

Andrey Zhmoginov

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EDUCATION

Princeton University, Princeton NJ Jan 2012

Ph.D. in Plasma Physics, Department of Astrophysical Sciences

Thesis: *Resonant Wave-Particle Manipulation Techniques*, Advisor: Prof. Nathaniel Fisch

Lobachevsky State University of Nizhny Novgorod, Nizhny Novgorod Russia June 2006

M.Sc. in Physics, Advanced School for General and Applied Physics

Awards:

- Dynasty Foundation Fellowship, Russian Federation Government Fellowship
- Awards in National Olympiads in Computer Science, Physics and Mathematics including North-Eastern European Regional ACM ICPC Contest

SKILLS, TECHNOLOGIES AND INTERESTS

- **Current Research Interests:** fundamentals of deep learning, computer vision, model compression, adversarial attacks and adversarial robustness, generative models, reinforcement learning (with applications to robotics), transfer learning and domain adaptation, memorization and continual lifelong learning, semi- and self-supervised learning, information theory, physics-inspired approaches to machine learning
- **Additional Background:** statistics and probability theory, basic data structures and algorithms, numerical methods for scientific applications, physics, applied and abstract mathematics
- **Languages:** C, C++ (with MPI, OpenMP and CUDA), Python, Matlab, Mathematica
- **Libraries and Frameworks:** TensorFlow, Torch, Boost, Qt, GTK, OpenCV, scikit-learn
- **Interests:** hiking, drawing, singing, literary events, chess and tabletop games

COMPUTER SCIENCE EXPERIENCE

Google, Mountain View Sep 2015 - Now

Software Engineer

- Conducting research aimed at understanding the fundamentals of deep learning and devising new methods for model compression (for both convolutional neural networks and sequence models)
- Conducting research in the field of generative models including Generative Adversarial Networks: both theoretical research (convergence, stability, variational Bayesian methods) and practical applications within the field of computer vision
- Designing and training classification and object detection models for commercial products (including various Android applications and Google Clips product; co-creator of [MobileNetV2](#) model)
- Developing novel approaches to transfer learning, continual learning and semi-supervised learning
- Using sequence models and reinforcement learning methods for applications within the field of computer vision and robotics
- Authored and co-authored 7 publications and 3 patent applications
- Supervised and co-supervised 6 interns and 2 junior software engineers

Intel, Nizhny Novgorod Russia

Oct 2006 - Aug 2007

Research Intern

- Conducted research in multi-agent learning with Bayesian Classification and Regression Tree forests; proposed probabilistic Bayesian method for making inference from ensembles of classifiers; applying this method to regression problems resulted in higher prediction accuracy in a desired range of values
- Conducted research on time series prediction using support vector machines and regularized least-squares (RLSC) identifying kernels best suited for making the inference
- Implemented optimized leave-one-out cross-validation error calculation for RLSC and then used it for model selection showing competitive results in “*Agnostic Learning vs. Prior Knowledge*” competition
- Improved and optimized internal closed machine learning library including algorithms related to classification and regression trees and regularized least-squares

NNSU and Intel Russia Research Center, Nizhny Novgorod Russia

Sept 2001 - Aug 2003

Research Intern

- Conducted research on classification and regression trees and Bayesian networks (under supervision of NNSU professors M. Moshkov and V. Alekseev) developing theory of tree stability and implementing an algorithm proposed by Prof. Moshkov for building decision trees from Bayesian networks
- Developed, studied and implemented a method based on suboptimal rule selection for improving performance of classification and regression tree ensembles
- As an intern in OpenCV team, implemented (as a separate part of the OpenCV library) Combinatorial GMDH algorithm; compared it to other models including CART and demonstrated that it had comparable or better performance for some data sets
- Presented at Intel seminars on applications of Bayesian networks

PHYSICS EXPERIENCE

University of California Berkeley, Berkeley CA

Feb 2012 - Apr 2015

Postdoctoral Researcher

- Conducted theoretical research in the area of antihydrogen physics (as a member of the ALPHA collaboration) that resulted in new detailed understanding of the role of nonlinear resonance in atom trapping, a mass measurement technique based on separatrix-crossing theory, designs of ballistic and interferometric experiments for measuring antihydrogen mass, quasi-equilibrium models of “rotating wall” plasma compression and symplectic formalism for describing evolution of chaotic systems
- Proposed an adiabatic technique for gravity measurement in a vertical trap that inspired a new major experiment at CERN called [ALPHA-g](#) (launched in 2018)
- Co-managed a theoretical research group including 3 graduate and 4 undergraduate students
- Developed parallelized numerical codes (using MPI, OpenMP, CUDA) for studying antihydrogen motion, anti-atom interferometry, chaotic behaviour in dynamical systems and plasma compression
- Performed statistical analysis of the ALPHA experimental data using a modified K-S test, proposed Machine Learning algorithms for improving accuracy of the statistical analysis by up to a factor of 4

Princeton University, Princeton NJ

Sept 2005 - Jan 2012

Graduate Research Assistant

- Conducted theoretical research on wave-particle interaction in the context of magnetic fusion and laser-plasma applications that resulted in deep understanding and experimental proposals for alpha-channeling in mirror machines, solving a non-linear optimization problem in networks of heat/electricity conductors, perturbation theory approach to the “negative mass effect” and practical

- applications of this effect including harmonic generation and wave group velocity manipulation
- Made a patent disclosure for my method of plasma heating by alpha-channeling waves relying on minority ion injection
 - As a part of my research, developed numerical codes for studying particle dynamics and diffusion in phase space, plasma dynamics (1D PIC code) and wave propagation in plasmas

PUBLICATIONS (see full list of publications)

- Co-authored 7 publications in the field of deep learning and gave 4 external talks
- Co-authored more than 20 physics articles published in *Nature*, *Nature Communications*, *Physical Review Letters*, *Physics of Plasmas* and other journals
- Co-authored several patent disclosures
- Gave invited talks at universities and major meetings including APS and NIPS (together with summer intern Casey Chu)

LIST OF MACHINE LEARNING PUBLICATIONS

1. M. Sandler, J. Baccash, A. Zhmoginov, A. Howard, *Non-discriminative data or weak model? On the relative importance of data and model resolution*, **ICCV 2019 Workshop** (arXiv preprint **arXiv:1909.03205v1**).
2. A. Zhmoginov, I. Fischer, M. Sandler, *Information-Bottleneck Approach to Salient Region Discovery*, **ICML 2019 Workshop on Self-Supervised Learning** (arXiv preprint **arXiv:1907.09578v1**).
3. P. Mudrarkarta, M. Sandler, A. Zhmoginov, A. Howard, *K For The Price Of 1: Parameter Efficient Multi-task And Transfer Learning*, **ICLR 2019** (arXiv preprint **arXiv:1810.10703v1**)
4. M. Sandler, A. Howard, M. Zhu, A. Zhmoginov, L. C. Chen, *Inverted Residuals and Linear Bottlenecks: Mobile Networks for Classification, Detection and Segmentation*, **CVPR 2018**, arXiv preprint **arXiv:1801.04381** (2018)
5. C. Chu, A. Zhmoginov, M. Sandler, *CycleGAN: a Master of Steganography*, arXiv preprint **arXiv:1712.02950** (talk at the **NIPS 2017 Workshop “Machine Deception”**) (2017)
6. S. Changpinyo, M. Sandler, A. Zhmoginov, *The power of sparsity in convolutional neural networks*, arXiv preprint **arXiv:1702.06257** (2017)
7. A. Zhmoginov, M. Sandler, *Inverting face embeddings with convolutional neural networks*, arXiv preprint **arXiv:1606.04189** (2016)

LIST OF PHYSICS PUBLICATIONS

1. I. Y. Dodin, A. I. Zhmoginov, D. E. Ruiz, *Variational principles for dissipative (sub) systems, with applications to the theory of linear dispersion and geometrical optics*, **Physics Letters A** **381**, 1411-1430 (2017)
2. M. Ahmadi, M. Baquero-Ruiz, W. Bertsche, E Butler, et al., *An improved limit on the charge of antihydrogen from stochastic acceleration*, **Nature** **529**, 373 (2016)

3. C. Amole, M. D. Ashkezari, M. Baquero-Ruiz, W. Bertsche, E. Butler, A. Capra, C. L. Cesar, M. Charlton, S. Eriksson, J. Fajans, T. Friesen, M. C. Fujiwara, D. R. Gill, A. Gutierrez, J. S. Hangst, W. N. Hardy, M. E. Hayden, C. A. Isaac, S. Jonsell, L. Kurchaninov, A. Little, N. Madsen, J. T. K. McKenna, S. Menary, S. C. Napoli, P. Nolan, K. Olchanski, A. Olin, A. Povilus, P. Pusa, C. Ø. Rasmussen, F. Robicheaux, E. Sarid, D. M. Silveira, C. So, T. D. Tharp, R. I. Thompson, D. P. van der Werf, Z. Vendeiro, J. S. Wurtele, A. I. Zhmoginov and A. E. Charman, *An experimental limit on the charge of antihydrogen*, **Nature Comm.** **5**, 3955 (2014)
4. P. Hamilton, A. Zhmoginov, F. Robicheaux, J. Fajans, J. Wurtele and H. Müller, *Antimatter Interferometry for Gravity Measurements*, **Phys. Rev. Lett.** **112**, 121102 (2014)
5. A. I. Zhmoginov, J. S. Wurtele, J. Fajans, and A. Charman, *Nonlinear Dynamics of Antihydrogen in Magnetostatic Traps: Implications for Gravitational Measurements*, **Classical Quant. Grav.** **30**, 205014 (2013)
6. J. W. Burby, A. I. Zhmoginov and H. Qin, *Hamiltonian Mechanics of Stochastic Acceleration*, **Phys. Rev. Lett.** **111**, 195001 (2013)
7. C. Amole, M. D. Ashkezari, M. Baquero-Ruiz, W. Bertsche, E. Butler, A. Capra, C. L. Cesar, M. Charlton, S. Eriksson, J. Fajans, T. Friesen, M. C. Fujiwara, D. R. Gill, A. Gutierrez, J. S. Hangst, W. N. Hardy, M. E. Hayden, C. A. Isaac, S. Jonsell, L. Kurchaninov, A. Little, N. Madsen, J. T. K. McKenna, S. Menary, S. C. Napoli, P. Nolan, A. Olin, P. Pusa, C. Ø. Rasmussen, F. Robicheaux, E. Sarid, D. M. Silveira, C. So, R. I. Thompson, D. P. van der Werf, J. S. Wurtele, A. I. Zhmoginov (ALPHA Collaboration) and A. E. Charman, *Description and First Application of a New Technique to Measure the Gravitational Mass of Antihydrogen*, **Nature Comm.** **4**, 1785 (2013)
8. C. Amole, M. D. Ashkezari, M. Baquero-Ruiz, W. Bertsche, E. Butler, A. Capra, C. L. Cesar, M. Charlton, A. Deller, S. Eriksson, J. Fajans, T. Friesen, M. C. Fujiwara, D. R. Gill, A. Gutierrez, J. S. Hangst, W. N. Hardy, M. E. Hayden, C. A. Isaac, S. Jonsell, L. Kurchaninov, A. Little, N. Madsen, J. T. K. McKenna, S. Menary, S. C. Napoli, K. Olchanski, A. Olin, P. Pusa, C. O. Rasmussen, F. Robicheaux, E. Sarid, C. R. Shields, D. M. Silveira, C. So, S. Stracka, R. I. Thompson, D. P. van der Werf, J. S. Wurtele, A. I. Zhmoginov (ALPHA Collaboration) and L. Friedland, *Experimental and computational study of the injection of antiprotons into a positron plasma for antihydrogen production*, **Phys. Plasmas** **20**, 043510 (2013)
9. C. Amole, M. D. Ashkezari, M. Baquero-Ruiz, W. Bertsche, E. Butler, A. Capra, C. L. Cesar, M. Charlton, A. Deller, S. Eriksson, J. Fajans, T. Friesen, M. C. Fujiwara, D. R. Gill, A. Gutierrez, J. S. Hangst, W. N. Hardy, M. E. Hayden, C. A. Isaac, S. Jonsell, L. Kurchaninov, A. Little, N. Madsen, J. T. K. McKenna, S. Menary, S. C. Napoli, K. Olchanski, A. Olin, P. Pusa, C. O. Rasmussen, F. Robicheaux, E. Sarid, C. R. Shields, D. M. Silveira, C. So, S. Stracka, R. I. Thompson, D. P. van der Werf, J. S. Wurtele, A. I. Zhmoginov (ALPHA Collaboration) and L. Friedland, *Autoresonant-spectrometric determination of the residual gas composition in the ALPHA experiment apparatus*, **Rev. Sci. Instrum.** **84**, 065110 (2013)
10. A. I. Zhmoginov and N. J. Fisch, *Applying Alpha-Channeling to Mirror Machines*, **Phys. Plasmas** **19**, 055702 (2012) (Invited Paper)
11. A. I. Zhmoginov and N. J. Fisch, *Channeling of Fusion Alpha-Particle Power using Minority Ion Catalysis*, **Phys. Rev. Lett.** **107**, 175001 (2011)
12. A. I. Zhmoginov, I. Y. Dodin, and N. J. Fisch, *A Hamiltonian Model of Dissipative Wave-Particle Interactions and the Negative-Mass Effect*, **Phys. Lett. A.** **375**, 1236 (2011)
13. A. I. Zhmoginov and N. J. Fisch, *Feasibility Studies of Alpha-Particle Channeling in Mirror Machines*, **Fusion Sci. and Tech.** **57**, 361 (2010)
14. A. I. Zhmoginov, I. Y. Dodin, and N. J. Fisch, *Negative Effective Mass of Wave-Driven Classical Particles in Dielectric Media*, **Phys. Rev. E** **81**, 036404 (2010)
15. A. I. Zhmoginov and N. J. Fisch, *Waves for Alpha-Channeling in Mirror Machines*, **Phys. Plasmas** **16**, 112511 (2009)

16. I. Y. Dodin, A. I. Zhmoginov, and N. J. Fisch, *Manley-Rowe Relations for an Arbitrary Discrete System*, **Phys. Lett. A** **372**, 6094 (2008)
17. A. I. Zhmoginov and N. J. Fisch, *Flux Control in Networks of Diffusion Paths*, **Phys. Lett. A** **372**, 5534 (2008)
18. A. I. Zhmoginov and N. J. Fisch, *Simulation of Alpha-Channeling in Mirror Machines*, **Phys. Plasmas** **15**, 042506 (2008)
19. A. I. Zhmoginov and G. M. Fraiman, *Generation of Harmonics of Intense Laser Radiation in a Transparent Collisionless Plasma*, **J. Exp. Theor. Phys.** **100**, 895 (2005)