Hello folks,

Here's what you folks might find interesting today. A relatively quiet day for ML-in-HEP, but a couple of items are worth flagging.

Di-Higgs Searches

[Improved analysis of non-resonant Higgs boson pair production in the bb tautau final state with 196 fb-1 of data at sqrt(s) = 13 TeV and 13.6 TeV with the ATLAS detector]

This is the latest ATLAS non-resonant HH search in the bb-tautau channel, combining 140 fb-1 at 13 TeV and 56 fb-1 at 13.6 TeV. The observed significance is 2.6 sigma over the background-only hypothesis, with a measured signal strength of mu_HH = 2.6 (+1.4/-1.0), and the Higgs self-coupling modifier is constrained to kappa_lambda in [-3.4, 1.6] union [5.5, 10.1] at 95% CL. This might be interesting for you, Jingjing, as it represents the state of the art in HH sensitivity for this final state and could serve as a benchmark for projecting future ML-enhanced analyses. The paper itself does not employ ML techniques, but the improved reconstruction and analysis techniques mentioned could be a target for simulation-based inference or density ratio methods in future iterations.

Quantum Information in Particle Decays

[Qubit-qubit-qutrit quantum correlations in H to f fbar V]

This paper maps out the full quantum correlation structure -- bipartite entanglement, genuine 2x2x3 entanglement, Bell inequality violations, and non-stabiliserness (magic) -- in the decay H to tau- tau+ Z, working with exact tree-level spin states. Notably, **Michael Spannowsky** is among the authors. The paper derives semi-analytical expressions for tight 4x4x2 Bell inequalities for the 2x2x3 system for the first time and shows that the differential decay rate concentrates in the most nonclassical phase-space regions. This is interesting for you, Jingjing, if you are thinking about quantum information observables in Higgs decays, and for you, Aritra, if quantum circuit architectures for particle physics entanglement studies are on your radar. The connection to Lorentz-equivariant quantum circuits is indirect but the entanglement structure analysis could inform quantum ML approaches.

Jet Substructure and Medium Response

[Imaging non-hydrodynamic modes with jet wakes]

This paper shows that the angular structure of the jet wake in heavy-ion collisions provides a spectroscopic probe of non-hydrodynamic modes of the QGP, with higher angular moments encoding microscopic non-equilibrium dynamics. While not an ML paper, this is interesting for you, Aritra, because the angular-moment decomposition of jet wakes is conceptually related to jet substructure observables that ML methods often exploit. The framework connecting angular moments to the relaxation spectrum of the collision operator could inspire information-theoretic or ML-based approaches to extracting non-hydrodynamic signatures from jet data.

Neural Network Methods for Lattice Gauge Theory

[Neural quantum states for non-Abelian lattice gauge theories with dynamical fermions]

This paper uses a neural-network variational Monte Carlo ansatz to determine the ground state of untruncated SU(2) lattice gauge theory with dynamical staggered fermions, combining a neural-network gauge wavefunction with a gauge-covariant Gaussian fermionic correction. The method is sign-problem-free and scales polynomially in variational parameters. This is tangentially relevant to you, Aritra, insofar as it represents a neural-network architecture designed to respect gauge symmetry -- conceptually parallel to Lorentz-equivariant ML architectures, though in a lattice gauge theory context rather than collider physics.

Slim pickings today overall -- no dedicated ML-for-HEP papers appeared. The ATLAS HH result is the most actionable for Jingjing's program, and the jet-wake paper offers a physics angle worth keeping in mind for Aritra's jet substructure interests.

Back tomorrow with more!

P.S. In the most recent submission window: hep-ph: 30 papers hep-ex: 6 papers hep-th: 29 papers