



SPRACE

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

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

CMS Physics Week
11-15 September 2011
Brussels, Belgium

André Hignaux, Art Director (1940)
© Communications & Support Group, 2011
#cmsweek2011 #ULB #VUB #CERN

Scientific committee

ACOSTA Darin, Florida university
CLERBAUX Barbara, Université Libre de Bruxelles
DE ROECK Albert, CERN/Université Antwerpen
D'HONDT Jorgen, Vrije Universiteit Brussel
DISERTORI Günther, ETH Zurich
INGANELLA Joe, CERN/UCS
RODRIGO Teresa, Santander
ROLANDI Gigi, (chair) CERN
TONELLI Guido, CERN/Pisa

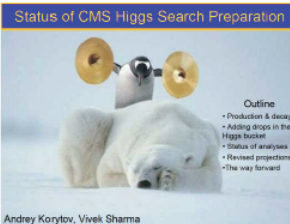
Local organizing committee

BLEKMAN Freya, Vrije Universiteit Brussel
CLERBAUX Barbara (co-chair), Université Libre de Bruxelles
DALBIE Evelynne, Université de Mons
D'HONDT Jorgen (co-chair), Vrije Universiteit Brussel
JANSSEN Xavier, Université Antwerpen
LEMAITRE Vincent, Université catholique de Louvain
TYTGAT Michael, Université Gent
VANLAER Pascal, Université Libre de Bruxelles

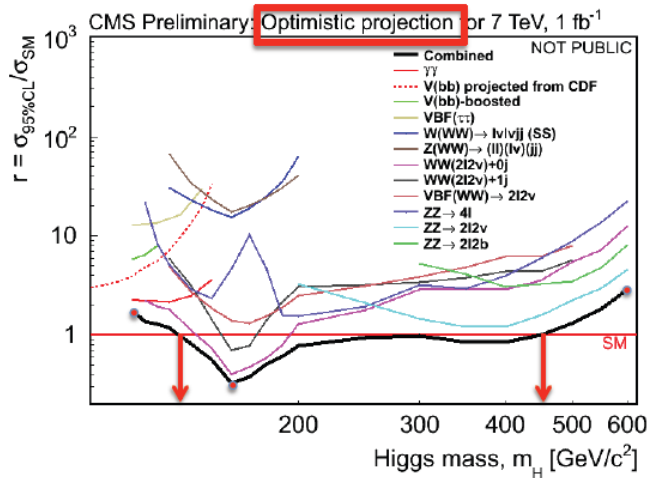
Contact: cmsweek2011@listserv.ulb.ac.be
<http://cmsweek2011.ihe.ac.be>

Université Libre de Bruxelles - Vrije Universiteit Brussel

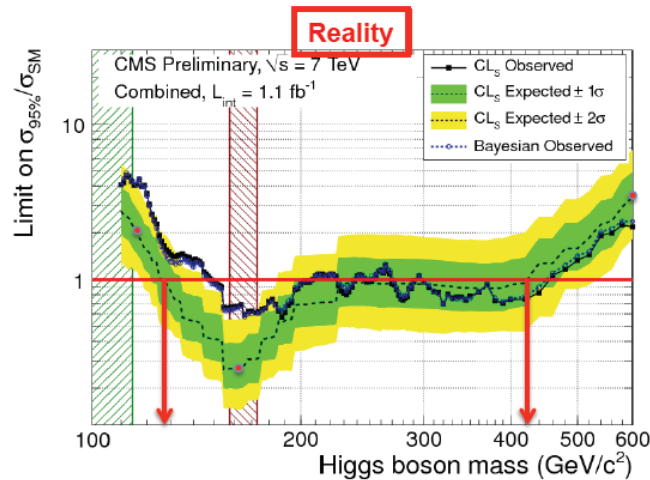
From projections to reality at 1 fb⁻¹



So how did CMS do? -- Very well!



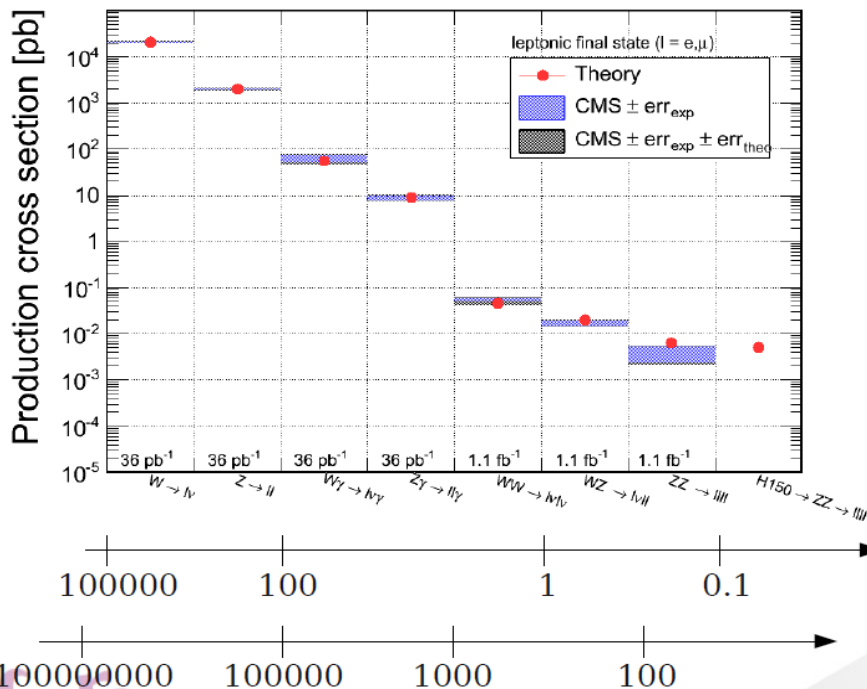
Projected sensitivity at Bodrum: 135-450 GeV



Sensitivity reported at EPS: 127-420 GeV



Cross-sections overview

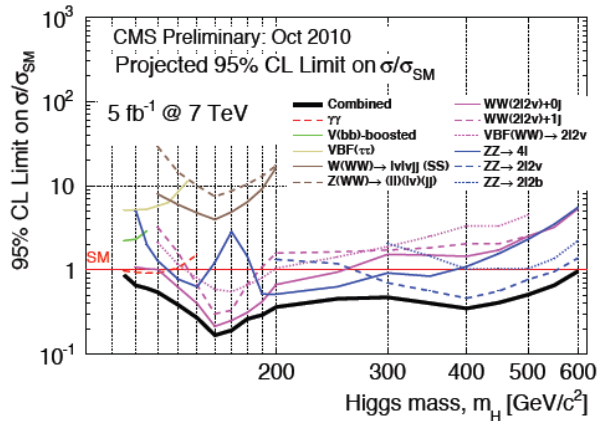


Already covering 6 (!)
orders of magnitude
from W to ZZ !

From Moriond,
in terms of statistics:

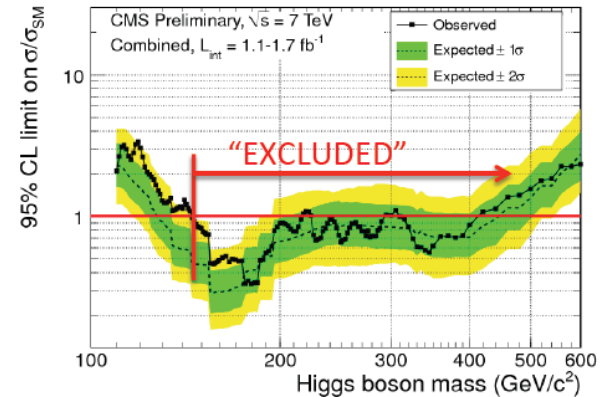
*“From Z•
to ZZ→ll”*

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 $\sim 2\sigma$ 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:

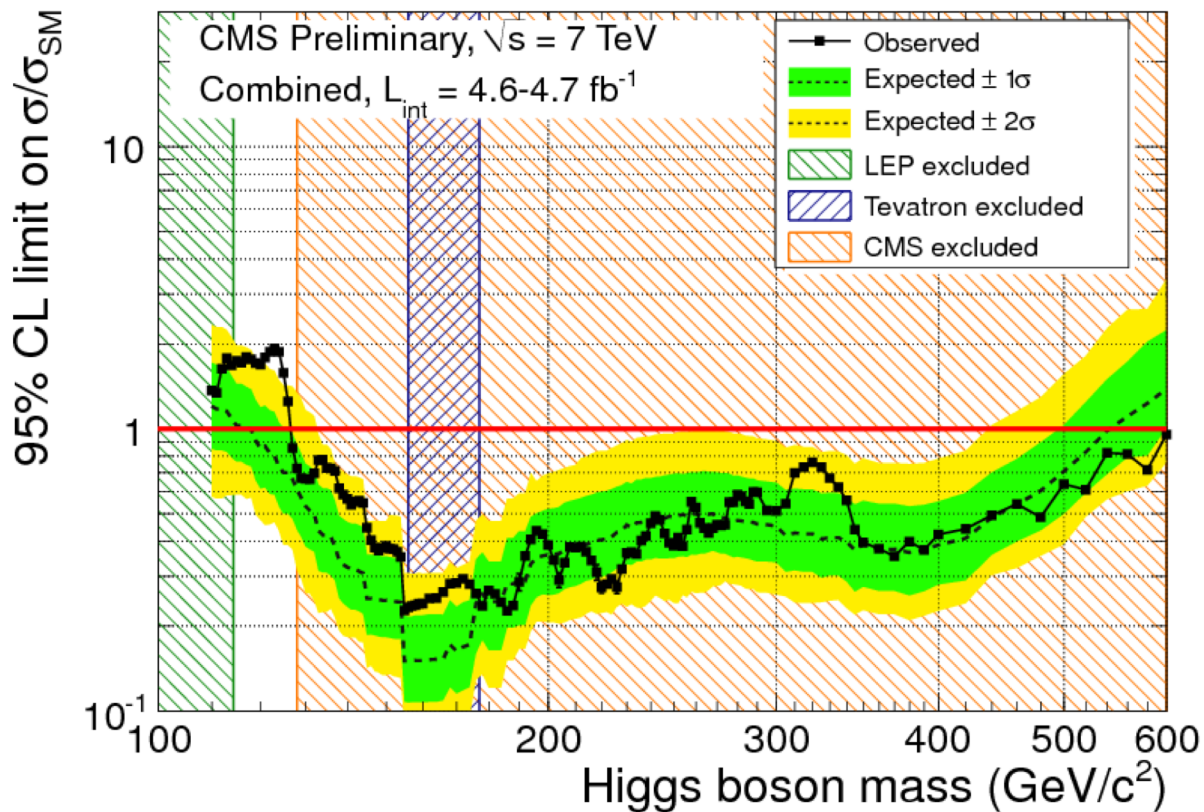
If we see no SM Higgs boson:

- 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:

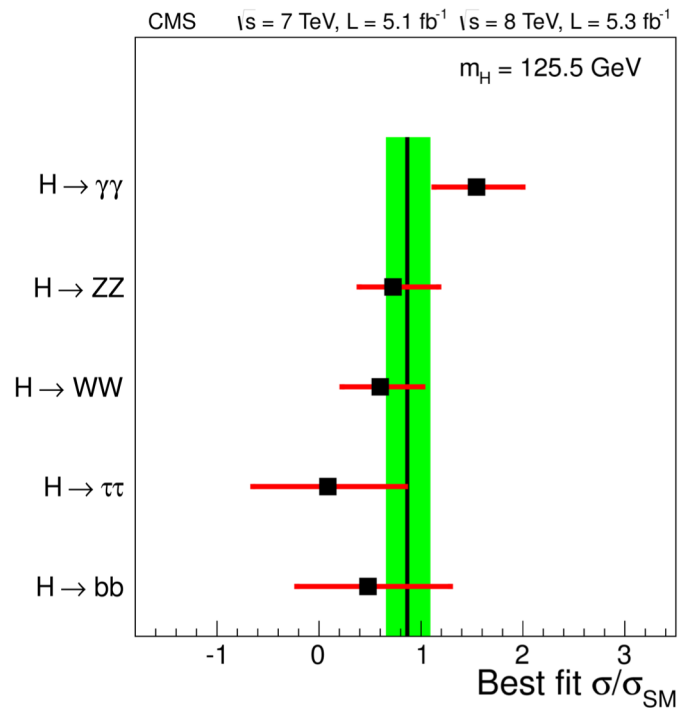
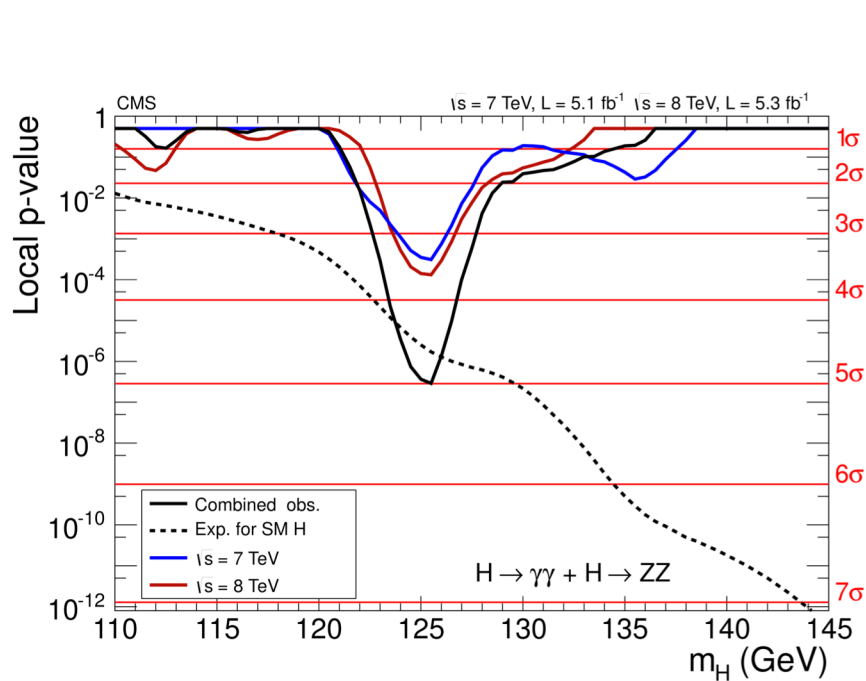
- Do we have a checklist for establishing the discovery?
- Are we ready to switch from a search to measurements?
- Are we broad enough in searches for BSM Higgs sector extensions?

4 de Julho de 2012



Do paper da descoberta:

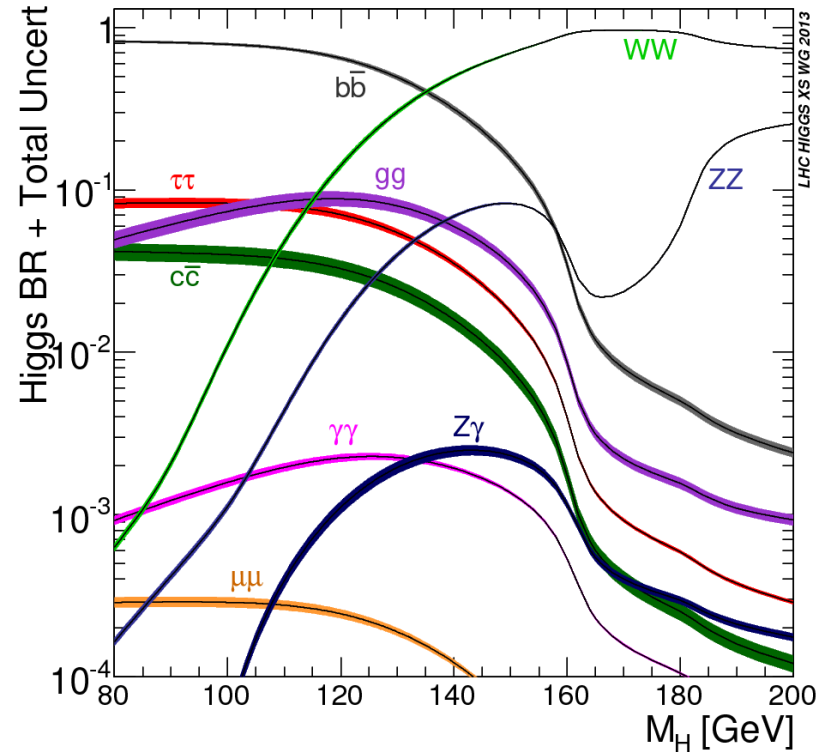
Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC



Why measure Higgs properties ?

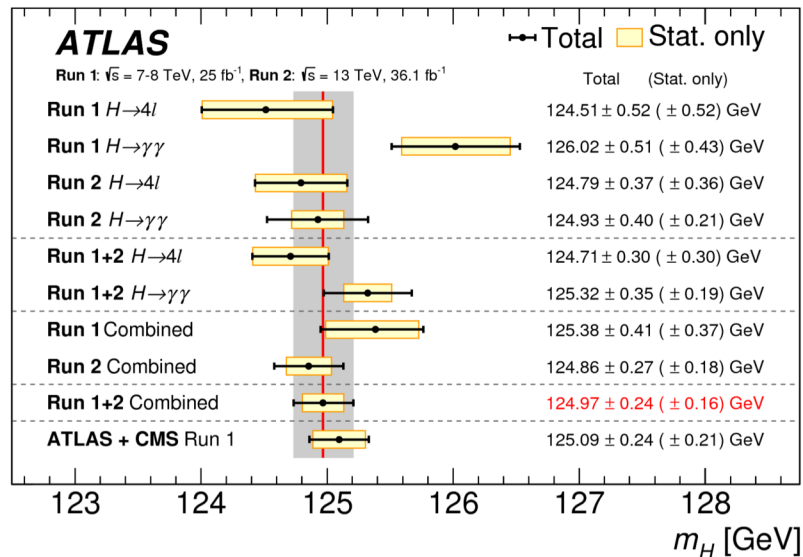
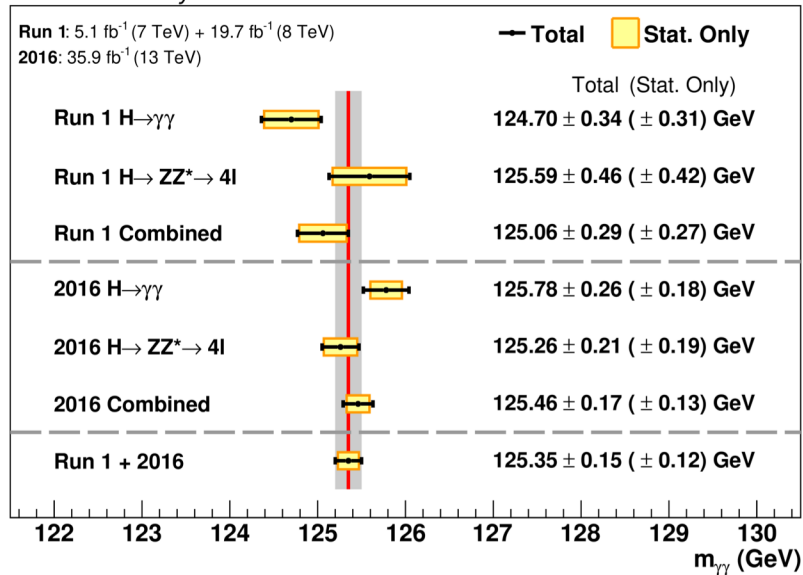
“ this theory is sometimes dignified with the title ‘the minimal standard model’, but its is not really a model at all ”

Murayama and Peskin
(hep-ex/9606003)

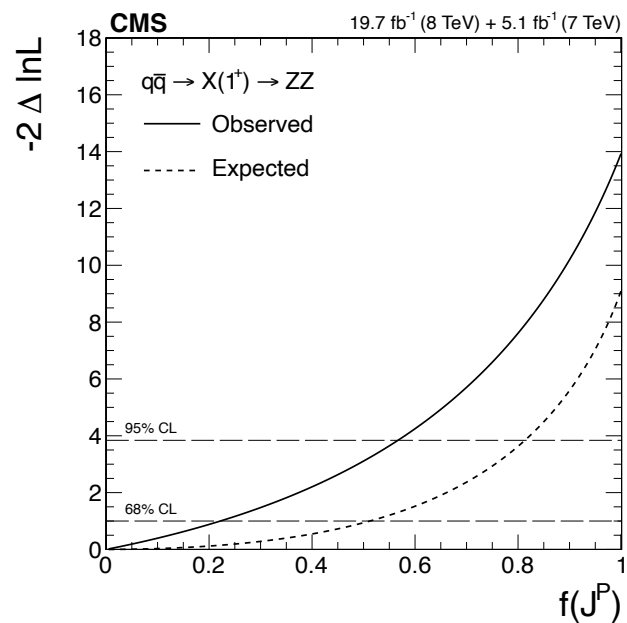
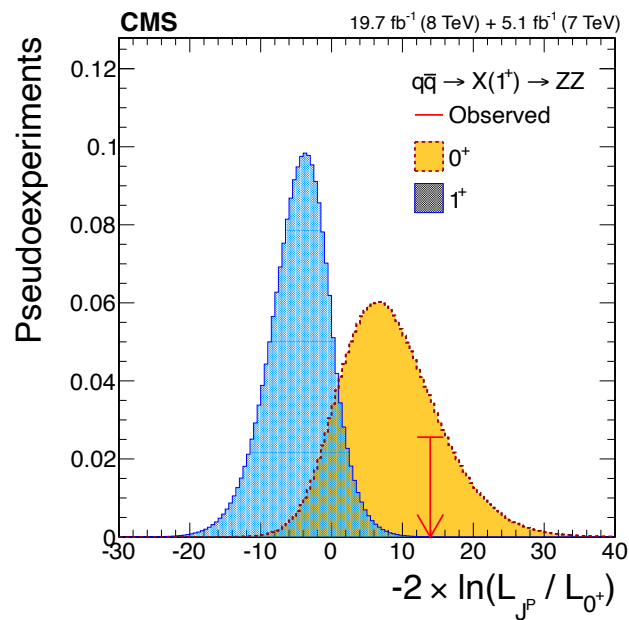


Mass Measurement

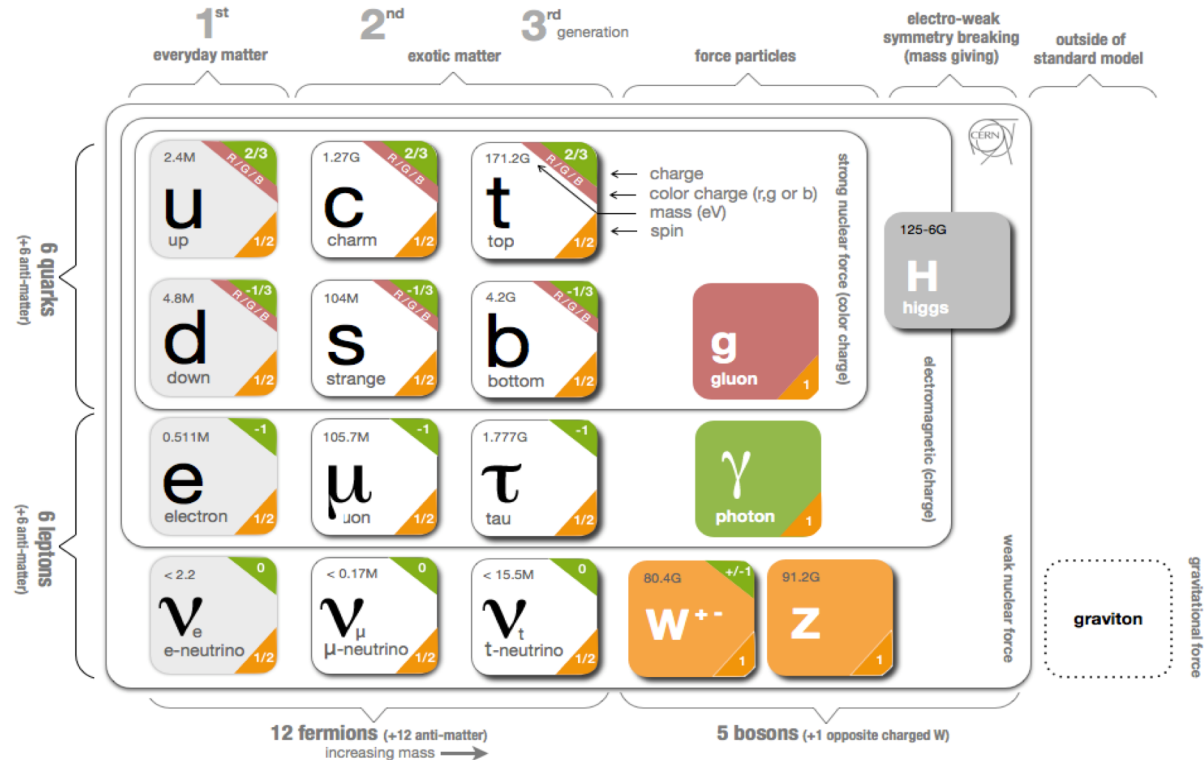
CMS Preliminary



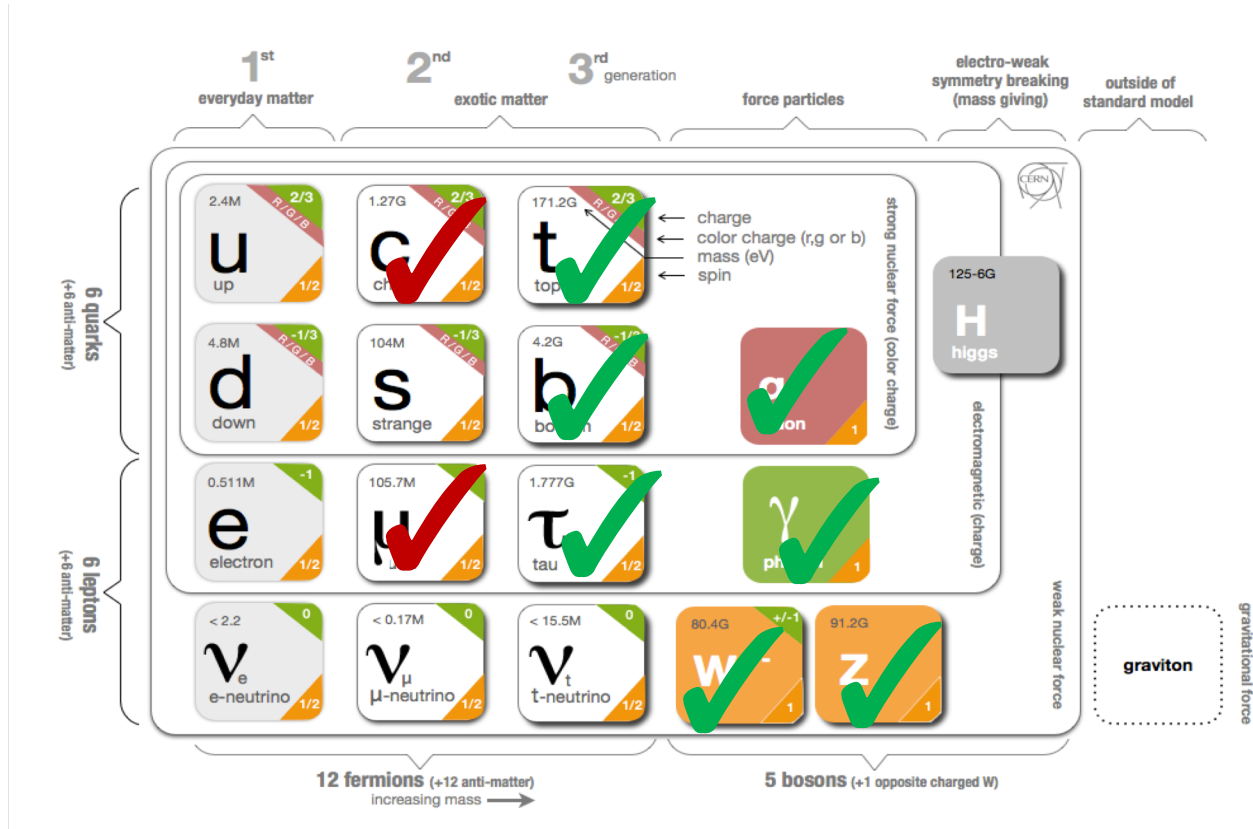
Qual o spin da partícula observada?



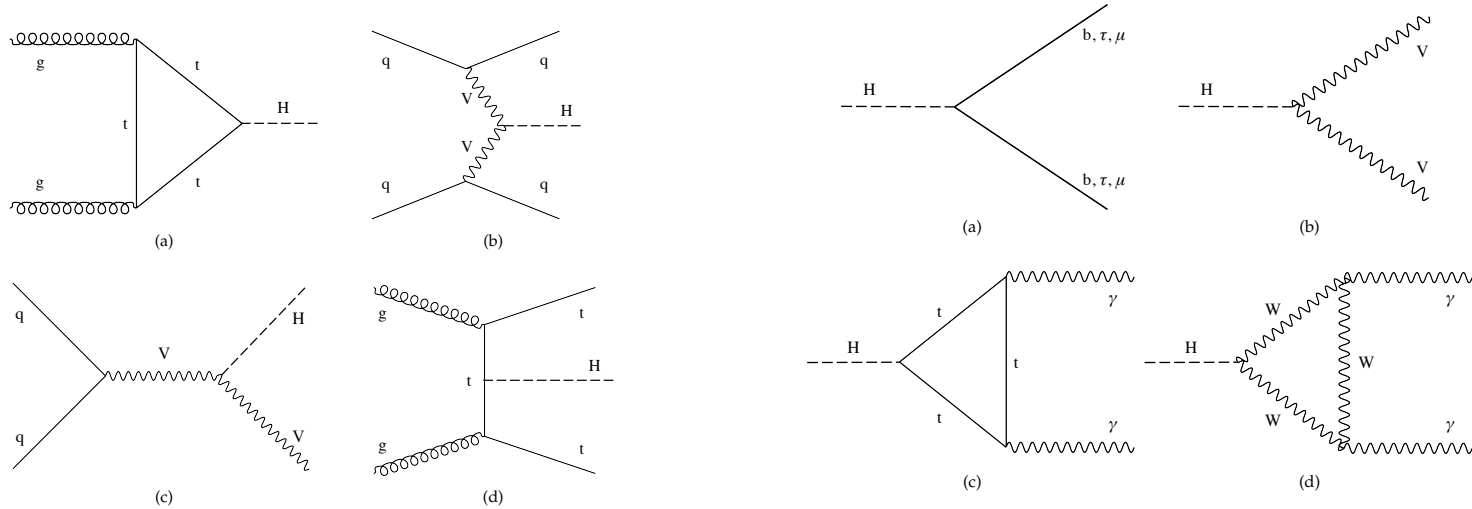
Acoplamentos do Boson de Higgs



Acoplamentos do Boson de Higgs



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



CMS-PAS-HIG-17-031

Parametrização do Sinal

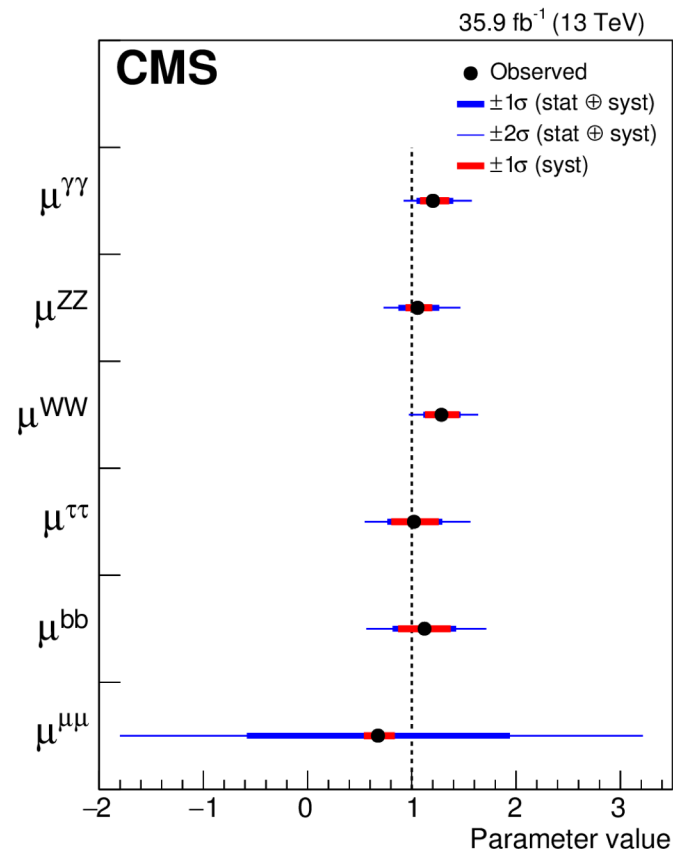
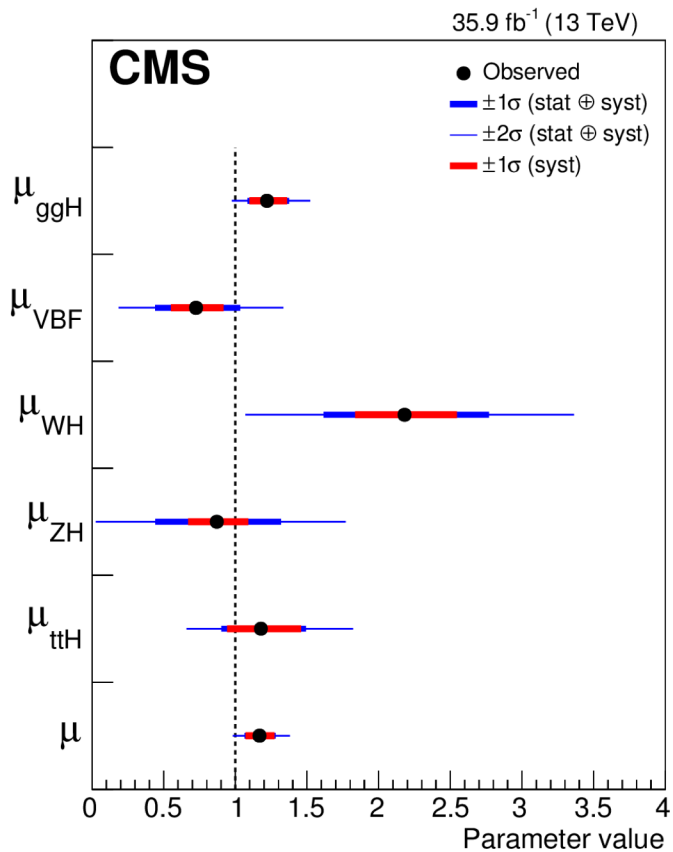
Para um sinal experimental $i \rightarrow H \rightarrow f$, podemos extrair:

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

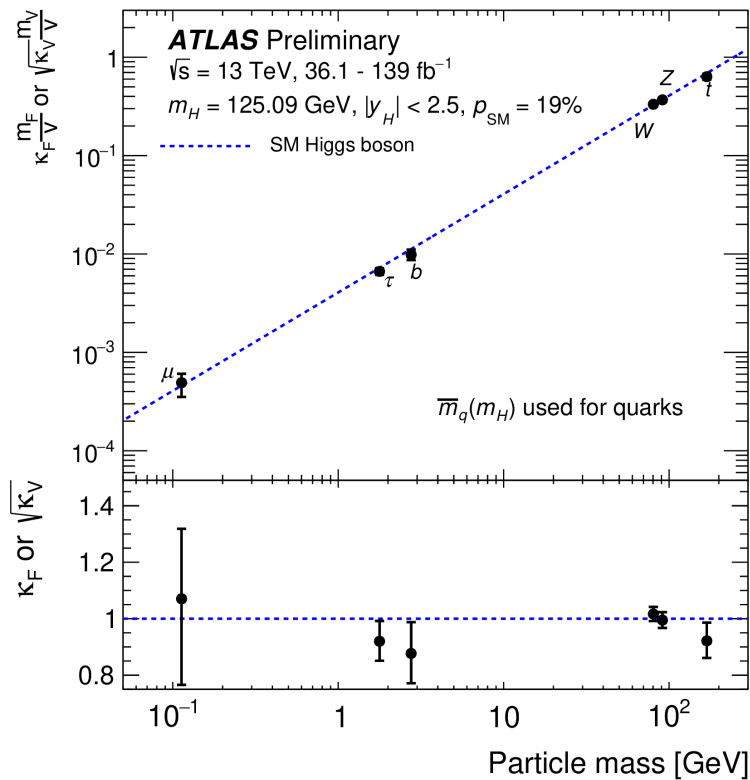
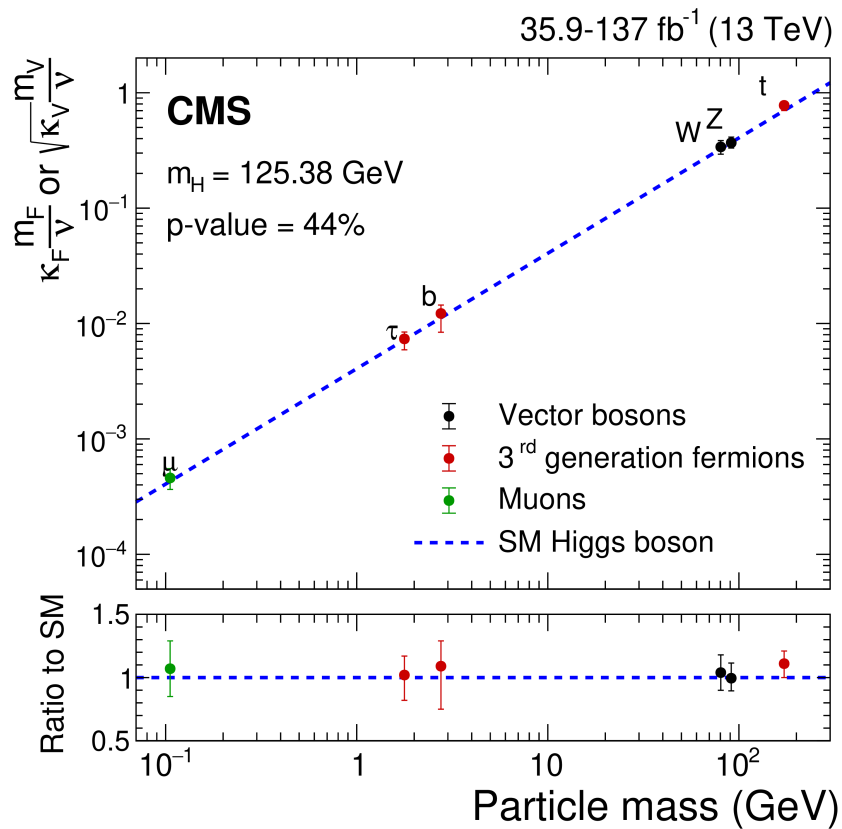
De um fit global de todas as analyses, com um parâmetro apenas, podemos extrair um fit global:

$$\mu = 1.002 \pm 0.057 \quad \text{CMS}$$

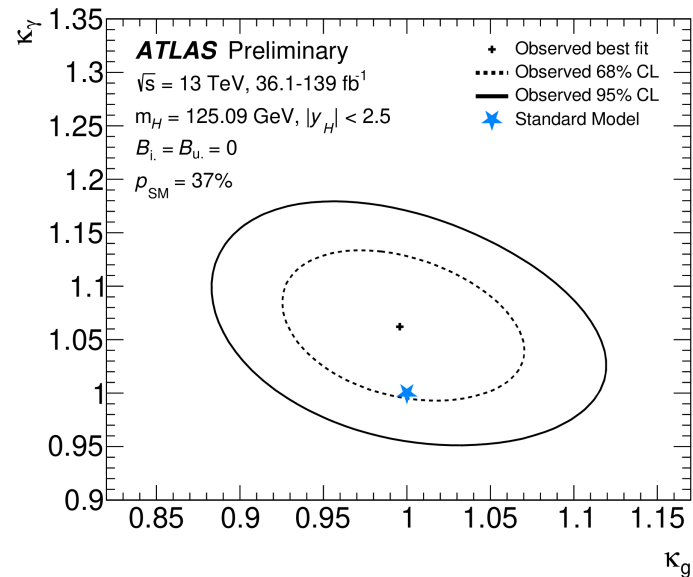
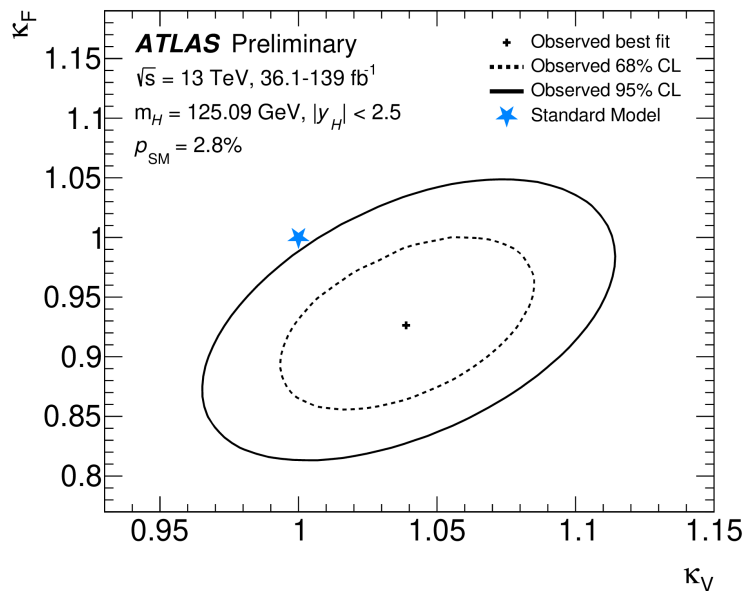
Produção e Decaimento: Diferentes modos



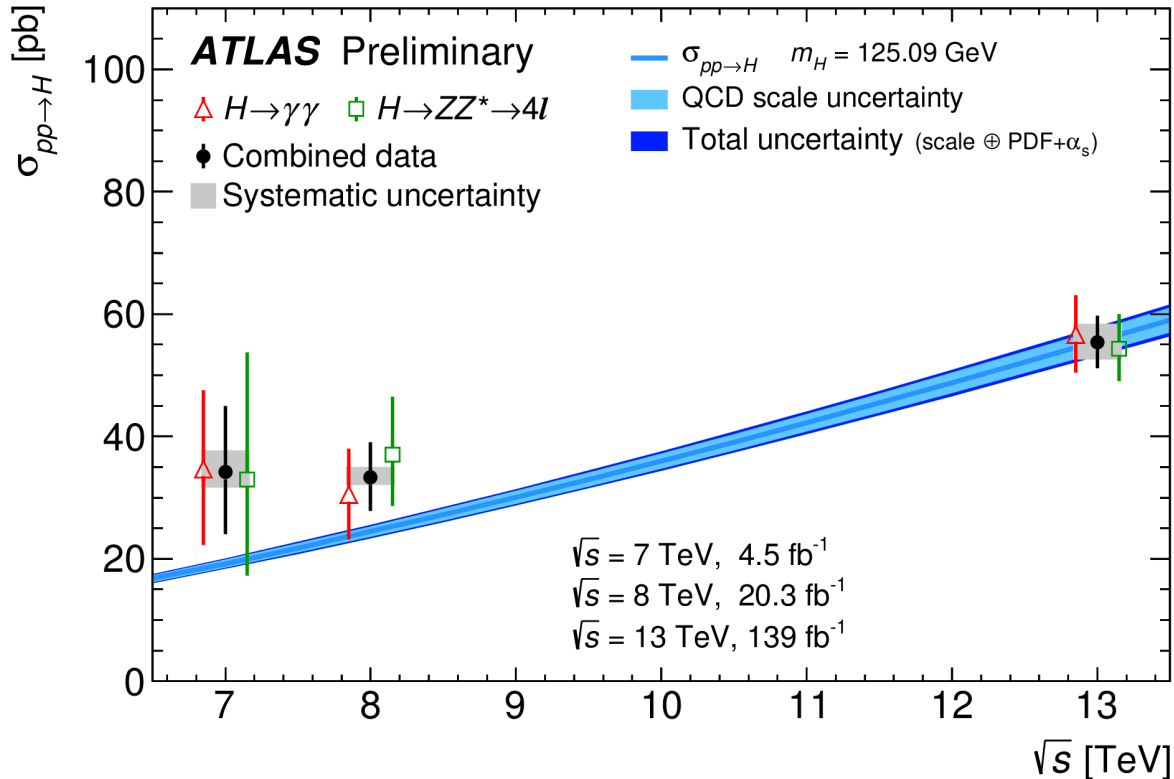
Acoplamentos do Higgs



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?