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THE HIGGS BOSON – THE SEARCH FOR THE PARTICLE AND THE ROLE OF SIMULATION

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BIOGRAPHY

Robert Roser is senior member of the scientific staff at Fermi National Accelerator Laboratory. He began his career at the University of Connecticut where he majored in physics. While earning his bachelors degree, he worked in a Van de Graaff accelerator laboratory doing atomic physics and began the process of learning how to be an experimental physicist. Upon graduation, he entered the University of Rochesters PHD program in experimental particle physics and worked at Fermilab on a fixed-target experiment studying the QCD process of direct photons. After graduation, he accepted a postdoctoral fellowship with the University of Illinois in Urbana-Champaign and joined the CDF experiment. He was part of the team that discovered the top quark in 1995 and led the top quark physics analysis group from 1996-1998. Dr. Roser joined the Fermilab scientific staff as a Wilson Fellowship in 1997. He has held a number of leadership positions on the CDF experiment including supervising much of the Run II upgrades, leading the Detector Commissioning and early Operations effort and has served as its leader and scientific spokesperson for the past eight years where this group found first evidence of the Higgs Boson. Most recently, he has accepted the position as head of the Scientific Computing Division at Fermilab and is now a member of the CMS experiment at CERN. He is a member of numerous scientific advisory panels, is a fellow of the American Physical Society and is the author of over 600 refereed publications.

ABSTRACT

Answers to pressing questions in high-energy physics may lie in electroweak symmetry breaking, the phenomenon for explaining why the weak and electromagnetic forces are different. From solving the mystery of dark energy to string theory, our entire philosophy depends on the unknown physics at the electroweak scale. The hunt for the elusive Higgs boson has gone on for almost half a century. Its discovery was finally announced on July 4, 2012. The discovery of the Higgs boson is even more significant than often discussed. This grand experimental achievement in the largest, most powerful machine ever built, the Large Hadron Collider, marks a far wider scientific, philosophical and intellectual triumph – and one that spans human history from the dawn of civilization. It has to do with the idea of symmetry: amazingly, the Higgs boson was predicted to exist not for any physical reasons, but on strictly mathematical grounds based on arcane symmetries usually studied in ”pure” mathematics. And the search for these symmetries involves a major quest that began with the Babylonians and Egyptians and continued to the ancient Greeks, the Arabs, medieval Europe, and on through the 19th century to our own time. This talk will begin with

a brief overview of particle physics and why the Higgs Boson is so important and how it completes the symmetry. It will then explain how one goes about searching for this particle and expand the critical role simulation efforts played not only in the final analysis but also in designing the detector systems, which truly are modern marvels. I will discuss with some other highlights from these experiments and what to expect as the LHC gears up to come back on line in early 2015 at its design energy, nearly double its current 8 GeV operating point. Finally, I will close with a few words on particle physics and society and how the search for the perhaps esoteric has benefited society.