Opal Issan

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EDUCATION

University of California San Diego — La Jolla, CA
Ph.D. in Mechanical and Aerospace Engineering — Sept. 2021 – Present
Specialization in Plasma Physics and Numerical Methods
GPA: 4.0/4.0

San Diego State University — San Diego, CA
B.S. in Applied Mathematics — Aug. 2017 – May 2021
Specialization in Computational Science
Major GPA: 4.0/4.0

RESEARCH EXPERIENCE

Graduate Student Researcher — Remote Work
T–5 Plasma Physics Theoretical Division, Los Alamos National Laboratory — April 2024 – Present
Advisors: Dr. Gian Luca Delzanno, Dr. Salomon Janhunen, and Dr. Vadim Roytershteyn (Space Science Institute)

- Developed quasilinear theory to understand how cold electrons dampen whistler waves and how cold protons dampen electromagnetic ion cyclotron waves via a secondary drift-driven instability.
- Validated the quasilinear theory via comparison to nonlinear kinetic particle-in-cell and hybrid simulations.

Graduate Research Assistant — La Jolla, CA
Department of Mechanical and Aerospace Engineering, University of California San Diego — Sept. 2021 – Sept. 2024
Advisor: Prof. Boris Kramer

- Developed a reduced-order model that predicts the ambient solar wind 30% faster than MAS, with comparable accuracy [7].
- Performed variance-based global sensitivity analysis and Bayesian inference of the ambient solar wind parameters via ACE observations [6].

Heliophysics Researcher — Remote Work
Frontiers Development Lab — June 2024 – Aug. 2024
Advisors: Dr. Mike Heyns (Imperial College London)

- Developed a Gaussian process spherical harmonic and spherical elementary currents interpolator with quantified uncertainty of global geomagnetic ground perturbations via nearly 600 magnetometer station measurements.

Space Weather Summer School Student — Los Alamos, NM
T–5 Plasma Physics Theoretical Division, Los Alamos National Laboratory — June 2023 – July 2023
Advisors: Dr. Gian Luca Delzanno, Dr. Oleksandr Koshkarov, and Dr. Federico Halpern (General Atomics)

- Formulated an anti-symmetric and positivity-preserving spectral discretization for the Vlasov-Poisson equations. This novel formulation is unconditionally stable, structure-preserving, and conserves the number of particles, which is important for long-term numerical simulations of plasma processes [1–4].

Undergraduate Research Assistant — San Diego, CA
Department of Mathematics and Statistics, San Diego State University — May 2020 – Aug. 2021
Advisor: Prof. Christopher Curtis

- Developed an autoencoder that finds a finite-dimensional approximation of the Koopman operator with Tensorflow 2.0. The encoder mapping transforms the nonlinear trajectories to a space where the dynamics are linear [8].

Solar Physics Intern — San Diego, CA
Predictive Science Inc. — Dec. 2019 – July 2021
Advisors: Dr. Pete Riley and Dr. Cooper Downs

- Developed a robust method for automatically tracking spatiotemporal properties of coronal holes as part of Coronal Hole Mapping and Analysis Pipeline (*CHMAP*) Python package.
- Refined the Heliospheric Upwind eXtrapolation (HUX) model, which maps solar wind proton velocity from the inner heliosphere to Earth via employing finite-difference flux-limiter higher-order schemes. The HUX model is tested on observational data from various spacecrafts, e.g., Parker Solar Probe, Ulysses, and Wind [9-10].
- Developed *mesh-generator*, a Python package, for a spherical mesh generator that increased the accuracy of simulating coronal mass ejections.

AWARDS AND FELLOWSHIPS

1. UCSD MAE **Outstanding PhD Student of the Year Award** (2025).
2. UCSD MAE **Outstanding PhD Teaching Assistant of the Year Award** (2024).
3. Center for Space and Earth Science **(CSES) Fellowship** (June 2024): This fellowship is given by the LANL on our proposal "Effect of cold plasma on whistler waves in the magnetosphere" (with co-PI Oleksandr Koshkarov), total of 210,000$ for three years.
4. Awardee of the LANL **Vela Fellowship** (July 2023): Funding for PhD students as part of the Space Weather Summer School, total of 14,000$.
5. Awardee of the 2023 **best presentation award** at the CaCAO (ChAos, Computation, Analysis, and Optimization) group led by Prof. Mattias Morzfeld at the Scripps Institution of Oceanography.
6. Strategic Enhancement of Excellence Through Diversity **(SEED) Fellowship** (Aug. 2021): This award is given to outstanding PhD students at UCSD, which provides three years of funding.

PREPRINTS

[1] **Issan O**, Roytershteyn V, Delzanno GL, Janhunen S (2025). Understanding cold electron impact on parallel-propagating whistler chorus waves via moment-based quasilinear theory (submitted). preprint doi: arXiv:2512.03269

JOURNAL PUBLICATIONS

[2] **Issan O**, Koshkarov O, Halpern F, Delzanno GL, Kramer B (2025). Conservative data-driven model order reduction of a fluid-kinetic spectral solver. Physics of Plasmas, 32:083907. doi: 10.1063/5.0275478

[3] **Issan O**, Chapurin O, Koshkarov O, Delzanno GL (2025). *Effects of Artificial Collisions, Filtering, and Nonlocal Closure Approaches on Hermite-based Vlasov-Poisson Simulations.* Physics of Plasmas, 32:033906. doi: 10.1063/5.0252456

[4] **Issan O**, Koshkarov O, Halpern F, Kramer B, Delzanno GL (2025). *Conservative Closures of the Vlasov-Poisson Equations Discretized with a Symmetrically Weighted Hermite Spectral Expansion in Velocity.* Journal of Computational Physics, 524:113741. doi: 10.1016/j.jcp.2025.113741

[5] **Issan O**, Koshkarov O, Halpern F, Kramer B, Delzanno GL (2024). *Anti-symmetric and Positivity Preserving Formulation of a Spectral Method for Vlasov-Poisson Equations.* Journal of Computational Physics, 514:113263. doi: 10.1016/j.jcp.2024.113263

[6] Bychkov A, **Issan O**, Pogudin G, Kramer B (2023). *Exact and Optimal Quadratization of Nonlinear Finite-Dimensional Non-autonomous Dynamical Systems.* SIAM Journal on Applied Dynamical Systems, 23:982-1016. doi: 10.1137/23M1561129

[7] **Issan O**, Riley P, Camporeale E, Kramer B (2023). *Bayesian Inference and Global Sensitivity Analysis for Ambient Solar Wind Prediction.* Space Weather, 21, e2023SW003555. doi: 10.1029/2023SW003555

[8] **Issan O** and Kramer B (2022). *Predicting Solar Wind Streams from the Inner-Heliosphere to Earth via Shifted Operator Inference.* Journal of Computational Physics, 473:111689. doi: 10.1016/j.jcp.2022.111689

[9] Alford-Lago D, Curtis C, Ihler A, and **Issan O** (2022). *Deep Learning Enhanced Dynamic Mode Decomposition.* Chaos, 32(3):033116. doi: 10.1063/5.0073893

[10] **Issan O** and Riley P (2022). *Theoretical Refinements to the Heliospheric Upwind eXtrapolation Technique and Application to in-situ Measurements.* Frontiers in Astronomy and Space Sciences, 8:795323. doi: 10.3389/fspas.2021.795323

[11] Riley P and **Issan O** (2021). *Using a Heliospheric Upwinding eXtrapolation Technique to Magnetically Connect Different Regions of the Heliosphere.* Frontiers in Physics, 9:679497. doi: 10.3389/fphy.2021.679497

RELEVANT COURSEWORK

• Astrophysical Fluid Dynamics • Probabilistic Reasoning & Learning • Model Reduction • Hydrodynamic Instability • Potential Flow • Computational Fluid Dynamics • Uncertainty Quantification • Numerical Methods • Fluid Dynamics • Geophysical Data Analysis • Applied Mathematics • Plasma Physics • Turbulence

COMPUTER SKILLS

• Programming languages: Python, Matlab, Maple, Julia, C/C++. • Version control tools: Git, Bitbucket.
• Operating systems: MacOS, Windows, Linux.