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J. J. Sakurai Prize for Theoretical Particle Physics Lecture: Improving the precision of high-energy simulation and analysis tools

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Comparing theoretical predictions with experimental data on particle collisions like those at the Large Hadron Collider is far from straightforward. The predictions usually concern fundamental objects (quarks, gluons, leptons, ...) whereas the colliding hadrons are complicated bound states. Furthermore, final states of interest often contain high-energy jets of many hadrons, together with underlying lower-energy hadron production. The jets may come from primary interactions producing energetic quarks and gluons, or from the decays of heavy or highly boosted objects, possibly new forms of matter. I will discuss the development of computer simulations of jet production in hard collisions, and of jet-finding algorithms that aim to reconstruct the fundamental collision and decay dynamics from hadronic final states. In both cases, improvements in the underlying theoretical framework have led to a better description of Standard Model processes at the LHC, and better tools for the discovery of any new processes that may lie within its reach.