Antonin Sulc, PhD

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RESEARCH INTERESTS

Autonomous Systems (Particle Accelerators) · Computer Vision (Geometry, Light Fields) · Anomaly Detection · Physics-Informed Machine Learning · Agentic AI

TECHNICAL SKILLS

- **Core AI/ML:** Anomaly Detection, LLMs (Fine-tuning, LoRA), Computer Vision.
- **Engineering & MLOps:** Python, Docker, Git, SQL, High Performance Computing (HPC), Linux envs.
- **Specialized:** Quantum Computing (Qiskit), Geometric Vision, Physics-Informed ML.
- **Languages:** English (C1), German (B2), Czech (Native).

ACADEMIC APPOINTMENTS

Lawrence Berkeley National Lab (LBNL) **Jan 2025 – Present**
Researcher *Berkeley, USA*

- **Topic:** Agentic AI for Accelerator Controls.
- Developing intelligent algorithms for autonomous accelerator operation.

Helmholtz Association (DESY/XFEL) **May 2021 – Oct 2024**
Senior Data Scientist *Hamburg, Germany*

- **Topic:** Real-time accelerator control algorithms. **PIs:** Prof. Eichler, Dr. Wilksen.
- Developed unsupervised log anomaly detection and "PACuna" (fine-tuned LLMs).
- Researching "ChatQCD" and LLM applications in High Energy Physics.

University of Haifa - Marine Imaging Lab **Mar 2020 – Aug 2020**
Visiting Researcher *Haifa, Israel*

- Developed algorithms for robust scene reconstruction and shape from refraction.

National Institute of Informatics (NII) **Oct 2018 – Mar 2019**
Visiting Researcher *Tokyo, Japan*

- Research on spectral defocus blur and depth estimation.

Vendavo Inc. **Jan 2014 – Dec 2015**
Software Engineer & Data Scientist *Prague, Czech Republic*

- Development of recommender systems for B2B pricing.

EDUCATION

University of Konstanz **2015 – 2020**
PhD in Artificial Intelligence (Computer Vision) *Germany*

- Grade: *Magna Cum Laude* (1.0) · Advisor: Prof. Dr. Bastian Goldluecke
- Focus: Inverse Lightfield Rendering, Geometry, Natural Illumination.

Czech Technical University **2008 – 2014**
MSc in Artificial Intelligence *Prague*

- Award: Nominated for IT Master Thesis of the Year 2014.

SOFTWARE & OPEN SOURCE

event2vector PyPI · GitHub
A scikit-learn style Python library providing a geometric approach to learning composable, highly interpretable representations of discrete event sequences.

torchmodal PyPI · GitHub
A framework introducing Differentiable Modal Logic for PyTorch—enabling the training of Modal Logical Neural Networks (MLNNs).

osprey-framework PyPI · GitHub
A scalable, production-ready framework for orchestrating agentic AI in safety-critical facility operations. Deployed at the Advanced Light Source.

PACuna GitHub
Automated data collection and fine-tuning pipelines designed to adapt Large Language Models securely to the domains of particle accelerators.

SELECTED PEER-REVIEWED PUBLICATIONS

1. **A. Sulc**. Differentiable Modal Logic for Multi-Agent Diagnosis, Orchestration and Communication. *arXiv preprint*, 2026.
2. **A. Sulc**. Solving PDEs in One Shot via Fourier Features with Exact Analytical Derivatives. *arXiv preprint*, 2026.
3. **A. Sulc**. Differentiable Logical Programming for Quantum Circuit Discovery and Optimization. *arXiv preprint*, 2026.
4. T. Hellert, D. Bertwistle, S. C. Leemann, **A. Sulc**, M. Venturini. Agentic artificial intelligence for multistage physics experiments at a large-scale user facility particle accelerator. *Physical Review Research*, 2026.
5. T. Hellert, J. Montenegro, **A. Sulc**. Osprey: Production-ready agentic AI for safety-critical control systems. *APL Machine Learning*, 2026.
6. **A. Sulc**. Modal Logical Neural Networks. *arXiv preprint*, 2025.
7. **A. Sulc**. Event2Vec: A Geometric Approach to Learning Composable Representations of Event Sequences. *NeurReps PMLR Proceedings*, 2025.
8. **A. Sulc**. Quantum Noise Tomography with Physics-Informed Neural Networks. *NeurIPS ML4Physics Workshop*, 2025.
9. **A. Sulc**, T. Hellert, A. Reed, A. Carpenter et al. eLog Analysis for Accelerators: Status and Future Outlook. *16th International Particle Accelerator Conference (IPAC)*, 2025.
10. **A. Sulc**, P. Connor. QCD in Language Models: What do they really know about QCD? *EPS-High Energy Physics*, 2025.
11. **A. Sulc**, P. Connor. ChatQCD: Let Large Language Models Explore QCD. *42nd ICHEP*, 2024.
12. **A. Sulc**, T. Hellert, R. Kammering, H. Hoschouer, J. St. John. Towards Agentic AI on Particle Accelerators. *NeurIPS ML4Physics Workshop*, 2024.
13. **A. Sulc**, G. Hartmann, J. Maldonado, V. Kain et al. Towards Unlocking Insights from Logbooks Using AI. *15th International Particle Accelerator Conference (IPAC)*, 2024.
14. **A. Sulc**, R. Kammering, A. Eichler, T. Wilksen. PACuna: Automated Fine-Tuning of Language Models for Particle Accelerators. *NeurIPS ML4Physics Workshop*, 2023.

15. **A. Sulc**, A. Eichler, T. Wilksen. Unsupervised Log Anomaly Detection with Few Unique Tokens. *IET Information Security*, 2023.
16. **A. Sulc**, A. Eichler, T. Wilsken. A data-driven anomaly detection on SRF cavities at the European XFEL. *Journal of Physics: Conference Series*, 2023.
17. S. Ishihara, **A. Sulc**, I. Sato. Depth Estimation Using Spectrally Varying Defocus Blur. *Journal of the Optical Society of America A*, 2021.
18. S. Ishihara, **A. Sulc**, I. Sato. Depth from Spectral Defocus Blur. *ICIP*, 2019.
19. O. Johannsen, **A. Sulc**, B. Goldluecke. What Sparse Light Field Coding Reveals About Scene Structure. *CVPR*, 2016.

SERVICE & LEADERSHIP

- **Program Chair:** Foundations of Agentic Systems Theory (FAST) @ AAAI 2025.
- **Scientific Chair:** ICFA Beam Dynamics Mini-Workshop on ML for Particle Accelerators.
- **Reviewer:** CVPR, NeurIPS (2023-2025), BMVC, ICLR.