APR12-2012-000683

Abstract for an Invited Paper
for the APR12 Meeting of
the American Physical Society

Higgs Theory and Phenomenology in the Standard Model

DOREEN WACKEROTH, University at Buffalo, The State University of New York

Particle physics has entered an exciting era: The CERN Large Hadron Collider (LHC) performed exceptionally well since its start of operation at an energy of 3.5 TeV per beam in 2010 and is exploring the new energy regime where we hope to find answers to some of the most fundamental questions in particle physics and cosmology. Soon, the LHC may reveal the origin of electroweak symmetry breaking, discover physics beyond the Standard Model, and may even identify a candidate for dark matter. The Standard Model (SM) has been immensely successful in describing electroweak and strong interactions of fundamental particles, surviving all experimental tests since its formulation in the 1970s. Nevertheless, it leaves many questions unanswered, not the least of which concerns the origin of mass. The experimental fact that weak gauge bosons, the $W^{\pm}$ and Z^0 bosons, are massive has been accommodated within the SM by spontaneously breaking the electroweak symmetry via the Higgs-Kibble mechanism. As a consequence of this mechanism, the SM requires the existence of a spin-0, neutral, massive particle, the Higgs boson. We know from comparing very precise measurements of properties of SM particles, such as the W and Z bosons, to their SM predictions (which depend on the Higgs boson mass through quantum-loop effects), that the Higgs boson is relatively light. So light, in fact, that it should not escape detection at the LHC, if it exists. The search for the Higgs boson and the measurement of its properties, once discovered, requires excellent theoretical control of predictions for its production and decay processes. Since the very rare Higgs event has to be extracted from a much larger background of processes that do not include a Higgs, these background processes have to be very well understood, as well. I will review recent theoretical advances in providing precise predictions of observables of Higgs production and background processes that are crucial in the search for the SM Higgs boson at the LHC.