Preliminary Studies on Dilepton Acceptance

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Outline:

- Introduction/Motivation
- Dilepton analysis (a la winter conf.)
- Acceptance Studies
- Future work

Dilepton channel:

- **provides the cleanest signal**
  (not just for $t\bar{t}$, but also for new physics searches.)

- **suffers from the lowest branching ratios**

$t\bar{t}$ dilepton signal:

$t\bar{t} \to W^+ b\, W^- \bar{b} \to (\ell^+ \nu b)(\ell^- \bar{\nu} \bar{b})$ **with** $\ell = e, \mu$

event signature:

2 high p_T leptons + jets + $\not\!\!E_T$

Backgrounds:

WW, WZ, ZZ

Drell-Yan $(Z/\gamma^* \to e^+e^-, \mu^+\mu^-)$

Z $\to \tau^+\tau^-$

W + Jets (fake: a jet mimics a lepton)

Event Selection (a la Winter Conferences):

- 2 isolated "tight" leptons above > 20 GeV
- m_Z veto ($76 < M_{ee,\mu\mu} < 106$ GeV)
- $\not\!\!E_T > 25$ GeV
- $\Delta\phi$ ($\not\!\!E_T$ and nearest lepton/jet) $> 20°$ (if $\not\!\!E_T < 50$ GeV)
- $N_{jets} \geq 2$ ($|\eta| < 2$ and $E_T > 10$ GeV)

"tight": a set of track quality and energy requirements to obtain "high quality" leptons.

dilepton categories:

	region$_1$	region$_2$
e e	CEM	CEM
$\mu\,\mu$	CMUP	CMUP
	CMUP	CMU
	CMUP	CMP
	CMUP	CMX
	CMX	CMX
	CMX	CMU
	CMX	CMP
e μ	CEM	CMUP
	CEM	CMU
	CEM	CMP
	CEM	CMX

$t\bar{t}$ dilepton acceptance (Herwig inclusive 242K)

	Geom	ID	Iso	Zmass	MET	DPHI	Njets
CEM-CEM	25535	656	533	403	347	306	259
el el	25535	656	533	403	347	306	259
CMUP-CMUP	624	234	176	143	132	124	110
CMUP-CMU	303	96	66	46	41	40	33
CMUP-CMP	426	142	115	89	73	68	60
CMUP-CMX	493	213	163	134	116	109	89
CMX-CMX	120	61	45	34	28	25	19
CMX-CMU	119	38	29	26	24	23	19
CMX-CMP	147	50	41	30	26	24	21
mu mu	2232	834	635	502	440	413	351
CEM-CMUP	7591	792	635	635	543	500	433
CEM-CMU	2078	148	121	121	105	94	81
CEM-CMP	2418	235	179	179	158	145	126
CEM-CMX	3302	370	292	292	255	239	207
el mu	15389	1545	1227	1227	1061	978	847

$A_{\ell\ell} = 0.60 \pm 0.02$ % (after ≥ 2 jets cut requirement)

(compared with 0.60 ± 0.01 from CDF note 6301)

for the individual channels: $ee = 0.11\,\%$ $\mu\mu = 0.14\,\%$ $e\mu = 0.35\,\%$

Comparisons with Pythia sample 340K :

$A_{\ell\ell} = 0.50 \pm 0.01$ %

$ee = 0.10\,\%$ $\mu\mu = 0.12\,\%$ $e\mu = 0.28\,\%$

Current CDF results (circulated at winter conf.):

$A_{\ell\ell} = 0.52 \pm 0.01$ **(including H_T + opposite charge cuts)**

yielding only to a cross section measurement for the moment.

Can we increase the acceptance and do better ?
idea: ask instead for a "tight" lepton + isolated track

two categories in this case:

tight electron + isolated track (CEM-ISOT)

tight muon + isolated track (CMUP-ISOT)

Isolated track requirements (pass 0):

- **track pt > 10**
- **at least 16 COT stereo hits**
- **at least 20 COT axial hits**
- **the sum of the pt of tracks above 1 GeV in a cone of ΔR($\eta - \phi$) 0.4 must be less than 4 GeV**

	CEM-CEM	CEM-ISOT	CMUP-CMUP	CMUP-ISOT
$N_{jets} \geq 2$	0.107	1.879	0.045	1.176

$t\bar{t}$ signal acceptance change in %

	CEM-CEM	CEM-ISOT	CMUP-CMUP	CMUP-ISOT
$N_{jets} \geq 2$	0.002	0.357	0.002	0.204

WW background acceptance change in %

	CEM-CEM	CEM-ISOT	CMUP-CMUP	CMUP-ISOT
$N_{jets} \geq 2$	0.004	0.271	0.000	0.163

WZ background acceptance change in %

	CEM-CEM	CEM-ISOT	CMUP-CMUP	CMUP-ISOT
$N_{jets} \geq 2$	0.001	0.050	0.000	0.047

Drell-Yan background acceptance change in %

	CEM-CEM	CEM-ISOT	CMUP-CMUP	CMUP-ISOT
$N_{jets} \geq 2$	0.000	0.005	0.000	0.005

$Z \rightarrow \tau^+\tau^-$background acceptance change in %

Conclusion

- current CDF dilepton analysis has a low acceptance
- other measurements than a cross section would be possible with a higher delepton acceptance
- the tight lepton + isolated track analysis seems promissing

Future work

- implement "pass 1" analysis
- perform background studies
- fake rate study