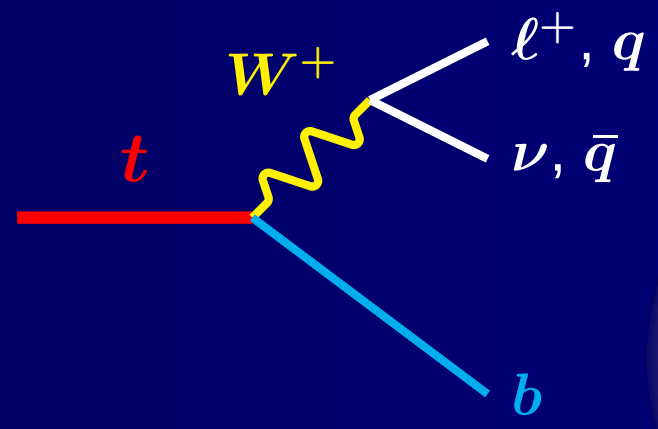
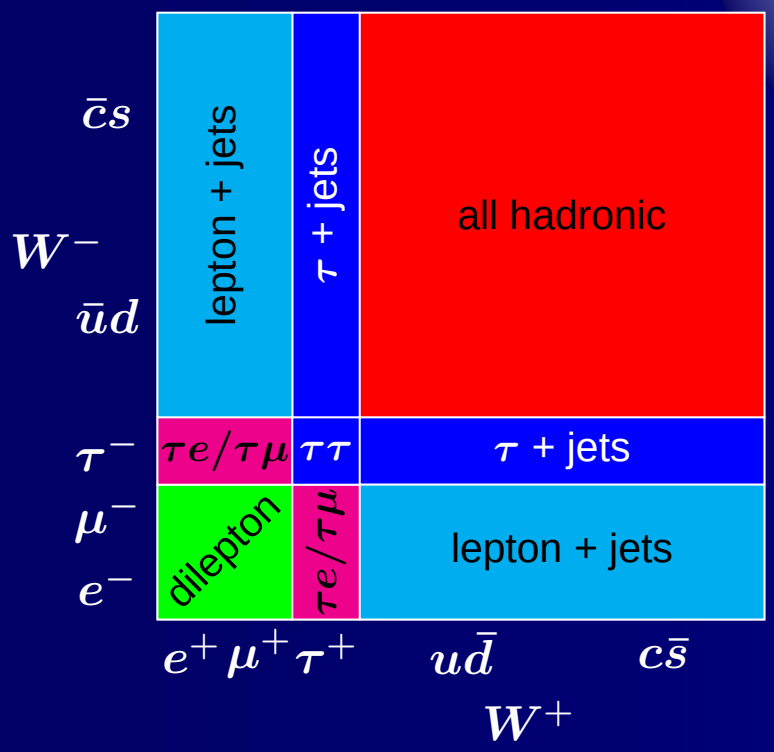
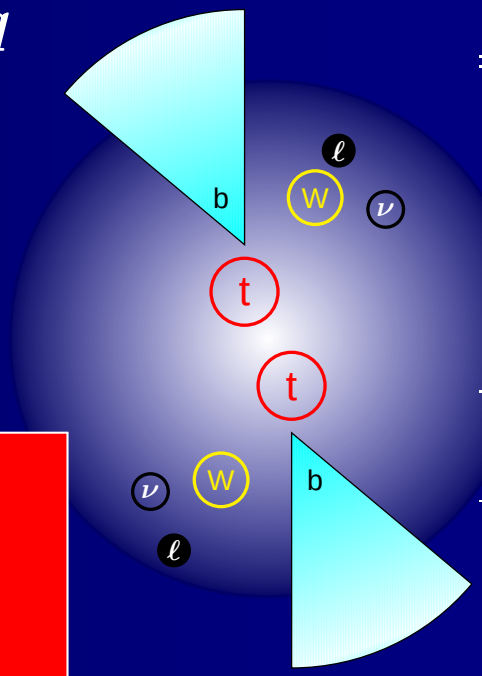
Analysis of the $t\bar{t}$ lepton+track decay channel

Michael Begel

$t\bar{t}$ Cross Section







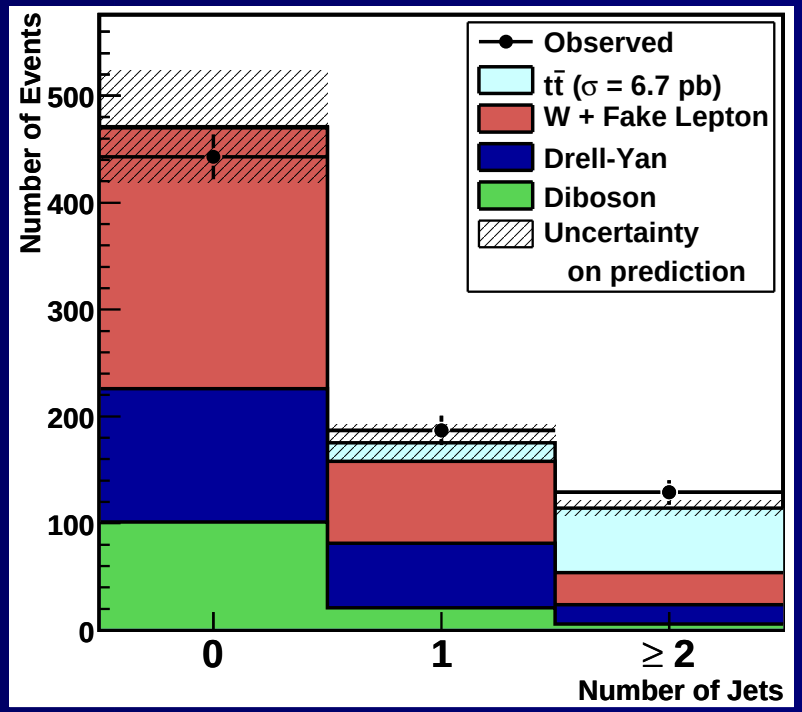
Signature	Branching Ratio
$e\mu$	0.0317
$\ell\tau$	0.0349
$\tau\tau$	0.0048
$\ell\ell$	0.0633
ℓ+track	0.0903
$\ell\ell + \ell\tau$	0.0982
ℓ+jet	0.3418
τ+jet	0.0942
all hadronic	0.4610

$\approx 85\%$ of τ decays have one isolated track

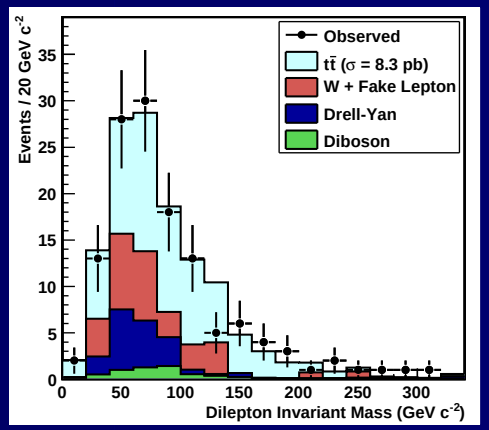
ℓ+track decay channel

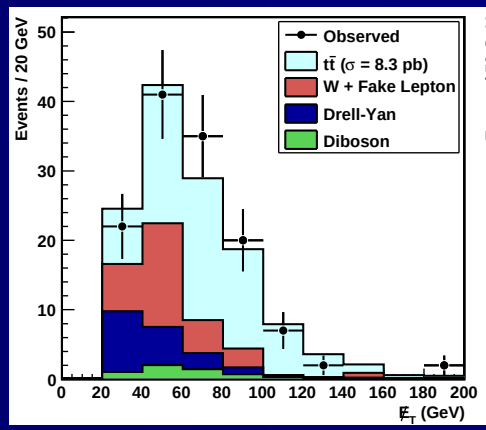
Signature	Fraction
$e\mu$	35.1%
ee	17.5%
$\mu\mu$	17.5%
$e\tau$	15.0%
$\mu\tau$	15.0%

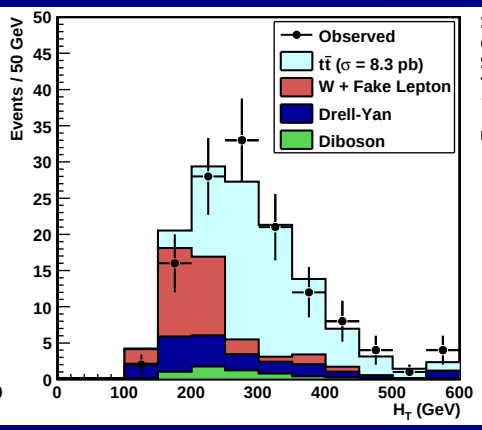
$t\bar{t}$ Cross Section (CDF with 1.1 fb^{-1})

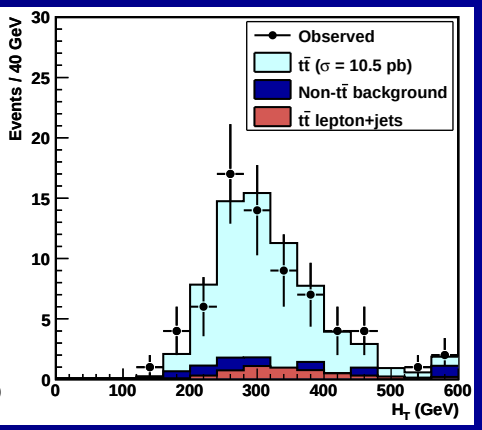


Sample	Pre-tag	Tagged
WW	3.7 ± 0.4	
WZ	1.3 ± 0.2	
ZZ	0.8 ± 0.1	
$Z/\gamma^\star \to ee$	7.6 ± 2.2	
$Z/\gamma^\star \to \mu\mu$	3.2 ± 1.1	4.4 ± 2.6
$Z/\gamma^\star \to \tau\tau$	7.3 ± 0.9	
$W+$fake	29.9 ± 5.9	5.2 ± 1.2
Backgrounds	53.8 ± 6.7	9.5 ± 2.8
$t\bar{t}$ ($\sigma = 6.7$ pb)	60.3 ± 1.9	37.7 ± 2.4
Predicted	114.2 ± 7.1	47.3 ± 3.7
Observed	129	69





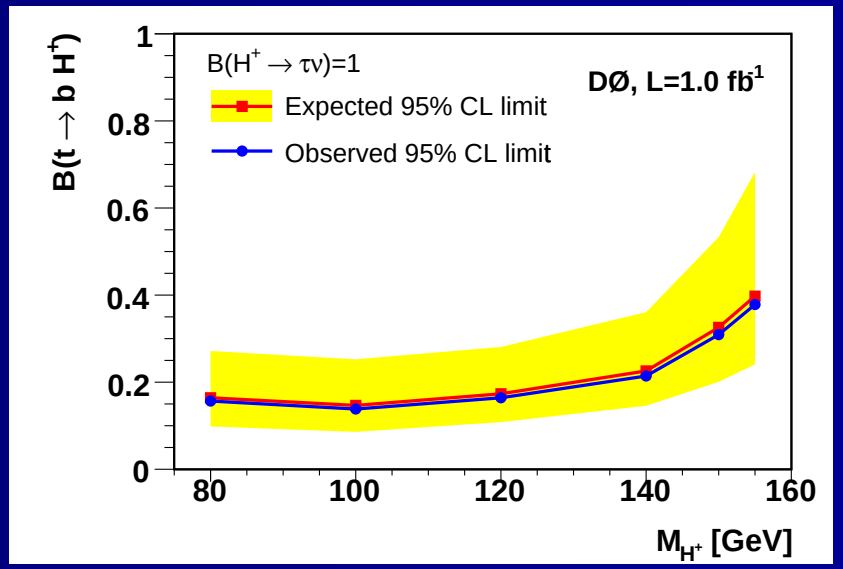




Beyond Standard Model

Higgs

If $m_W < m_{H^+} \lesssim m_t$ and $\tan\beta \gg 1$ then the $t\bar{t}$ branching fraction into τ modes is enhanced. CDF & DØ search for H^+ by comparing the $t\bar{t}$ cross sections measured in each decay channel assuming various m_{H^+} and $\tan\beta$. The ℓ+track decay channel has enhanced sensitivity to H^+ production because of the τ component.



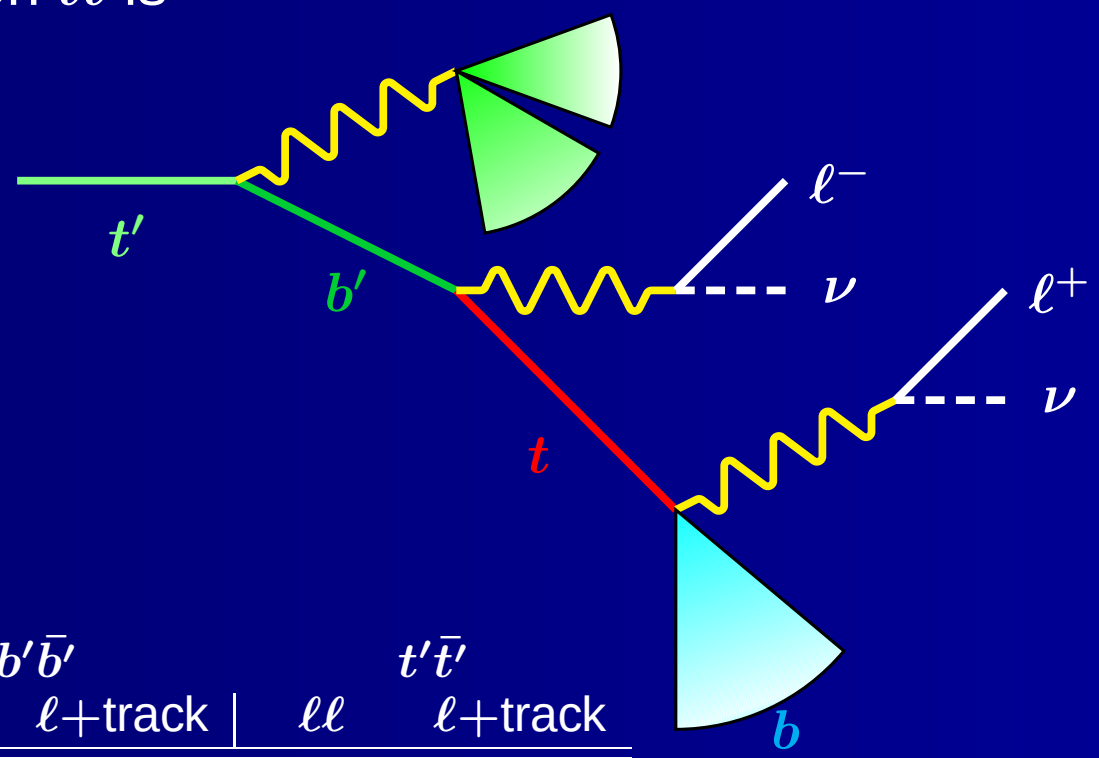
SUSY

$t\bar{t}$ in the dilepton decay channel is an important background in SUSY searches. Understanding e, μ, & τ ID through the isolated track is a key element in the lepton veto. Stephanie Majewski (BNL) began such a SUSY background study last year.

Beyond Standard Model

One model of fourth generation quarks [Amarjit Soni (BNL)] has final state $\ell\ell\ell(+\ell)b\bar{b}+$jets. Dilepton $t\bar{t}$ is key to this search.

$\ell+$track significantly improves the signal acceptance.



Branching Fractions

Leptons (e & μ)	$t\bar{t}$ $\ell\ell$	$t\bar{t}$ $\ell+$track	$b'\bar{b}'$ $\ell\ell$	$b'\bar{b}'$ $\ell+$track	$t'\bar{t}'$ $\ell\ell$	$t'\bar{t}'$ $\ell+$track
0	0.560	0.483	0.314	0.233	0.176	0.112
1	0.377	0.424	0.422	0.409	0.354	0.296
2	0.063	0.093	0.213	0.270	0.298	0.326
3			0.048	0.079	0.134	0.191
4			0.004	0.009	0.033	0.063

Same sign requirement reduces signal acceptance by half, but significantly suppresses real-lepton backgrounds.