**Nikhil Tilak, Ph.D.**

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# SUMMARY

I’m a Postdoctoral associate in physics at Rutgers University with 8+ years of experience in nanofabrication of devices and their characterization via electronic tunneling and transport measurements. I’m a quick learner who thrives in a collaborative environment. I’m highly skilled at designing experiments, collecting and analyzing data, and presenting findings as evidenced by my 6 peer-reviewed journal publications and conference talks. Additionally, I am experienced in numerical and machine learning techniques using Python and am always working to expand my skill set. I’m currently seeking process/yield engineering roles in the semiconductor industry and data scientist/analyst positions.

# SKILLS

* **Device fabrication:** Silicon wafer cleaning (RCA), Nanofabrication using e-beam lithography (FEI Sirion, Hitachi S-5500), thermal metal deposition (Gold, Chromium, Titanium), reactive ion/Plasma etching (O2, CHF3), HF wet etching of silicon dioxide, wire bonding (West Bond).
* **Characterization:** Scanning tunneling microscopy (built my own system), atomic force microscopy (NT-MDT, Asylum Cypher), Kelvin probe force microscopy, Electrostatic force microscopy, Piezoresponse microscopy, force-distance spectroscopy, electronic transport, Raman spectroscopy (Renishaw), optical microscopy.
* **Vacuum & cryogenics:** Expert at design, construction and maintenance of HV/UHV chambers and cryogenic temperature measurement apparatus. Helium leak detection (Agilent).
* **Mechanical and electronics:** Soldering, Brazing, CAD (Fusion 360), Machining (Drilling, Lathe, Milling), Arduino circuits.
* **Data analysis & programming:**
  + **Languages & platforms**: Python, C, SQL, HTML, CSS, Git/Github.
  + **Python packages**: NumPy, SciPy, Pandas, Scikit-Learn, OpenCV, NLTK, TensorFlow.
  + **Machine learning**: Linear/Logistic regression, KNN, SVM, PCA, Random Forests, XGBoost, NLP.
  + **Certificates**: Erdos institute data science bootcamp 05/2020 - 07/2020

Applied data science with Python. (Univ. of Michigan on Coursera) 01/2020 - 06/2020

# PROFESSIONAL EXPERIENCE

* **Postdoctoral Associate** | Rutgers University, Piscataway, New Jersey 07/2023-present   
  Studying correlated phases in two-dimensional heterostructures and moire materials with tunneling and electrical transport measurements.
* **Graduate Research Assistant** | Rutgers University, Piscataway, New Jersey 05/2018 - 06/2023   
  Conducted Scanning tunneling microscopy experiments on twisted two-dimensional materials leading to 6 high impact journal publications.
* **Teaching Assistant** | Rutgers University, Piscataway, New Jersey 09/2015 - 05/2018  
  TA for extended analytical physics (115), analytical physics (123 & 124), intro solid state physics (406), graduate quantum mechanics 1 (501), electromagnetism (385) and classical physics lab (276).
* **Physics Faculty** | Bakliwal Tutorials, Pune, India. 06/2014 - 05/2015   
  Taught calculus-based physics for the highly selective Indian institutes of technology joint entrance exam (IIT-JEE). 1200+ hours of teaching experience to over 550 high school juniors and seniors.
* **Research Intern** | INRS, Montreal, Canada 05/2013 - 07/2013

Won the prestigious MITACS Globalink summer internship award. Worked on lead-sulfide quantum dots.

# RESEARCH PROJECTS

* **Structure and electronic properties of marginally twisted MoS2.**

Studied lattice-relaxation, moire potentials and interfacial ferroelectricity in marginally twisted MoS2 bilayers using scanning tunneling microscopy (STM) and piezoresponse force microscopy (PFM).

* **Carrier confinement in magic-angle twisted bilayer graphene.**

Investigated the effects of substrate potential disorder on magic-angle twisted bilayer graphene using STM/STS.

* **Proximity-induced charge density wave in graphene/1T-TaS2.**

Investigated the incommensurate and commensurate CDW phases in 1T-TaS2. Used graphene as a cover to protect TaS2 surface from degradation.

* **Design and construction of a low temperature scanning tunneling microscope.**

Designed and constructed a dip-stick style STM and a scanner head capable of operating from 300 K to 4.2 K. System was optimized to reduce heat-load to reduce cryogen consumption.

* **Effect of strain on CVD graphene microdrums.**

Optimized the growth of monolayer graphene on copper foils. Transferred the graphene to holey silicon nitride substrates to make suspended graphene devices for strain measurements.

# SELECTED DATA PROJECTS

# Bookend : predict author from text snippet | [repo](https://github.com/data-dart/bookend), [video](https://www.youtube.com/watch?v=P1Sq7T9PvP0) 05/2020 - 07/2020

*Won 1st place in the final project competition of Erdos data bootcamp.*

* Trained an ensemble classifier model on books scraped from project Gutenberg to predict the authorship of a snippet of text with 93% accuracy.
* Led a team of four and was responsible for dividing tasks and establishing a GitHub-based workflow to maximize productivity.
* Implemented a bag-of-words model which gave the highest prediction accuracy score 85% among the models in the ensemble.

# Sudoku-Solver: solve a Sudoku puzzle given its picture | [repo](https://github.com/NikhilTilak/sudoku-solver), [webapp](https://sudoku-solver-2ik3k7t6qq-uk.a.run.app/) 11/2022 - 01/2023

* Wrote a custom pipeline which processes the image, identifies the filled digits and produces a solution.
* Deployed a Docker containerized Dash/Plotly app to Google Cloud (GCP).

# BreweryXplorer: explore 3000+ breweries in the US | [repo](https://github.com/NikhilTilak/BreweryExplorer), [webapp](https://brewxplorer2.herokuapp.com/) 05/2021 - 08/2021

* Scraped and cleaned unstructured brewery data from Wikipedia and other open sources.
* Designed an interactive Dashboard using Dash/Plotly which was deployed to Heroku.

# EDUCATION

* **Ph.D. in Physics** | Rutgers University, Piscataway, New Jersey 09/2015 - 06/2023

Dissertation: *Scanning tunneling microscopy studies of twisted van der Waals heterostructures.*

* **B.Tech. in Engineering Physics** | Indian Institute of Technology, Guwahati, Assam, India. 08/2010-05/2014  
  Placed 2nd in my cohort with a GPA of 9.04/10.

# SELECTED PUBLICATIONS ([google scholar](https://scholar.google.com/citations?user=ehlgV_0AAAAJ&hl=en))

1. N. Tilak, M. A. Altvater, S.-H. Hung, *et al.*, “Revealing the charge density wave proximity effect in graphene 1t-TaS2.,” *(under review at Nature materials)*, 2023.
2. N. Tilak, G. Li, T. Taniguchi, K. Watanabe, and E. Y. Andrei, “Moiré potential, lattice relaxation, and layer polarization in marginally twisted MoS2 bilayers,” *Nano Letters*, 2022.
3. N. Tilak, X. Lai, S. Wu, *et al.*, “Flat band carrier confinement in magic-angle twisted bilayer graphene,” *Nature communications*, vol. 12, no. 1, p. 4180, 2021.
4. M. A. Altvater, N. Tilak, S. Rao, *et al.*, “Charge density wave vortex lattice observed in graphene-passivated 1t-tas2 by ambient scanning tunneling microscopy,” *Nano Letters*, vol. 21, no. 14, pp. 6132–6138, 2021.
5. M. A. Altvater, N. Tilak, S. Rao, *et al.*, “Observation of a topological defect lattice in the charge density wave of 1t-tas2,” *Applied Physics Letters*, vol. 119, no. 12, p. 121 601, 2021.
6. R. S. Bisht, J. Park, H. Yu, *et al.*, “Spatial interactions in hydrogenated perovskite nickelate synaptic networks,” *Nano Letters*, Jul. 2023.
7. R. K. Biroju, N. Tilak, G. Rajender, S. Dhara, and P. Giri, “Catalyst free growth of zno nanowires on graphene and graphene oxide and its enhanced photoluminescence and photoresponse,” *Nanotechnology*, vol. 26, no. 14, p. 145 601, 2015.

# CONFERENCE TALKS & POSTERS

* STM studies of marginally twisted MoS2 bilayers [poster] Rutgers Center for Materials Theory symposium, 2022
* Moiré bands in twisted MoS2 homobilayers [talk] APS March Meeting 2022, Chicago
* Observation of charging peaks near the flat band in magic-angle twisted bilayer Graphene [talk] APS March Meeting 2021
* A method for controllably inducing ultra-high strain in suspended 2D materials [talk] APS March Meeting 2018, LA

# RECENT HONORS

# • David C. Langreth Graduate Development Award 2017

“Presented annually to an especially promising early-stage graduate student by the Department of Physics and Astronomy at Rutgers.”

# REVIEWER FOR

ACS Nano, ACS Nano Letters, NPJ Quantum materials.

# LEADERSHIP AND MENTORSHIP

* Directly mentored five undergraduate students leading to successful transitions to graduate school and industry.
* Student representative on the graduate studies and life committee (AY 2018-19)
* Vice President of the Physics and Astronomy Graduate Student Organization. (AY 2016-17)