

B.L. DuBois

ML Scientist | Mathematician | Former Green Beret

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Research Interests

ML Theory + Application

- 📌 I'm interested in new ML techniques, methods, and architectures from a theoretical and mathematical perspective. I'm also interested in how advances in ML theory can enable new applications in science, technology, and AI.

Application Areas

- 📌 **ML for Science:** Intelligent processing of astrophysical simulations and spectral-line observations. Automating scientific insight, discovery, and theory genesis.
- 📌 **ML for Technology:** Image processing, advanced sensing methods, passive radar for air/space-domain awareness.
- 📌 **ML for AI:** New architectures and modularized/adaptive memory for language models.

Education

- Class of 2026
- 📌 **BS, University of Connecticut.** Mathematics (GPA: 3.73).
Graduate coursework: *Modern Analysis, Abstract Algebra I–II, Measure Theory, Functional Analysis.*

Employment

- 2024 – 2026
- 📌 **Researcher,** Department of Physics, University of Connecticut.
 - ◇ Led an independent research program applying ML solutions to problems in astrophysics, with a focus on deciphering the 3D structure of the Milky Way Galaxy's Central Molecular Zone (CMZ).
 - ◇ Work culminated in creation of the IRIS project, yielding a publication and open-source code release.
 - ◇ Designed neural networks and PyTorch training pipelines involving convolutional neural networks (CNNs), generative adversarial networks (GANs), autoencoders, transformers, and neural fields.
 - ◇ Used a purpose-designed CNN to infer 3D spatial structure in radio/microwave spectral-line observations by training on a massive custom dataset of galactic simulations.
 - ◇ Developed code to synthetically observe galactic/hydrodynamic simulations differentially in PyTorch by simulating radiation physics.
- 2017 – 2024
- 📌 **Green Beret + Other Roles,** US Army.
 - ◇ Among other roles, served as a Senior Special Forces Communications Sergeant (18E) on an Operational Detachment Alpha (ODA).

Publications

- 1 **B. L. DuBois,** C. Battersby, J. C. Baade, D. R. Lipman, H. P. Hatchfield, J. Sullivan, R. Bentley, S. Reissl, R. S. Klessen, V. F. Ksoll, M. C. Sormani, Z.-X. Feng, A. Ginsburg, and R. G. Tress, "IRIS: Deciphering spectral-line imagery of the galactic center by machine-learning on simulations," 2026. [DOI: 10.48550/arXiv.2607.01338](#). arXiv: 2607.01338 [astro-ph.GA].

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D. R. Lipman, C. Battersby, D. Walker, M. Clavel, **B. L. DuBois**, A. Ginsburg, J. D. Henshaw, R. S. Klessen, E. A. C. Mills, F. Nogueras-Lara, M. C. Sormani, and R. G. Tress, “3D CMZ. V. A New Orbital Model of Our Galaxy’s Center, Informed by Data Across the Electromagnetic Spectrum,” *The Astrophysical Journal*, vol. 1002, no. 1, p. 24, May 2026, Art. no. 24. [DOI: 10.3847/1538-4357/ae561f](https://doi.org/10.3847/1538-4357/ae561f).






Code Releases

2026 **Imagery Reversion Informed by Simulation (IRIS)**

github.com/blDubois/IRIS

- ◇ A large ML project in astrophysics, released in tandem with the IRIS paper [1].
- ◇ Uses a deep convolutional neural network (CNN) to infer spatial structure in microwave spectral-line observations of the galactic center by training on galactic simulations.
- ◇ Results yielded a new “bird’s eye” perspective of our own galaxy’s Central Molecular Zone (CMZ).
- ◇ Also includes code for the synthetic observation of spectral lines in galactic/hydrodynamic simulations by modeling radiation physics.
- ◇ The IRIS synthetic-observation code is fully differentiable in PyTorch and, through GPU acceleration, provides speedups in excess of 10,000x against established counterparts.

Skills

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| Coding |  A variety of imperative and functional languages, including Python, C, Haskell. |
| ML |  PyTorch, TensorFlow, Keras; familiarity with a broad variety of training techniques and architectural heuristics including convolutional neural networks (CNNs), generative adversarial networks (GANs), autoencoders, transformers, and neural fields. |
| HPC |  Scientific and parallel/distributed computing techniques for high-performance CPU and GPU clusters (HPCs), including with NumPy, CuPy, MPI, mpi4py, Slurm. |
| Languages |  Mandarin Chinese, basic familiarity; formerly 3/3 on the Oral Proficiency Interview (OPI). |
| Misc. |  Git version control, typesetting with \LaTeX and TikZ. |