Wbb̄ production at DØ

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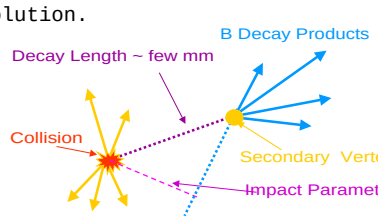
We present results from an analysis of the production of bb in association with a W boson at DØ experiment at Fermilab. This process is of great importance for understanding Electroweak symmetry breaking. In the Standard Model, for low Higgs masses the qq→Wh$_{SM}$ mode dominates (here the W boson decays in eν and h$_{SM}$ in bb). In the Technicolor Straw man Model (TCSM), which is a low scale model of the dynamical electroweak symmetry breaking, low massive Technipion (π_T) are predicted to be copiously produced at the Tevatron (bb is by far the dominant decay channel for π_T).

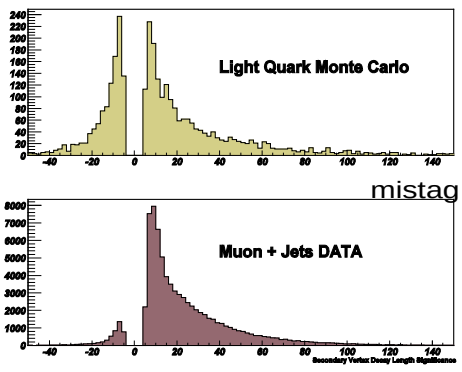
Identifying b-quark jets

B-hadrons lifetime is about 1.6 ps which corresponds to a decay flight of about 3 mm for a momentum of 40 GeV/c. Thus, when extrapolated backwards, reconstructed tracks from b-hadron can not be fitted to the Primary Vertex (PV) of interaction. The Impact Parameter (IP) is the minimal distance between the PV and the track. Tracks from B decays have an average IP of 400 μm. Tracks originated from light quarks have IP much closer to zero but they are smeared due to detector resolution.



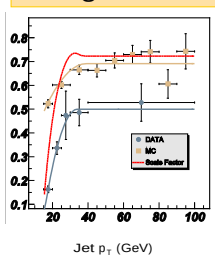
Jet Lifetime algorithm assigns a probability to each calorimeter jet of originating from the fragmentation of a b-quark, based on the IP of all the tracks associated with the jet.

Secondary Vertex algorithm determines the decay point of the b-quark by an iterative fit to all the high IP tracks which belong to a calorimeter jet. Jets which contain a vertex with large Decay Length Significance (the decay length weighted by its error) are identified as a b-quark jet.

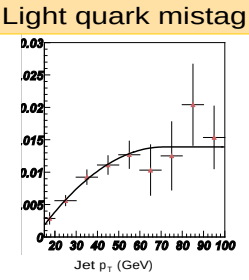


We show the efficiency for identifying b-quark jets in DATA and Monte Carlo simulation (left). Also shown on the right is the secondary vertex light quark tag rate as a function of jet pT.

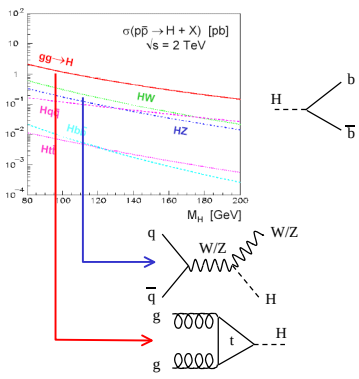
b tag efficiency



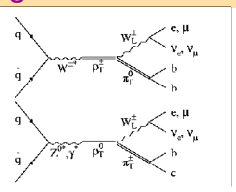
Light quark mistag rate



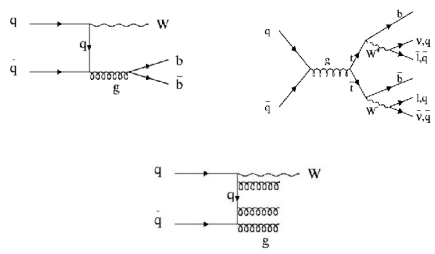
Higgs Production



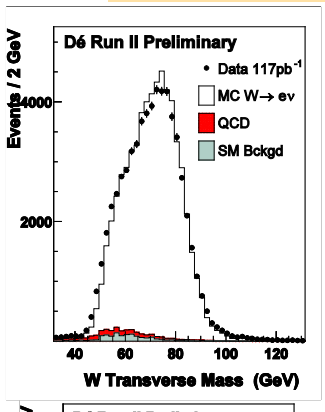
New Particles, e.g. Technicolor

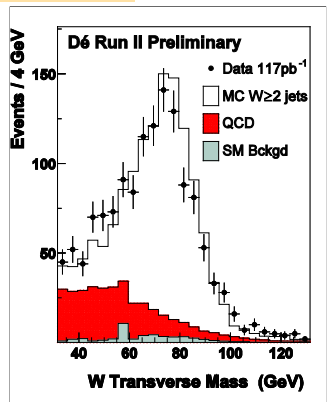


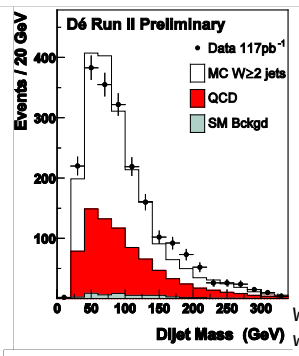
Main Background Processes



W(→eν) + ≥0 jets



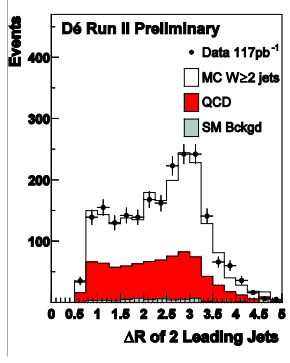




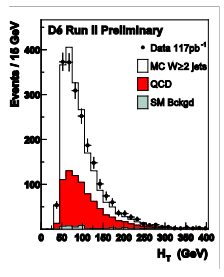
Data sample (117pb^{-1})
Selection:
electron p_T > 20 GeV/c
missing E_T > 25 GeV

W candidates: 65446
background events from misidentified electrons in QCD multijets: 3100

W transverse mass spectrum is well reproduced by PYTHIA.



Good description of the jet kinematics properties by ALPGEN (based on exact matrix elements at LO) compared to PYTHIA.



W(→eν) + dijet events with a b-quark jet

One jet is identified as a b-quark jet due to the presence of secondary vertex or a lifetime probability consistent with a b-quark production. We use two different b-quark identification methods to select these events.

Jet Lifetime tag

Number of dijet events with one jet identified as a b-quark: 92
Number of background events expected from Standard Model processes: 89.5 ± 22.4

Secondary Vertex tag

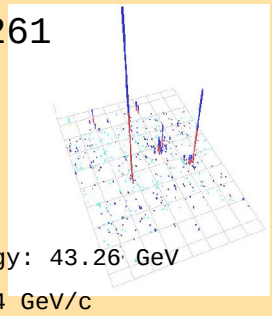
Number of dijet events with one jet identified as a b-quark: 60
Number of background events expected from Standard Model processes: 57.7 ± [sys err]

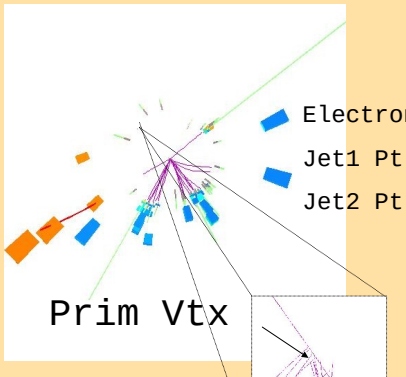
We compare the kinematic distributions of the dijet events in our data with those expected from several Standard Model background processes and find a good agreement between the two.

Event 6854840 Run 169261

2 Jets Lifetime tagged

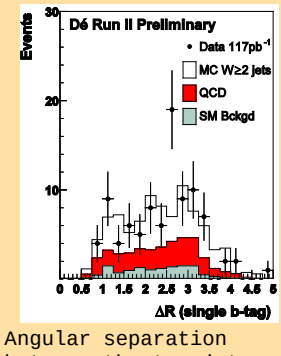
1 Jet Secondary Vertex tagged



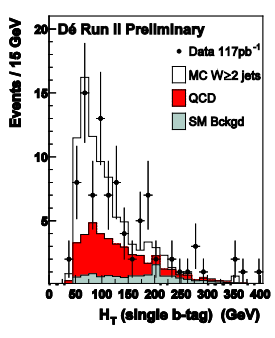


Electron energy: 43.26 GeV
Jet1 Pt: 41.44 GeV/c
Jet2 Pt: 50.85 GeV/c
MET: 60.81 GeV
M(jj): 73.57 GeV/c^2
H_T: 92.28 GeV
ΔR: 2.35

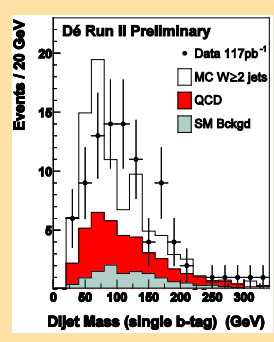
Jet Lifetime Tag



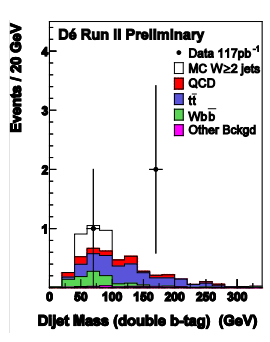
Angular separation between the two jets
Δ R(jj)=$\sqrt{(\Delta\Phi^2+(\Delta\eta^2)}$
Φ:azimuthal angle
η: pseudo rapidity



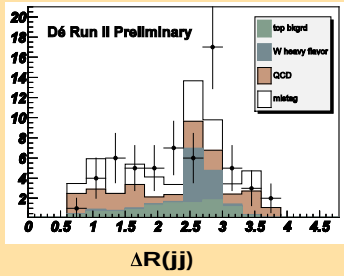
Sum of p_T of all jets

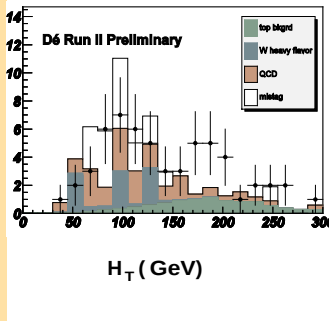


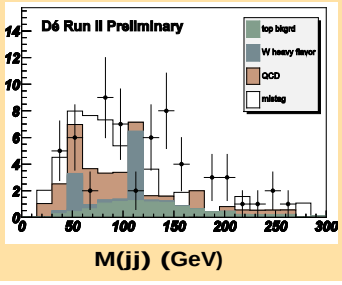
Invariant mass of the two jets (one is tagged as a b-jet)



Secondary Vertex Tag







2b-tagged jets Events:

Data	3
Expected Wbb	0.9
Backgrounds:	
tt:	2.3
W+jets mistags:	1.1
Other processes:	1.2

95% C.L. Upper Limit on Wbb production Cross Section: 33.4pb