

The Brout-Englert-Higgs mechanism and its scalar boson

Abstract

The impressive developments in physics during the first half of the 20th Century made it then conceivable that all phenomena, from the atomic scale to the edge of the visible universe, be governed solely by the two known laws of classical general relativity, Einstein's generalization of Newtonian gravity, and quantum electrodynamics, the quantum version of Maxwell's electromagnetic theory.

But gravitational and electromagnetic interactions are *long range* interactions. The discovery of subatomic structures had revealed the existence of other fundamental interactions that are *short range*, that is negligible at larger distance scales. In the beginning of the 60s, the theoretical interpretation of short range fundamental interactions seemed to pose insuperable obstacles.

Inspired by Nambu's work on spontaneous symmetry breaking, Brout and Englert, and also Higgs, postulated in 1964 the existence of scalar bosons that condense into a field pervading the universe. The condensation provides a mechanism for generating fundamental short range forces out of long range ones, leads to a dynamical origin for the elementary particle masses and opens new perspectives on the unity of the laws of nature.

I will explain spontaneous symmetry breaking, the BEH mechanism, its consequences and the properties of its scalar boson(s). I will show how the recent impressive discovery at CERN confirms the validity of the mechanism in a direct way and has implications for the structure of matter constituents at yet unexplored energies.