Contribution ID: **189** Type: **Short Talk**

Reframing Jet Physics with New Computational Methods

Thursday 20 May 2021 15:13 (13 minutes)

We reframe common tasks in jet physics in probabilistic terms, including jet reconstruction, Monte Carlo tuning, matrix element –parton shower matching for large jet multiplicity, and efficient event generation of jets in complex, signal-like regions of phase space. We also introduce Ginkgo, a simplified, generative model for jets, that facilitates research into these tasks with techniques from statistics, machine learning, and combinatorial optimization. We also review some of the recent research in this direction that has been enabled with Ginkgo. We show how probabilistic programming can be used to efficiently sample the showering process, how a novel trellis algorithm can be used to efficiently marginalize over the enormous number of clustering histories for the same observed particles, and how the dynamic programming and reinforcement learning can be used to find the maximum likelihood clusterinng in this enor- mous search space. This work builds bridges with work in hierarchical clustering, statistics, combinatorial optmization, and reinforcement learning.

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Session Classification: Artificial Intelligence

Track Classification: Offline Computing