CMS ML KNOWLEDGE GROUP NEWSLETTER

July 2025, v3

Welcome to the
third edition of the
CMS ML Knowledge Group
Newsletter

Quick Peak

- Scholar Spotlight: Aaron Wang from UIC
- Report from NeurIPS
- Events on our Radar

SCHOLAR SPOTLIGHT

Meet Aaron Wang, a Ph.D student at UIC

Could you tell us a little more about your background and how you got into particle physics?
I have a background in physics, having earned my undergraduate degree from the University of Washington. Initially, I worked in quantum materials growth, but during the COVID-19 pandemic, I transitioned to computational work due to the remote nature of research at the time. I discovered that I enjoyed computational research much more and began working with machine learning during this period. This sparked my interest in applying ML techniques to physics problems. My journey in particle physics began under the guidance of Professor Shih-Chieh Hsu, focusing on jet tagging, and I found myself increasingly drawn to the intersection of AI/ML and particle physics.

Could you tell us a little more about your research?
My research focuses on developing Efficient Transformer models for eventual deployment on triggers. One particularly exciting aspect of this work is that Particle Transformer, a cutting-edge model, has achieved some of the best benchmarks for jet tagging. This demonstrates that transformer architectures, especially with their attention mechanisms, can effectively capture complex particle physics information. Attention appears to excel at identifying and utilizing relationships among particles, which is critical in jet tagging. Building on this success, my work aims to address the computational challenges associated with transformers, particularly the quadratic complexity in multi-head attention, to make these models more efficient and deployable in real-time systems. This involves developing new algorithms, studying existing methods, and conducting interpretability analyses to better understand how transformers process particle physics data.

Where are you in your academic journey? What are you interested in doing in the future?
I'm currently a third-year PhD student in physics at the University of Illinois Chicago, working with Professor Richard Cavanaugh. As for the future, I'm open to opportunities in both academia and industry, though I haven't decided yet. I am particularly passionate about interpretability and AI alignment, and I hope to continue leveraging AI and machine learning in meaningful ways throughout my career.

Is there anything else you would like to share?
In my free time, I enjoy learning how to play jazz piano and listening to a wide variety of music. These activities help me stay creative and bring balance to my work in research.

Author: Jieun Yoo

REPORT FROM NEURIPS 2024

Marius Köppel from ETH reports from NeurIPS

NeurIPS (Conference on Neural Information Processing Systems) is one of the big annual conferences in machine learning and artificial intelligence. Established in 1987, it serves as a platform for presenting cutting-edge research in neural computation, deep learning, reinforcement learning, and other AI disciplines.

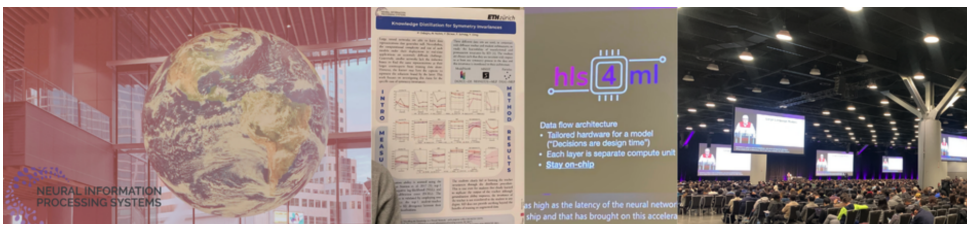
Attending NeurIPS for the first time was an inspiring and fascinating experience. Beyond the many general advancements in AI and ML, the dedicated workshop on ”Machine Learning and the Physical Sciences” was particularly notable for this newsletter. It featured insightful talks on topics like data-driven vs. inductive bias-driven methods, real-time ML at the LHC, and generative models for scientific inference. A key takeaway was the potential of Julia for scientific ML.

Another highlight was the ”Symmetry and Geometry in Neural Representations” workshop, exploring the impact of mathematical structures on neural coding in both biological systems and machine learning models. The talks covered diverse topics such as manifold-constrained pose estimation and symmetry in robotic trajectory tracking, which could prove valuable for physics-informed methods in CMS analysis.

The panel talks on advancing (x)LSTM models to compete with transformer architectures and on how children learn and what this reveals for improving machine learning models, were particularly impressive.

NeurIPS offered numerous contributions and a great way to explore them is through their graphical tool: NeurIPS Visualization.

Author: Marius Köppel



EVENTS ON OUR RADAR

- Fast Machine Learning for Science Conference 2025

- Machine Learning and the Physical Sciences, NeurIPS 2025 Workshop

JOIN US

This newsletter was brought to you by the **CMS ML Knowledge Sub-group**. We meet every two weeks and **welcome new members**!

If you've enjoyed this newsletter, please let us know. If you have an idea for content, want to nominate someone for an interview, or contribute, we'd love to hear from you.

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