25 February 2026 **Quiz number 1**

Phenomenology of Physics Beyond the Standard Model

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1. Blue band plot

Comment on the so-called Blue band plot in Figure 1. In particular:

- Give examples of observables used for the fit in Figure 1. What is their dependence on the Higgs boson mass ?
- Sketch examples of Feynman diagrams at 1 loop for Higgs boson corrections to gauge bosons propagators.
- What was the main limitation for LEP in discovering the Higgs boson?

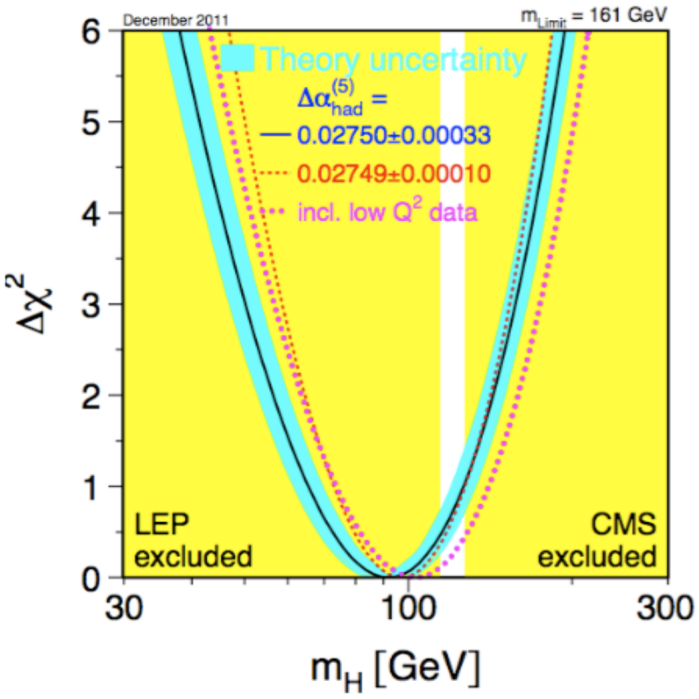


Figure 1: The Blue band Plot for SM Higgs mass boson - December 2011

2. Higgs mechanism within SM

Consider the spontaneous symmetry breaking (SSB) of the EW symmetry within the Standard Model $SU(2)_L \times U(1)_Y \to U(1)_{QED}$. Complete the following tables in 1 with the right number of degrees of freedom for each field in the Higgs and gauge sectors:

SM field content before EW SSB (no fermions)	
Field	DOFS
ϕ	
B	
W^α	

SM field content after EW SSB (no fermions)	
Field	DOFS
Z	
$W^\pm$	
A	
h	

Table 1: Tables to complete with the right number of degrees of freedom for each field

How are the degrees of freedom coming from the Higgs doublet ϕ before EW SSB transferred to the massive gauge bosons? What is the difference between the breaking of a global and a local symmetry in terms of the spectrum of the broken theory?