Asif Iqbal

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Research Vision and Interests

My research focuses on theoretical and computational modeling of plasma and vacuum discharge phenomena, including glow and streamer discharges, multipactor, RF-driven breakdown, and secondary electron emission processes. I specialize in fluid and kinetic (Particle-in-Cell and Monte Carlo) simulation frameworks, complemented by scientific machine learning, to construct predictive models of nonlinear, threshold-driven plasma systems. My work bridges first-principles multiphysics modeling with scalable data-driven prediction to enhance reliability in accelerator, high-power microwave, and fusion-relevant plasma applications.

Academic Positions

University of Michigan, Ann Arbor, MI
Research Fellow, Nuclear Engineering and Radiological Sciences (Jan 2025 - Present)

Michigan State University, East Lansing, MI
Research Associate, Electrical and Computer Engineering (Apr 2021 - Dec 2024)
Graduate Research Assistant, Electrical and Computer Engineering (Aug 2017 - Apr 2021)

Daffodil International University, Dhaka, Bangladesh
Lecturer, Electrical and Electronic Engineering (Sep 2015 - Jul 2017)

Education

Michigan State University, East Lansing, MI
Ph.D. in Electrical Engineering, April 2021
Thesis: Multipactor Discharge with Two-Frequency RF Fields
Advisor: Prof. Peng Zhang

Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh
B.Sc. in Electrical and Electronic Engineering, September 2015

Grants & Proposals

- *Machine Learning for Multipactor Prediction and Modeling in Accelerator Applications*
  Role: Senior / Key Personnel (PI: Prof. Peng Zhang)
  Department of Energy, BES Accelerator and Detector Research Program
  $764,651.00 | 3 years

Awards & Honors

- Outstanding Graduate Student Award, Michigan State University (2020)
- MIPSE Graduate Fellowship, Michigan Institute for Plasma Science and Engineering (2019)
- Best Presentation Award, MIPSE Graduate Student Symposium (2019, 2021)
- Dean's List Fellowship, Faculty of EEE, BUET (2010 - 2015)
- University Merit Scholarship, BUET (2010 - 2015)
- Education Board Scholarship, Bangladesh (2007 - 2015)

Professional Services

- Visa/International Chair**,** International Conference on Plasma Science (ICOPS 2026, Lake Tahoe, NV) — IEEE NPSS
- Session Chair: International Vacuum Electronics Conference (2022, 2024), IEEE International Conference on Plasma Science (2023)
- Judge: MIPSE Graduate Student Symposium (2022)
- Secretary: IEEE NPSS Student Chapter, Michigan State University (2020)

Referee Services

Reviewer of Journals :

- Scientific Reports
- IEEE Transactions on Electron Device
- Plasma Sources Science and Technology
- Transactions on Microwave Theory and Techniques
- Physical Review E
- Physics of Plasmas
- IEEE Transactions on Plasma Science

Research Software and Computational Expertise

- PASCHEN-1D: Designed and developed a one-dimensional drift–diffusion plasma solver with multi-mechanism surface emission physics and flexible external circuit coupling
- Development of fluid and kinetic (Particle-in-Cell and Monte Carlo) simulation frameworks for RF-driven vacuum discharge systems
- Scientific machine learning for multipactor susceptibility prediction and nonlinear discharge modeling (PyTorch, TensorFlow, scikit-learn)
- Numerical methods and high-performance computing implementations in Python, C/C++, and MATLAB
- Multiphysics simulation platforms: CST Particle Studio, COMSOL

Publications (Peer Reviewed Journal Articles)

1. **Iqbal, A.**, Verboncoeur, J., & Zhang, P. (2026). "A supervised machine learning framework for multipactor breakdown prediction in high-power RF devices and accelerator components: A

case study in planar geometry." *Under review*, *PRX Intelligence*. Preprint available at arXiv:2507.17881.

2. **Iqbal, A.**, Heri, Y., Wang, B., Jin, L., Faisal, Md. A., & Zhang, P. (2026). "PASCHEN-1D: A one-dimensional fluid plasma solver with multi- mechanism surface emission and flexible external circuit coupling" *Under review*, *Computer Physics Communications*.
3. Mashrafi, Md., **Iqbal, A.**, Verboncoeur, J., & Zhang, P. (2025). "Two-frequency RF fields induced multipactor 2 in coaxial transmission lines", *Physics of Plasmas*, 32, 102112.
4. **Iqbal, A.**, Zhang, P., & Verboncoeur, J. (2025). "Coaxial multipactor with non-sinusoidal RF fields." *Physics of Plasmas*, 32(8), 082112.
5. **Iqbal, A.**, Wen, D., Verboncoeur, J., & Zhang, P. (2023). "Two-surface multipactor with non-sinusoidal RF fields." *Journal of Applied Physics*, 134, 153304.
6. **Iqbal, A.**, Bentz, B. Z., Zhou, Y., Youngman, K., & Zhang, P. (2023). "Pulsed photoemission induced plasma breakdown." *Journal of Physics D: Applied Physics*, 56, 505204.
7. **Iqbal, A.**, Wen, D., Verboncoeur, J., & Zhang, P. (2023). "Recent advances in multipactor physics and mitigation." *High Voltage*, 8(6), 1095–1114.
8. **Iqbal, A.**, Wozniak, D., Rahman, M. Z., Banerjee, S., Verboncoeur, J., Zhang, P., & Jiang, C. (2022). "Influence of discharge polarity on streamer breakdown criterion of ambient air in a non-uniform electric field." *Journal of Physics D: Applied Physics*, 56, 035204.
9. Mirmozafari, M., **Iqbal, A.**, Zhang, P., Behdad, N., Booske, J. H., & Verboncoeur, J. P. (2022). "Secondary electron yield characterization of high porosity surfaces for multipactor-free microwave components." *Physics of Plasmas*, 29, 082109.
10. **Iqbal, A.**, Verboncoeur, J., & Zhang, P. (2022). "Two-surface multipactor discharge with two-frequency RF fields and space-charge effects." *Physics of Plasmas*, 29, 012102.
11. **Iqbal, A.**, Wong, P., Wen, D., Verboncoeur, J., & Zhang, P. (2021). "A review of recent studies on two-frequency RF field-induced single-surface multipactor discharge." *IEEE Transactions on Plasma Science*, 49, 3284. [Invited Paper]
12. **Iqbal, A.**, Wong, P. Y., Wen, D.-Q., Lin, S., Verboncoeur, J. P., & Zhang, P. (2020). "Time-dependent physics of single-surface multipactor discharge with two carrier frequencies." *Physical Review E*, 102, 043201.
13. **Iqbal, A.**, Wong, P. Y., Verboncoeur, J. P., & Zhang, P. (2020). "Frequency-domain analysis of single-surface multipactor discharge with single- and dual-tone RF electric fields." *IEEE Transactions on Plasma Science*, 48, 1950.
14. **Iqbal, A.**, Ludwick, J., Fairchild, S., Cahay, M., Gortat, D., Sparkes, M., O'Neill, W., Back, T. C., & Zhang, P. (2020). "Empirical modeling and Monte Carlo simulation of secondary electron yield suppression of laser-drilled micro-porous gold surfaces." *Journal of Vacuum Science & Technology B*, 38, 013801.
15. Ludwick, J., **Iqbal, A.**, Gortat, D., Cook, J., Cahay, M., Zhang, P., Back, T. C., Fairchild, S., Sparkes, M., & O'Neill, W. (2020). "Angular dependence of secondary electron yield from microporous gold surfaces." *Journal of Vacuum Science & Technology B*, 38, 054001.

16. **Iqbal, A.**, Verboncoeur, J., & Zhang, P. (2019). "Temporal multiparticle Monte Carlo simulation of dual-frequency single-surface multipactor." *Physics of Plasmas*, 26, 024503.
17. Wen, D.-Q., **Iqbal, A.**, Zhang, P., & Verboncoeur, J. (2019). "Suppression of single-surface multipactor discharges due to non-sinusoidal transverse electric field." *Physics of Plasmas*, 26, 093503.
18. **Iqbal, A.**, Verboncoeur, J., & Zhang, P. (2018). "Multipactor susceptibility on a dielectric with two carrier frequencies." *Physics of Plasmas*, 25, 043501.

Conference Presentations

1. Iqbal, A., Wen, D.-Q., Wong, P. Y., Lin, S., Suresh, S., Mashrafi, M., Verboncoeur, J., & Zhang, P. (2024). "Multipactor in a coaxial geometry with non-sinusoidal RF fields." *International Vacuum Electronics Conference (IVEC 2024)*, April 22–25, Monterey, CA, USA. [Oral]
2. Iqbal, A., Bentz, B., Zhou, Y., Youngman, K., & Zhang, P. (2023). "Characterization of plasma breakdown induced by pulsed photoemission." *IEEE International Conference on Plasma Science (ICOPS 2023)*, May 21–25, Santa Fe, NM, USA. [Oral]
3. Iqbal, A., Mirmozafari, M., Zhang, P., Behdad, N., Booske, J. H., & Verboncoeur, J. (2023). "Secondary electron yield reduction in high porosity surfaces and its application for multipactor suppression." *IEEE International Conference on Plasma Science (ICOPS 2023)*, May 21–25, Santa Fe, NM, USA. [Oral]
4. Iqbal, A., Wen, D.-Q., Verboncoeur, J., & Zhang, P. (2023). "Two-surface multipactor with non-sinusoidal RF fields and space-charge effects." *International Vacuum Electronics Conference (IVEC 2023)*, April 25–29, Beijing, China. [Oral]
5. Iqbal, A., Verboncoeur, J., & Zhang, P. (2022). "Non-sinusoidal RF field induced two-surface multipactor discharge." *IEEE International Conference on Plasma Science (ICOPS 2022)*, May 22–26, Seattle, WA, USA. [Oral]
6. Wen, D.-Q., Iqbal, A., Scutt, C., Zhang, P., & Verboncoeur, J. (2022). "Multipactor mitigation via Gaussian-shape transverse RF electric field near a dielectric surface." *IEEE International Conference on Plasma Science (ICOPS 2022)*, May 22–26, Seattle, WA, USA. [Oral]
7. Iqbal, A., Wong, P. Y., Wen, D.-Q., Lin, S., Verboncoeur, J., & Zhang, P. (2022). "Investigation of two-surface multipactor with two-frequency RF fields and space-charge effects." *International Vacuum Electronics Conference (IVEC 2022)*, April 25–29, Monterey, CA, USA. [Oral]
8. Iqbal, A., Verboncoeur, J., & Zhang, P. (2021). "Study of two-frequency RF field induced two-surface multipactor." *IEEE International Conference on Plasma Science (ICOPS 2021)*, September 12–16, USA. [Oral]
9. Wozniak, D., Rahman, M. Z., Jiang, C., Iqbal, A., Banerjee, S., Verboncoeur, J., & Zhang, P. (2021). "Meeks' criterion for breakdown examined in air using a needle-to-plate configuration." *IEEE International Conference on Plasma Science (ICOPS 2021)*, September 12–16, USA. [Oral]
10. Iqbal, A., Wong, P. Y., Wen, D.-Q., Lin, S., Verboncoeur, J., & Zhang, P. (2021). "Multipactor dynamics near a dielectric due to two-frequency RF fields." *International Vacuum Electronics Conference (IVEC 2021)*, April 27–30, Monterey, CA, USA. [Oral]

11. Iqbal, A., Wong, P. Y., Verboncoeur, J., & Zhang, P. (2020). "Analysis of single-surface multipactor discharge in the frequency domain." *21st International Vacuum Electronics Conference (IVEC 2020)*, October 26–29, Monterey, CA, USA. [Oral]
12. Iqbal, A., Ludwick, J., Fairchild, S., Cahay, M., Gortat, D., Sparkes, M., O'Neill, W., Back, T. C., & Zhang, P. (2020). "A general empirical model of secondary electron yield and its application in Monte Carlo simulation of a microporous gold surface." *21st International Vacuum Electronics Conference (IVEC 2020)*, October 26–29, Monterey, CA, USA. [Oral]
13. Lin, S., Iqbal, A., Zhang, P., & Verboncoeur, J. (2020). "Quantitative analysis of single-surface dielectric multipactor susceptibility with dual carrier frequencies." *21st International Vacuum Electronics Conference (IVEC 2020)*, October 26–29, Monterey, CA, USA. [Contributed Oral]
14. Iqbal, A., Ludwick, J., Fairchild, S., Cahay, M., Gortat, D., Sparkes, M., O'Neill, W., Back, T. C., & Zhang, P. (2019). "Empirical modeling and Monte Carlo simulation of secondary electron yield from a microporous surface." *International Vacuum Nanoelectronics Conference (IVNC 2019)*, July 22–26, Cincinnati, OH, USA. [Oral]
15. Iqbal, A., Verboncoeur, J., & Zhang, P. (2019). "Temporal study of dual-frequency multipactor on a dielectric." *IEEE Pulsed Power and Plasma Science Conference (PPPS 2019)*, June 23–28, Orlando, FL, USA. [Oral]
16. Iqbal, A., Ludwick, J., Fairchild, S., Cahay, M., Gortat, D., Sparkes, M., O'Neill, W., Back, T. C., & Zhang, P. (2019). "Monte Carlo simulation of secondary electron yield from a microporous surface." *IEEE Pulsed Power and Plasma Science Conference (PPPS 2019)*, June 23–28, Orlando, FL, USA. [Poster]
17. Iqbal, A., Verboncoeur, J., Wong, P., & Zhang, P. (2019). "Temporal study of dual-frequency single-surface multipactor by multiparticle Monte Carlo simulations." *20th International Vacuum Electronics Conference (IVEC 2019)*, April 28–May 1, Busan, South Korea. [Contributed Poster]
18. Iqbal, A., Verboncoeur, J., & Zhang, P. (2018). "Time-dependent physics of single-surface multipactor by multiparticle Monte Carlo simulations." *9th Annual MIPSE Graduate Student Symposium*, November 14, Ann Arbor, MI, USA. [Poster]
19. Iqbal, A., Verboncoeur, J. P., & Zhang, P. (2018). "Dual-frequency multipactor on a dielectric." *45th IEEE International Conference on Plasma Science (ICOPS 2018)*, June 24–28, Denver, CO, USA. [Oral]
20. Iqbal, A., Zhang, P., & Verboncoeur, J. (2018). "Dual-frequency multipactor susceptibility on a dielectric." *19th International Vacuum Electronics Conference (IVEC 2018)*, April 24–26, Monterey, CA, USA. [Contributed Oral]