Mina Papahn Zadeh

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SUMMARY OF QUALIFICATIONS

PhD candidate in Physics and Engineering Physics specializing in particle-in-cell (PIC) simulations of plasma systems, including Hall thrusters, Penning discharges, and magnetic nozzles. Proficient in developing and applying open-source and commercial codes for Multiphysics plasma modeling, with strong expertise in Python, C, C++, Fortran, and Linux-based workflows, and GPU-accelerated high-performance computing. Expertise in analytical/numerical evaluation of plasma dispersion relations and data-driven modeling with a growing interest in leveraging physics-informed machine learning to accelerate plasma research. Collaborated with industry and national laboratories (Applied Materials Inc., Princeton Plasma Physics Laboratory) to address applied plasma challenges. Over 14 years of physics teaching experience, combining deep technical knowledge with strong communication, mentoring, and project management skills.

TECHNICAL SKILLS – COMPUTATIONAL & SCIENTIFIC

- **Programming & Scripting:** Python (NumPy, Pandas, Matplotlib, Seaborn, Plotly, PyTorch), Fortran, C++, Bash, Linux, Java
- **Simulation Frameworks:** WarpX, EDIPIC, VSim, XOOPIC, XES1
- **Scientific Computing:** FFT, MUSIC spectra, Dispersion solvers, Numerical integration/differentiation
- **High-Performance Computing:** GPU acceleration (CUDA, GPU-enabled codes), SLURM job scheduling, Cluster setup, Parallel computing (MPI/OpenMP)
- **Independent Machine Learning Study:** Physics-Informed Neural Networks (PINNs), MySQL
- **Data Analysis & Visualization:** Signal processing, Phase space visualization, Mode decomposition
  Tools & Platforms: MATLAB, Mathematica, Jupyter Notebooks, PyCharm, Anaconda, MS office, MS windows, MS Excel, MS outlook
- **Version Control:** Git/GitHub workflows for simulation deployment
- **Web & IT Systems:** Cascade CMS (content management and customization), Wix web design & development, Cengage WebAssign (digital courseware setup, integration, user support)

EDUCATION & TRAINING

- **PhD (Plasma Physics)** **2021 – 2025 (expected)**
  University of Saskatchewan, Saskatoon, SK, Canada
- **M.Sc. (Plasma Physics)** **2019 – 2021**
  University of Saskatchewan, Saskatoon, SK, Canada
- **M.Sc. (Physics)** **2005 – 2008**
  Amir Kabir University of Technology (Tehran Polytechnic), Tehran, Iran
- **B.Sc. (Physics teaching)** **2001 – 2005**
  Shahid Rajaee Teacher Training University, Tehran, Iran

WORK & RESEARCH EXPERIENCE

Plasma Modeling and Simulation Researcher **Sep 2019 – Present**
University of Saskatchewan, SK, Canada

- Developed a computational setup and performed 2D and 3D Monte Carlo kinetic simulations of plasma systems—including Penning reflex discharges, Hall thrusters, and magnetic nozzles—using VSim, WarpX, EDIPIC, and XOOPIC.
- Conducted spatiotemporal instability analysis, investigated spoke structures, and performed data-driven diagnostics of plasma behavior using custom Python scripts.
- Performed analytical and mathematical investigation to support theoretical plasma physics research and dispersion relation modeling.
- Conducted data-driven diagnostics of plasma behavior using custom Python scripts.

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- Perform large-scale plasma simulations using HPC resources, including GPU workflows on Compute Canada, Plato, and Princeton clusters.
- Served as a peer reviewer for the Physics of Plasmas (PoP) journal, contributing to scholarly review in the field.

Industrial Research Collaboration **Jun 2022 – Present**

Applied Materials & Princeton Plasma Physics Laboratory (PPPL)-Remote

- Participated in the Landmark Benchmark Initiative, a collaborative effort involving 21 international institutions and 17 simulation codes to verify kinetic low-temperature plasma models.
- Modeled and performed 2D and 3D PIC simulations to computationally support experimental studies of cylindrical Penning discharges in the reflex configuration.
- Collaborated closely with experimental teams at Applied Materials and PPPL to analyze electron and ion dynamics, characterize azimuthal and axial fluctuations, and identify mechanisms driving plasma instabilities and electron transport.
- Gained in-depth knowledge of industry-specific challenges and applied physics in commercial and national lab settings.

Lecturer in Physics **Sep 2023 – Present**

University of Saskatchewan, SK, Canada

- Developed course websites and integrated digital content using CMS and LMS platforms (Cengage WebAssign, Canvas)
- Designed engaging multimedia presentations informed by best practices in adult education.
- Synthesized complex technical information and presented it to general/non-specialist audiences.
- Coordinated with a team of three lecturers and two teaching assistants to ensure content delivery was standardized and aligned with department guidelines.
- Demonstrated exceptional communication and public speaking skills through weekly presentations.
- Developed and updated course materials, syllabi, and assessments, including quizzes, exams, assignments. and hands-on demonstrations to actively engage students.

Independent Researcher **Mar 2023 – July 2023**

University of Saskatchewan, SK, Canada

- Conducted a comprehensive study on magnetic reconnection processes in laboratory and space plasmas.
- Explored topics including magnetohydrodynamics, ideal MHD, magnetic field topology, tearing instabilities, magnetic islands, classical reconnection models, and magnetic turbulence.
- Studied Harris equilibrium profiles and analyzed reconnection dynamics using theoretical and analytical approaches.
- Acquired an extensive understanding of magnetic reconnection and its impact on fusion devices (plasma confinement, stability) and space phenomena (solar flares, coronal mass ejections, geomagnetic storms).

Teaching Assistant **Sep 2019 – Present**

(Lab Demonstrator / Marker / Help Desk Assistant)

University of Saskatchewan, SK, Canada

- Collaborated with instructors to support undergraduate physics courses.
- Assisted in laboratory instruction and student supervision
- Graded assignments and exams, and provided student support through the departmental help desk

Physics Teacher in High school **2008 - Aug 2019**

Ministry of Education, Iran

- Developed and delivered physics lesson plans, labs and assessments aligned with national curriculum.
- Adapted instructional strategies to accommodate diverse learners, and student engagement.
- Designed and conducted hands-on, inquiry-based physics experiments.

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- Monitored academic progress of students monthly and communicated results with parents and administration.
- Collaborated with faculty on student success and curriculum improvement initiatives.
- Recognized for excellence in teaching (2011); served as Regional Physics Leader (2014–2019) and member of Gilan Province Physics Curriculum and Teacher Societies.

Lecturer in Physics at University **2008 - 2010**

Islamic Azad University of Shooshtar, Iran
Payame Noor University of Shooshtar, Iran

- Taught courses Phys 111, 112, 115 and Phys 112L lab

PUBLICATION

Published /Preprints

- Azimuthal and axial structures in 3D Particle-in-Cell simulation of Penning discharge. *Plasma Sources Science and Technology*. Papahn Zadeh, M., Likhanskii, A., Smolyakov, A. I., Tyushev, M., Chopra, N. S., Romadanov, I., & Raitses, Y. (2025). Doi: 10.1088/1361-6595/ae1a16
- Impact of the radial electric field on plasma instabilities in a penning discharge: Insights from a 3D particle-in-cell model. *Physics of Plasmas*, 32, no. 8(2025) https://doi.org/10.1063/5.0271375
- Multimodal azimuthal oscillations in electron beam generated E×B plasma. *Physics of Plasma*, 32, no. 7(2025) https://doi.org/10.1063/5.0273397
- Mode transitions and spoke structures in E × B Penning discharge. *Physics of Plasmas*, 32, no. 1 (2025) https://doi.org/10.1063/5.0238577
- Azimuthal structures and turbulent transport in Penning discharge. *Physics of Plasmas* 30, no. 3 (2023) https://doi.org/10.1063/5.0129804
- The electron cyclotron drift instability: a comparison of particle-in-cell and continuum Vlasov simulations. *Physics of Plasmas*, 30, no. 3 (2023) https://doi.org/10.1063/5.0134457
- The role of noise in PIC and Vlasov simulations of the Buneman instability. *Physics of Plasmas*, 28, no. 12 (2021) https://doi.org/10.1063/5.0070482
- Backward waves in the nonlinear regime of the Buneman instability. *Physics of Plasmas*, 28, no. 2 (2021) https://doi.org/10.1063/5.0032520

Under Review / Submitted Manuscripts

- *Physics of Plasmas* (June 2025) – *Under review*
  Benchmark for two-dimensional large-scale coherent structures in partially magnetized E×B plasmas: Community collaboration & lessons learned
  Authors: A.T. Powis, E. Ahedo, A. Álvarez Laguna, et al., including Mina Papahn Zadeh

Published book (2017)

- Along with physics 3 and laboratory, is a book for high school students by focusing on problem-solving in classical Electromagnetism.

CONFERENCES PRESENTATION

78th Annual Gaseous Electronics Conference (October 2025)

- Oral Presentation Title: Investigation of Azimuthal and Axial Dynamics in 3D PIC Simulations of $E \times B$ Penning Discharge

CAP Congress 2025, (June 2025)

- Oral Presentation Title: Azimuthal and axial structures in 3D Particle-in-Cell simulation of Penning discharge

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77th Annual Gaseous Electronics Conference, (October 2024)

- Poster Presentation Title: Mechanisms of gradient-drift instabilities in partially magnetized $E \times B$ plasmas.

76th Annual Gaseous Electronics Conference, (October 2023)

- Oral Presentation Title: 3D effects in the simulations of the magnetized DC plasma sources for ion implantation.

XXXV edition of International Conference on Phenomena in Ionized Gases ICPIG (July 2023)

- Poster presentation Title: Benchmark of particle-in-cell simulations of a Penning-type discharge: Preliminary results.

65th Annual Meeting of the APS Division of Plasma Physics, (October 2023), Virtual

- Oral Presentation Title: Spoke and spiral arm structures in Penning discharges.

74th Annual Gaseous Electronics Conference Volume 66, Number 7 (October 2021), Virtual

- Oral Presentation Title: Structures and anomalous transport in Penning discharge driven by the electron beam source
- Presented multiple oral and poster contributions at the Iranian Conference on Physics Education from 2014 to 2016, focusing on innovative teaching methods and experimental approaches in physics education.