SEARCH FOR NARROW WIDTH $t\bar{t}$ RESONANCES IN $p\bar{p}$ COLLISIONS AT $\sqrt{s} = 1.8$ TEV.

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We present a preliminary result on a search for narrow width resonances that decay into $t\bar{t}$ pairs using 130 pb^{-1} of lepton plus jets data in $p\bar{p}$ collisions at $\sqrt{s} = 1.8$ TeV. No significant deviation from Standard Model prediction is observed. 95% C.L. upper limits on the production cross section of the narrow width resonance times its branching fraction to $t\bar{t}$ are presented for different resonance masses M_X. We also exclude the existence of a leptophobic topcolor particle, X, with $M_X <$ 560 GeV/c^2 for a width $\Gamma_X = 0.012 M_X$.

Particles with narrow width that decay to $t\bar{t}$ pairs are predicted by several non Standard Model theories [1,2]. For instance, in one of the scenarios of the topcolor-assisted technicolor model in Ref. [2], a heavy Z' is predicted, that couples preferentially to the third quark generation.

At present, direct searches for these heavy particles or resonances are possible only at the Tevatron, the 1.8 TeV $p\bar{p}$ collider located at the Fermi National Accelerator Laboratory. Experiments seek an excess, beyond that predicted by the Standard Model (SM), in the distribution of the invariant mass of the $t\bar{t}$ decay products. Previous searches [3] from the Tevatron have limited a leptophobic Z' to a mass higher than 480 GeV/c^2. In this paper we present a preliminary result based on a direct search for $t\bar{t}$ narrow width, heavy resonances in the inclusive decay modes $t\bar{t} \to \ell\,\nu + 4$ (or more) jets, where $\ell = e$ or μ, using 130 pb^{-1} of data recorded from 1992 to 1996 by the DØ experiment at the Tevatron.

We consider two orthogonal classes of events for this analysis, whose selection is based on: a) a purely topological selection of lepton+jets events which we denote as $e + jets$ and $\mu + jets$, and b) a selection based primarily on the presence of a non-isolated, soft muon (μ tag) from b and c

quark semileptonic decays, with additional selections on the topology of the event. These events are denoted as $e{+}jets/\mu$ and $\mu{+}jets/\mu$. The principal sources of background are due to SM $t\bar{t}$ production, production of $W(\rightarrow l\nu)$ + ≥ 4 jets, and production of multijets ($N_j \sim 5$), in which one of the jets is misidentified as a lepton, and instrumental effects simulate sufficient $\not\!\!E_T$ satisfying the neutrino requirement. The selection criteria used to reduce the contribution from non-$t\bar{t}$ sources are summarized in Table 1.

Table 1. Summary of event selections.

	e+jets	μ+jets	e+jets/μ	μ+jets/μ
Lepton	E_T >20 GeV $\lvert\eta\rvert$ <2	p_T >20 GeV/c $\lvert\eta\rvert$ <1.7	E_T >20 GeV $\lvert\eta\rvert$ <2	p_T >20 GeV/c $\lvert\eta\rvert$ <1.7
$\not\!\!E_T$	$\not\!\!E_T$ >20 GeV	$\not\!\!E_T$ >20 GeV	$\not\!\!E_T$ >20 GeV	$\not\!\!E_T$ >20 GeV
Jets	$\geq$ 4 jets, $\lvert\eta\rvert$ <2 E_T >15 GeV	$\geq$ 4 jets, $\lvert\eta\rvert$ <2 E_T >15 GeV	$\geq$ 4 jets, $\lvert\eta\rvert$ <2 E_T >15 GeV	$\geq$ 4 jets, $\lvert\eta\rvert$ <2 E_T >15 GeV
μ tag	No	No	Yes	Yes
Other	E_T^W >60 GeV $\lvert\eta^W\rvert$ <2	E_T^W >60 GeV $\lvert\eta^W\rvert$ <2	$\not\!\!E_T$ >35 GeV, if $\Delta\phi(\not\!\!E_T,\mu) < 25^\circ$	$\Delta\phi(\not\!\!E_T,\mu) < 170^\circ$, if $\frac{\lvert\Delta\phi(\not\!\!E_T,\mu)-90^\circ\rvert}{90^\circ} < \frac{\not\!\!E_T}{45GeV}$
Events selected	42	41	4	3

We consider the resonance signal ($X \rightarrow t\bar{t}$) at nine different masses M_X between 400-1000 GeV/c^2, with a natural width $\Gamma_X = 0.012 M_X$. We perform a three constraint kinematic fit to the $t\bar{t} \rightarrow l$ + jets, decay hypothesis [4], and apply a cut of χ^2<10 to further reduce non-$t\bar{t}$ background, whereupon 41 events are left in the data sample of which 4 are μ-tagged.

We then use Bayesian statistics [5] to fit the data $m_{t\bar{t}}$ distribution to a three-source model comprising signal ($X \rightarrow t\bar{t}$) and the SM backgrounds [4]. No significant deviation is seen in the data $m_{t\bar{t}}$ distribution from SM expectations for any of the resonance masses considered.

To conclude, after investigating 130 pb^{-1} of data, we find no statistically significant evidence for $t\bar{t}$ resonance, and so establish upper limits on $\sigma_X B(X \rightarrow t\bar{t})$ at 95% confidence for M_X between 400 and 1000 GeV/c^2. These limits, as shown in Fig. 1, are used to constrain a model of topcolor assisted technicolor and exclude at 95% confidence level, the existence of a leptophobic Z' [2] with mass M_X<560 GeV/c^2 for a width $\Gamma_X = 0.012 M_X$.

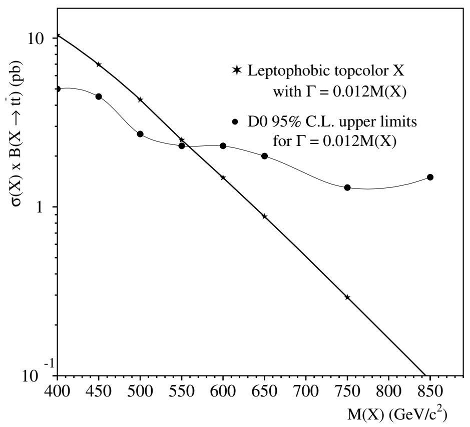

Figure 1. The DØ Run I 95% confidence level upper limits on $\sigma_X B$ as a function of resonance mass M_X. Included for reference are the predicted topcolor assisted technicolor cross sections for a width $\Gamma_X = 1.2\%\ M_X$.

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