Contribution ID: **481**   Type: **Parallel**

Fair Universe HiggsML Uncertainty Challenge

Wednesday 9 July 2025 16:00 (20 minutes)

Measurements and observations in Particle Physics fundamentally depend on one's ability to quantify their uncertainty and, thereby, their significance. Therefore, as Machine Learning methods become more prevalent in HEP, being able to determine the uncertainties of an ML method becomes more important. A wide range of possible approaches has been proposed, however, there has not been a comprehensive comparison of individual methods.

To address this, the Fair Universe project organized the Fair Universe HiggsML Uncertainty Challenge (https://fair-universe.lbl.gov/ and the white paper introducing to the competition https://arxiv.org/abs/2410.02867), which took place from Sep 2024 to 14th March 2025, and was accepted as an official NeurIPS2024 competition. The goal of the challenge was to measure the Higgs to tau+ tau- cross-section, using a dataset of particle 4-momenta. Participants were evaluated on both their ability to precisely determine the correct cross-section, as well as on their ability to report correct and well-calibrated uncertainty intervals.

In this talk, we present an overview of the competition itself and of the infrastructure that underpins it. Further, we present the winners of the competition and discuss the performance of their winning uncertainty quantification approaches.

The dataset and associated metric will serve as a permanent benchmark for further developments.

Secondary track

T08 - Higgs Physics

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Session Classification: Joint T08+T16 (Higgs Physics + AI for HEP (special topic 2025))

Track Classification: T16 - AI for HEP (special topic 2025)