

# Jatan Buch

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EMPLOYMENT	<b>Postdoctoral Research Scientist</b> Lamont-Doherty Earth Observatory, Columbia University <b>Visiting Assistant Professor</b> Department of Physics, Brown University	June 2021 – present February – May 2021
EDUCATION	<b>Ph.D. in Physics, Brown University</b> Providence, USA Thesis: <i>Astroparticle Searches for Dark Matter Physics</i> <b>M.Sc. in Physics, IIT Kharagpur</b> Kharagpur, India <b>B.Sc. in Physics, IIT Kharagpur</b> Kharagpur, India	September 2016 – February 2021 July 2013 – May 2015 July 2010 – June 2013
RESEARCH INTERESTS	My primary research objective is to develop physics-informed machine learning models to forecast global wildfire activity in particular, and extreme events broadly, using multiscale climate, vegetation, and population datasets. I am also interested in applying probabilistic modeling, causal inference, and deep learning methods to address complex real-world problems, with an emphasis on ones that involve quantifying the ecological and socioeconomic impact of climate change.	
FELLOWSHIPS & AWARDS	Deans' Faculty Fellow, Brown University, USA PRISMA Fellow, Mainz Institute for Theoretical Physics (MITP), Germany IRCC Fellow, IIT Bombay, India CEA Masters Internship, Institut de Physique Théorique (IPhT) Saclay, France KVPY Fellow, Department of Science and Technology, India	<b>2020</b> <b>2016</b> <b>2015</b> <b>2014</b> <b>2010</b>
MANUSCRIPTS	<b>J. Buch</b> , A. Jivani, X. Huan, A. Park Williams, P. Gentine, Learning Fire Spread Dynamics with Physics-Constrained Machine Learning ( <i>In preparation</i> ) G. P. Langlois, <b>J. Buch</b> , J. Darbon, Efficient and Robust Nonlinear High-Dimensional Maximum Entropy Estimation via Nonlinear Primal-Dual Hybrid Gradient Algorithms ( <i>In preparation</i> )	
PUBLICATIONS	(Abbreviations: AGU = American Geophysical Union; JCAP = Journal of Cosmology and Astroparticle Physics; Phys. Rev. D = Physical Review D) <b>J. Buch</b> , A. Park Williams, C.S. Juang, W.D. Hansen, P. Gentine, SMFire1.0: a Stochastic Machine Learning Model for Wildfire Activity in the Western United States ( <i>submitted</i> )    <a href="#">preprint</a>    <a href="#">code</a> <b>J. Buch</b> , M.A. Buen-Abad, J.S.C. Leung, J. Fan, Dark Matter Substructure Under the Electron Scattering Lamppost, <i>Phys. Rev. D</i> , <a href="https://doi.org/10.1103/PhysRevD.102.083010">doi.org/10.1103/PhysRevD.102.083010</a>    <a href="#">preprint</a>    <a href="#">code</a> <b>J. Buch</b> , M.A. Buen-Abad, J.S.C. Leung, J. Fan, Galactic Origin of Relativistic Bosons and XENON1T Excess, <i>JCAP</i> , <a href="https://doi.org/10.1088/1475-7516/2020/10/051">doi.org/10.1088/1475-7516/2020/10/051</a>    <a href="#">preprint</a> <b>J. Buch</b> , J.S.C. Leung, J. Fan, Implications of the Gaia Sausage for Dark Matter Nuclear Interactions, <i>Phys. Rev. D</i> , <a href="https://doi.org/10.1103/PhysRevD.101.063026">doi.org/10.1103/PhysRevD.101.063026</a>    <a href="#">preprint</a> <b>J. Buch</b> , J. Fan, J.S.C. Leung, Using Gaia DR2 to Constrain Local Dark Matter Density and Thin Dark Disk, <i>JCAP</i> , <a href="https://doi.org/10.1088/1475-7516/2019/04/026">doi.org/10.1088/1475-7516/2019/04/026</a>    <a href="#">preprint</a> <b>J. Buch</b> , P. Ralegankar, V. RENTALA, Late decaying 2-component dark matter scenario as an explanation of the AMS-02 positron excess, <i>JCAP</i> , <a href="https://doi.org/10.1088/1475-7516/2017/10/028">doi.org/10.1088/1475-7516/2017/10/028</a>    <a href="#">preprint</a>	

**J. Buch**, M. Cirelli, G. Giesen, M. Taoso, PPPC 4 DM secondary: A Poor Particle Physicist Cookbook for secondary radiation from Dark Matter, *JCAP*, [doi.org/10.1088/1475-7516/2015/09/037](https://doi.org/10.1088/1475-7516/2015/09/037) | | preprint

Total preprints: 1; Total publications: 6 | | Metrics: [Google Scholar](#)

#### TEACHING

(All at Brown University)

Instructor, Statistical Physics of Inference and Deep Learning Spring 2021

Assistant Instructor, Techniques in Experimental Physics Fall 2017/ Spring 2018

Teaching Assistant, Basic Physics A and B Fall 2016 – Fall 2017

#### MENTORING EXPERIENCE

Graduate students: Caroline Juang (Columbia; 2021 - present), Louis Hamaide (Brown; 2018-2019)

Undergraduate students: Adam Tropper (Brown; 2018), Pranjal Ralegankar (IIT Bombay; 2016-2017)

High School students: Kyleen Liao (Junior, Saratoga High; 2022)

#### CONTRIBUTED TALKS

K. Liao, K. Lamb, **J. Buch**, P. Gentine, Disentangling the Effects of Meteorological Variability and Wildfires on PM2.5 Concentrations in California using Machine Learning, AGU Fall Meeting, Chicago, USA December 2022

A. P. Williams, W. D. Hansen, J. Abatzoglou, **J. Buch**, A. T. Trugman, C.S. Juang, An Updated Attribution of the Effect of Anthropogenic Climate Trends on Western United States Forest Fire: 1984 – 2022, AGU Fall Meeting, Chicago, USA December 2022

**J. Buch**, A. P. Williams, C. S. Juang, W.D. Hansen, P. Gentine, Modeling wildfire activity with stochastic machine learning, AGU Fall Meeting, Chicago, USA December 2022

**J. Buch**, A. P. Williams, C. S. Juang, W.D. Hansen, P. Gentine, Multiscale climate-fire relationships in the western United States, APS March Meeting, Chicago, USA March 2022

**J. Buch**, M. A. Buen-Abad, J. Fan, J.S.C. Leung, Dark matter substructure under the electron scattering lampost, Cosmology from Home (Virtual talk) August 2020

**J. Buch**, J. Fan, J.S.C. Leung, Forecasting dark matter searches at next-generation direct detection experiments in light of astrophysical uncertainties: Method and Results, Division of Particles and Fields Meeting, Boston, USA July 2019

**J. Buch**, J.S.C. Leung, J. Fan, Estimating the local dark matter content using Gaia DR2, Stasis and Disequilibrium in the Milky Way Conference, Santa Barbara, USA April 2019

**J. Buch**, J.S.C. Leung, J. Fan, Estimating the local dark matter content using Gaia DR2, Identification of Dark Matter Conference, Providence, USA July 2018

**J. Buch**, The cosmological story of dark matter: a perspective, ICTP Summer School on Cosmology, Trieste, Italy June 2018

**J. Buch**, P. Ralegankar, V. Rentala, Late decaying 2-component dark matter as an explanation of the AMS-02 positron excess, TeV Particle Astrophysics Conference, Columbus, USA August 2017

#### PROFESSIONAL MEMBERSHIPS

Member: Asian Americans and Pacific Islanders in Geosciences (AAPIiG)

Early career member: American Physical Society (APS), American Geophysical Union (AGU), International Network of Networks for the Prediction and Management of Wildland Fires (iFireNet)

#### COMMUNITY ACTIVITIES

Reviewer: *Nature Geoscience*, *Environmental Research: Climate* 2022 - present

Student organizer, Centre for Fundamental Physics of the Universe (CFPU) seminars Fall 2020

Convenor, Applied Statistics Reading Group, Brown University 2018 – 2019

Graduate peer mentor, Undergraduate Paired Reading Program, Brown University 2017 – 2018

OUTREACH *Dark Matter: Real or Fake News?*, Public talk for Summer@Brown 2019  
Activity co-ordinator, Providence Big Bang Science Fair 2019  
Volunteer, Providence Big Bang Science Fair 2018

SKILLS *Statistics*: Likelihood-based methods, hypothesis testing, MCMC, graphical models, variational inference, Gaussian processes, supervised and unsupervised learning algorithms.  
*Deep learning*: convolutional neural networks, recurrent neural networks, generative adversarial networks, energy based networks  
*Programming*: Python, C, C++, high-performance computing, SQL, Git,  $\LaTeX$ ; Julia and MATLAB basics; Linear programming  
*Libraries*: NumPy, SciPy, Matplotlib, scikit-learn, pandas, PyTorch, TensorFlow and xarray  
*Scientific Software*: [PPPC4DMID secondary](#), [SMLFire1.0](#)  
*Languages*: English (proficient), Hindi (proficient), Gujarati (proficient), German (elementary).

REFERENCES

**A. Park Williams**  
**Associate Professor, University of California Los Angeles**  
Contact: [williams@geog.ucla.edu](mailto:williams@geog.ucla.edu)

**Pierre Gentine**  
**Maurice Ewing and J. Lamar Worzel Professor of Geophysics, Columbia University**  
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**Jiji Fan**  
**Associate Professor, Brown University**  
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