", *Nanotechnology* **31**, 32LT02 (2020).
Impact Factor: **2.9**; WoS/JCR Q: **Q3.**
13. **P. C. Adak***, S. Sinha*, U. Ghorai, L. D. V. Sangani, K. Watanabe, T. Taniguchi, R. Sensarma[†], M. M. Deshmukh[†], "Tunable bandwidths and gaps in twisted double bilayer graphene on the verge of correlations", *Physical Review B* **101**, 125428 (2020).
Impact Factor: **3.9**; WoS/JCR Q: **Q2,** category: Condensed Matter Physics; Role: **Co-first author.**
14. B. Datta[†], **P. C. Adak**, L. Shi, K. Watanabe, T. Taniguchi, J. C. W. Song[†], M. M. Deshmukh[†], "Nontrivial quantum oscillation geometric phase shift in a trivial band", *Science Advances* **5**, eaax6550 (2019).
Impact Factor: **13.9**; WoS/JCR Q: **Q1**

Invited Talks, Seminars, and Conference Presentations

Invited Talks and Seminars:

1. Special Seminar at Kavli ENSI, UC Berkeley, Berkeley, USA, 28 July 2026**.**
2. Quantum Frontiers of Light–Matter Interactions in 2D Materials (Q-FARM workshop) at Stanford University, Stanford, CA, USA, 29–31 July 2026.
3. Physics Colloquium at City College of New York, New York, NY, USA, 13 May 2026.
4. MRS Spring Meeting 2026, Honolulu, Hawai'i, USA, 26 April–1 May 2026.
5. Quantum Material Seminar series at Columbia University, New York, USA, 8 April 2026**.**
6. Center for Computational Quantum Physics (CCQ), New York, USA, 7 February 2025.

Oral Presentations:

7. CLEO 2026, at Charlotte, NC, USA, 17–21 May 2026 (**Postdeadline oral presentation**).
8. APS Global Physics Summit 2025, Anaheim, CA, USA, 16–21 March 2025.
9. APS March Meeting 2024, Minneapolis, MN, USA, 3–8 March 2024.
10. MRS Fall Meeting 2023, Boston, MA, USA, 26 November–1 December 2023.
11. APS March Meeting 2023, Las Vegas, NV, USA, 5–10 March 2023.
12. APS March Meeting 2022, Chicago, IL, USA, 14–18 March 2022.
13. Asia-Pacific Conference on Condensed Matter Physics (AC2MP) 2021.
14. Mumbai-Pune Semiconductor Meeting 2019, IIT Bombay, Mumbai, India, 3 February 2019.

Poster Presentations:

15. EPiQS Moore Postdoctoral Symposium 2026, Los Angeles, CA, USA, 10–14 August 2026.
16. Gordon Research Conference at Southern New Hampshire University in New Hampshire, USA, 21–26 June 2026.
17. Max Planck-New York Center Symposium at Simons Foundation and Flatiron Institute, New York, NY, USA, 28–30 April 2025.

18. Competing Orders in Quantum Materials (Nature Conferences) at Yale University, New Haven, CT, USA, 31 March–2 April 2025.
19. Max Planck Center Spring Meeting at Simons Foundation and Flatiron Institute, New York, NY, USA, 24–25 May 2023.
20. Novel Phases of Quantum Matter, at ICTS, Bangalore, India, 23 December 2019–3 January 2020.
21. Conference on Quantum Measurement: Fundamentals, Twists, and Applications at ICTP, Trieste, Italy, 29 April–4 May 2019.
22. Topological Aspects of Quantum Matter (TAQM 2018) at TIFR, Mumbai, India, 17–20 December 2018.
23. Gordon Research Conference at Stonehill College, Easton, USA, 3–8 June 2018.
24. Mumbai-Pune Semiconductor Meeting 2018, Pune, India, February 2018.

Teaching Experience

Teaching Fellow January 2025–April 2025

World Science Foundation, New York, NY 10115.
Course: Light–Matter Interaction at the Nanoscale
Principal Instructor: Prof. Vinod Menon

- Conducted weekly recitation classes and led interactive Q&A sessions.
- Developed supplementary materials for recitation classes, designed discussion topics and course summaries, created project outlines.
- Translated advanced research topics into accessible concepts for a diverse cohort of high school students.

Adjunct Lecturer January 2024–May 2024

The City College of New York, New York, USA.
Course: Undergraduate Physics Laboratory
Principal Instructor: Prof. Pouyan Ghaemi

- Guided students through physics experiments, explaining the underlying fundamental concepts.
- Simplified complex topics for non-physics majors, encouraging curiosity and confidence in experimental science.
- Evaluated experimental reports and provided feedback.

Mentoring Experience

Mentored more than ten undergraduate students and provided technical training to five PhD students in nanofabrication, optical spectroscopy, cryogenic measurements, instrumentation, and data analysis.

Experimental Skills

- **Advanced nanofabrication and cleanroom use:**
    - EBL, RIE, metal deposition, AFM, Raman characterisation
    - Van der Waals heterostructure assembly
    - Device design (AutoCAD, KLayout)
- **Cryogenic & quantum measurement:**
    - Dilution fridge (10 mK)
    - Helium-flow cryostat (1.5 K)
    - Optical cryostats (OptiCool by Quantum Design and CryoCore by Montana Instruments)
- **Optical setup & spectroscopy:**
    - Free-space and fibre optics
    - Angle-resolved reflectivity and photoluminescence

    - Heterodyne/homodyne detection
    - CW and pulsed laser systems, interferometry, spectrometers
- **Microwave device & spectroscopy:**
    - Design and fabrication of coplanar waveguides (CPW)
    - RF measurements using VNA, RF spectrum analyser, microwave source
- **Software and automation**:
    - Python, MATLAB, Mathematica, LabVIEW
    - Data acquisition, signal processing, automation pipelines

Peer Review Activities

- Nature (1)
- Nature Communications (3)
- Nano Letters (1)
- ACS Nano (2)
- Journal of Physics D: Applied Physics (2)
- Journal of the American Chemical Society (1)
- Physica Scripta (2)

Awards and Achievements

- **Best Early Career Presenter Award**, MRS Spring Meeting & Exhibit, 2026
- The Geeta Udgaonkar **Best Thesis Commendation in Physics, 2023 (Honourable Mention)** for PhD thesis at TIFR.
- **Outstanding Reviewer Award** (2022), Journal of Physics D, IOP Publishing.
- **Best oral presentation award**, Asia-Pacific Conference on Condensed Matter Physics (AC2MP 2021).
- All India rank 5 in GATE 2016 (Physics), conducted by IITs.
- All India rank 6 in JAM 2014 (Physics), conducted by IITs for MSc admissions.
- All India rank 21 in JEST 2014 (Physics), a national-level entrance for PhD programmes.
- INSPIRE scholarship for Higher Education (2011), DST, Govt. of India.
- JBNSTS (Jagadish Bose National Science Talent Search) scholarship (2011), West Bengal.
- NTSE (National Talent Search Exam) scholarship (2007), awarded by NCERT, Govt. of India.