Motto: "waiting for Higgs"

Higgs Physics at Future Colliders

Maria Krawczyk and Filip Żarnecki

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in collaboration with IPJ, UJ/IFJ-Kraków, UŚ-Katowice, UŁ-Łódź !

- Standard Model
- 2 Higgs Doublet Model and Minimal Supersymmetric Standard Model
- Direct searches
- Precision measurements or indirect searches

- High energy colliders: LEP, TEVATRON, HERA, ...LHC, LC, PLC
- Low energy experiments: g-2...

Organization

meetings each Friday
video connections to Kraków/Katowice/Łodz
common meetings with Kraków/Katowice/Łodz - once in semester?
a few theoretical talks
details of ongoing analyses

Zaliczenie: obecność + krótkie opracowanie jakiegoś tematu (plakat)
Możliwość włączenia się w aktualnie prowadzone analizy

Conveners (main interests):
Piotr Zalewski IPJ - LEP, LHC
Grzegorz Wrochna IPJ - LHC
Filip Żarnecki IFD UW - HERA, PLC
Maria Krawczyk IFT UW - Theory, HERA, PLC
...

STANDARD MODEL

Symmetry $\rightarrow$ basic idea of modern particle physics

STANDARD MODEL

$$\text{SM}=\text{SU}(2)_{I_{weak}}\text{x}\text{U}(1)_{Y_{weak}}\text{x}\text{SU}(3)_{color}$$

Origin of masses of elementary particles :
$\rightarrow$ spontaneous symmetry breaking

Higgs mechanism in SM and beyond (MSSM, 2HDM,...) :
Higgs Part icle (s) predicted

Higgs sector- a clue to further understanding of matter

THE THEORY OF MATTER $\Leftrightarrow$ STANDARD MODEL

F. Wilczek, LEPFest, Nov.2000 (hep-ph/0101187)

Theory of Matter = $SU(2)_{I_{weak}} x U(1)_{Y_{weak}} x SU(3)_{color}$

Theory of Matter refers to the core concepts

- quantum fiel theory
- gauge symmetry
- spontaneous symmetry breaking
- asymptotic freedom

- the assignments of the lightest quarks and leptons

Standard Models:

Choose the number of Higgs (scalar) doublets.

Standard Models

SM = 1HDM $\Rightarrow$ one Higgs SU(2) doublet

Basic parameter v - vacuum expecation value of scalar field

one Higgs boson

one unknown parameter describing whole sector:

mass or selfcoupling

nteraction with gauge bosons:$M_V \sim gv$, coupling $\sim M_V$

Yukawa interaction with fermions:$m_f \sim g_f$

Direct searches: $M_{H_{SM}}$ larger than 114.4 GeV.

2HDM $\Rightarrow$ two Higgs SU(2) doublets

CP conservation: Higgs sector: h,H,A, $H^{\pm}$; $\tan\beta = v_2/v_1$
many parameters: masses $M_h, M_H, M_A, M_{H^{\pm}}$, mixing between (h,H) α +
..
CP violation: mixing between h_1, h_2, h_3, more angles

nteraction with gauge bosons - Higgs bosons share obligations
various models of Yukawa interaction with fermions:
eg Model II where one scalar doublet couples to up-type quarks, other
to down-type quarks and charged leptons

Higgs sector of MS-SM has structure of 2HDM (II)!
(CP conservation, number of independent parameters :2
n more general case all couplings treated as effective ones like in
2HDM(II))

What that means: SM in agreement with data?

2HDM (II) - in agreement with data even in such extreme cases:

with the lightest Higgs boson

- very light, with mass eg. few GeV,
  and with very weak (or no) coupling to Z/W

- SM-like, with mass eg. 115 GeV, couplings as for H_{SM}
  (relative couplings $\chi_V, \chi_u, \chi_d = 1$)

Challenge $\rightarrow$ SM-like scenarios in the extensions of the SM

HAVE FUN
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