Laurits Tani

Curriculum Vitae

Personal Information

Place and Date of Birth:	Estonia — 1. May 1994
email:	laurits.tani@cern.ch
Linkedin	https://www.linkedin.com/in/laurits-tani-795068115
Github	https://github.com/Laurits7

Work experience

11/2024 - 07/2025	**Visiting researcher / Postdoc** INFN Bari Activities: ML based τ_h identification and reconstruction, ML based cluster counting for particle identification in drift chambers, CMS HH$\rightarrow$ $bb\mu\mu$ analysis
06/2024 - ...	**Researcher** National Institute of Chemical Physics and Biophysics Activities: ML based τ_h identification and reconstruction, Tallinn Tier2 assistant system administrator
09/2019 - 06/2024	**Junior researcher** National Institute of Chemical Physics and Biophysics Activities: PhD studies: Hyperparameter optimization, CMS HH$\rightarrow$multilepton analysis, ML based τ_h identification and reconstruction, Tallinn Tier2 assistant system administrator. Supervised 4 summer students and gave exercise classes in a particle physics course.

Education

09/2019 - 06/2024	PhD in Physics **Tallinn University of Technology + National Institute of Chemical Physics and Biophysics** Thesis: "Measurement of Higgs Boson Properties in Leptonic Final States using ML-methods" — Supervisors: Prof. Dr. Mario Kadastik, Dr. Christian Veelken
09/2017 - 04/2019	Master of Science in Physics **ETH Zürich** Thesis: "Monitoring the optical quality of the FACT Cherenkov telescope" — Supervisor: Prof. Dr. Adrian Biland
09/2014 - 05/2017	Bachelor of Science in Engineering Physics **Tallinn University of Technology** Thesis: "The effect of light on the capacitive properties of the solar cell" — Supervisor: Dr. Raavo Josepson

Key publications

1. Laurits Tani, Joosep Pata, and Joschka Birk. "Reconstructing hadronically decaying tau leptons with a jet foundation model". In: **preparation**

   Contribution: As the main driver of the analysis, I am the first and corresponding author. I was also responsible for producing training samples and data management. I implemented ML models for the studies, developed the code base, analyzed the results, prepared the figures, and contributed substantially to writing the manuscript.

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2. Laurits Tani et al. "A unified machine learning approach for reconstructing hadronically decaying tau leptons". In: *Comput. Phys. Commun.* 307 (Feb. 2025), p. 109399. DOI: https://doi.org/10.1016/j.cpc.2024.109399. arXiv: 2407.06788 [hep-ex]

   Contribution: As the main driver of the analysis, I was the first and corresponding author. I was also responsible for producing training samples and data management. I implemented ML models for the studies, developed the code base, analyzed the results, prepared the figures, and contributed substantially to writing the manuscript. As the corresponding author I also handled the peer-review. Presented the results in a conference.

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3. Laurits Tani. "Measurement of Higgs Boson Properties in Leptonic Final States using ML-methods". PhD thesis. Tallinn U. Tech., 2024. DOI: 10.23658/taltech.25/2024

Contribution: PhD dissertation.

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4. Torben Lange et al. "Tau lepton identification and reconstruction: A new frontier for jet-tagging ML algorithms". In: *Comput. Phys. Commun.* 298 (2024), p. 109095. DOI: 10.1016/j.cpc.2024.109095. arXiv: 2307.07747 [hep-ex]

   Contribution: I was responsible for producing the samples for the training and developing the code base for the project. I analyzed the results, prepared the figures and contributed substantially to writing the manuscript. As the main driver of the analysis, I was the corresponding author, and was responsible for the peer-review process. Presented the results in a conference.

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5. Laurits Tani and Christian Veelken. "Comparison of Bayesian and particle swarm algorithms for hyperparameter optimisation in machine learning applications in high energy physics". In: *Comput. Phys. Commun.* 294 (2024), p. 108955. DOI: 10.1016/j.cpc.2023.108955. arXiv: 2201.06809 [physics.data-an]

   Contribution: I implemented the algorithms from scratch, and utilized the evaluation framework I developed for the previous hyperparameter optimization paper. As the lead author, I prepared all experimental results and figures, and wrote the manuscript. As the main driver of the analysis, I was the first and corresponding author, handling peer-review. Also, presented the results in a conference.

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6. CMS Collaboration. "Search for Higgs boson pairs decaying to WW^*WW^*, $WW^*\tau\tau$, and $\tau\tau\tau\tau$ in proton-proton collisions at $\sqrt{s} = 13$ TeV". in: *JHEP* 07 (2023), p. 095. DOI: 10.1007/JHEP07(2023)095. arXiv: 2206.10268 [hep-ex]

   Contribution: I was responsible for the two analysis channels targeting the 4τ decay mode. Additionally I created the ML framework to to be used across the analysis. Wrote parts of the analysis note and contributed in reviewing the final paper.

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7. Laurits Tani et al. "Evolutionary algorithms for hyperparameter optimization in machine learning for application in high energy physics". In: *Eur. Phys. J. C* 81.2 (2021), p. 170. DOI: 10.1140/epjc/s10052-021-08950-y. arXiv: 2011.04434 [hep-ex]

   Contribution: I implemented the algorithms from scratch and developed the evaluation framework. As the lead author, I prepared all experimental results and figures, and wrote the manuscript. As the main driver of the analysis, I was the first and corresponding author, handling peer-review. Also, presented the results in a conference.

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8. Laurits Tani. "Monitoring the optical quality of the FACT Cherenkov Telescope". MA thesis. ETH Zürich, 2019. arXiv: 2001.06712 [astro-ph.IM]

   Contribution: MSc thesis. Wrote the air shower simulation from scratch, developed methods to identify muon rings from gammaray and cosmic ray showers. Quantified the muon ring spread to evaluate the image quality and applied the methods on real data. Results later presented in a conference.

Teaching

09/2021 - 01/2022	**Teaching assistant** Tallinn University of Technology Exercise classes in *Introduction to particle physics (YFX1130)*
08/2016 - 05/2017	**Lecturer** Tallinn University of Technology Math and physics prepcourses
02/2016 - 03/2016	**Lecturer** Mektory Physics crash course for high school students

Workshops and Schools

29/08/2022 - 07/09/2022	**The International Doctorate Network in Particle Physics, Astrophysics and Cosmology (IDPASC)** Olomouc, Czech Republic https://indico.cern.ch/event/1137808/
02/08/2021 - 06/08/2021	**Baltic School of High-Energy Physics and Accelerator Technologies 2021** Camping "Ronīši", Latvia https://indico.cern.ch/event/1029085/
15/07/2021 - 30/07/2021	**Seventh Machine Learning in High Energy Physics Summer School 2021 (MLHEP)** Virtual https://indico.cern.ch/event/1025052/
05/07/2021 - 09/07/2021	**PyHEP 2021** Virtual https://indico.cern.ch/event/1019958/

23/09/2020 - 30/09/2020	**CMS Data Analysis School (CMSDAS)** Virtual https://indico.cern.ch/event/886923/overview
02/12/2019 - 04/12/2019	**Combine Workshop and tutorial** CERN, Meyrin, Geneva, Switzerland https://indico.cern.ch/event/859454/
11/08/2019 - 18/08/2019	**Trans-European School of High Energy Physics** Svityaz, Volyn region, Ukraine https://teshep.lal.in2p3.fr/teschool19/
01/04/2015 - 31/05/2017	**Internship** Department of Physics, Tallinn University of Technology, Estonia Testing solar cells and practice programming in Labview
01/07/2015 - 30/08/2015	**CERN Summer School** CERN, Meyrin, Geneva, Switzerland https://indico.cern.ch/event/387910/
01/03/2015 - 31/06/2015	**Internship** Technomedicum, Tallinn University of Technology, Estonia Nuclear magnetic resonance spectroscopy

Projects

04/2015 - 05/2017	**Member of the Satelline team** Mektory Spacecenter Member of Team Power. Main activity: Solar panels

Conferences

15/10/2024 - 17/10/2024	**4th CERN Baltic Conference (CBC 2024)** `Talk:` "Improving Hadronically Decaying Tau Lepton Identification and Reconstruction with Unified End-to-End Machine Learning Methods" `Misc:` Session chair Tallinn, Estonia https://indico.cern.ch/event/1416853/overview
23/10/2022 - 28/10/2022	**The 21st International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT 2022)** `Talk:` "Evolutionary algorithms for hyperparameter optimization in machine learning for application in high energy physics" Villa Romanazzi Carducci in Bari, Italy https://indico.cern.ch/event/1106990/overview
10/10/2022 - 12/10/2022	**The 2nd CERN Baltic Conference (CBC 2022)** `Talk:` "Evolutionary algorithms for hyperparameter optimization in machine learning for application in high energy physics" Vilnius, Lithuania https://indico.cern.ch/event/1147717/overview
25/03/2019 - 29/03/2019	**DPG-Frühjahrstagung** `Talk:` "FACT-Measuring the Evolution of the Optical Point Spread Function using Muon-Rings" Aachen, Germany https://aachen19.dpg-tagungen.de/index.html

Collaboration Memberships

09/2019 - ... 07/2015 - 09/2015	**CMS Collaboration** Authorship: 01/2021 - ... https://cms.cern/
09/2018 - 10/2019	**FACT Collaboration** Authorship: 02/2019 - 10/2019 https://ipa.phys.ethz.ch/research/ResearchProjects/fact.html

Awards

11/2024 - 08/2025	**MAECI grant** Ministry of Foreign Affairs and International Cooperation (MAECI), Italy https://www.esteri.it/en/opportunita/borse-di-studio/per-cittadini-stranieri/borsestudio_stranieri/

Languages

Estonian:	C2 (Mothertongue)
English:	C1 [2017: IELTS]
German:	C1 [2013: Deutsches Sprachdiplom by Goethe Institute]
Russian:	A2