O que aprendemos em uma década

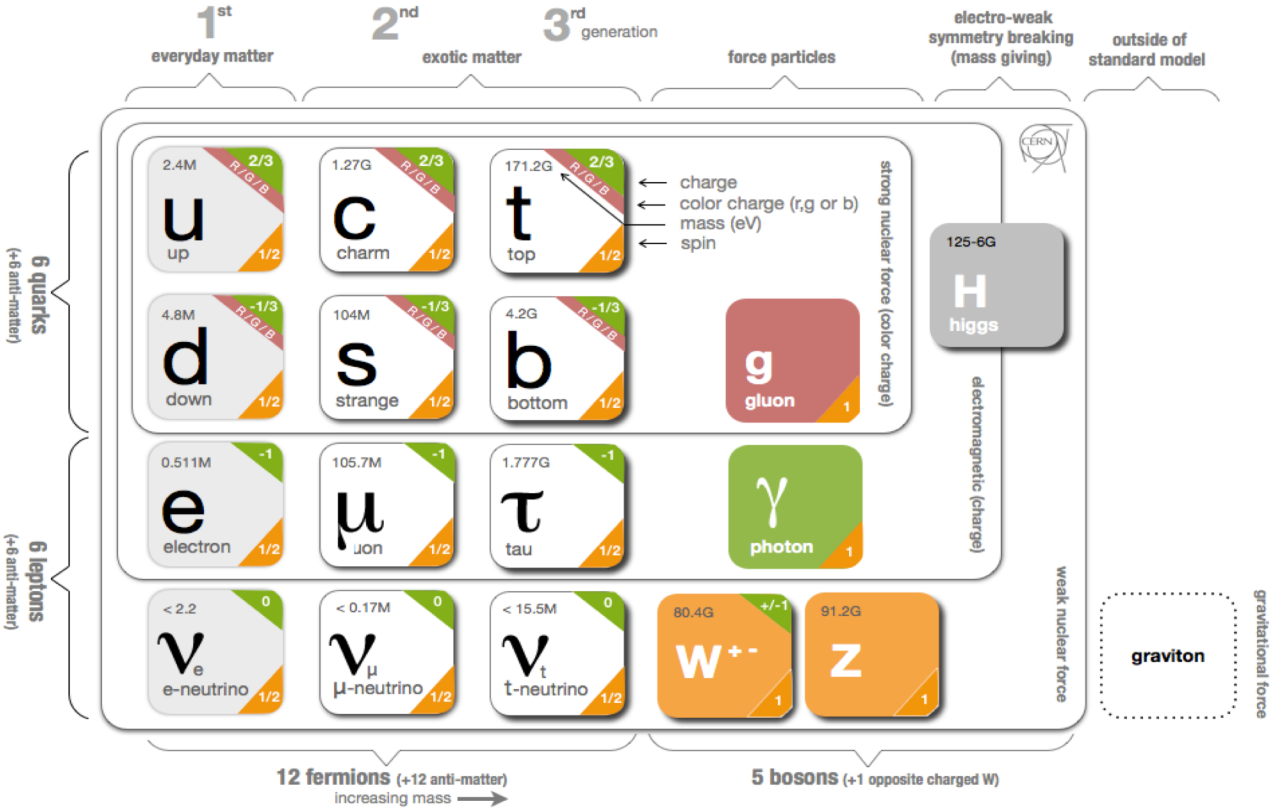
PEDRO MERCADANTE - UFABC

SPRACE

“We propose to build a general purpose detector designed to run at the highest luminosity at the LHC. The CMS (Compact Muon Solenoid) detector has been optimized for the search of the SM Higgs boson over a mass range from 90 GeV to 1 TeV, but it also allows detection of a wide range of possible signatures from alternative electro-weak symmetry breaking mechanisms.”

Abstract of the CMS Letter of Intent, submitted to the LHC Experiments Committee (LHCC) on 1 October 1992

O Modelo Padrão



Busca por Nova Física

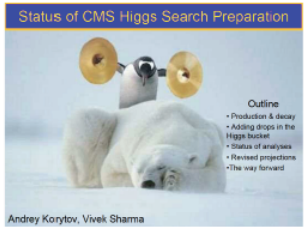
Avanços significativos na ciência são marcados pela confirmação de conjecturas ousadas ou pela falsificação de conjecturas conservadoras

A. Chalmers

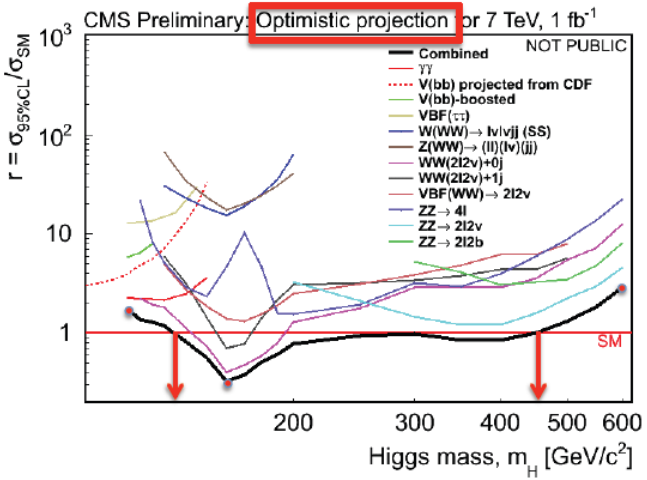
Um ano antes… (da descoberta)

CMS Physics Week in Bruxelles

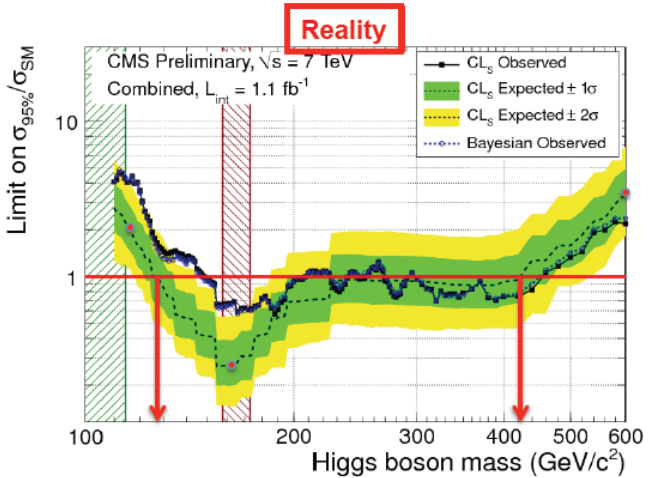
From projections to reality at 1 fb^{-1}



So how did CMS do? -- Very well!

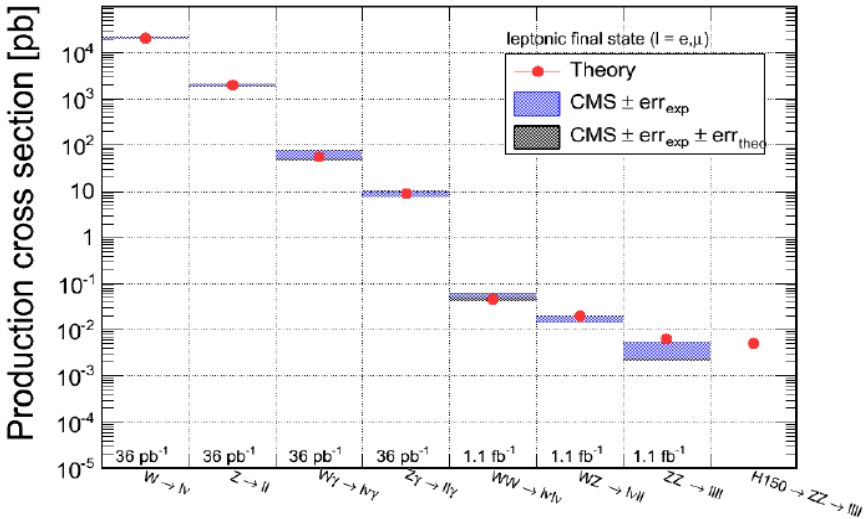


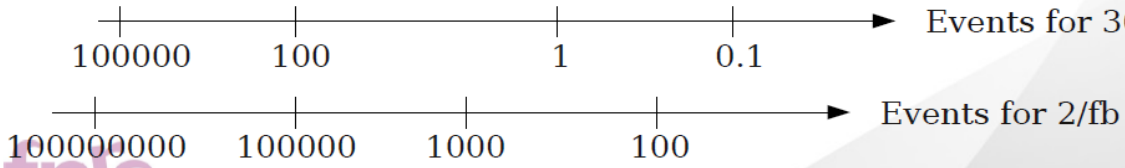
Projected sensitivity at Bodrum: 135-450 GeV



Sensitivity reported at EPS: 127-420 GeV

Cross-sections overview



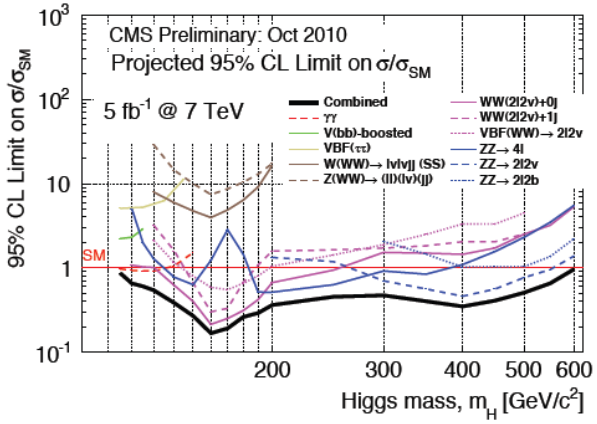


Already covering 6 (!) orders of magnitude from W to ZZ !

From Moriond, in terms of statistics:

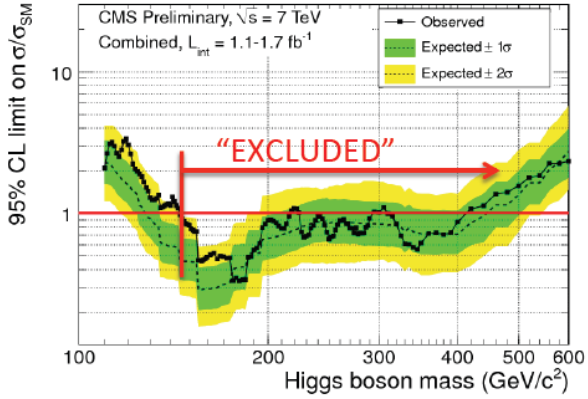
"From Z• to ZZ->ll"

When can we say "no SM Higgs"



2010 projection:

If Higgs is not there, we expected to be able to assert this at 95%CL with **5 fb^{-1}**



However, we see ~2σ excess at low mass

Updated back-of-envelope projection:

If Higgs is not there (i.e. the excess we see is a statistical fluke), it will now take more data to dissolve it. **We can expect to be able to exclude the SM Higgs boson in the full mass range at 95%CL with 8-10 fb^{-1}**

Crystal ball talk today: 30 fb^{-1}

Main questions today:

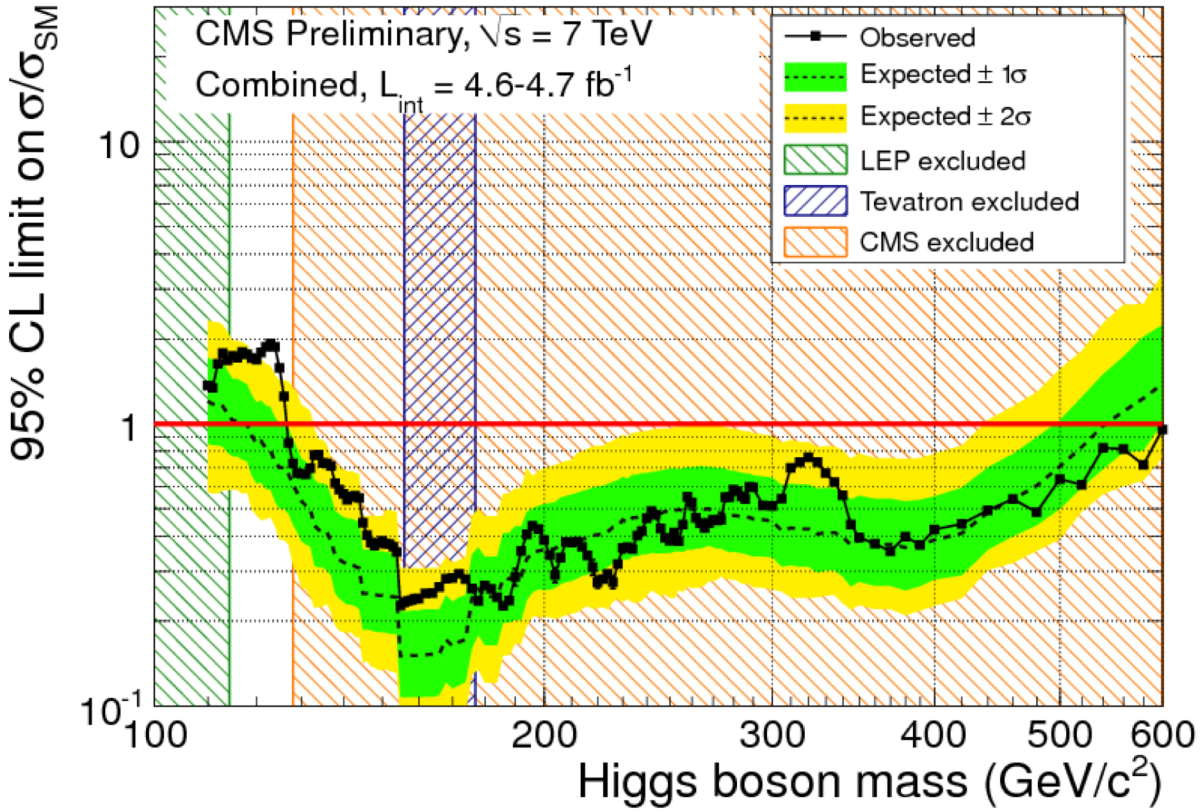
If we see no SM Higgs boson:

- How deep should we dig to claim "the SM Higgs boson is no more"?
- Can we also exclude fermiophobic Higgs?
- Can we see anomalies in WW scattering?

If the case for SM Higgs boson builds up:

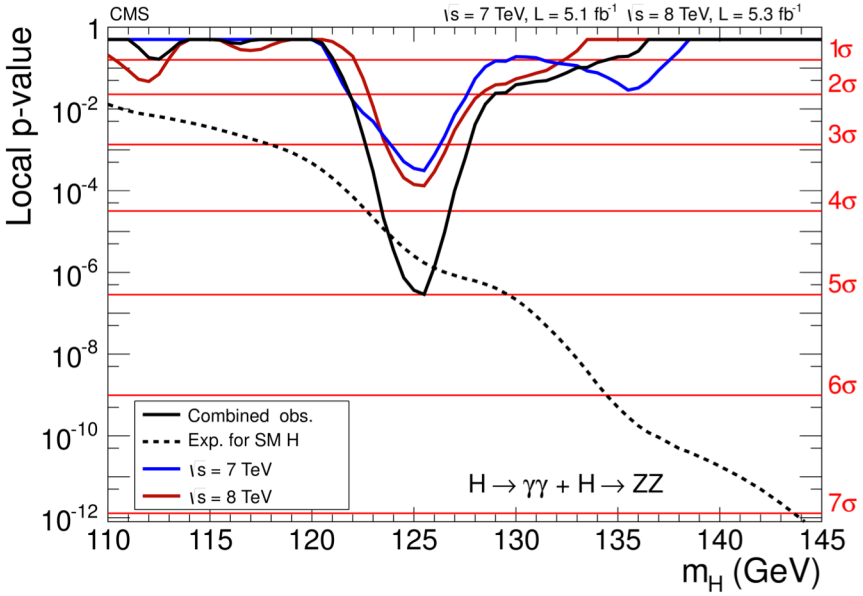
- Do we have a checklist for establishing the discovery?
- Are we ready to switch from a search to measurements?
- Are we broad enough in searches for BSM Higgs sector extensions?

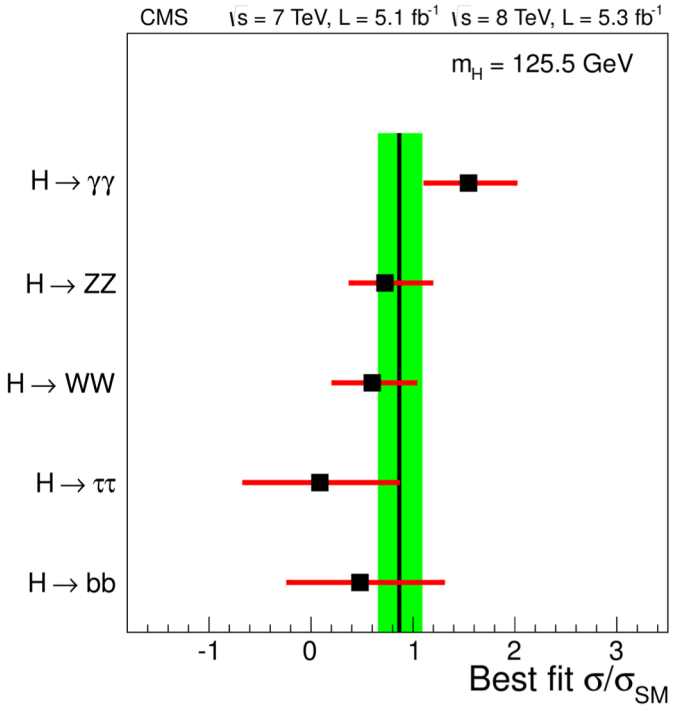
4 de Julho de 2012



Do paper da descoberta:

Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC



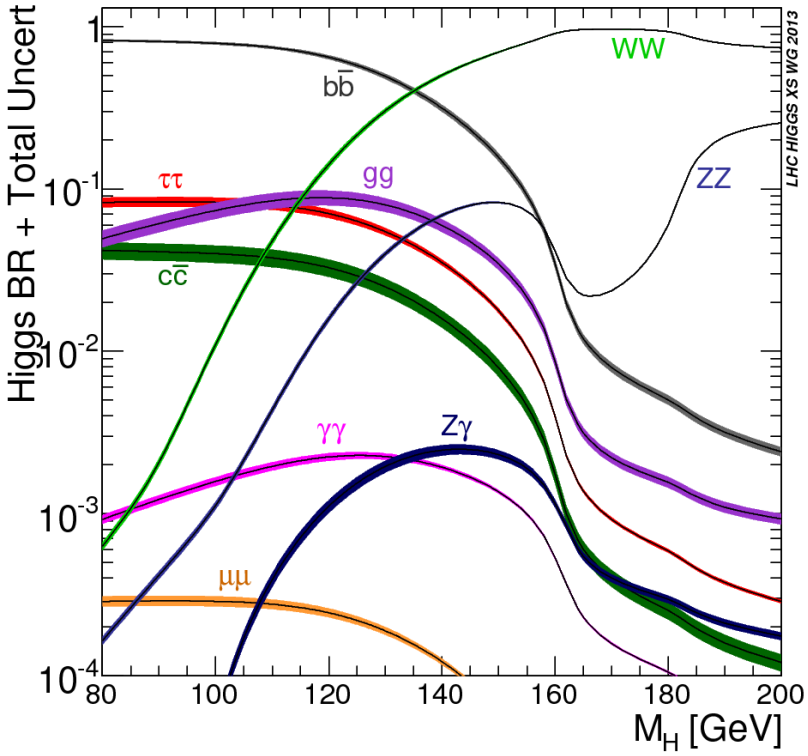


Why measure Higgs properties ?

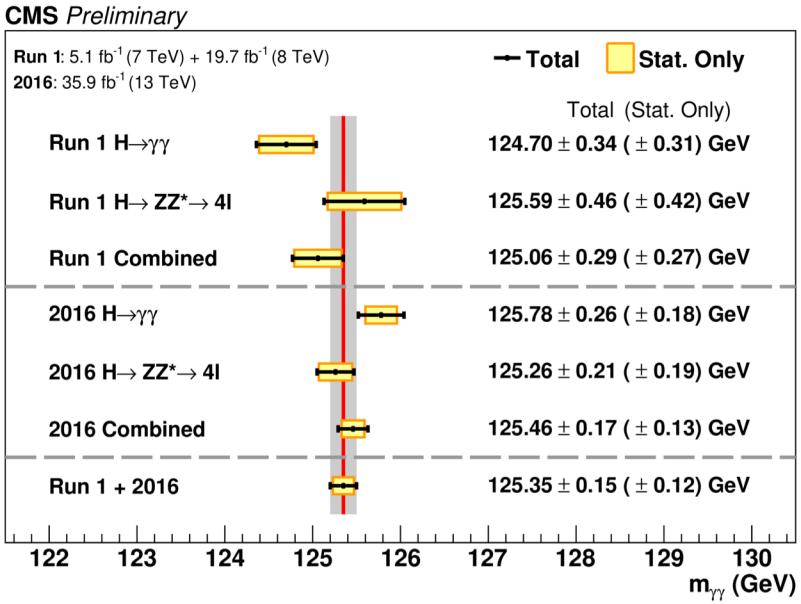
“ this theory is sometimes dignified with the title `the minimal standard model´, but its is not really a model at all ”

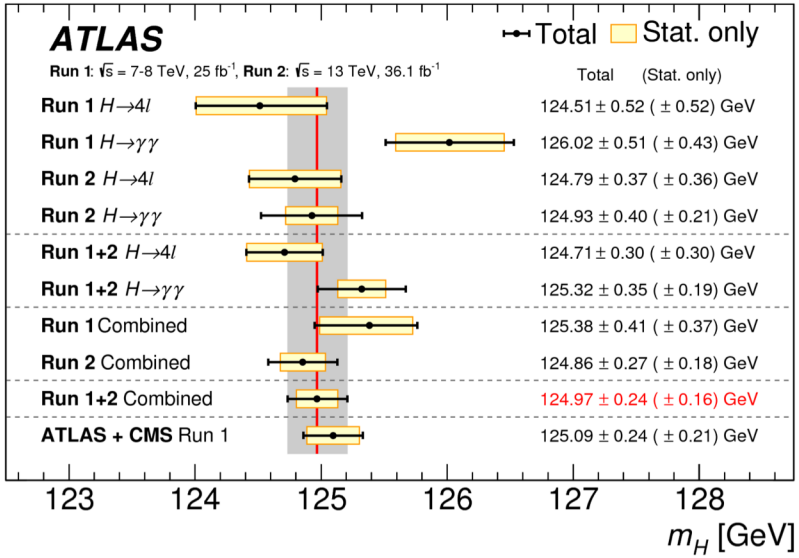
Murayama and Peskin

(hep-ex/9606003)

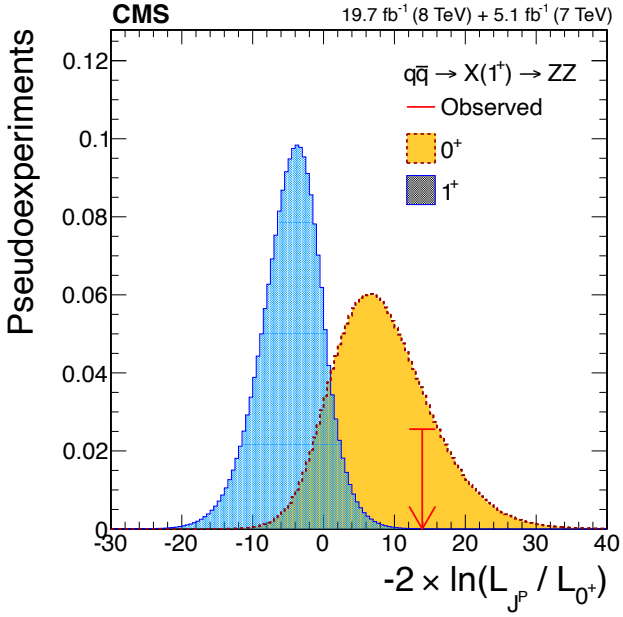


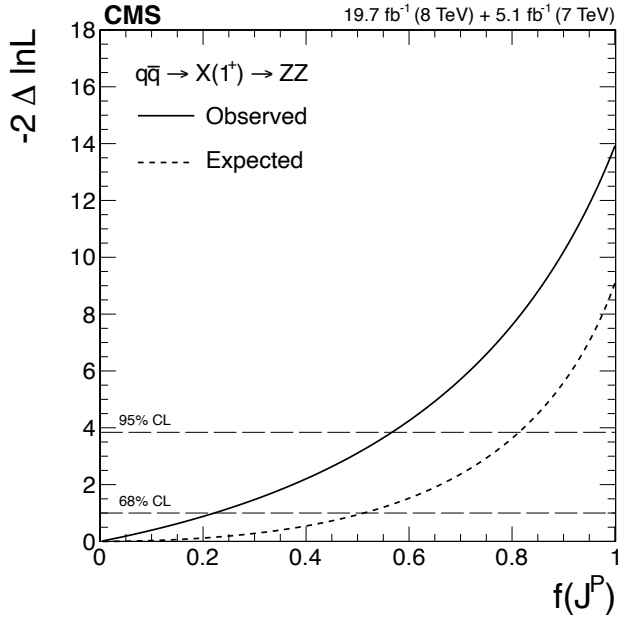
Mass Measurement



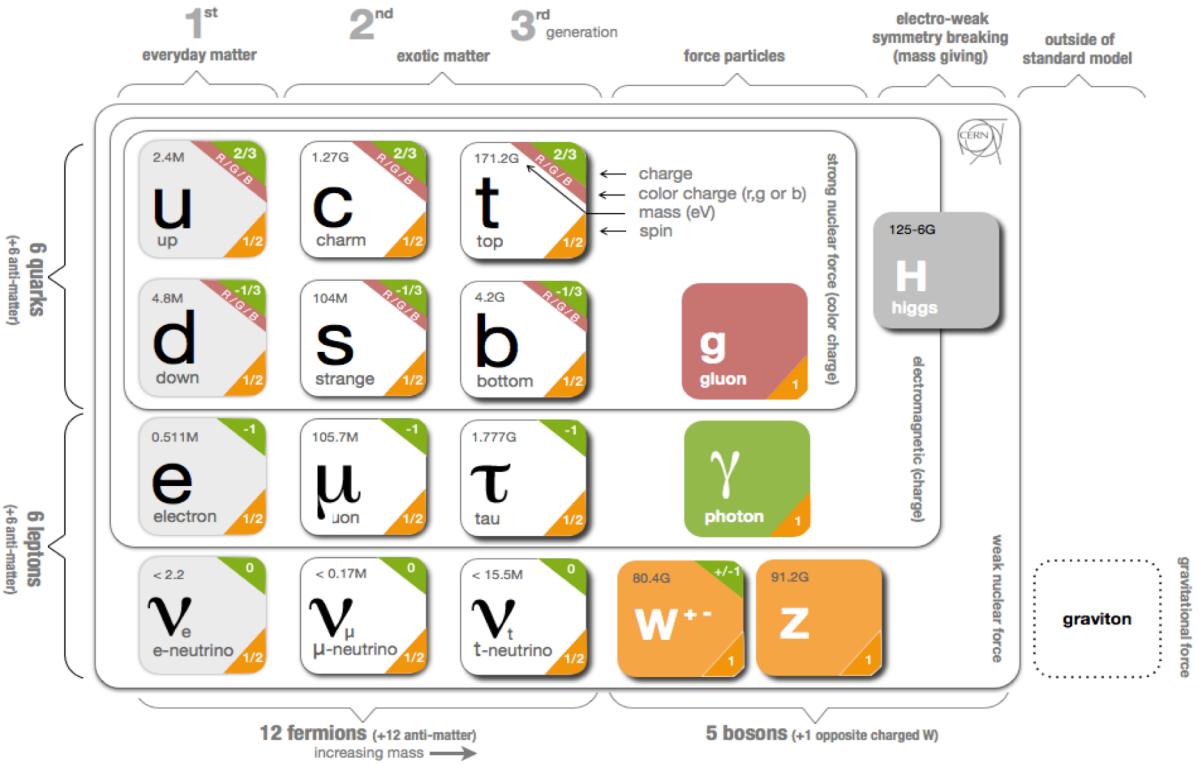


Qual o spin da partícula observada?

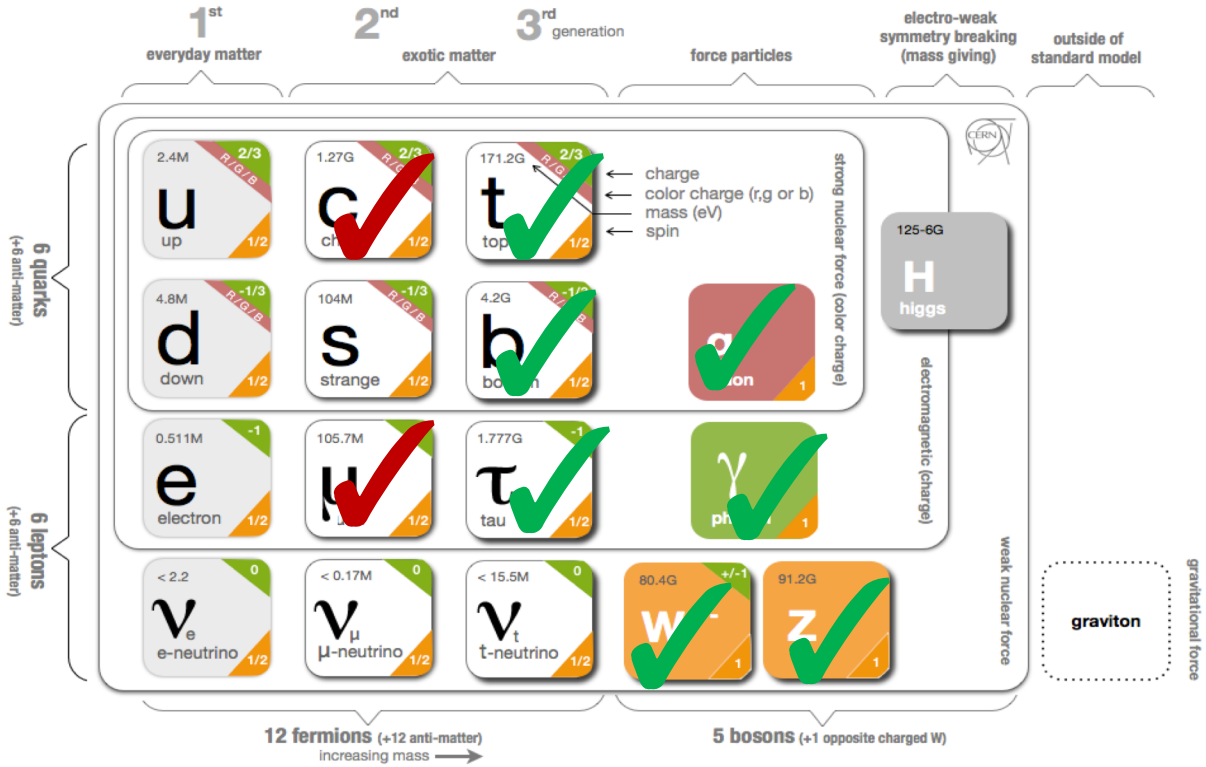




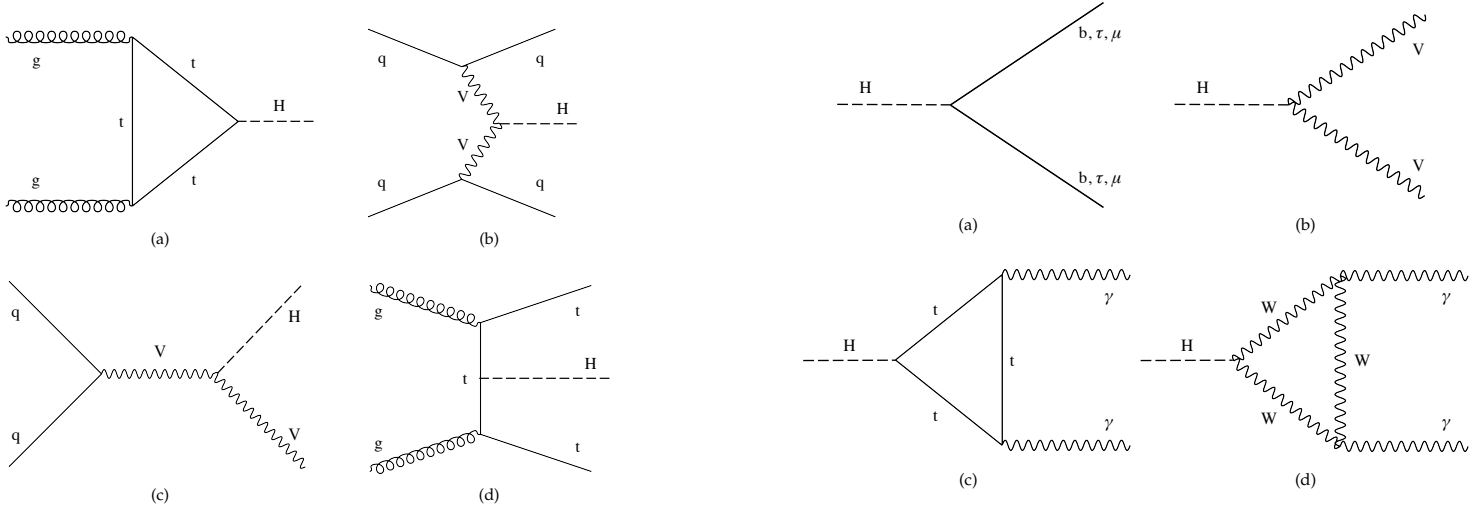
Acoplamentos do Boson de Higgs



Acoplamentos do Boson de Higgs



Combined Measurements of the Higgs Boson Couplings at 13 TeV (CMS)



CMS–PAS-HIG-17-031

Parametrização do Sinal

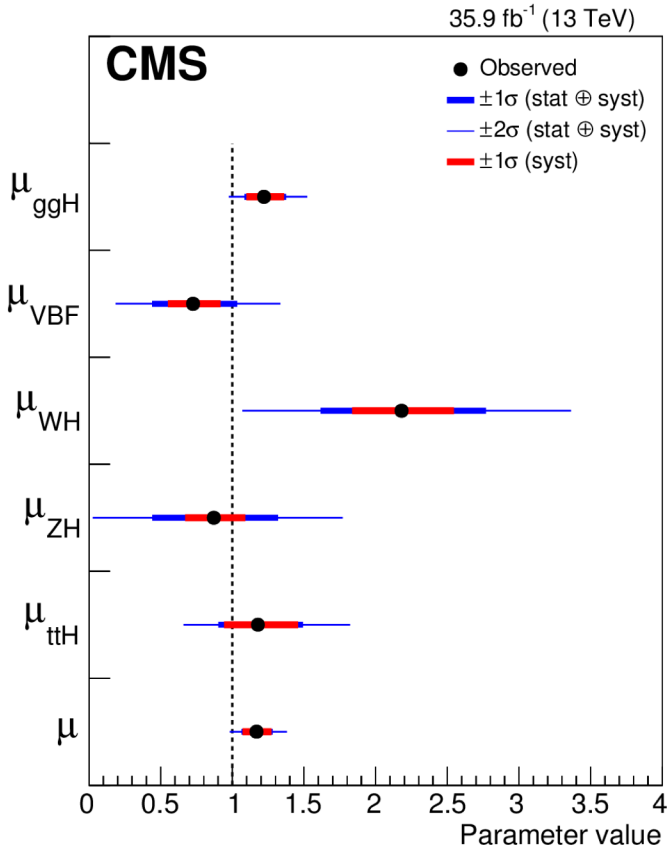
Para um sinal experimental i -> H -> f, podemos extrair:

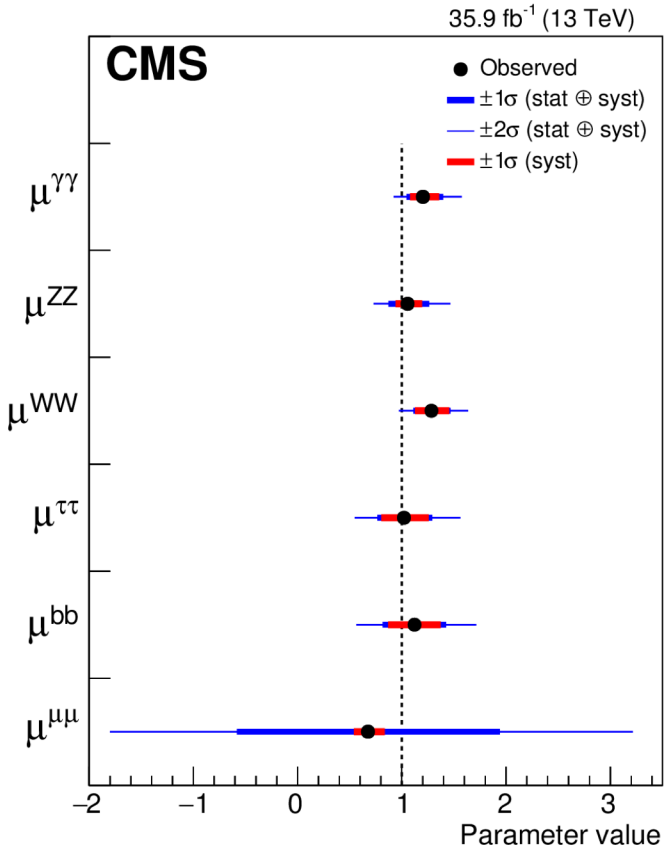
$$\mu_i^f = \frac{\sigma_i \cdot \mathrm{BR}^f}{(\sigma_i)_{\mathrm{SM}} \cdot (\mathrm{BR}^f)_{\mathrm{SM}}} = \mu_i \times \mu^f$$

De um fit global de todas as analyses, com um parâmetro apenas, podemos extrair um fit global:

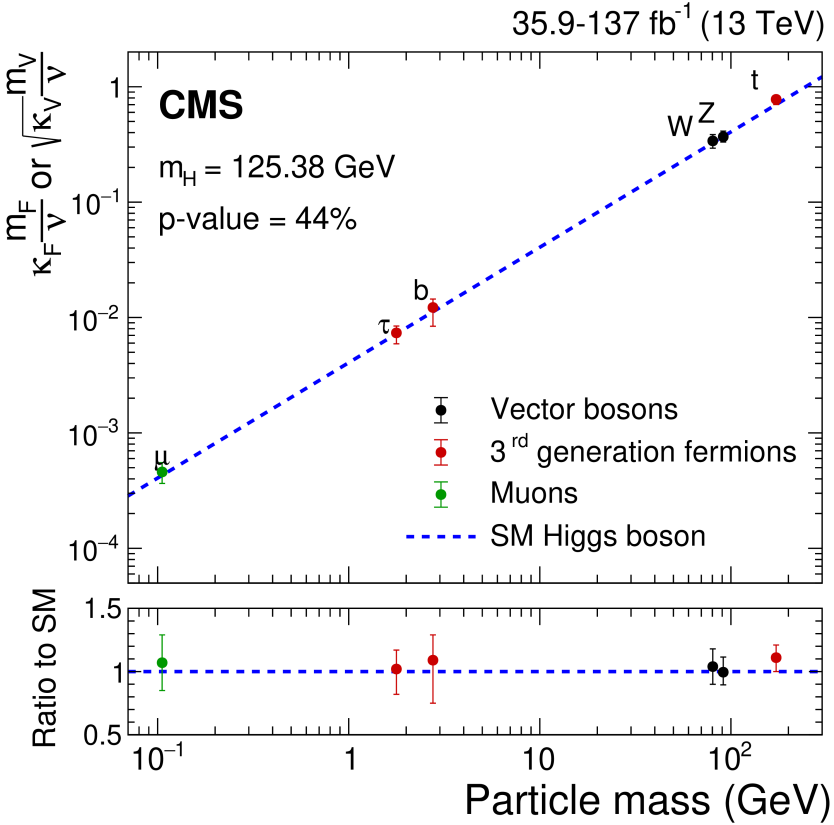
μ=1.002 $\pm$0.057 CMS

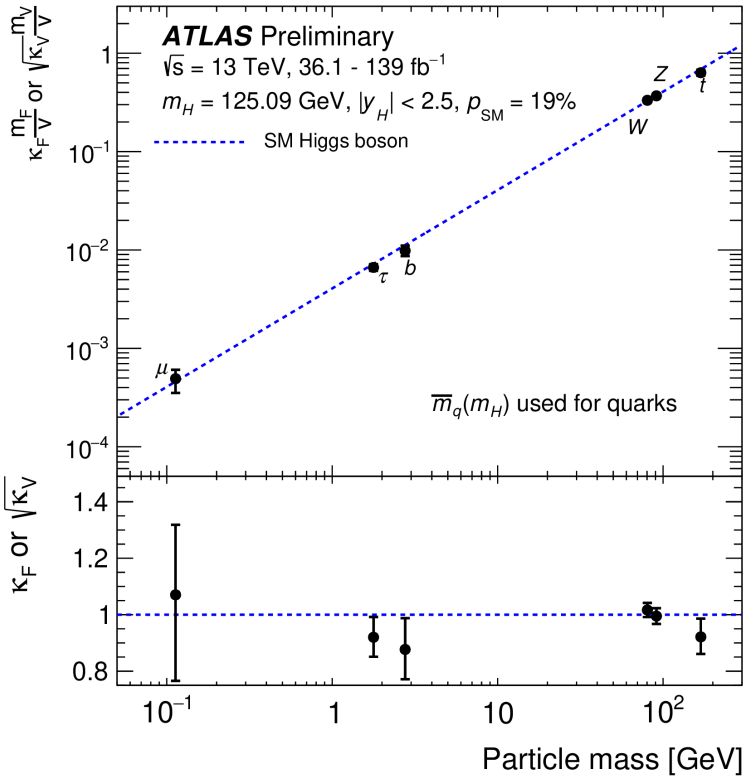
Produção e Decaimento: Diferentes modos



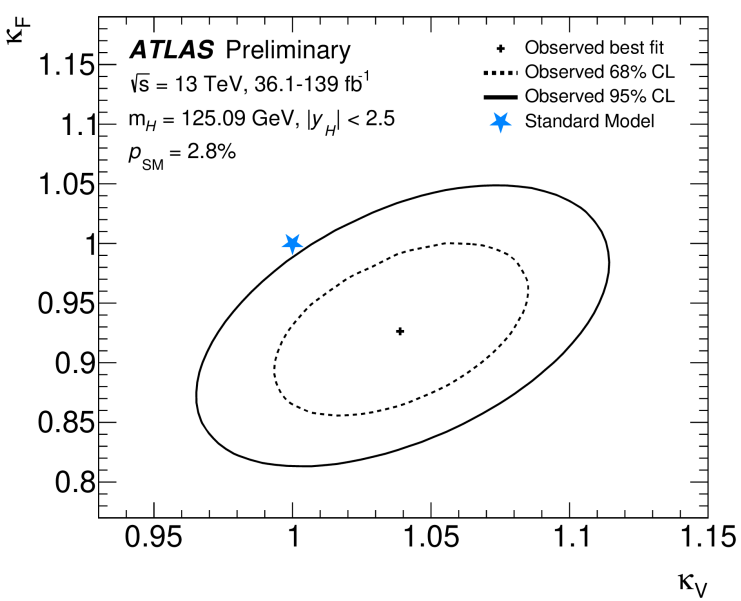


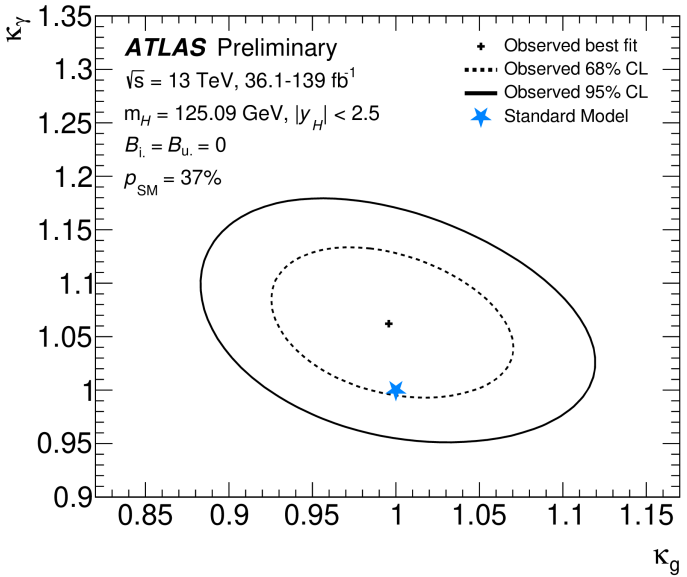
Acoplamentos do Higgs



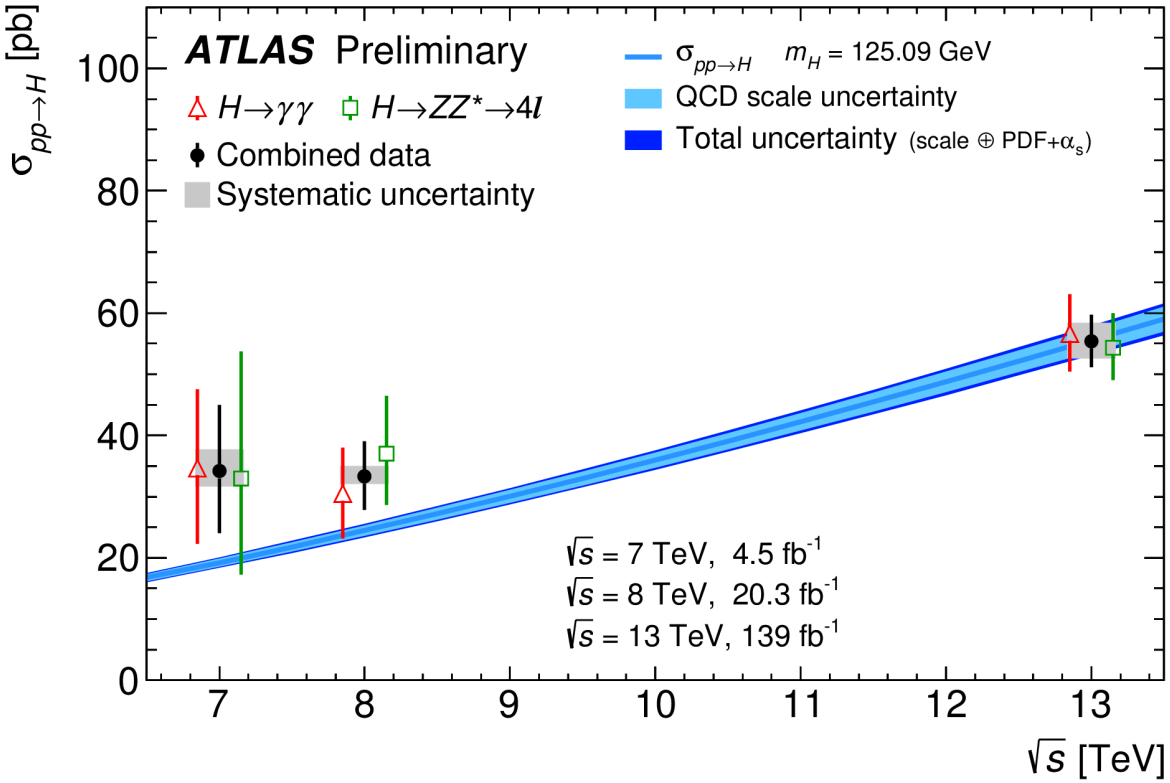


Acoplamentos





Seção de Choque



O que aprendemos?

Estudamos a produção e decaimento em vários canais

- ❑ Conhecemos a massa com precisão
- ❑ Conhecemos a largura de decaimento
- ❑ Sabemos o acoplamento com bosons de gauge e a maioria dos fermions
- ❑ Conhecemos o spin

Ao que tudo indica: é o boson de Higgs do modelo padrão

- ❑ Surpresa? (Como pode estar certo o modelo mínimo?)
- ❑ Decepção? (Queremos uma revolução?)
- ❑ Possíveis pistas para o futuro?