Status of ttbar analysis

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CNRS/IN2P3/LAL Orsay

... on behalf of groups at
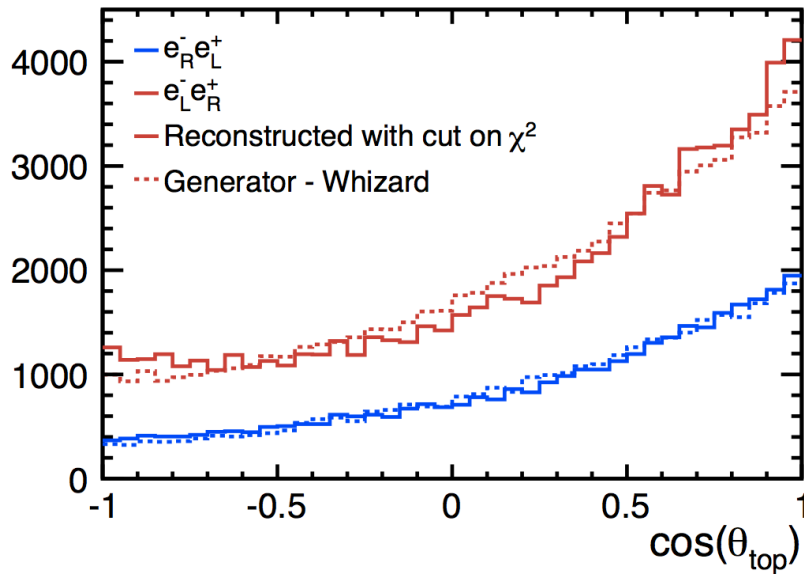
SL- Remarkable results on AFB and helicity distribution

Selection efficiency: ~ 50% including tau leptons (~70% w/o taus)

AFB:
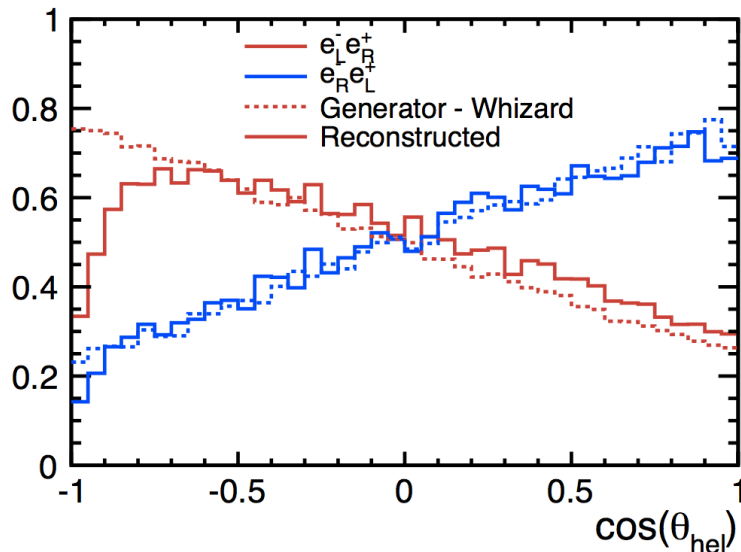
Precision on AFB ~ 2%

Suffers from migration effects in particular
For eL

Chi2 is doubtful remedy – no plateau so far

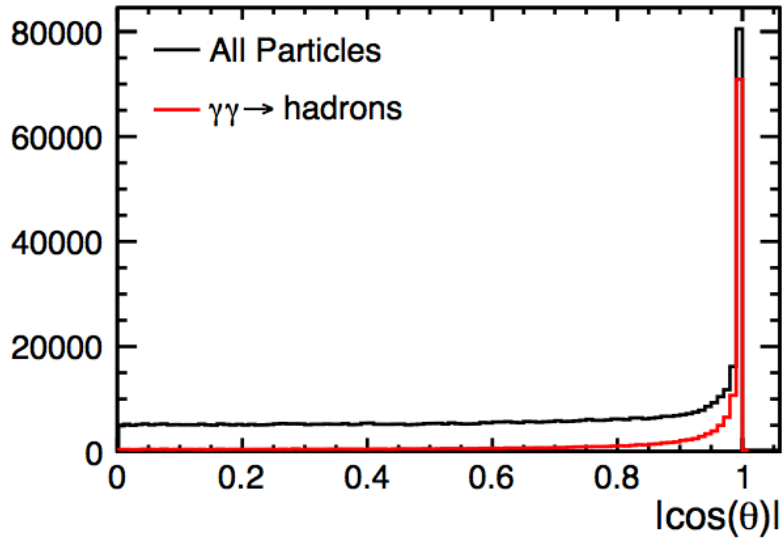Needs to be better understood

Other solutions?
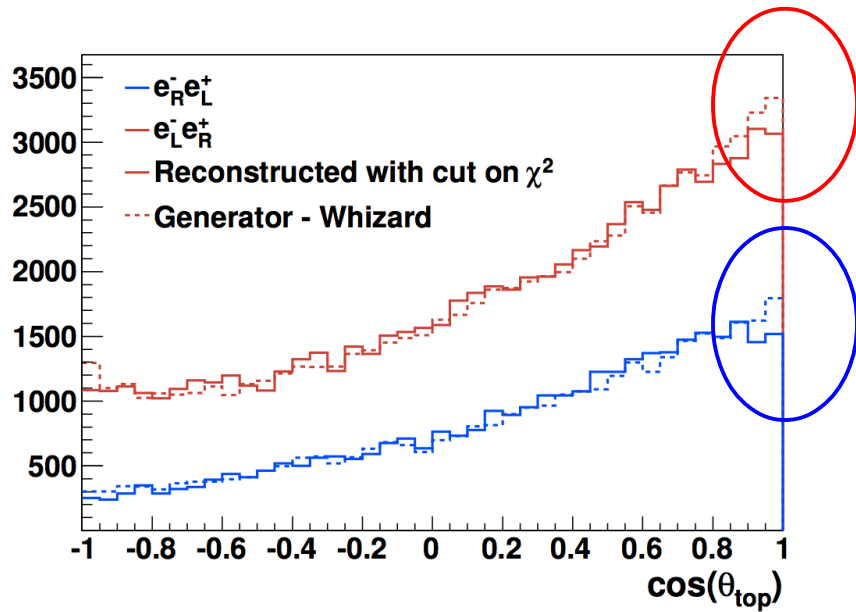

Helicity angle:

Precision on slope ~2%

- More robust

- No particular observations so far

gamma gamma background

Angluar distribution of final state particles
From ee reaction and gamma gamma bkgr.
(Fig. taken from tth analysis)

Holes after naive removal of PFOs with
|cos theta| > 0.98
KT algorithm may be a remedy
(used in tth analysis)

Input to studies – Questions on cross sections (RL)

Semi-leptonic files

Fully hadronic files

LR:

36902 6f_yyxylv 6f_ttbar 500.0 L R 1000.0 232.019 232019 14

36898 6f_yyxyev 6f_ttbar 500.0 L R 1000.0 116.93   116930 7

36894 6f_yyvlyx 6f_ttbar 500.0 L R 1000.0 232.153 232153 14

36882 6f_yyveyx6f_ttbar 500.0 L R 1000.0 117.017 117017   7

The total cross section is 232.019+116.93+232.153+117.017=**698.119** fb

36910 6f_yyuyyc 6f_ttbar 500.0 L R 999.998 164.211 164211 13

36914 6f_yycyyu 6f_ttbar 500.0 L R 1000.0 165.095   165095 13

37610 6f_bbuyyu 6f_ttbar 500.0 L R 1000.0 159.352   159352 13

37622 6f_bbcyyc 6f_ttbar 500.0 L R 1000.0 159.855 15985513

The total cross section is
164.211+165.095+159.352+159.855=**648.513** fb

$\sigma_{SL} > \sigma_{had}$????

RL:

36903 6f_yyxylv 6f_ttbar 500.0 R L 1000.0   88.9028 88903 6
36899 6f_yyxyev 6f_ttbar 500.0 R L 999.995 44.3852 44385 3
36895 6f_yyvlyx 6f_ttbar 500.0 R L 1000.0   88.919   88919 6
36883 6f_yyveyx 6f_ttbar 500.0 R L 999.992 44.5454 44545 3

Total SL x section ~ 266.7 fb-1
Expected: 0.435x724 ~ 315 fb-1

36911 6f_yyuyyc 6f_ttbar 500.0 R L 1000.0 64.2029 64203 6
36915 6f_yycyyu 6f_ttbar 500.0 R L 1000.0 63.9447 63945 6
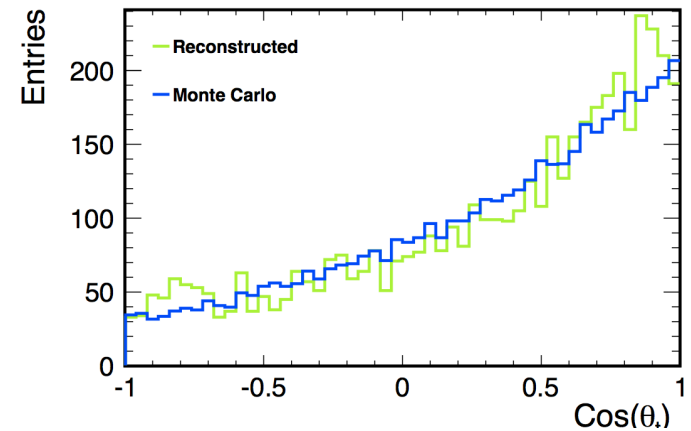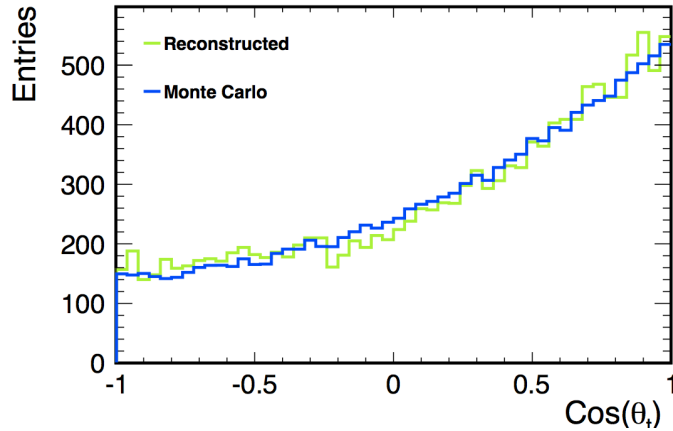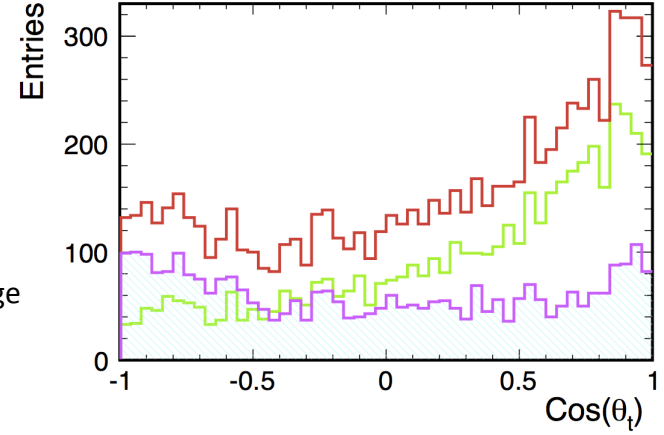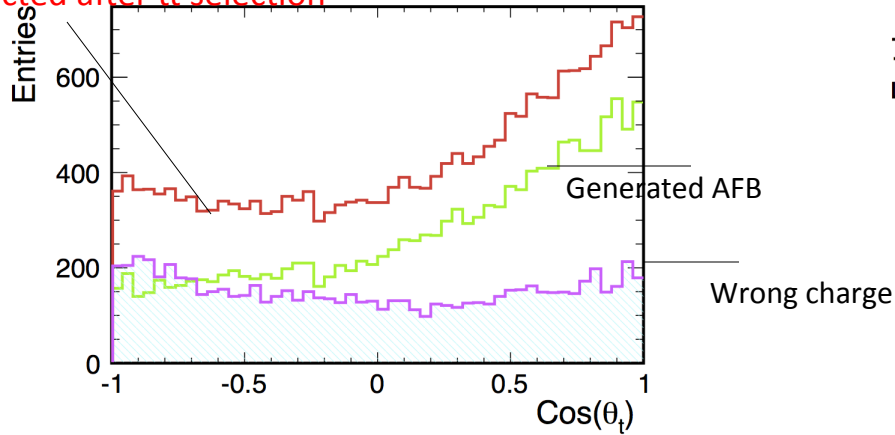37611 6f_bbuyyu 6f_ttbar 500.0 R L 999.999 63.8951 63895 5
37623 6f_bbcyyc 6f_ttbar 500.0 R L 1000.0   63.8627 63863 6

Total SL x section ~ 256 fb-1
Expected: 0.46x724 ~ 333 fb-1

$\sigma_{SL} > \sigma_{had}$ and σ_{SL} , σ_{had} wrong

AFB in fully hadronic

Uncorrected after tt selection

Generated AFB

Wrong charge

P, P'	$(A_{FB}^t)_{gen.}$	A_{FB}^t	$(\delta_{A_{FB}}/A_{FB})_{stat.}$ [%]	$(\delta_{A_{FB}}/A_{FB})_{syst.}$ [%]
$-1, +1$	0.355	0.344	2.9 (corrected to $P, P' = -0.8, +0.3$)	0.8
$+1, -1$	0.438	0.443	3.2 (corrected to $P, P' = +0.8, -0.3$)	0.3

Selection efficiency ~13-23% (depending on cuts)
At least 60% with correct b charge measurement (LCFIPlus not yet optimised for charge
Measurement),
b charge is handle too control migrations in AFB_SL (and would be cleanest solution, feasibility?)

The "30% issue"

ILD and SiD observe that about 30% of the events have no ttbar in the event record

Study of event composition in semi-leptonic
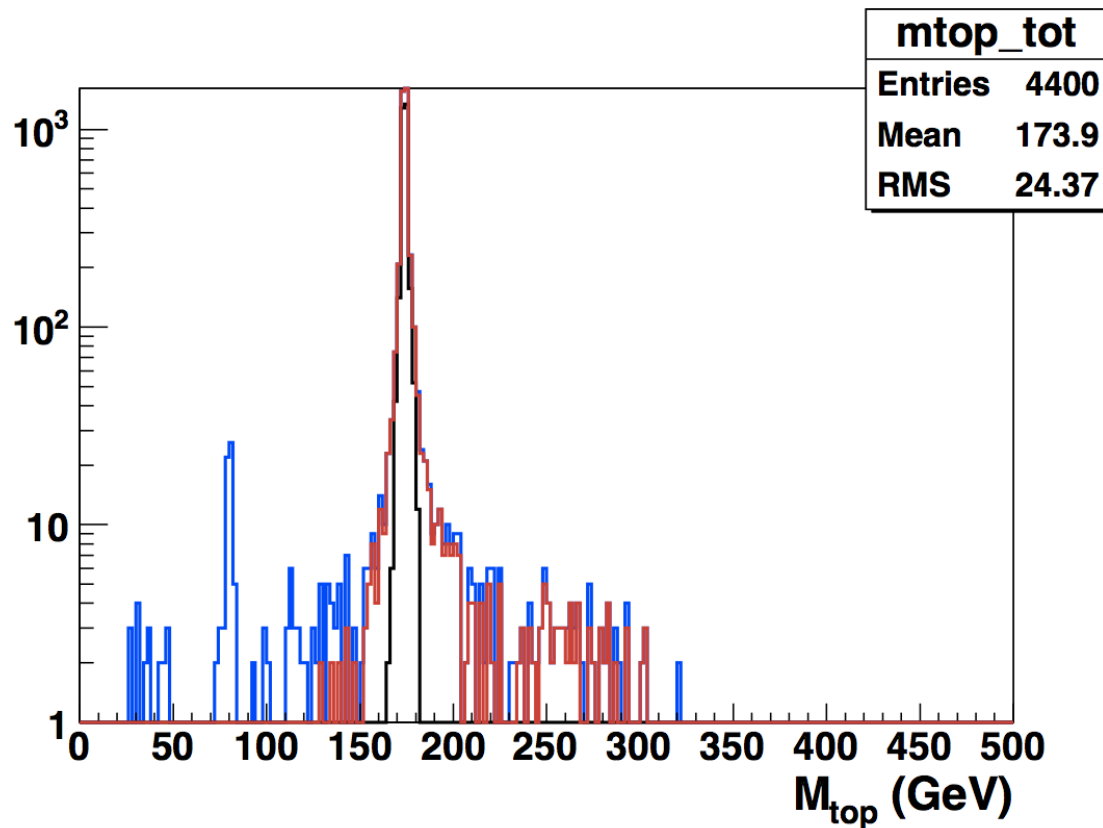
- Blue all events in file
- Black: ttbar event record (Selection of region of 5Gamma around nominal Top mass
- Red: Spectrum after "composition" of top quarks from 6fermions and cut against ZWW

Most of non-tagged events look like good tops

All generated events (fully hadronic in this case)

NMCTop12fmass

Historical cuts BEFORE
start of "six fermion crisis"

eLpR
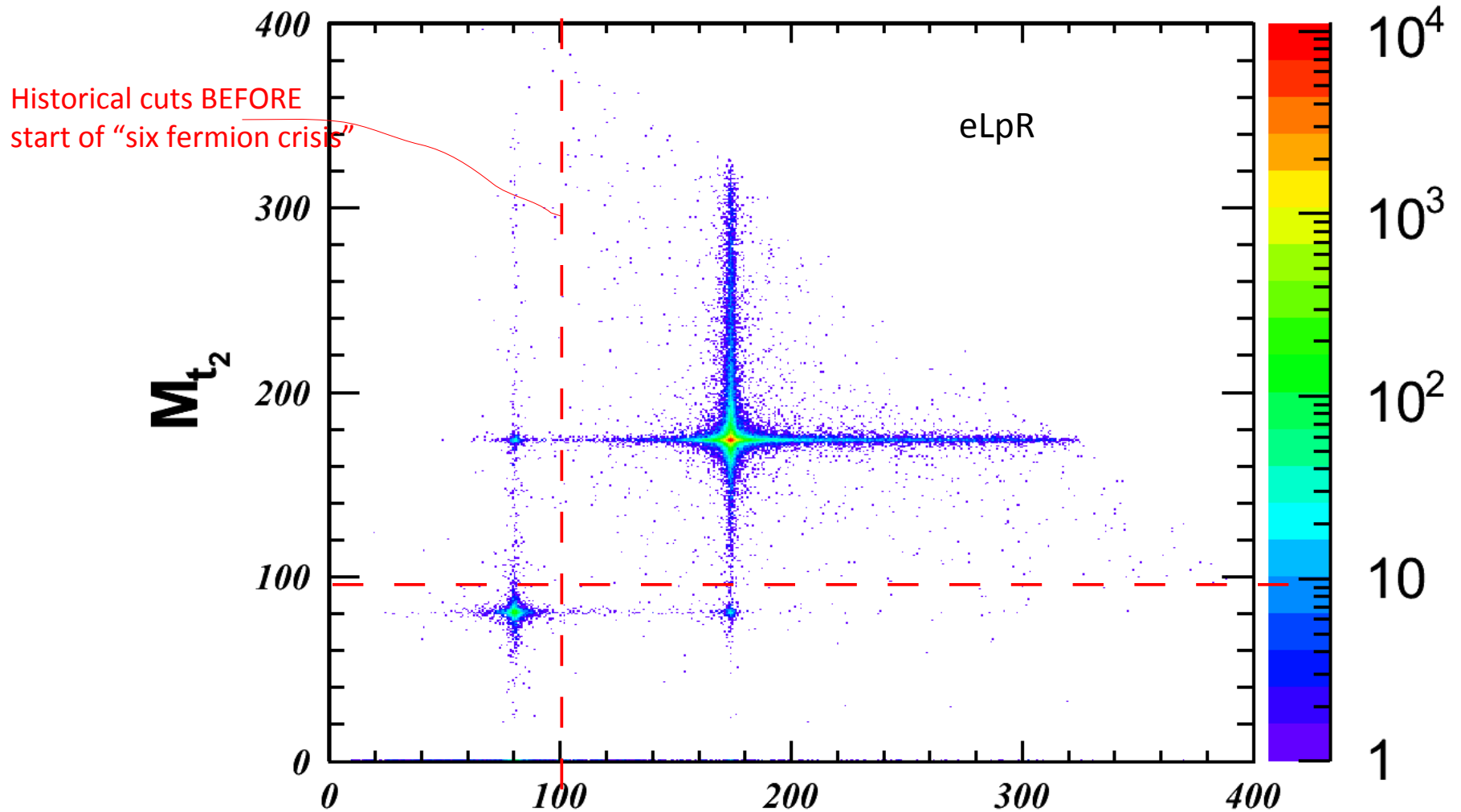
AFB ~ 30% with historical cuts
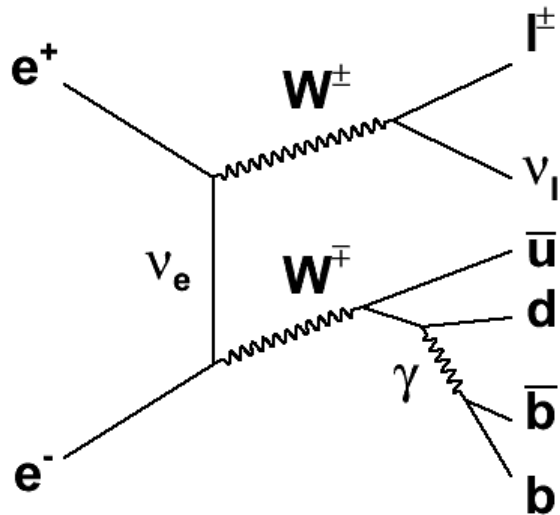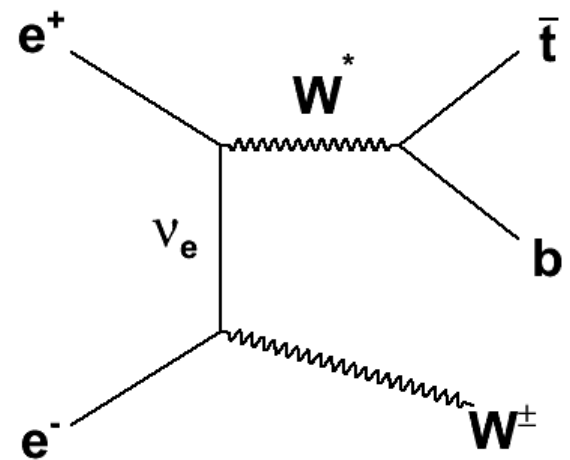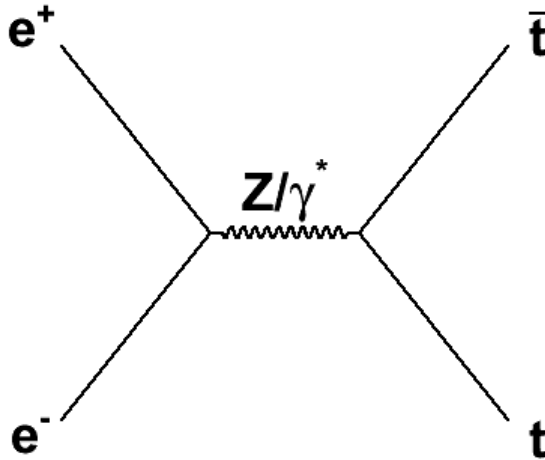AFB ~ correct with 'Barklow' selection

Observation consistent in semi-leptonic and
Fully hadronic analysis

Contributions to six fermions (from M. Vos)

+ s-channel
t-channel only
relevant for eL

+ s-channel
t-channel only
relevant for eL

What about interferences? Whizard consistent with MADGRAPH!?
Is Whizard right and there are massive negative interferences

Conclusion

- ttbar analyses for semi-leptonic and fully hadronic top decays
LC-REP-2013-007 (SL), LC-REP-2013-008 (fully hadronic)
- Already remarkable progress but still open issues towards (SL) paper
 - Open issues
  Common to both analysis:
  - Inclusion of Standard Model background (non six fermions)
  - Understanding the six fermion event sample
    Single top is not all
    If understood may entail reprocessing of entire event sample
    If pure ttbar cannot be isolated need to understand relation between
    Measurement and theoretical quantities
  - gamma gamma background

  - Control of migration effects in AFB
    Improvement of chi2 analysis
    i) extension to entire angular distribution, other variables?
    ii) Use other handles to control migrations (e.g. b charge)
   The LCFIPlus group is very helpful
  Fully hadronic:
   - Control of migrations in AFB
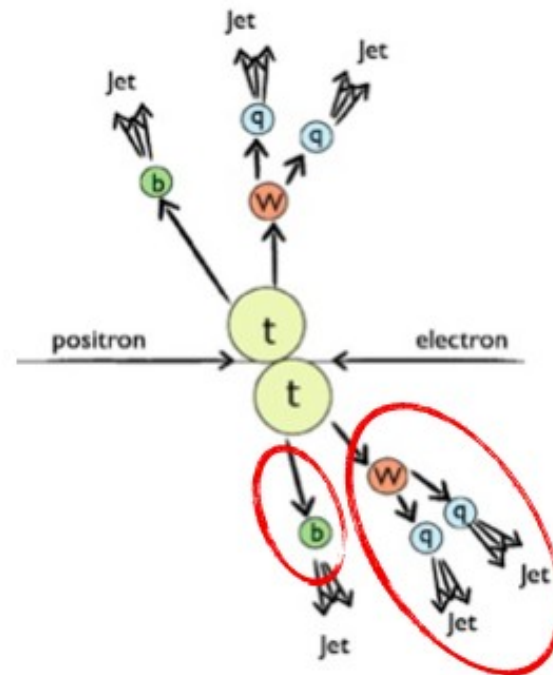   - Optimisation of charge measurement

Backup

Elements of top quark reconstruction

- By far dominating decays: All-hadronic (46%), semi-leptonic / lepton+jets (45%, 30% w/o τ)
  - try to avoid decays into τ, increased uncertainties from additional neutrino

lepton ID
tracking

isolated lepton

missing energy

Jet

6 jets

flavor tagging
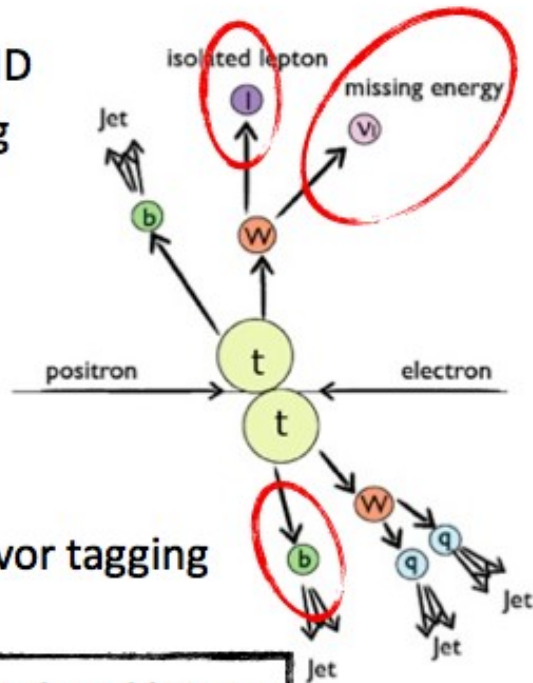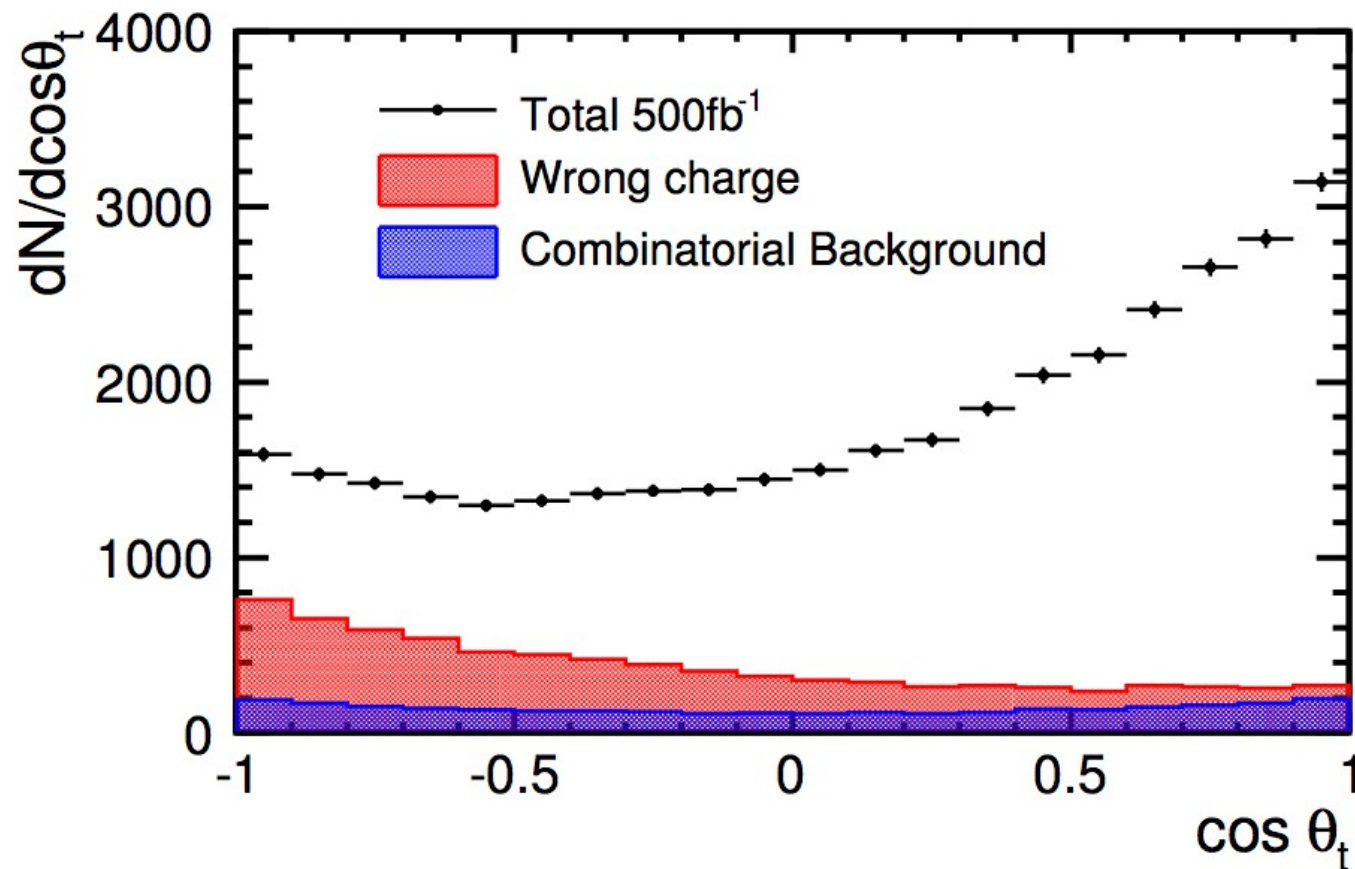
4 jets, isolated lepton

jet energy
reconstruction,
global event
reconstruction

Uses all aspects of LC detectors!

Nice illustration stolen from Frank

Reminder on A_{FB} in LOI

Fully hadronic channel, only one polarisation mode $P(e^+, e^-) = (+30\%, -80\%)$

$$A^t_{FB} = 0.334 \pm 0.008$$