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Inar Timiryasov

# Inar Timiryasov

My academic background is in theoretical physics, where I applied advanced numerical tools to solve complex problems. Initially, I employed machine learning and neural networks as tools to analyze physical phenomena. Now, my focus has shifted to a deep interest in comprehending the intricacies of AI. I am particularly drawn to the challenges of interpreting and responsibly improving Large Language Models. I aspire to leverage my unique blend of skills to contribute to Kyutai's mission of advancing multimodal AI models and democratizing AI technology.

## AI/ML Experience

**Training Large Language Models**

Participated in the BabyLM challenge, focusing on training LLMs on a small dataset. I proposed, implemented, and trained models featuring various architectural choices (local attention, RopE, SwiGLU nonlinearity), and used techniques like sharpness-aware minimization and knowledge distillation. The model I developed ranked in the top 5% and was the best decoder model in the "small-strict" task.

**Deep-learning for Physics**

- Leading the development of a Bert-style foundational model on particle physics data, focusing on fine-tuning for specific tasks.
- Mentoring students and heading the ML components in *"New Physics searches with automated anomaly detection"*. Two ongoing projects involving gravitational wave data and particle collider data from CERN.

**Kaggle Expert**

Participated in two Kaggle Competitions, where I initiated and led the teams

- *G2Net Detecting Continuous Gravitational Waves*: Gold Medal, ranking in the top 1%.
- *IceCube – Neutrinos in Deep Ice*: Silver Medal, ranking in the top 2%.

## Academic Experience

2021–present **Senior Postdoctoral Researcher**, *Niels Bohr Institute, University of Copenhagen*
Developing AI models for applications in particle physics. Implemented an effective method to reinterpret LHC data analysis pipelines, extending them to new phenomena.

2016–present **Visiting Researcher**, *CERN*
An active member of the Search for Hidden Particles (SHiP) collaboration that pioneered application of *Generative Adversarial Networks* to particle physics modeling.

2016–2021 **Postdoctoral Researcher**, *École Polytechnique Fédérale de Lausanne*
Transformed complex theoretical problems into computable models and used advanced numerical tools to analyze them. Taught *group theory* and *classical field theory* courses to Masters's students. Supervised and co-supervised 8 Master's students, guiding thesis projects and research.

## Technical Skills

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|---|---|
| Languages: | Python, Julia, Wolfram Mathematica, C/C++ |
| AI/ML: | PyTorch, Transformers, scikit-learn, PyTorch Lightning, Keras, JAX |
| Data Science: | Pandas, NumPy, Matplotlib, PyArrow |
| Tools: | Linux, bash/zsh, Git, HPC (Slurm, Lustre) |
| Numerical Methods: | Markov Chain Monte Carlo, Stiff ODEs, Computer Algebra, Lattice Methods for PDEs |
| Mathematics: | Statistics, Tensor Algebra, Real and Complex Analysis, Differential Geometry, Field Theory, Group Theory, Differential Equations, Information Theory |

## Education

2013 – 2016 **PhD in Theoretical Physics**, *Lomonosov Moscow State University*

Developed numerical methods for searches for new particles. My results became a part of the physics program of the planned SHiP experiment at CERN. Assisted in teaching courses on *Group Theory, Quantum Field Theory, and Advanced Numerical Methods*.

2007 – 2013 **Master's Degree in Physics**, *Lomonosov Moscow State University*

Graduated Summa Cum Laude. Average grade: 4.96 / 5.0.

## Academic Service

Conference organization: 1-2 February 2024, organizing a session on *Geometric Deep Learning* at the "Danish Digitalization, Data Science and AI" conference.

23 February 2023, organized *SCIENCE Postdoc Day 2023* at the University of Copenhagen, with 150 attendees.

13-17 June 2022, organized an online workshop *Physics of the Early Universe*, with 1005 registered participants.

Peer Review: Referee for top high-energy physics journals: Phys.Rev.Lett.; Phys.Rev.D.; JCAP; JHEP; Int.J.Mod.Phys.A.; JEPT

## Publications

- *41 papers* (13 as a member of the SHiP collaboration) in the high-energy physics database inSPIRE-hep.
- *1500+ citations*, H-index is 26 according to Google Scholar.

Selected papers

- Inar Timiryasov, Jean-Loup Tastet, *"Baby Llama: knowledge distillation from an ensemble of teachers trained on a small dataset"*, arXiv:2308.02019, Accepted to **CoNLL–CMCL 2023, BabyLM Challenge** Shared Task.
- Juraj Klarić, Mikhail Shaposhnikov, Inar Timiryasov, *"Uniting Low-Scale Leptogenesis Mechanisms"*, arXiv:2008.13771, **Phys. Rev. Lett. 127 no. 11**, (2021) 111802.
- SHiP Collaboration, "Fast simulation of muons produced at the SHiP experiment using Generative Adversarial Networks,", arXiv:1909.04451, **JINST 14 (2019)P11028.**