

Jakub Vrábek

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BIO

I am a fifth-year Ph.D. candidate in applied physics. My specialization is in interpretable machine learning (ML) for spectroscopic data and physics-inspired learning. Recently, I have become interested in foundational ML, where I work on mode connectivity, sparsity (lottery tickets), and overparametrization (NTK, double descent). My goal is to contribute to interpretable and safe ML/AI.

EDUCATION

2019 - present	Ph.D. candidate in applied physics	Central European Institute of Technology (CZ)
2024 - present	visiting grad. student (superv. David Krueger)	University of Cambridge (UK)
2021 - 2022	visiting grad. student (superv. Hans Lohninger)	Technische Universität Wien (AT)
2017 - 2019	Master's deg. - appl. physics (<i>with distinction</i>)	FME, Brno University of Technology
2016 - 2017	additional Bc. studies - appl. physics	FME, Brno University of Technology
2013 - 2016	Bachelor's degree - mechatronics	FME, Brno University of Technology

extra courses: statistical physics of fields, GTR, advanced quantum mech., Lie groups, data mining

WORK EXPERIENCE

2016 - present	Research associate – CEITEC (CZ), Group of Laser Spectroscopy <i>Topic: machine learning for spectroscopic data, laser-induced plasma physics</i>
2018	Research intern – Complutense University of Madrid (ES), 6 months <i>Topic: characterization of laser-induced plasmas (with prof. Caceres)</i>
2015 - 2017	Multimedia specialist – Moravia IT (now RWS) (CZ), part-time <i>Localization of Microsoft Office (video editing, vector/raster graphics, scripting)</i>

SUMMER SCHOOLS

2023	IAIFI Summer School - Physics and AI (Boston, USA) ELLIS Summer School - Probabilistic ML (Cambridge, UK)
2022	IAIFI Summer School - Physics and AI (Boston, USA) Arnold Sommerfeld Centre Summer School - Physics meets AI (Munich, DE) Erwin Schrödinger Institute Summer School – ML for materials (Vienna, AT)
2021	Machine Learning in Quantum Physics and Chemistry Summer School (Warsaw, PL)

SELECTED PUBLICATIONS

2023 *Spectral library transfer between distinct Laser-Induced Breakdown Spectroscopy systems trained on simultaneous measurements.* **Vrábek, J.** et al. JAAS, IF 4.35 DOI: [10.1039/D2JA00406B](https://doi.org/10.1039/D2JA00406B)

2022 *Improving laser-induced breakdown spectroscopy regression models via transfer learning.* Képeš, E., **Vrábek, J.** et al. JAAS, IF 4.35 DOI: [10.1039/D2JA00180B](https://doi.org/10.1039/D2JA00180B)

2021 *Interpreting support vector machines applied in laser-induced breakdown spectroscopy.* Képeš, E., **Vrábek, J.** et al. Analytica Chim. Acta, IF 6.91 DOI: [10.1016/j.aca.2021.339352](https://doi.org/10.1016/j.aca.2021.339352)

2020 *Restricted Boltzmann Machine method for dimensionality reduction of large spectroscopic data.* **Vrábek, J.** et al. Spectrochim. Acta B, IF 3.66 DOI: [10.1016/j.sab.2020.105849](https://doi.org/10.1016/j.sab.2020.105849)

2020 *Benchmark classification dataset for laser-induced breakdown spectroscopy.* Képeš, E., **Vrábek, J.** et al. Scientific Data, IF 8.50 DOI: [10.1038/s41597-020-0396-8](https://doi.org/10.1038/s41597-020-0396-8)

* a complete list of publications can be found on [Google Scholar](#)

STATS

- H-index: 9 (250 citations)
- 14 journal articles
- 7 conference talks, 4 posters
- PI of 5 student projects (funding 50,000 €)
- 3 book chapters (all published by Wiley)
- superv. of 5 students (bachelor, internship)

CONFERENCES

2024	Youth in High Dimensions (Trieste, IT)	poster
2023	IAIFI workshop (Boston, USA)	poster
2022	SCIX (Covington - KY, USA)	oral presentation
2022	LEA (Tokyo, JP)	(online) oral presentation
2022	IAIFI workshop (Boston, USA)	poster
2022	LIBS2022 (Bari, IT)	oral presentation
2021	EMSLIBS (Gijon, ES)	(online) oral presentation
2020	LIBS2020 (Kyoto, JP)	(online) oral presentation
2020	IOM-LIBS (fully-online)	(online) oral presentation
2019	EMSLIBS (Brno, CZ)	poster and oral presentation
2017	EMSLIBS (Pisa, IT)	poster

SKILLS

machine learning (artificial neural networks, kernel methods), statistical physics, Python (JAX, Pytorch, scikit-learn, Pandas), R (data processing, visualization), GitHub, cloud & GPU computing (Azure, GCP)

OTHER ACHIEVEMENTS & ACTIVITIES

Josef Hlávka award, 2nd place in the Competition of Young Spectroscopists (IMMSS), rector's honorable mention, involved in 3 national-wide and 2 international projects, teaching seminars for Physics 1&2.

ONGOING WORK

1. *Input space mode connectivity* (with D. Krueger, University of Cambridge). (manuscript under preparation). We extend the concept of loss landscape mode connectivity to the input space of deep neural networks. We explore and show applications of the concept for interpretability and adversarial detection. My role: concept, numerical experiments, theory.
2. *Sparse interpretable neural networks for spectroscopic data*. (manuscript under preparation). I study various approaches to achieve sparse models that are natively interpretable. This includes L1 and custom-developed regularizations, and lottery tickets. My role: concept, numerical experiments, theory.
3. *Neural tangent kernel (NTK) & double descent* (with O. Shem-Ur and Y. Oz, Tel Aviv University). In this project, we aim to find connections between linearization (NTK regime) and overparametrization in neural networks. My role: numerical experiments.

FURTHER CAREER PLAN

With a deep passion for science, particularly physics and ML, I am driven to learn and explore these areas continuously. My aim is to make valuable contributions to the scientific community. My next objective is to find a postdoc or industry-research position that aligns with my interests and aspirations.