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)

**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→bb at 125 GeV/c²

**Tevatron Accelerator, CDF & D0 Detectors**
- CDF & D0 experiments at Tevatron collider at Fermilab, USA
- pp 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→bb Channels**
- WH→llb̅b̅ CDF (9.45 fb⁻¹) D0 (9.7 fb⁻¹)
- ZH→llb̅b̅ CDF (9.45 fb⁻¹) D0 (9.7 fb⁻¹)
- ZH→ννb̅b̅ 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**
- Pretag s/b ~ 1/4000 s x 100
- 2 b Tags s/b ~ 1/80 s x 10

**Validate in VZ, Z→bb**
- 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: o(WH)+o(ZH)xBR(H→bb)=0.23+0.09-0.08 (stat+sys) pb
- Evidence for a new particle consistent with SM Higgs boson