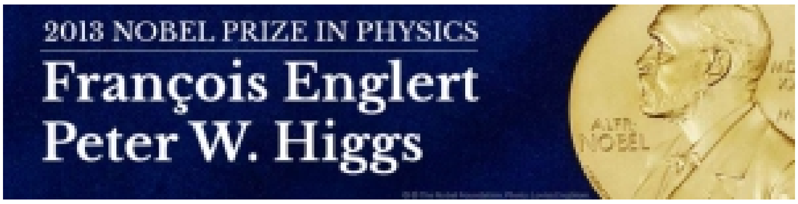


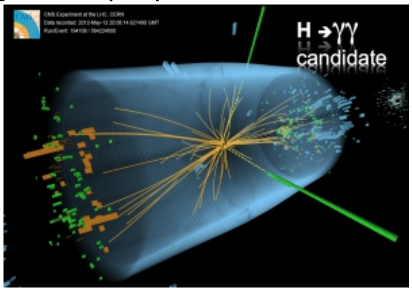
The 2013 Nobel Prize in Physics was awarded to François Englert (Belgium) and Peter W. Higgs (U.K).

The press release of the Nobel committee is very careful in its wording. First of all the prize is awarded to two theorists "*for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particle* ". This Nobel refers to the BEH mechanism (for Brout, Englet and Higgs). In 1964 Brout and Englert wrote a paper putting forth the idea. Within a few weeks the same proposal was made by Higgs albeit in a slightly different language. The mechanism itself was a way to counter a theorem (Goldstone theorem, which in fact was put on firm ground by Goldstone, Salam and Weinberg). The theorem predicts the appearance of massless spin-0 bosons (Nambu-Goldstone bosons) whenever there is spontaneous symmetry breaking. In short this refers to the situation where the dynamics and the equations describing the physics have a symmetry that is not shared by the solution of the equation, in particular by the ground state of the theory.

There may be an infinite set of solutions for the ground state. Since one has to choose one of the solutions, the symmetry is then broken or rather hidden. This situation commonly occurs when one solves differential equations that can exhibit a symmetry (x, the variable, into –x) but a particular solution may not retain the symmetry. In field theory, with continuous symmetries, this entail a massless scalar bosons.

In the BEH mechanism, as one introduces an interaction with the gauge bosons which, without those scalars, would be massless, the Nambu-Goldstone bosons are "eaten" by the gauge bosons. The latter become massive. This is how gauge particles gain mass. The same set-up also gives mass to matter particles. This is the mechanism. The mechanism does not really require the existence of another physical particle. Nonetheless in the original implementation of the BEH mechanism another particle came along with the Nambu-Goldstone boson. It was initially given little importance or even totally ignored for quite sometime. This other particle is what is now known as the Higgs particle. The Nobel committee underlines the importance of this fundamental particle which was discovered at CERN's LHC (Large Hadron Collider) in July

2012 

. The Nobel committee gives credit to both ATLAS and CMS, the two experiments at CERN. There is no denying the tremendous work that both experiments, with 3000 scientists each, have achieved and the titan achievement of the whole LHC(machine and experiments). One should not also forget the work of so many theorists who, for years, turned the idea into a more and more realistic concept. These theorists are still working towards ever more precise predictions and also towards a better understanding of the properties of this new particle. We have come a long way since 1975 when one of the 

first theory papers digged into the properties of the Higgs particle. John Ellis, Mary K. Gaillard and Dimitri Nanopoulos wrote in their seminal paper (Nucl. Phys. B 106 (1976) 292) "*We should perhaps finish with an apology and a caution. We apologize to experimentalists for not having any idea what is the mass of the Higgs boson, unlike the case with charm, and for not being sure of its couplings to other particles, except that they are probably all very small. For these reasons, we do not want to encourage big experimental searches for the Higgs boson, but we do feel that people performing experiments vulnerable to the Higgs boson should know how it may turn up."*

LAPTh theorists have added their bit to the story of the Higgs. Many of us have been working on the properties of this particle for a long time. We have also contributed to the field of precision predictions for the LHC and future colliders. A partial list of articles by LAPTh theorists with "Higgs" in the title is here .

For general public presentations on the subject of the Higgs, see

- La traque du boson de Higgs, Oct. 2012, in French

1. Theory (Geneviève Bélanger, LAPTh) and 2. Experiment : (Elizabeth Petit, LAPP)

- Higgs et la Masse , Dec. 2012, in French, Fawzi Boudjema, LAPTh
- Un boson nommé Higgs , Oct 2013, in French, Paul Sorba, LAPTh

For non specialists but with some background in physics (M2 Level),see

- Higgs and Symmetry Breaking/ X et brisure de symétrie , Fawzi Boudjema, LAPTh, Oct 2013 in English with parts in French