Mariel Pettee

Physicist, AI researcher, and artist

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Education

2021 — Yale University — *New Haven, CT*
PhD in Physics

2015 — University of Cambridge • Trinity College — *Cambridge, UK*
MASt in Physics, Commendable Performance
Lt. Charles H. Fiske III Harvard-Cambridge Scholar

2014 — Harvard University — *Cambridge, MA*
AB in Physics and Mathematics (Cum Laude, High Honors in Field)
Dramatic Arts Secondary

Research Positions

2022 - Now — Guest Researcher • *Flatiron Institute Center for Computational Astrophysics*

- Building foundation models for science with the Polymathic AI Collaboration
- **Supervisor:** Prof. Shirley Ho

2021 - Now — Chamberlain Postdoctoral Fellow • *Lawrence Berkeley National Lab*

- Identifying stellar streams in the Gaia dataset with weakly-supervised anomaly detection
- Performing an unbinned measurement of 24 Z+jets observables in the ATLAS detector
- Developing GNNs for particle reconstruction in the ATLAS detector
- Exploring best practices for learning likelihood ratios in physics datasets with AI
- **Supervisor:** Dr. Benjamin Nachman

2020 — AI Intern • *Intel AI Lab*

- Using recurrent VAEs to learn latent graph representations of the human body
- **Supervisor:** Dr. Hanlin Tang

2016 - 2021 — Graduate Researcher • *Yale University & CERN*

- Searching for $V \rightarrow$ leptons, $H \rightarrow \tau\tau$ in Run 2 with the ATLAS Experiment
- Identifying tau leptons in the ATLAS trigger with Recurrent Neural Networks
- Optimizing trigger & data acquisition for the Mu2e Experiment at Fermilab
- **Supervisor:** Prof. Sarah Demers

Publications

Full list of papers with the ATLAS Collaboration. (**Note:** ▷ *indicates alphabetical author ordering.*)

2023 — The ATLAS Collaboration. Evidence of the VH, H⟶ττ process with the ATLAS detector in Run 2. HIGG-2018-20. (Submitted to Phys. Rev. B).

The ATLAS Collaboration. A Simultaneous Unbinned Differential Cross Section Measurement of 24 Z+jets Kinematic Observables with the ATLAS Detector. (In preparation).

S. Golkar, **M. Pettee**, M. Eickenberg, A. Bietti, M. Cranmer, G. Krawezik, F. Lanusse, M. McCabe, R. Ohana, L. Parker, B. Régalo-Saint Blancard, T. Tesileanu, K. Cho, S. Ho. xVal: A Continuous Number Encoding for Large Language Models. (In review at ICLR; accepted to NeurIPS AI for Science Workshop).

M. Pettee, S. Thanvantri, B. Nachman, D. Shih, M. R. Buckley, J. H. Collins. Weakly-Supervised Anomaly Detection in the Milky Way. *MNRAS*. [arXiv:2305.03761] [astro-ph.GA].

S. Rizvi, **M. Pettee**, B. Nachman. Learning Likelihood Ratios with Neural Network Classifiers. (In review at JHEP; accepted to NeurIPS ML for the Physical Sciences Workshop). [arXiv:2305.10500] [hep-ph].

V. Mikuni, **M. Pettee**, B. Nachman. Fast Point Cloud Generation with Diffusion Models in High Energy Physics. *Phys. Rev. D.* [arXiv:2304.01266] [hep-ph].

▷ A. Huang, X. Ju, J. Lyons, D. Murnane, **M. Pettee**, L. Reed. Heterogeneous Graph Neural Network for Identifying Hadronically Decayed Tau Leptons at the High Luminosity LHC. *JINST*. [arXiv:2301.00501] [physics.ins-det].

2022 ▷ A. Bogatskiy, S. Ganguly, T. Kipf, R. Kondor, D. W. Miller, D. Murnane, J. T. Offermann, **M. Pettee (co-editor)**, P. Shanahan, C. Shimmin, and S. Thais. Symmetry Group Equivariant Architectures for Physics. *Snowmass 2021 White Paper*. [arXiv:2203.06153] [cs.LG].

The ATLAS Collaboration. Point Cloud Deep Learning Methods for Pion Reconstruction in the ATLAS Experiment. [ATL-PHYS-PUB-2022-040].

M. Papillon, **M. Pettee**, N. Miolane. PirouNet: Creating Dance through Artist-Centric Deep Learning. *EAI ArtsIT 2022 (Best Paper Award)*. [arXiv:2207.12126] [cs.LG].

M. Papillon, **M. Pettee**, N. Miolane. Intentional Choreography with Semi-Supervised Recurrent VAEs. *NeurIPS 2022 Workshop on Machine Learning for Creativity and Design*. [arXiv:2209.10010] [cs.LG].

▷ G. Kasieczka, R. Mastandrea, V. Mikuni, B. Nachman, **M. Pettee**, D. Shih. Anomaly Detection Under Coordinate Transformations. [arXiv:2209.06225] [hep-ph].

2021 **M. Pettee**. Interdisciplinary Machine Learning for Particle Physics. *PhD Thesis, Yale University*.

2020 **M. Pettee**, S. Miret, S. Majumdar, and M. Nassar. Choreo-Graph: Learning Latent Graph Representations of the Dancing Body. *NeurIPS 2020 Workshop on Machine Learning for Creativity and Design*.

2019 **M. Pettee**, C. Shimmin, D. Duhaime, and I. Vidrin. Beyond Imitation: Generative and Variational Choreography via Machine Learning. *Proceedings of the 10th International Conference on Computational Creativity*. [arXiv:1907.05297] [cs.LG].

The ATLAS Collaboration (**co-editor**). Expected Performance of the ATLAS Detector at the High-Luminosity LHC. [ATL-PHYS-PUB-2019-005].

Talks

Invited Talks

2024 Towards Foundation Models for Fundamental Physics

- AI-Driven Discovery in Physics and Astrophysics Workshop, University of Tokyo
- ML for HEP Workshop, KEK, Japan

2023 xVal: A Continuous Number Encoding for Large Language Models

- IBM Research Seminar

Interdisciplinary AI for Fundamental Physics

- Hammers & Nails (Swiss Edition) – *Ascona, Switzerland*
- Workshop on Data-Driven Galaxy Evolution – *KITP & CCA*

Weakly-Supervised Anomaly Detection in the Milky Way

- University of Chicago Data Science Institute & James Franck Institute Seminar
- Rutgers University High-Energy Physics Theory Seminar

Equivariance Meets Invariance: Physics-Informed Machine Learning *Minneapolis, MN*

- American Physical Society (APS) April Meeting

2022 Machine Learning for High-Energy Physics *University of Alabama*

- Departmental Colloquium: Physics & Astronomy

Dancing With Myself *University of Alabama*

- Departmental Colloquium: Theatre & Dance

Panel Discussion: Creativity, Science, and Ethics *Ballet Des Moines*

Y-Exchange Featured Artist *Kinetech Arts*

2021 - 2022 Interdisciplinary Machine Learning for Choreography & Particle Physics *Online*

- Stanford Linear Accelerator (SLAC) AI Seminar
- UC Irvine Physics & Astronomy Machine Learning Seminar Series
- Imperial College London, DataLearning Working Group Seminar
- Amherst College, Artificial Intelligence in the Liberal Arts Seminar Series
- Cornell Laboratory for Elementary Particle Physics Journal Club
- Berkeley Institute for Data Science (BIDS) ML + Science Forum
- Physics Dept. Colloquium at Seattle University
- HEP Seminar Speaker at University of Tennessee, Knoxville
- University of Alabama, Machine Learning Graduate Course Guest Seminar
- Flatiron Institute Center for Computational Astrophysics ML Forum

2020 Choreo-Graph: Learning Latent Graph Representations of the Dancing Body *Online*
Kinetech Arts (San Francisco, CA)

Beyond Imitation: Generative Choreography with AI *Brown University*
Conference for Research on Choreographic Interfaces (CRCI)

Contributed Talks

2023 Weakly-Supervised Anomaly Detection in the Milky Way *New York, NY*
Flatiron-Wide Machine Learning Meeting

2022 Point Cloud Methods for Pion Reconstruction in the ATLAS Detector

- Inter-experiment Machine Learning Workshop *CERN*
- APS April Meeting *New York, NY*

2021 Dancing with Myself *St. Louis, MO*
Strange Loop

2020 Choreo-Graph: Learning Latent Graph Representations of the Dancing Body *Online*
NeurIPS Workshop on ML for Creativity and Design

Run 3 Triggers for HLeptons Analyses *Online*
ATLAS Tau & HLeptons Workshop

2019 Expected ATLAS Performance at the HL-LHC *UMass Amherst*
US ATLAS Workshop

Overview of Tau vs. Jet Identification *Prague, Czech Republic*
ATLAS Tau & HLeptons Workshop

Beyond Imitation: Generative Choreography via Machine Learning *Charlotte, NC*
International Conference on Computational Creativity (ICCC)

2018 RNN Tau Identification within the ATLAS HLT *Fermilab*
US LHC Users Association Meeting

RNN Tau Identification in the ATLAS HLT *CERN*
ATLAS Machine Learning Workshop

The 2018 ATLAS Tau Trigger & Combined Performance *Pittsburgh, PA*
US ATLAS Workshop

Tau Trigger & CP Performance at High μ *CERN*
ATLAS P&P Physics Plenary

FTK & the Tau Trigger *CERN*
ATLAS TDAQ Week

Awards

2021 Owen Chamberlain Postdoctoral Fellowship *Lawrence Berkeley National Laboratory*

2018 Lightning Round Talk Winner *US LHC Users Association*

Women's Faculty Forum Seed Grant *Yale University*

2016 Winner, Windy City Physics Slam *ICHEP*
- PBS Chicago Interview Clip

Poster Award for *Trigger Studies for the Muze Experiment* *ICHEP*

2015 Leigh Page Prize (for potential contributions to the field of physics) *Yale University*

Honorable Mention *NSF Graduate Research Fellowship Program*

2014 Harvard-Cambridge Scholarship *Harvard University*
- Full tuition for a master's program at the University of Cambridge

Julia Shaffner Memorial Prize (outstanding woman in science) *Harvard University*

2013 President's Challenge Finalist *The Harvard Innovation Lab*

15 Most Interesting Seniors *The Harvard Crimson*

2012 Judges' Award for Acting *The International Student Drama Festival*

Certificate of Distinction in Teaching *Harvard University*

The Caroline Isenberg and Elizabeth Cary Agassiz Fellowships *Harvard University*

2011 Best Lead Actress in a Play *Harvard Theater Award*

Press

2023 "Scientists Begin Building AI for Scientific Discovery Using Tech Behind ChatGPT"
- Simons Foundation Press Release
- Berkeley Lab Article

2022 Interviewee on the Cognicast podcast
- A wide-ranging discussion of my research trajectory across AI, physics, and art
- Episode webpage
- Listen on Apple Podcasts

2021 Mariel Pettee successfully defends PhD thesis, *Yale Physics*

2020 Advice to Women in STEM: Mariel Pettee, *Yale Scientific Magazine*

2019 Feature on Yale's Instagram page

2016 Scientists Battle for Physics Slam Crown, *PBS Chicago*

2013 15 Most Interesting Seniors: Mariel N. Pettee, *The Harvard Crimson*

Posters

2022 Point Cloud Methods for Pion Reconstruction in the ATLAS Detector — *Online*
LHCP 2022

2020 Choreo-Graph: Learning Latent Graph Representations of the Dancing Body — *Online*
Women in Machine Learning (WiML) at NeurIPS 2020

RNN Tau Identification in the ATLAS High-Level Trigger — *CERN*
ATLAS Trigger & Data Acquisition Week 2020

2019 Generative & Variational Choreography via Machine Learning — *Vancouver, Canada*
Women in Machine Learning (WiML) at NeurIPS 2019

Machine Woman: Preservation, Memory, Forgetting, and AI — *New Haven, CT*
Women's Faculty Forum at Yale

2017 Performance of the ATLAS Tau Trigger in Run 2 — *Seattle, WA*
Advanced Computing & Analysis Techniques in Physics Research (ACAT)

2016 Trigger Studies for the Mu2e Experiment — *Chicago, IL*
International Conference on High Energy Physics (ICHEP)

Writing

2023 LLMs and the Language of Science, *APS Topical Group on Data Science Newsletter*

xVal: A Continuous Number Encoding for LLMs, *Polymathic AI Collaboration Blog Post*

2018 Theories of Everything, *Sightline Arts*

Now or Never: The Case for a Larger Hadron Collider, *Yale Distilled Magazine*

Leadership & Service

2017 - 2021 HLeptons Trigger Liaison: Trigger Studies for the ATLAS $H \to \tau\tau$ Analysis Group

2019 - 2020 Reviewer for NeurIPS Physical Sciences Workshop

2020 Session Co-Convener, PyHEP 2020 (Conference for Python in High-Energy Physics)

2019 Reviewer for Women in Machine Learning (WiML) Workshop

Teaching

Guest Lectures

2023 The Language of Movement *Amherst College*

Training

2016 Physics 530: Theory and Practice of Scientific Teaching for Physical Scientists *Yale University*

2014 Astro 302: Scientists Teaching Science *Harvard University*

Yale University

2018 Physics 115: The Physics of Dance

American Studies 349: Technologies for Movement Research

2017 Physics 171: University Physics for the Life Sciences

Physics 115: The Physics of Dance

2016 Physics 205L: Modern Physical Measurement

Physics 115: The Physics of Dance

2015 Physics 165L: General Physics Laboratory

Harvard University

2013 Math 110: Vector Space Methods for Differential Equations

2012 - 2013 Math 121: Linear Algebra and Applications

Inclusion & Outreach Efforts

2022 - 2023 QuarkNet Speaker & Interviewee
- Presented a talk on physics, art, and ML to high school students
- Answered their questions in a separate hour-long interview

2020 Member of the American Physical Society's Inclusion, Diversity, and Equity Alliance (APS-IDEA)

2019 - 2021 Member of the Yale Physics Climate & Diversity Committee
- Advocated for a department-wide discussion of discrimination in our community
- Contributed to the design of our department's Code of Conduct

2018 - 2020 US LHC Users Association advocacy trip to Capitol Hill
- Met with the offices of around 15 representatives from Congress each year to ask for their support for high-energy physics research and STEM funding in general

2017 - 2018 Speaker, *Science in the News*, delivering scientific talks to the New Haven public

Girls' Science Investigations at Yale

2016 Winner, Windy City Physics Slam at ICHEP

Choreographer: *Form Factors*, a dance intervention with physicists at ICHEP

2015 - 2020 Yale Women in Physics Mentor

Arts

Directorial Work

2023 *mememormee*: an evening-length work featuring AI-generated choreography set on six dancers, following a residency at Amherst College

- Spotlight Presentation at the 2023 NeurIPS Workshop on ML for Creativity & Design

2021 Untitled Bird Project: a 1 hour pop-up exhibit featuring AI-generated bird calls situated in nature

2020 Mirror Exercise: an AI-generated duet with myself
- Featured in *Le Mérite*, at the Comédie de Caen, Théâtre des Cordes, France.
- Highlighted in the NeurIPS Workshop on ML for Creativity and Design's AI Art Gallery
- Digital exhibition at *Level Up*: The Dramaturgy of Digital Performance & Design
- Selected by the AI Transparency Institute & featured at the 2020 AI Governance Forum
- Boston Cyberarts Gallery exhibition *Perceptions / Distortions* (cancelled due to COVID-19)

2019 SIGMA: a short film of AI-generated choreography
- Featured in the NeurIPS 2019 Workshop on ML for Creativity & Design's AI Art Gallery

Performance Work

Bay Area

2022 Dancer, *Sublimation*
- By Kinetech Arts.
- Supported by the Djerassi Resident Artists Program and Creative Work Fund.
- Performed at David Ruth Glass Studio, Oakland, CA.

Dancer, *Detour*
- By Kinetech Arts, commissioned by the Berkeley Dance Project.
- Performed at Zellerbach Playhouse, Berkeley, CA.

Yale University

2020 Studio fellow, *Yale Center for Collaborative Arts & Media*
- Year-long paid fellowship to develop collaborative work across art & technology

Dancer & Coordinator, *Transpositions*
- Dancer in virtual performances by Brian Seibert and Elm City Dance Collective

Women+ Art AI: Part of a global collective of women working at the intersection of art & AI

Choreographer, *Elon Musk and the plan to Blow Up Mars the musical*
- Yale Cabaret, dir. Liam Bellman-Sharpe

Dancer, Coordinator, & Rehearsal Director, *Yale Dance Lab*
- New work by choreographer Vicky Shick: "*everywhere*"

2019 Featured performer, *Learning Film (working title)*

- Interviewed for a documentary by the Derek Jarman Lab, co-produced by Tilda Swinton

Bill T. Jones/Arnie Zane Dance Company Intensive, *Yale Dance Theater*
- Dancer in a restaging of *D-Man in the Waters*

2018 Dancer, *Dance Drawings (For Jock)*
- Choreography by Emily Coates located at the Yale Art Gallery's Sol LeWitt exhibit

Paul Taylor Dance Company Intensive, *Yale Dance Theater*
- Leading role as "The Hostess" in the first restaging of Taylor's *Party Mix* in four decades

Featured performer, *Machine Woman*
- An experiential short film documenting my AI-generated choreography research

2017 Choreographer: "La Mort du Chorégraphe", *A Different Drum Dance Company*

Urban Bush Women Intensive, *Yale Dance Theater*

2016 Gaga Intensive with Saar Harari & Lee Sher, *Yale Dance Theater*

Choreographer: "Rang Cherries", *A Different Drum Dance Company*

University of Cambridge

2015 Actor, *Attempts on Her Life*, dir. Tania Clarke, Corpus Playroom

Dancer, *Evolution*, ADC Theatre

Harvard University

2014 Director/Writer/Choreographer: *Symmetry Breaking*
- My creative physics thesis: an immersive multimedia performance about the Higgs boson

President, *The Signet Society of Arts & Letters*

Choreographer-in-Residence, *Harvard Dance Center*

Dancer, *Paper Wing*, chor. Jill Johnson, Farkas Hall

2013 Arts@CERN Internship

Eurydice, *Antigonick*, dir. Ianthe Demos, American Repertory Theater Mainstage

Isabelle & Executive Producer, *The Edge of the Map*, dir. Calla Videt (Sightline Theater Company)

Dancer, *At Last*, Loeb Experimental Theater

Dancer, *On The Run*, Harvard Dance Center

2012 Vice-President & Mainstage Coordinator, *The Harvard-Radcliffe Dramatic Club*
- 35+ productions as a performer, director, producer, designer, & choreographer

Lucy, *CryHurtFood*, Loeb Experimental Theater & Crucible Mainstage (Sheffield, UK)

Director: *for the purpose of catching ourselves in the act of being the most*
- Set the Guinness World Record for the longest telephone conversation between two people

2011 Co-founder and collaborator, *The Harvard Generalist* artistic collective

Drama & Dance Proctor, *Freshman Arts Program* (2011-2014)