

Charged Higgs boson Hunting

$t \rightarrow bH^\pm \rightarrow \tau^\pm v_\tau$25 May 2012
 $H^\pm \rightarrow tb$ and $H^\pm \rightarrow t\bar{v}$31 August 2015
 $H^\pm \rightarrow \tau^\pm v_\tau$ 11 March 2019
 $pp \rightarrow t(b)H^\pm \rightarrow tb$, all-jet.....21 January 2020
 $pp \rightarrow t(b)H^\pm \rightarrow W^\pm H^0(\tau\tau)$4 July 2022

Fotios Ptochos Promoted to Professor!

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Search for charged Higgs bosons decaying into a top and a bottom quark in the all-jet final state

A search for charged Higgs bosons (H^\pm) decaying into a top and a bottom quark in the all-jet final state is presented. The analysis uses LHC proton-proton collision data recorded with the CMS detector in 2016 at $\sqrt{s} = 13$ TeV, corresponding to an integrated luminosity of 35.9 fb^{-1} . No significant excess is observed above the expected background. Model-independent upper limits at 95% confidence level are set on the product of the H^\pm production cross section and branching fraction in two scenarios. For production in association with a top quark, limits of 21.3 to 0.007 pb are obtained for H^\pm masses in the range of 0.2 to 3 TeV. Combining this with a search in leptonic final states results in improved limits of 9.25 to 0.005 pb. The complementary s-channel production of an H^\pm is investigated in the mass range of 0.8 to 3 TeV and the corresponding upper limits are 4.5 to 0.023 pb. These results are interpreted using different minimal supersymmetric extensions of the standard model.

Physicists Find Elusive Particle Seen as Key to Universe

Results are presented from searches for the standard model Higgs boson in proton–proton collisions at and 8 TeV in the Compact Muon Solenoid experiment at the LHC, using data samples corresponding to integrated luminosities of up to 5.1 fb^{-1} at 7 TeV and 5.3 fb^{-1} at 8 TeV. The search is performed in five decay modes: $\gamma\gamma$, ZZ , t^+t^- , and $b\bar{b}$. An excess of events is observed above the expected background, with a local significance of 5.0 standard deviations, at a mass near 125 GeV, signalling the production of a new particle. The expected significance for a standard model Higgs boson of that mass is 5.8 standard deviations. The excess is most significant in the two decay modes with the best mass resolution, $\gamma\gamma$ and ZZ ; a fit to these signals gives a mass of $125.3 \pm 0.4(\text{stat.}) \pm 0.5(\text{syst.})$ GeV. The decay to two photons indicates that the new particle is a boson with spin different from one.



CDF publishes multi-muons!

We report a study of multi-muon events produced at the Fermilab Tevatron collider and recorded by the CDF II detector. In a data set acquired with a dedicated dimuon trigger and corresponding to an integrated luminosity of 2100 pb^{-1} , we isolate a significant sample of events in which at least one of the muon candidates is produced outside of the beam pipe of radius 1.5 cm. The production cross section and kinematics of events in which both muon candidates are produced inside the beam pipe are successfully modeled by known QCD processes which include heavy flavor production. In contrast, we are presently unable to fully account for the number and properties of the remaining events, in which at least one muon candidate is produced outside of the beam pipe, in terms of the same understanding of the CDF II detector, trigger, and event reconstruction. Several topological and kinematic properties of these events are presented in this paper. These events offer a plausible resolution to long-standing inconsistencies related to $b\bar{b}$ production and decay.

Higgs boson: a tool to discover new physics

A search for a charged Higgs boson H^\pm decaying into a heavy neutral Higgs boson H and a W boson is presented. The analysis targets the W decay into a pair of tau leptons with at least one of them decaying hadronically and with an additional electron or muon present in the event. The search is based on proton-proton collision data recorded by the CMS experiment during 2016–2018 at $\sqrt{s} = 13$ TeV, corresponding to an integrated luminosity of 138 fb^{-1} . The data are consistent with standard model background expectations. Upper limits at 95% confidence level are set on the product of the cross section and branching fraction for an H^\pm in the mass range of 300–700 GeV, assuming an H with a mass of 200 GeV. The observed limits range from 0.085 pb for an H^\pm mass of 300 GeV to 0.019 pb for a mass of 700 GeV. These are the first limits on H^\pm production in the $H^\pm \rightarrow HW^\pm$ decay channel at the LHC.

Top Quark, Last Piece of Matter, Appears to Be in Place

We establish the existence of the top quark using a 67 pb^{-1} data sample of pp collisions at $\sqrt{s} = 1.8$ TeV collected with the Collider Detector at Fermilab (CDF). Employing techniques similar to those we previously published, we observe a signal consistent with $t\bar{t}$ decay to $WWbb$, but inconsistent with the background prediction by 4.8σ . Additional evidence for the top quark is provided by a peak in the reconstructed mass distribution. We measure the top quark mass to be $176 \pm 8(\text{stat.}) \pm 10(\text{syst.})$ GeV/c², and the $t\bar{t}$ production cross section to be $6.8^{+3.6}_{-2.4}$.



Multi-Muons In CDF: The Mystery Continues

We present a phenomenological conjecture of new physics that is suggested by the topology and kinematic properties of the multi-muon events recently reported by the CDF collaboration. We show that the salient features of the data can be accounted for by postulating the pair production of three new states h_1 , h_2 , and h_3 with masses in the range of 15, 7.3, and 3.6 GeV/c², respectively. The heavier states cascade-decay into the lighter ones, whereas the lightest state decays into a τ pair with a lifetime of the order of 20 ps.