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Title: Mass-degenerate Higgs bosons at 125 GeV in the two-Higgs-doublet model

Author(s): Ferreira, P. M. [1,2]; **Santos, Rui** [1,2]; Haber, Howard E. [3]; **Silva, João P.** [1,4]

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Abstract: The analysis of the Higgs boson data by the ATLAS and CMS Collaborations appears to exhibit an excess of h -> gamma gamma events above the Standard Model (SM) expectations, whereas no significant excess is observed in h -> ZZ* -> four lepton events, albeit with large statistical uncertainty due to the small data sample. These results (assuming they persist with further data) could be explained by a pair of nearly mass-degenerate scalars, one of which is an SM-like Higgs boson and the other is a scalar with suppressed couplings to W+W- and ZZ. In the two-Higgs-doublet model, the observed gamma gamma and ZZ* -> four lepton data can be reproduced by an approximately degenerate CP-even (h) and CP-odd (A) Higgs boson for values of sin (beta - alpha) near unity and 0: 70 less than or similar to tan beta less than or similar to 1. An enhanced gamma gamma signal can also arise in cases where m(h) similar or equal to m(H), m(H) similar or equal to m(A), or m(h) similar or equal to m(H) similar or equal to m(A). Since the ZZ* -> 4 leptons signal derives primarily from an SM-like Higgs boson whereas the gamma gamma signal receives contributions from two (or more) nearly mass-degenerate states, one would expect a slightly different invariant mass peak in the ZZ* -> four lepton and gamma gamma channels. The phenomenological consequences of such models can be tested with additional Higgs data that will be collected at the LHC in the near future. DOI: 10.1103/PhysRevD.87.055009.

Keywords Plus: Standard Model; Doublet Model; Electroweak Fit; LHC; Search

Reprint Address: Ferreira, PM (reprint author) - Inst Super Engn Lisboa ISEL, P-1959007 Lisbon, Portugal

Addresses:
[1] Inst Super Engn Lisboa, P-1959007 Lisbon, Portugal
[2] Univ Lisbon, Fac Ciencias, Ctr Fis Teor & Computac, P-1649003 Lisbon, Portugal
[3] Univ Calif Santa Cruz, Santa Cruz Inst Particle Phys, Santa Cruz, CA 95064 USA
[4] Univ Tecn Lisboa, Inst Super Tecn, Ctr Fis Teor Particulas, P-1049001 Lisbon, Portugal

E-mail Addresses: ferreira@cii.fc.ul.pt; rsantos@cii.fc.ul.pt; haber@scipp.ucsc.edu; jpsilva@cftp.ist.utl.pt

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