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J. J. Sakurai Prize for Theoretical Particle Physics Talk: The Boundless Horizons of Supercollider Physics[1]

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The Large Hadron Collider at CERN is moving the experimental frontier of particle physics to the domain of electroweak symmetry breaking, reaching energies around one trillion electron volts for collisions among the basic constituents of matter. *We do not know what the new wave of exploration will find,* but the discoveries we make and the new puzzles we encounter are certain to change the face of particle physics and echo through neighboring sciences. In this new world, we confidently expect to learn what sets electromagnetism apart from the weak interactions, with profound implications for deceptively simple questions: Why are there atoms? Why chemistry? What makes stable structures possible? A pivotal step will be finding the Higgs boson-or whatever takes its place -and exploring its properties. But we hope for much more. More predictive extensions of the electroweak theory, including dynamical symmetry breaking and supersymmetry, imply new kinds of matter that would be within reach of LHC experiments. We suspect that candidates for the dark matter of the Universe could also await discovery on the TeV scale. The strong interactions may hold their own surprises. As we unravel the riddle of electroweak symmetry breaking, prospects arise for other new insights: into the different forms of matter, the unity of quarks and leptons, and the nature of spacetime. The questions in play all seem linked to one another-and to the kinship of the weak and electromagnetic interactions. I will speak of the evolving dialogue between theory and experiment, highlighting the work before us.

[1]Fermilab is operated by the Fermi Research Alliance under contract no. DE-AC02-07CH11359 with the U.S. Department of Energy.