

Research scientist interested in data science, machine learning, and deep learning, with strong track record of innovative and creative research ideas. Background in theoretical physics, allowing for strong conceptual, logical, and mathematical aptitude. Capable of learning new skills and concepts on the fly. Professional problem solver.

Education

Institutions

- 2013–2018 **PhD, MSc, Theoretical Physics**, *University of California*, Los Angeles.
Member of the Theoretical Elementary Particles and AstroParticle Physics (TEPAPP) group at UCLA. Thesis advisor is Alexander Kusenko.
- 2009–2013 **BSc, Physics**, *University of California*, San Diego.

Coursework

- Physics Classical mechanics, electrodynamics, quantum mechanics, statistical mechanics, quantum field theory, particle physics, astrophysics, general relativity, cosmology
- Mathematics Statistics, probability, linear algebra, calculus, abstract algebra/group theory, differential equations, complex analysis

Experience

Industry

- Feb 2019–Present **Data Scientist**, *American Tire Distributors*, Huntersville, NC.
- Data scientist working in automotive and replacement tire industry, with a focus on supply chain operations. Used machine learning and algorithmic approaches to improve supply chain operations and develop analytics software. Some projects I have worked on:
1. Conceptualized and currently developing agent-based simulation software for streamlining supply chain network analysis, warehouse operations, and more.
 2. Developed algorithm for identifying customers that cost more money to deliver to than we made in sales profit.
 3. Developed algorithm for determining optimal time to deliver to customer (ATD makes multiple deliveries each day) by using a Markov decision process to calculate the expected cost of delaying the decision to deliver.
 4. Implemented procedure for clustering products with similar sales history to use as input to demand forecasting algorithm.
 5. Analyzed source of redundant shipments between warehouses and proposed synchronizing vendor delivery schedules.

Academic

- 2014–2018 **Graduate Student Researcher**, *University of California*, Los Angeles, CA.
Research in particle astrophysics. Focus on exotic dark matter candidates such as boson stars, Q -balls, and primordial black holes. Used both analytical and numerical methods to simulate/model dark matter candidate production and interactions using deterministic and probabilistic analyses. Published several papers in top journals (link) as lead/single author, had my work featured in the news (link), and have been an invited speaker at several conferences.
- 2013–2018 **Teaching Fellow**, *University of California*, Los Angeles, CA.
Lead undergraduate laboratory and discussion sections. Some topics include Newtonian mechanics, electricity and magnetism, special relativity, hydrodynamics, thermodynamics, quantum mechanics, nuclear/particle physics, cosmology. Led classroom discussions with dozens of students of varying backgrounds. Excel at explaining complex concepts in an easy-to-understand manner. Have consistently scored high reviews and have won the department outstanding TA award.
- 2013-2018 **Tutor**, Los Angeles, CA.
Ran independent tutoring business to help students studying math and physics. Have helped students studying at UCLA and local high schools prepare for midterms/finals, qualifying exams, SAT, etc.

Internships

- 2011–2013 **Inertial Fusion Technology Intern**, *General Atomics*, La Jolla, CA.
Creation and operation of prototype fuel injection and target tracking systems for use in the National Ignition Facility for inertial confinement fusion (ICF) energy experiments.
- 2010–2011 **Engineering R&D Intern**, *Kyocera America*, San Diego, CA.
R&D laboratory and production of ceramic-based electronics. Used scanning electron microscopy to analyze samples, designed experiments to analyze and optimize soldering process.

Outreach

- 2014–2017 **Explore Your Universe Coordinator**, *UCLA*, Los Angeles, CA.
Graduate coordinator for UCLA's annual Explore Your Universe (EYU) event, which typically saw several thousand visitors. Oversaw groups of O(10) undergraduate volunteers while demonstrating various scientific experiments to the public.

Technical skills/experience/projects

- Python** Used extensively for both data science work and in physics research for data manipulation and visualization, machine learning, and numerical calculations and analysis. Familiar with numerous scientific (numpy, scipy, matplotlib, etc.) and ML (TensorFlow, Keras, sklearn) libraries, Jupyter notebooks, and constantly learning more.
- Databases/SQL** Extensive experience in creating, maintaining, and querying relational databases. Familiar with SQL Server, MySQL, Oracle, Google BigQuery, PostgreSQL, SQLite
- C Language** Used in graduate physics research to perform numerical simulations of boson star collisions and evolution of scalar solitons. Also used to program Arduino microcontrollers in undergraduate studies to construct a quadcopter and automated N₂ dessicator.
- Mathematica** Used extensively (practically every single day) in physics research for a large variety of mathematical tasks such as solving differential equations and integrals through analytic and numerical means, performing complex algebraic manipulations, preparing plots, data analysis, etc.
- Other languages** proficient: bash; familiar: C++, Java, Matlab/Octave
- Data Analysis** Familiar with numpy, scipy, pandas, matplotlib, Jupyter/labs notebooks, Spark, nltk; understand basics of time-series analysis
- Machine Learning** Familiar with TensorFlow, Keras, scikit-learn; knowledge of regression (linear, parametric fits, SVR, MLE), classification (logistic reg., SVM, k-NN), clustering (k-means, Gaussian mixture models), dimensional reduction (PCA, SVD, autoencoders) techniques.
- Deep Learning** Experience with CNN, reinforcement learning, image recognition, image segmentation, Inception, ResNet, Autoencoders, RNN, LSTM; completed entire deeplearning.ai course sequence on Coursera; read "Deep Learning" by Goodfellow et. al.; final round candidate for Microsoft AI Residency
- Reinforcement Learning** Reproduced results of DeepMind paper [arXiv:1312.5602] in TensorFlow, and successfully trained RL agent to play Pong using Q-learning (link).
- Computer Vision** Worked on various personal projects which included OCR of handwritten digits, image classification, and instance segmentation of microscopy images.
- Distributed computing** Knowledge of distributed/parallel computing principles and frameworks such as MPI and Spark.

Awards/Competitions/Distinctions

- 2019 Participant in ATD Reinvent The Wheel hackathon
- 2018 Participant in Citadel Data Open competition
- 2018 Final round candidate, Microsoft AI Residency
- 2016, 2018 Richardson Travel Grant

- 2016 UCLA Doctoral Travel Grant
- 2014-2017 UCLA Physics Fellowship
- 2014 Top 5, Physics PhD Qualifying Exam
- 2014 Physics Department Outstanding TA Award
- 2013 UCSD 120B Lab Most Impressive Student Project

Publications

- 2018-10-1 **Primordial black holes from inflaton fragmentation into oscillons.**
E. Cotner, A. Kusenko, V. Takhistov, Phys. Rev. **D 98**, 083513, [arXiv:1801.03321]
- 2017-11-6 **Primordial black holes from scalar field evolution in the early universe.**
E. Cotner, A. Kusenko, Phys. Rev. **D 96**, 103002, [arXiv:1706.09003]
- 2017-7-21 **Primordial black holes from supersymmetry in the early universe.**
E. Cotner, A. Kusenko, Phys. Rev. Let. **119**, 031103, [arXiv:1612.02529v2]
- 2017-3-20 **Linear Induction Accelerator with Magnetic Steering for Inertial Fusion Target Injection.**
R. Petzoldt, N. Alexander, L. Carlson, E. Cotner, D. Goodin, R. Kratz, Fusion Science and Technology **68:2**, 308-313
- 2016-12-12 **Astrophysical constraints on dark-matter Q -balls in the presence of baryon-violating operators.**
E. Cotner, A. Kusenko, Phys. Rev. **D 94**, 123006, [arXiv:1609.0097v2]
- 2016-9-8 **Collisional interactions between self-interacting non-relativistic boson stars: Effective potential analysis and numerical simulations.**
E. Cotner, Phys. Rev. **D 94**, 063503, [arXiv:1608.00547]

Conference presentations

- PACIFIC 2018 Invited speaker at PACIFIC 2018 in Kiroro, Hokkaido, Japan. Title: Primordial Black Holes from Nontopological Solitons ([link](#))
- PBH Focus Week Invited speaker at Primordial Black Hole focus week at University of Tokyo IPMU, in Chiba, Tokyo, Japan. Title: Primordial Black Holes from Nontopological Solitons ([link](#))
- PACIFIC 2016 Invited speaker at PACIFIC 2016 in Mo'orea, French Polynesia. Title: Dark Matter Boson Star Collisions ([link](#))