

Evidence for a particle produced in association with weak bosons and decaying to a bottom-antibottom quark pair in Higgs boson searches at the Tevatron (Phys. Rev. Lett. 109, 071804 (2012); arXiv:1207.6436)

Adrian Buzatu (University of Glasgow), on behalf of the CDF & D0 Collaborations

SM Higgs Boson Production

- Predicted by the mechanism explaining spontaneous symmetry breaking, origin of mass for elementary particles
- Mass - only free SM parameter
- Direct searches do not exclude at 95% CL 115.5 – 127 GeV/c²
- ATLAS & CMS observed independently at the LHC a particle with mass of about 125 GeV consistent with the SM Higgs boson
- 58% BR for H → bb̄ at 125 GeV/c²

Tevatron Accelerator, CDF & D0 Detectors

- CDF & D0 experiments at Tevatron collider at Fermilab, USA
- pp̄ collisions at a center-of-mass energy of 1.96 TeV
- Delivered ~ 12 fb⁻¹ integrated luminosity before shutdown 11/09/30
- This combined VH analysis uses the full dataset of ~ 10 fb⁻¹

Combined VH, H → bb̄ Channels

WH → lνbb̄ CDF (9.45 fb ⁻¹) D0 (9.7 fb ⁻¹)	ZH → llbb̄ CDF (9.45 fb ⁻¹) D0 (9.7 fb ⁻¹)	ZH → ννbb̄ CDF (9.45 fb ⁻¹) D0 (9.5 fb ⁻¹)
---	---	---

Divide, Conquer, Combine

- Divide data in different analysis channels based on topology
- Optimize each channel individually
- Primary s/b discriminant is the dijet invariant mass
- Multivariate techniques for object selection and final discriminant
- Dijet mass plus other kinematic variables: ANN, BDT
- Combine all these VH channels from CDF and D0

Analysis Strategy

- CDF WH as an example
- Two jets, one charged lepton, missing transverse energy
- Corrected dijet invariant mass using a NN
- Multivariate final discriminant (MVA) using the dijet invariant mass and other 5-6 variables: MET, HT, SumET

Validate in VZ, Z → bb̄

- Diboson search (WZ, ZZ), using the same analysis techniques as the VH search
- Measured VZ cross section as 3.9 +/- 0.6 (stat) +/- 0.7 (sys) pb, consistent with the SM prediction of 4.4 +/- 0.3 pb

Combined VH s/b Plots

Result: Evidence for a New Particle

Broad excess > 2 standard deviations (sd): [120 - 135] GeV/c²
Evidence: 3.3 sd local sig. at 135 GeV/c², 3.1 sd global sig. (using 115-150 GeV/c²)
Best fit to data: σ(WH)+σ(ZH)×BR(H→bb̄)=0.23+0.09-0.08 (stat+sys) pb
Evidence for a new particle consistent with SM Higgs boson