Update of the top cross section measurement in the all hadronic channel

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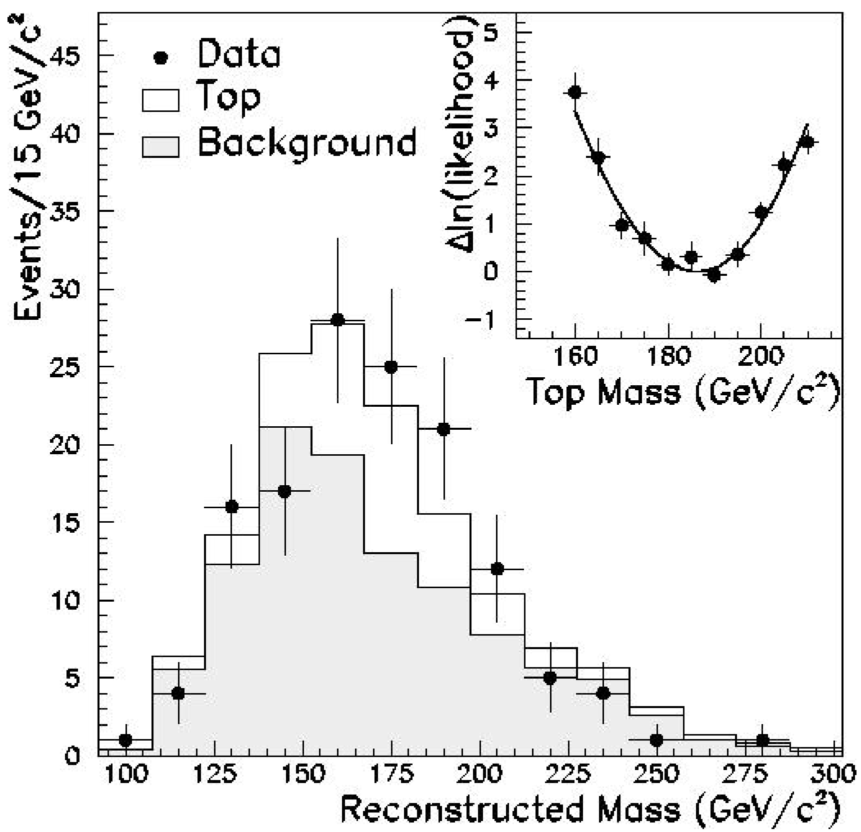
- Data Samples
- RunI Analysis strategy
- Kinematical Selection
- B-Tagging (Secvtx)
- "Method 1" background
- Alternative background estimate
- Future Plans

The all hadronic channel

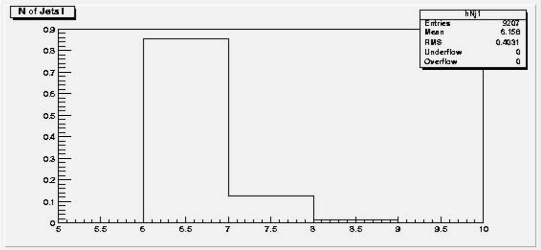
- The all hadronic channel:
  - ⇒ BR is large (46%)
  - ⇒ S/B is very small
- RunI Analysis strategy had 2 steps:
  - ⇒ A)Tight Kinematic + >=1 btag
  - ⇒ B) Loose Kinematic + >=2 btag
- 6jets-QCD background MC generation used to be very difficult
  - ⇒ use the data to evaluate the bkg after tagging in shape and normalization

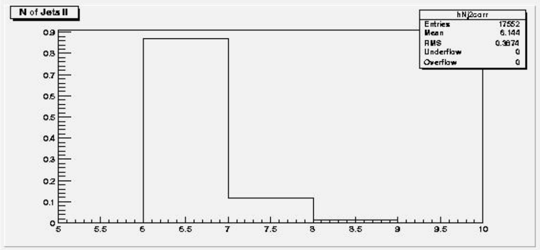


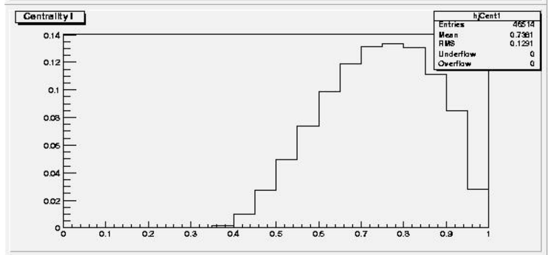
The datasets (data and MC)

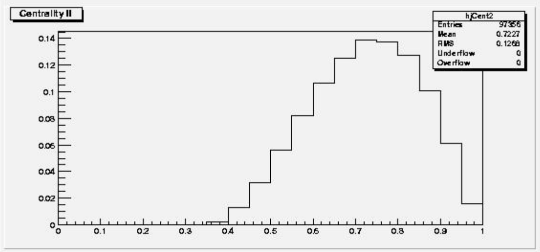
- Dedicated trigger: TOP_MULTI_JET (after Run 143938)
  - ⇒Requires: N(jet)>=4 with Et>=15 and ΣEt>125 GeV
  - ⇒Before Run 143938: L2 was only ΣEt>130 GeV cut
- $\int L_{int}$~ 100pb^{-1} (with good run list, no SVX requirement)
- $\int L_{int}$~ 69pb^{-1} (with good run list and SVX requirement)
  - ⇒1078473 events
- Events processed through the "REMAKE" procedure used by the other Top analyses + 4.9.1.hpt1 TopEventModule info
  - o RAW JET energy information used for NOW!
- Signal MC: ttop2i
  - ⇒Extra signal samples produced for systematic evaluation
    - o Different top masses
    - o Different conditions

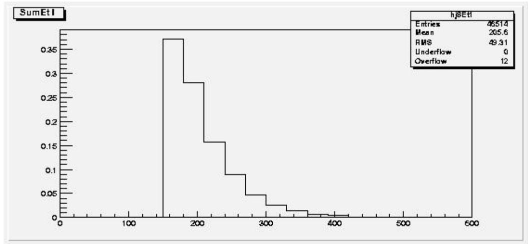
RunI vs RunII dataset kinematical properties

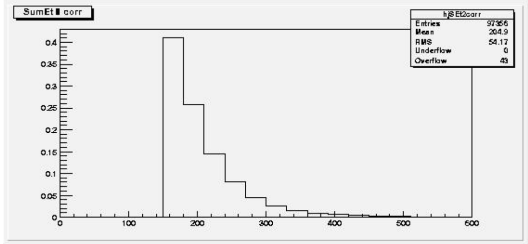


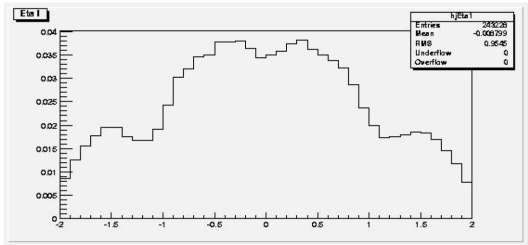


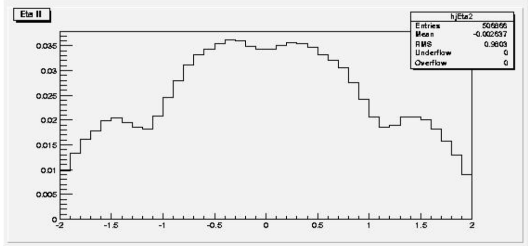










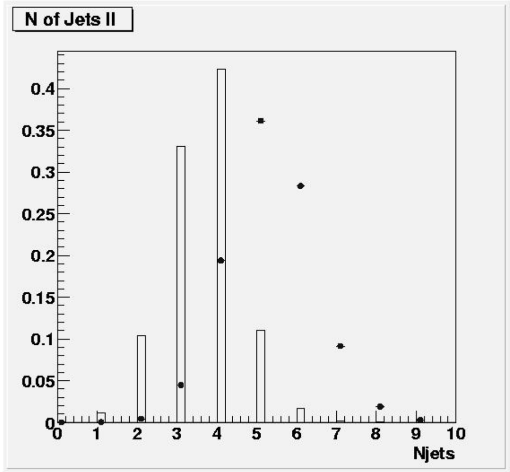


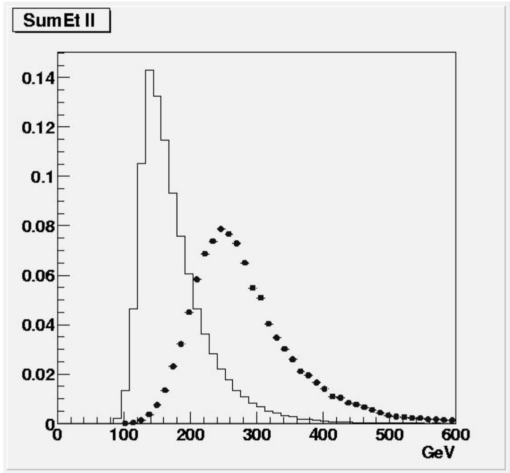
Sample clean-up

- The following requests are applied for a minimal clean-up of the sample:
  - ⇒ $|Z(vert)|<60$ cm
  - ⇒ $\Sigma Et \leq 2000$ GeV
  - ⇒ $MET/\sqrt{\Sigma Et} \leq 6\ GeV^{1/2}$
    - o 6% of data events removed
- To guarantee orthogonality with lepton+jets analysis events with at least one tight lepton (electron or muon) are rejected
    - o 1% of data events removed
    - o On all hadronic signal sample expect 1% of events removed

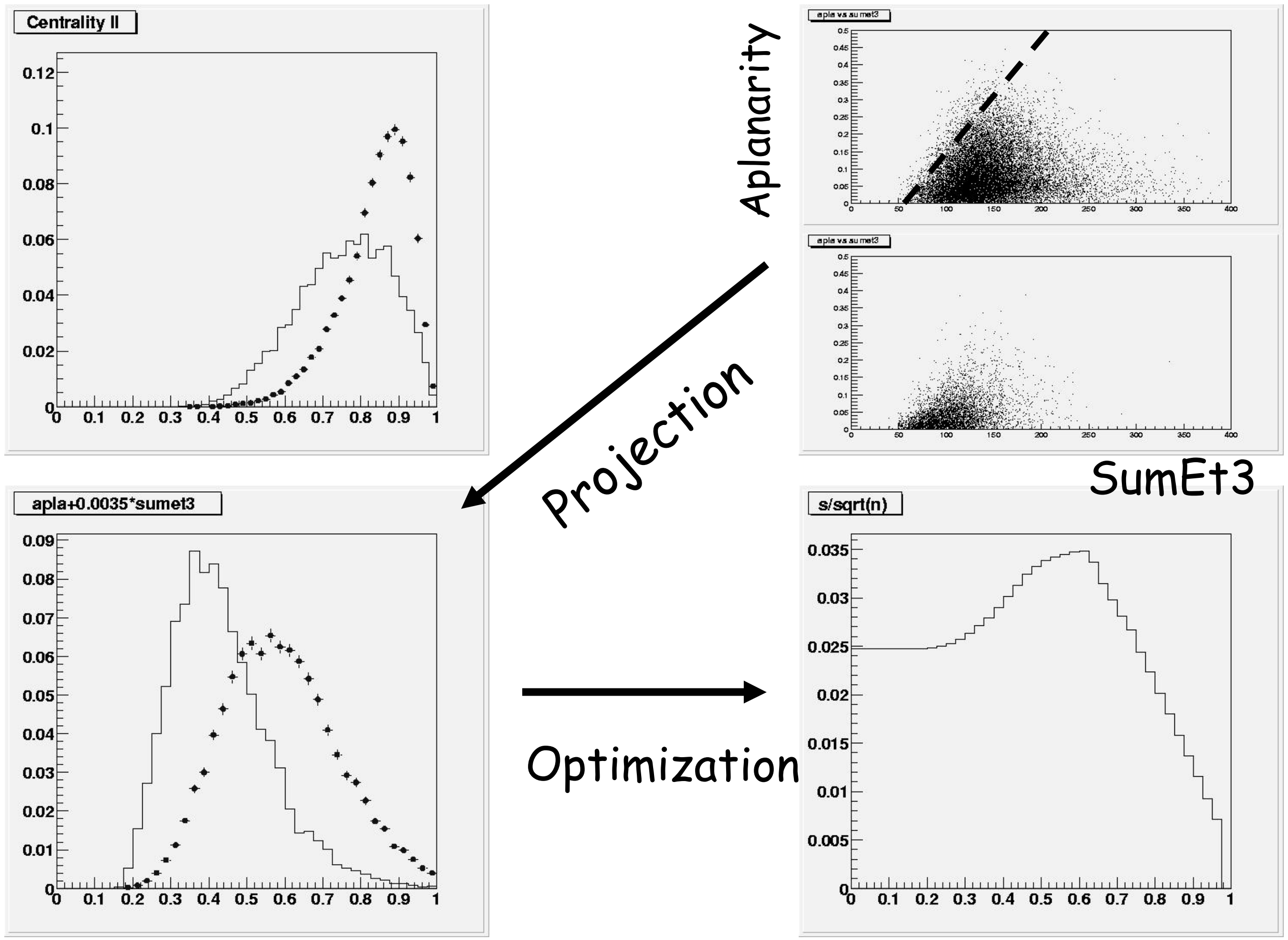
Kinematical selection optimization (RunI style)

- Jet counting definition:
  - ⇒ Et(raw)>15 GeV & |eta|<2
- Main background: QCD 2→2 processes with extra jets due to gluon radiation
  - ⇒ Kinematic very different from tt
- Use data before tag for the background shape
  - ⇒ Signal contamination negligible
- Cuts chosen:
  - ⇒ $5 \leq N(jet) \leq 8$
  - ⇒ $\Sigma Et \geq 250$ GeV
  - ⇒ $\Sigma Et/\sqrt{\hat{s}} \geq 0.75$ (centrality)
  - ⇒ Aplanarity+0.0035 x $\Sigma_3 Et \geq 0.55$





Kinematic cuts optimization



Summary table of kinematical selection

Cut	MJ events	Cum. Eff. (%)	Rel. Eff.(%)	S/B(*)
Trigger	1086208	99	99	1/5000
Clean-up	1017054	96	97	1/3400
Tight Lepton VETO	1009789	96	99	1/3400
Njet	130967	73	76	1/600
SumEt	11025	45	61	1/80
Centrality	5989	37	83	1/50
Aplanarity	1023	22	58	1/15
Signal inclusive eff (%)		10		1/14

(*)Assuming $\sigma(tt)$=7 pb

Systematics on kinematical selection

- Efficiency on exclusive hadronic events is 22% (BR=44%)
- Efficiency on inclusive tt events is 10%
  - ⇒RunI value was 9.9% using corrected energies
- The biggest systematic contribution is clearly from the jet energy scale. Since we are using raw jets we:
  - ⇒ varied the jet energies by +5,-10%
  - ⇒Obtained: +24,-38% on the efficiency
  - ⇒RunI value was: 8%
- For comparison the total RunI systematic uncertainty was 16%.
- *...Systematic evaluation in progress...*

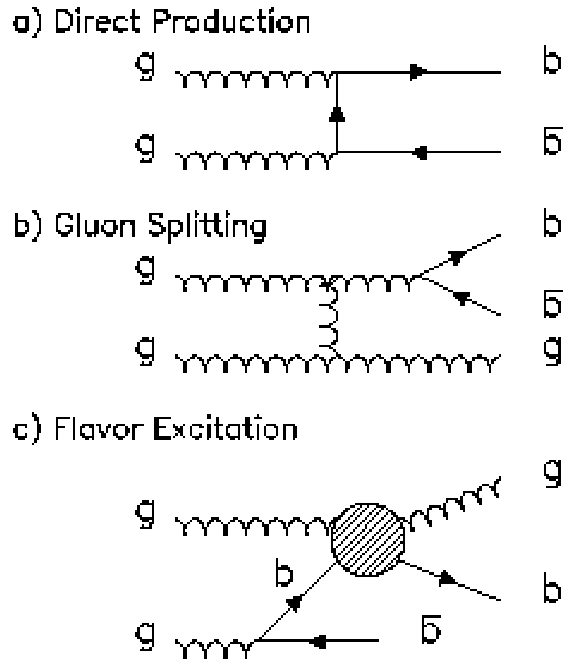
SecVtx efficiency in all-had tt events

- Given the higher density of jets in all hadronic tt events we went trough the exercise of remeasuring the btagging efficiency following the procedure of CDFNote 6329.
- Considering five or more jets after kinematical selection we find the following:

Quantity	All had(Njet≥5)	L+jets(Njet≥3)
ε_{btag}(%)	41.0 ± 0.3	43 ± 0.6
ε_{mistag} (%)	2.0 ± 0.3	2.7 ± 0.2
F_{1b}	0.316 ± 0.004	0.411 ± 0.007
F_{2b}	0.559 ± 0.004	0.459 ± 0.008
$\varepsilon_{b\text{-}tag}^{event}$ (%)	44.9 ± 0.7	44.1 ± 0.6
ε_{tag_event} (%)	46 ± 1	45±1

Background estimate after tagging (Method1)

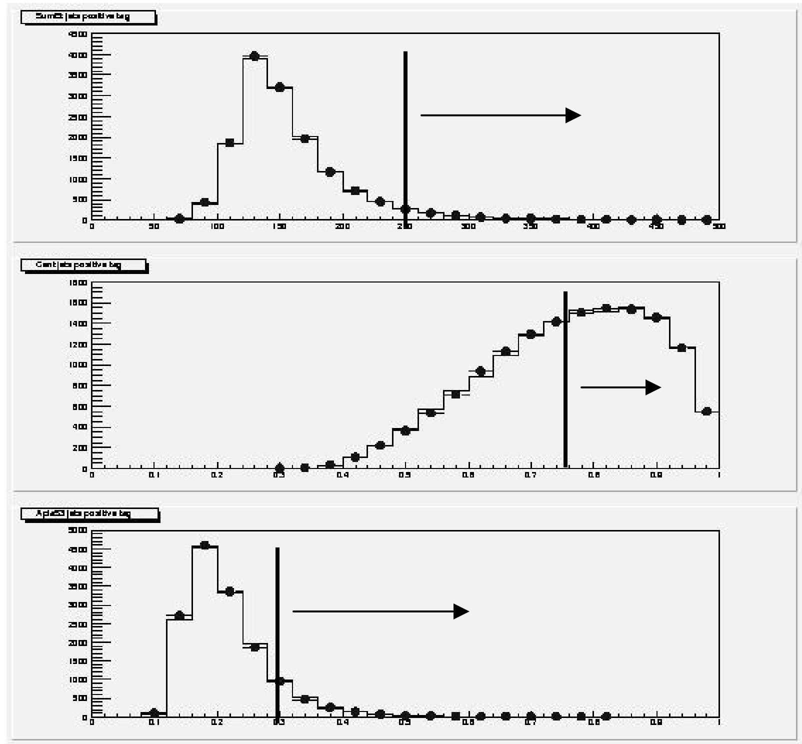
- In the multijet sample we expect the presence of tags coming from true heavy flavor due to the following QCD processes (apart from tt production):
  - ⇒ Direct production
  - ⇒ Gluon splitting
  - ⇒ Flavor excitation
- The method for this bkg estimate is based on the assumption that the contribution of these QCD processes remains the same (does not increase) as a function of jet multiplicity.
- The positive tag rate measured on the N(jet)=4 bin is then applied to higher multiplicities (Method1)



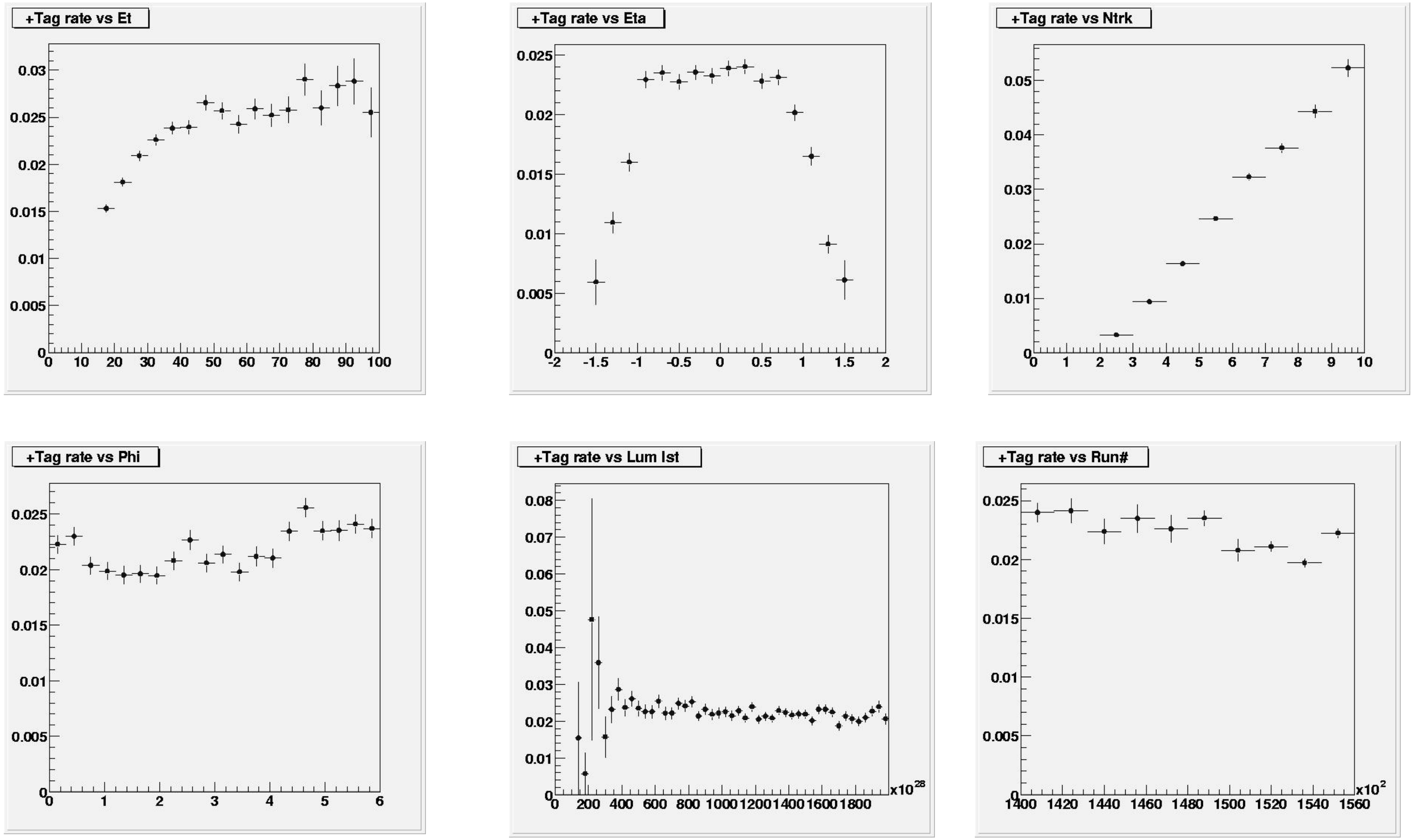
Tag Rate Parametrization & checks

- The tag rate is parameterized in terms of:
  - ⇒ Et
  - ⇒ number of good SVX tracks
  - ⇒ detector eta
  - ⇒ Matrix: 6x11X3
- Checks on the N(jet)=4 bin:

Cut	OBS	EXP	Delta(%)
N(jet)=4	14484	14484 ±118	--
Sumet	190	173 ±13	10 ±8
Centrality	2269	2332 ±48	-3 ±2
Aplanarity	409	393 ±20	4 ±5



Positive Tag rate dependence in N(jet)=4



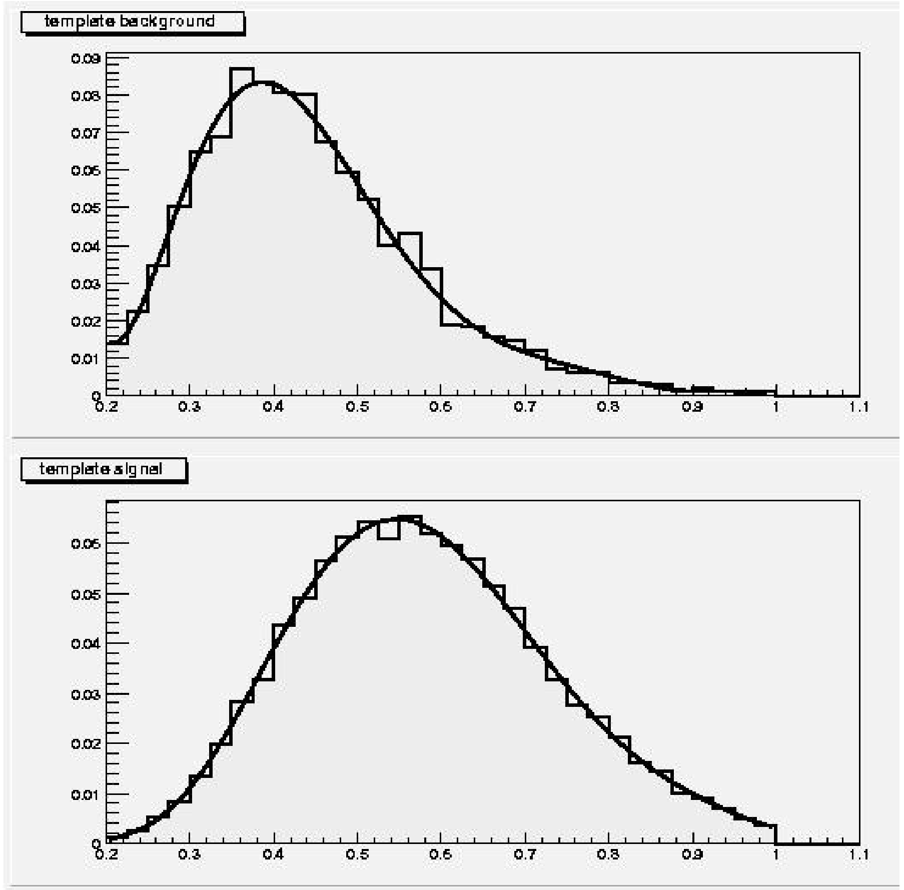
Tag Rate checks vs. N(jet) before kin.

N(jet)	Events	Tgbl. Jets	Obs	Exp	Delta(%)
4	283952	664735	14484	14484 ±118	--
5	75569	222068	4704	4712.6 ±67.5	0.2 ±1.4
6	11259	40067	761	850 ±28.5	-10 ±3
7 and 8	1479	6361	137	133.6 ±11.3	2 ±9

- For N(jet)=6 we see a significant depletion of observed tags.
  - ⇒ This is inconsistent with the checks from the btag group
  - ⇒ We are still investigating the technical details with the experts
- The bin with N(jet)=6 is where we expect the signal to show up once we apply the kinematical requirements. We need to have good agreement before any kinematic is applied.

Alternative background estimate

- Given the problems seen in the Method 1 background, another method has been investigated.
- The kinematical variable less sensitive to bias from the request of tag appears to be the Apl+Sumet3.
  - ⇒ The shape after tagging is well described by the tag rate parameterization
- Templates have been created:
  - ⇒ Signal: tt events with N(tag)≥1
  - ⇒ Background: data events weighted with the positive tag probability (from the matrix)



Likelihood fit

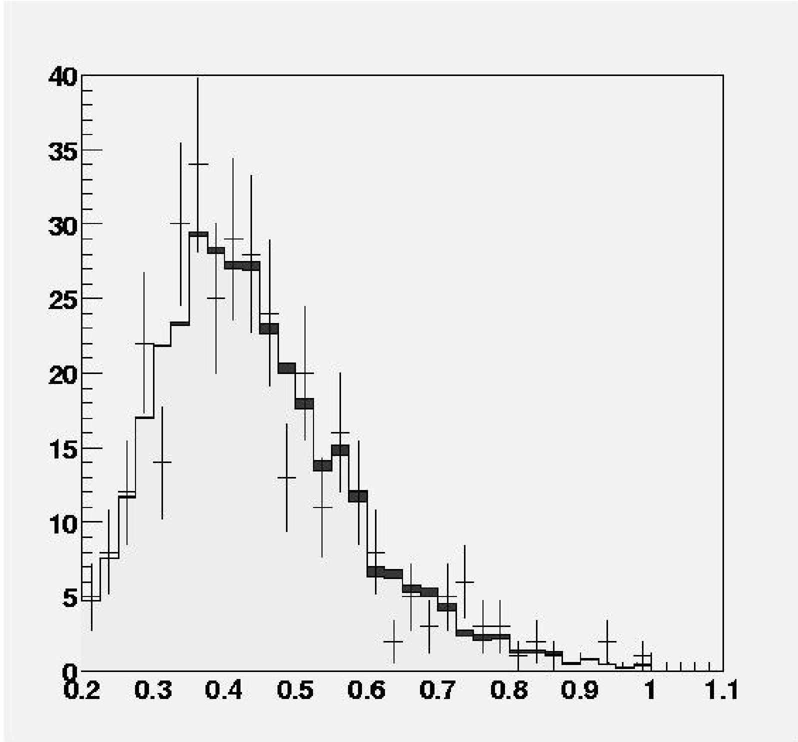
We define an unbinned likelihood as:

$$L = \prod_{i=1}^{N_{cand}} \frac{n_b f_b(x_i) + n_s f_s(x_i)}{n_b + n_s}$$

where:

- x_i represent the value of A + $0.0035 \times \sum_3 E_T$ for the i-th event
- n_b and n_s are respectively the number of background and signal events (in particular we consider $n_s = (N_{cand} - n_b)$)
- f_b and f_s are the probability densities for background and signal respectively.
- $N_{cand} = 347$ is the number of candidate events passing the alternative kinematical selection and with at least 1 b-tag.

$\Longrightarrow n_b = 336^{+11}_{-16}$ **background events**



...Still we cannot isolate a signal...

Plans for the future

- In the current datasets we are not yet able to extract a significant top signal in the hadronic channel in ~69 pb^{-1}
- It is interesting to know which S/B we expect in the various cases with the selections described:
  - ⇒Full kinematical selection + btag: S/B(expected) ~1/2
  - ⇒Loose kinematical + btag + fit: S/B(expected) ~1/9
  - ⇒Loose kinematical + 2btag: S/B(expected) ~1/2
    - – Not optimized yet for 2tag analysis!!!
- Future plans are aimed at:
  - ⇒Improving the tools (in progress now)
    - o Fixing problems with usage of Secvtx
    - o corrected jet energies
    - o event-by event vertex
    - o QCD background MC bb+2,3,4partons (Alpgen)

Plans for the future (cont'd)

⇒ Analysis strategy optimization (cross section measurement for the summer):
  - o Reevaluate kinematical selection
    - – maybe optimizing already also for mass?
  - o Require double tags
  - o Use JPB in conjunction with Secvtx

⇒ Mass analysis (Winter 2004):
  - o Reoptimize kinematical selection (if necessary)
  - o Fit method, jet corrections, tools (in conjunction with mass group)
  - o Improve choice of combination using b/charm info (JPB,Secvtx)
  - o Use Forward tags?

⊙ Lots of work, but the path is clear. Hope to have results soon!

⇒ Start giving regular presentation at Top Mtg