Jatan Buch

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Employment

Columbia University — June 2021 – present
Postdoctoral Research Scientist, Lamont-Doherty Earth Observatory,
Columbia Climate School

Brown University — February – May 2021
Visiting Assistant Professor, Department of Physics

Education

Brown University — Providence, USA
Ph.D., Physics — February 2021
Thesis: *Astroparticle Searches for Dark Matter Physics*

Indian Institute of Technology Kharagpur — Kharagpur, India
M.Sc., Physics — May 2015

Indian Institute of Technology Kharagpur — Kharagpur, India
B.Sc., Physics — June 2013

Research Interests

My current research focuses on modeling wildfire risk and spread, pyroconvection, aerosol-cloud interaction, and air quality impacts with physics-guided machine learning techniques. More broadly, I am interested in combining causal machine learning, dynamical simulations and multichannel data to address complex real-world solutions for climate mitigation and adaptation.

Fellowships & Awards

Eric and Wendy Schmidt AI in Science Postdoctoral Fellowship (*declined*) — 2023
University of California San Diego, USA

Deans' Faculty Fellow — 2020
Brown University, USA

PRISMA Fellow — 2016
Mainz Institute for Theoretical Physics (MITP), Germany

IRCC Fellow — 2015
Indian Institute of Technology (IIT) Bombay, India

CEA Masters Internship Award — 2014
Institut de Physique Théorique (IPhT) Saclay, France

KVPY Fellow — 2010
Department of Science and Technology, India

Publications

(Abbreviations: AGU = American Geophysical Union; JCAP = Journal of Cosmology and Astroparticle Physics; Phys. Rev. D = Physical Review D)

G. P. Langlois, **J. Buch**, J. Darbon, Efficient and Robust Nonlinear High-Dimensional Maximum Entropy Estimation via Nonlinear Primal-Dual Hybrid Gradient Algorithms *(In preparation)*

J. Buch, A. Park Williams, C.S. Juang, W.D. Hansen, P. Gentine, SMLFire1.0: a Stochastic Machine Learning Model for Wildfire Activity in the Western United States *(In revision)* | | preprint | | code

J. Buch, M.A. Buen-Abad, J.S.C. Leung, J. Fan, Dark Matter Substructure Under the Electron Scattering Lamppost, *Phys. Rev. D*, doi.org/10.1103/PhysRevD.102.083010 | | preprint | | code

J. Buch, M.A. Buen-Abad, J.S.C. Leung, J. Fan, Galactic Origin of Relativistic Bosons and XENON1T Excess, *JCAP*, doi.org/10.1088/1475-7516/2020/10/051 | | preprint

J. Buch, J.S.C. Leung, J. Fan, Implications of the Gaia Sausage for Dark Matter Nuclear Interactions, *Phys. Rev. D*, doi.org/10.1103/PhysRevD.101.063026 | | preprint

J. Buch, J. Fan, J.S.C. Leung, Using Gaia DR2 to Constrain Local Dark Matter Density and Thin Dark Disk, *JCAP*, doi.org/10.1088/1475-7516/2019/04/026 | | preprint

J. Buch, P. Ralegankar, V. Rentala, Late decaying 2-component dark matter scenario as an explanation of the AMS-02 positron excess, *JCAP*, doi.org/10.1088/1475-7516/2017/10/028 | | preprint

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 | | preprint

Total preprints: 1; Total publications: 6 || Metrics: Google Scholar

Invited Talks

Understanding and Modeling the Earth System with Machine Learning (USMILE) Seminar, Virtual talk — May 2023

Godard Institute of Space Studies (GISS) Lunch Seminar, NASA GISS — May 2023

Banerjee and Foufoula-Georgiou Group Meeting, UC Irvine — March 2023

Contributed Abstracts

J. Buch, A. Park Williams, P. Gentine, Seasonal forecasts of wildfire frequency and burned area in the western United States using a stochastic machine learning fire model (*Highlight talk*), EGU General Assembly, Vienna, Austria — April 2023

J. Buch, A. P. Williams, C. S. Juang, W.D. Hansen, P. Gentine, SMLFire1.0: A Stochastic Machine Learning model for wildfire activity in the Western United States, Scientific ML Symposium, San Diego, USA — March 2023

J. Buch, A. Jivani, X. Huan, A. Park Williams, P. Gentine, Learning Fire Spread Dynamics with Physics-Constrained Machine Learning, APS March Meeting, Las Vegas, USA — March 2023

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 lamppost, 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

Workshop Participation

Community Earth System Model (CESM) Tutorial, NCAR — July 2023

4th NOAA Workshop on Leveraging AI in Environmental Sciences, Virtual — September 2022

3rd NOAA Workshop on Leveraging AI in Environmental Sciences, Virtual — September 2021

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 - 2023), 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; 2022-2023)

Service

Reviewer: *Nature Geoscience*, *Environmental Research: Climate*, *Agricultural and Forest Meteorology*, *Global Change Biology* — 2022 - present

Judge, AGU Outstanding Student Presentation Award — 2022

Community Activities

Co-organizer, LEAP ML and Climate Seminar — 2023 - 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

General Secretary, Phi Society, IIT Kharagpur — 2013 – 2014

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

Scientific Software

SMLFire1.0: A Stochastic Machine Learning Model for Fire Activity

PPPC4DMID secondary: A Poor Particle Physicist Cookbook for Dark Matter Indirect Detection for secondary raditation

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

Pierre Gentine
Maurice Ewing and J. Lamar Worzel Professor of Geophysics, Columbia University
Contact: pg2328@columbia.edu

JiJi Fan
Associate Professor, Brown University
Contact: jiji_fan@brown.edu