



ATLAS-CAT top physics - status report



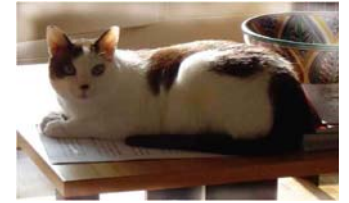
Richard Hawkings

ATLAS-CAT-physics meeting, 30/08/06

- Overview of ongoing activities
 - Some areas with 'critical mass' are emerging
 - b-tagging calibration studies in more detail



Ongoing activities - I



- Triggering in top events:
 - Attila Krasznahorkay, David Berge, in collaboration with Manchester (Thorsten Wengler et al)
 - Interested in evaluating standard selection efficiencies for top events (via high p_T lepton triggering), with expert trigger knowledge
 - Also backgrounds to top at trigger level, and using top to measure trigger efficiencies (e.g. triggering on jets/missing E_T at LVL2/3 to evaluate lepton efi)
 - Major contribution to CSC top note T5 (Thorsten is editor)
- Concentrated on infrastructure work so far
 - Production of ntuples from AOD samples (CSC non-hadronic top sample 5200)
 - Using TopView + additional trigger quantities - could eventually incorporate extra information into 'standard' TopView ntuples produced by Akira Shibata
 - Running on small samples on desktop machines - no big production (yet)
 - Framework for ROOT analysis of (EventView) ntuples being developed:
 - Dealing with common bookkeeping issues (histogram booking, chaining ntuples)
 - Will make this available to group soon - maybe also merge with CAT SUSY Sframe ..?
 - Will be interested in running on AODs available at CERN atldata using lxbatch ...



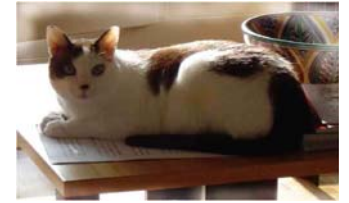
Ongoing activities - II



- Calorimeter calibration (LAR + tiles) for jets in ttbar events:
 - Tancredi Carli, Francesco Spano, Emanuel Rauter (Munich), other students ...
- Interests in several aspects of calorimeter calibration and jet algorithms
 - Approach based on 'local hadron' calibration - building up from response in each cell
 - Combined testbeam data analysis (taking most effort at present)
 - Significant use of dedicated ATLAS queues on lxbatch
 - Underlying event subtraction, techniques for doing this with k_T rather than cone algorithms
 - Promising theoretical / generator studies shown at MC workshops - can these methods be shown to work for 'realistic' detector data?
 - Trying to build up from parton/hadron/detector level - understand in detail
 - Not much work with MC ttbar events yet
- Also background interest in top cross-section measurement
 - For extraction of top mass via mass/cross-section measurement
 - Eventual interest in single top production



Ongoing activities - III



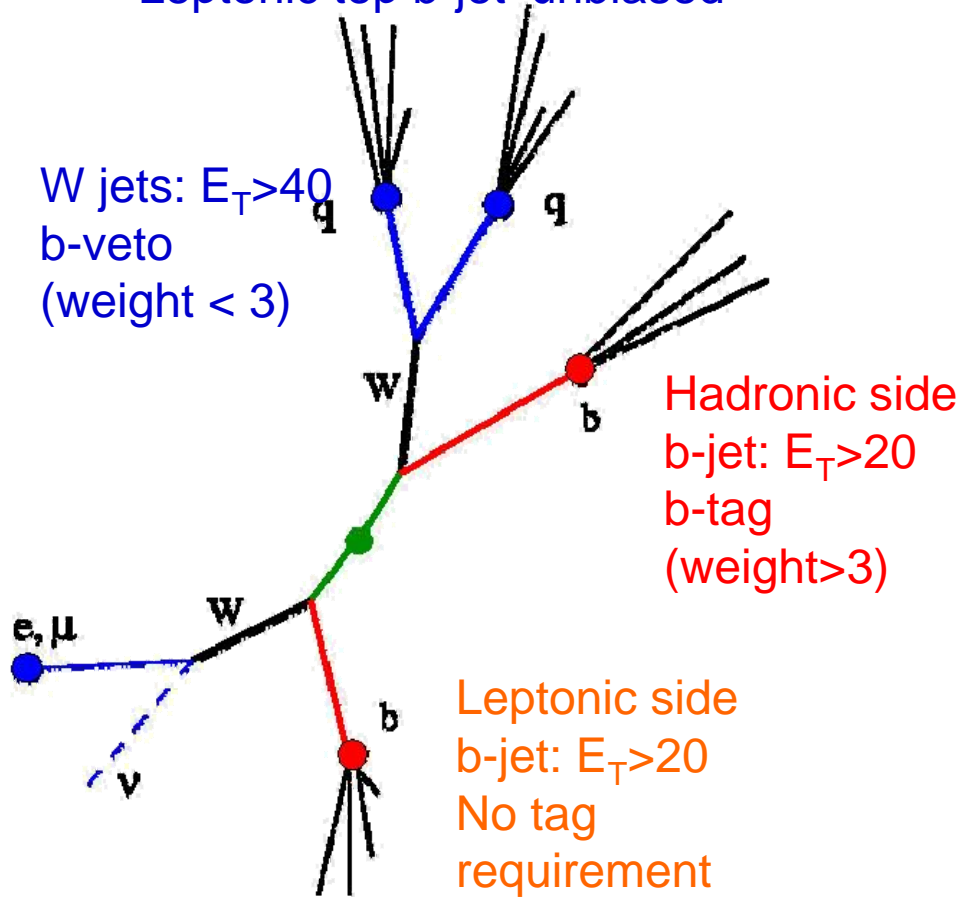
- B-tagging studies in $t\bar{t}b\bar{t}$ events
 - Richard Hawkings, Pamela Ferarri, Grant Gorfine, Christian Schmitt, Maria Costa
 - A lot of ID and b-tagging expertise (also from Tevatron), mainly limited by available time at present - a busy time for the ID in last few months
- Directions of activity:
 - Studying b-tagging algorithms with a view to top-cross section measurement
 - Extracting b-tagging efficiencies and backgrounds from $t\bar{t}b\bar{t}$ data
 - Tag counting methods ($t\bar{t}b\bar{t}$ events with one, two, three b-tags), possible use of kinematic fit to improve purity/combinatoric selection
 - Reference sample selection methods - selecting unbiased samples of known flavour composition
 - People looking at both TopView and straight-AOD analysis,
 - No 'common' software framework established yet
- Will show some results from reference sample selection (RH)
 - Done with TopView (AOD-> ntuple on lxbatch)
 - Analysis of n-tuples done with standalone C++ code using ROOT libraries
 - TopView n-tuples considerably modified for selection of all combinations, w/o b-tag



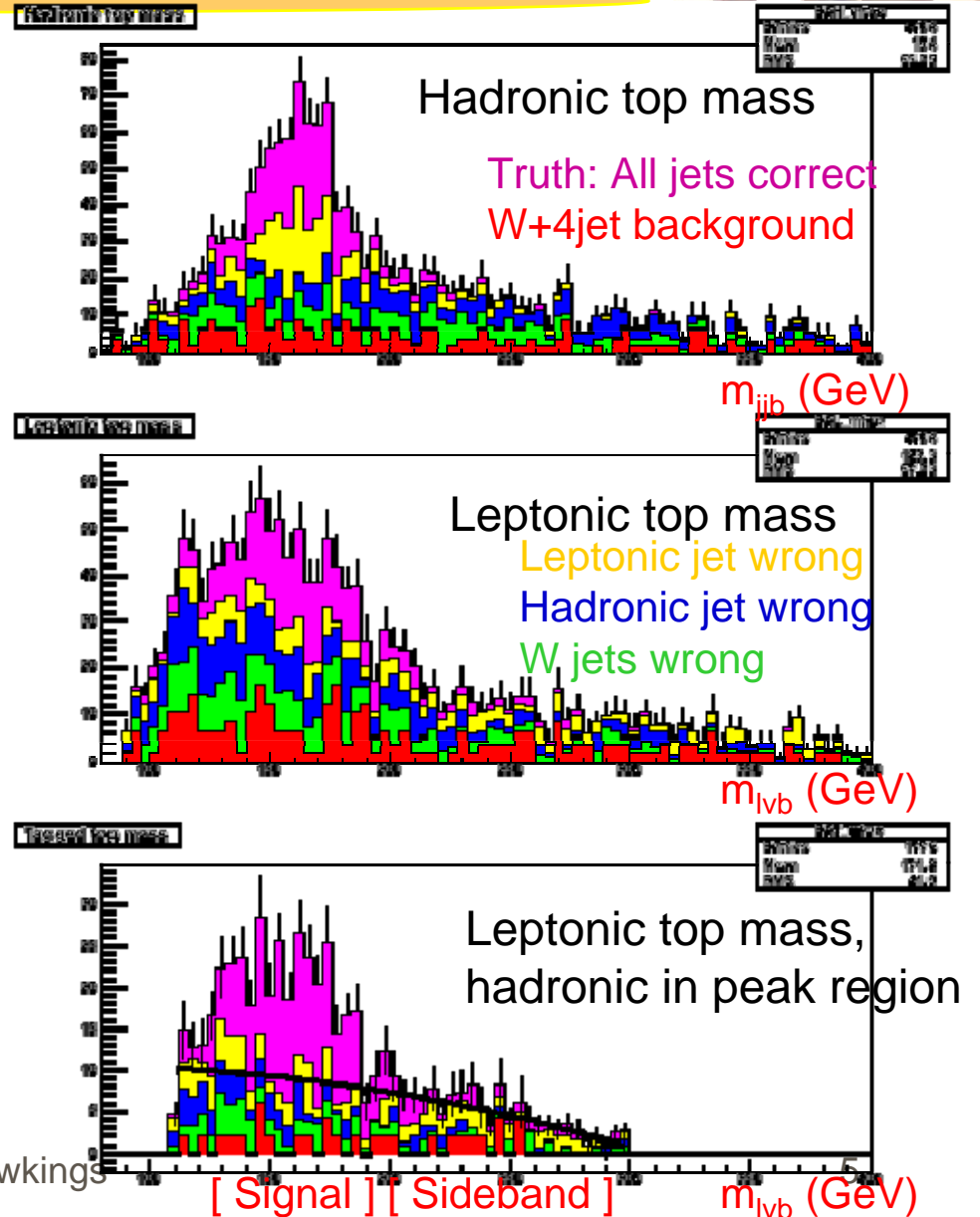
Selecting a reference sample of b-jets



- Select using b-tag on hadronic side
 - Leptonic top b-jet 'unbiased'



- MC sample: 268 pb^{-1} scaled to 100 pb^{-1}

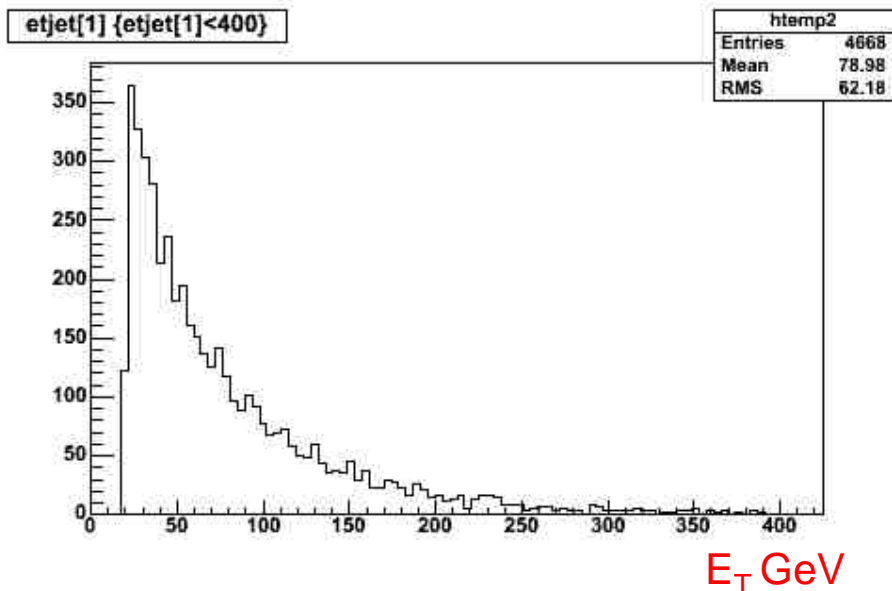




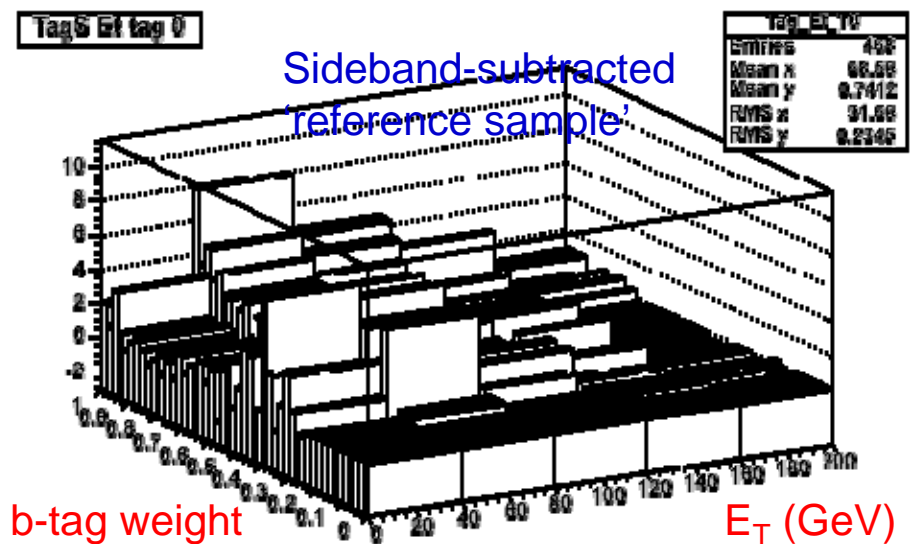
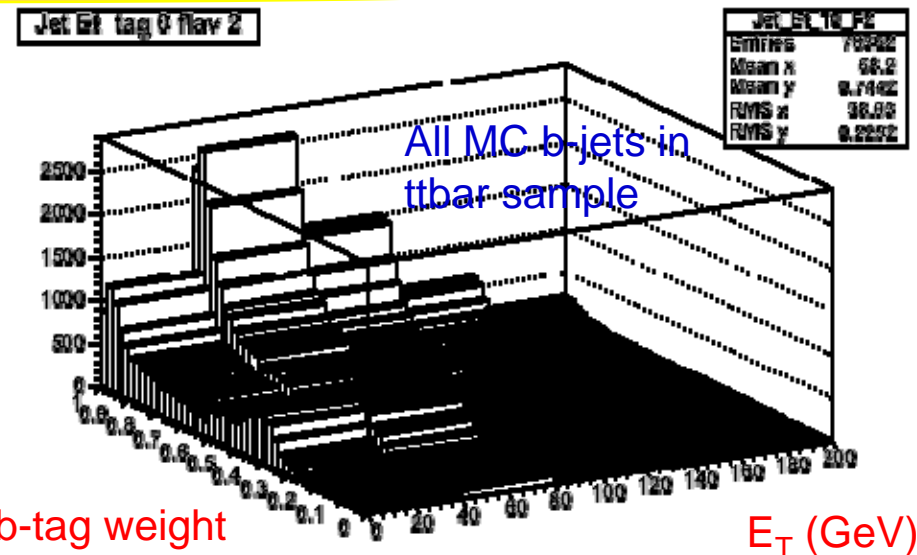
Tagging distributions vs jet E_T



- Momentum spectrum of leptonic b-jet:



- With this selection, get around 140 'unbiased' b-jets per 100 pb⁻¹
 - After subtracting scaled background from sideband region
 - Statistically, sample is then ~ pure b
- Look at the distribution of a b-tagging variable (here Marseille weight) ...
 - Transformed to lie between 0 and 1

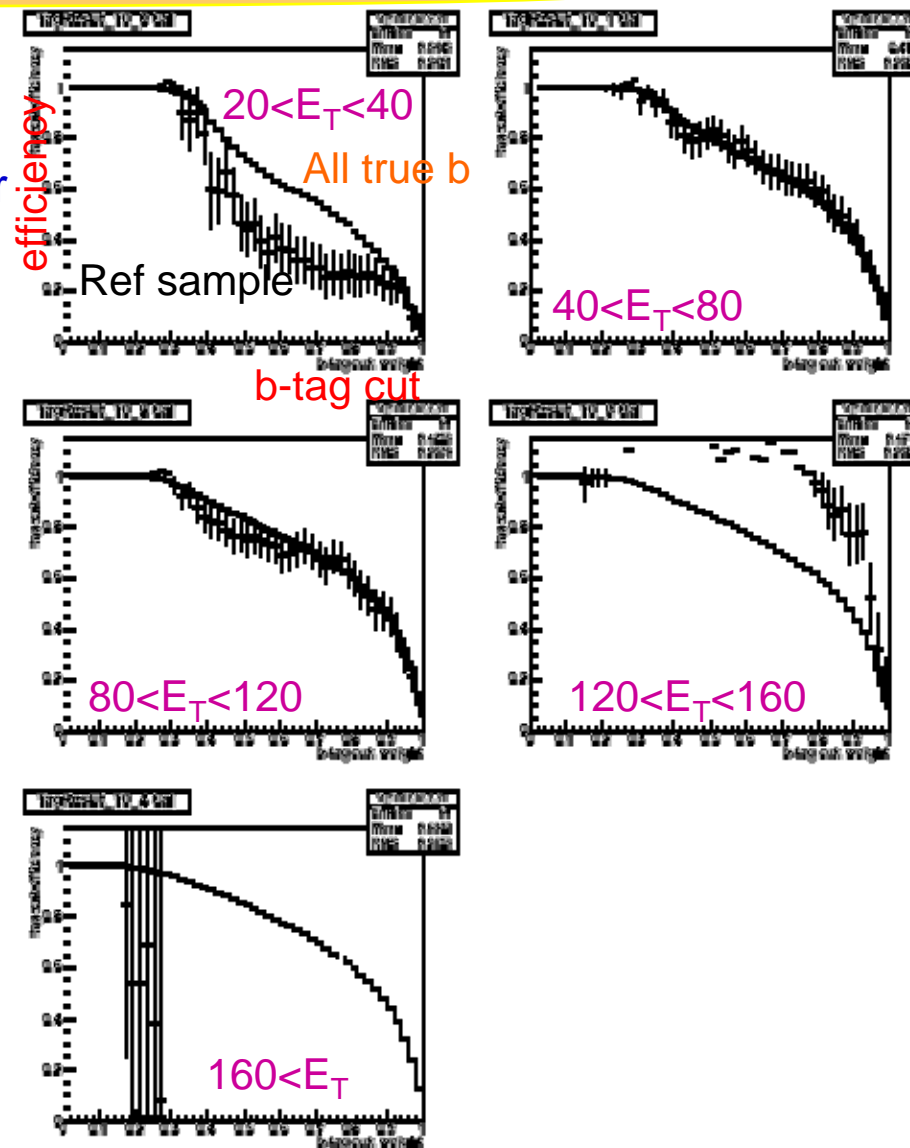




Measuring b-tagging efficiency



- For a given cut, extract b-tag efficiency
 - Fraction of weight distribution above cut
 - Calculate this for 'reference sample' and for all b-jets in $t\bar{t}$ events
 - As a function of jet E_T ...
 - If reference sample is unbiased, we can use this to measure the tag efficiency
 - Works well for 40-120 GeV
 - Seems to be some background contamination at $E_T < 40$ GeV
 - Procedure is quite sensitive to background subtraction - and we have a lot of background ...
 - Not enough statistics above 120 GeV
 - Statistical errors $\sim 5\%$ abs. for 250 pb^{-1}
 - Would be nice to improve selection efi ...
 - How does this compare with 1,2,3 jet counting methods?



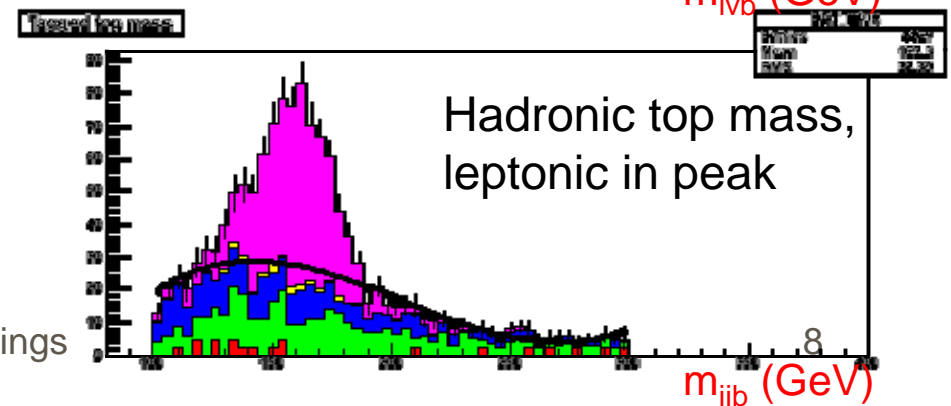
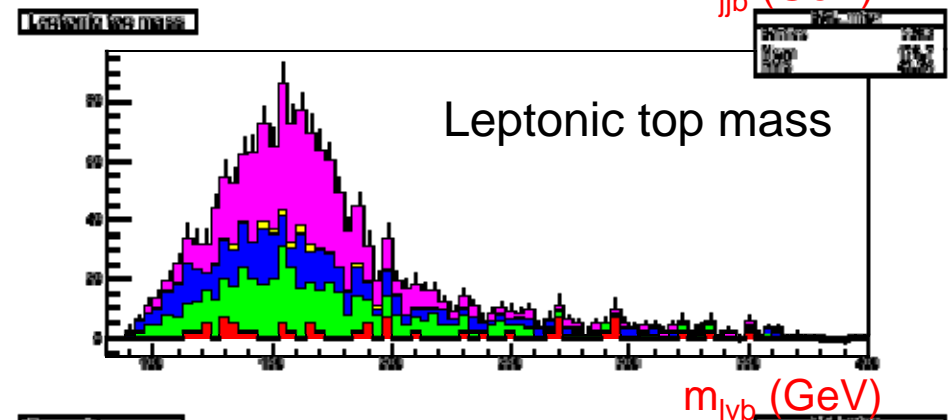
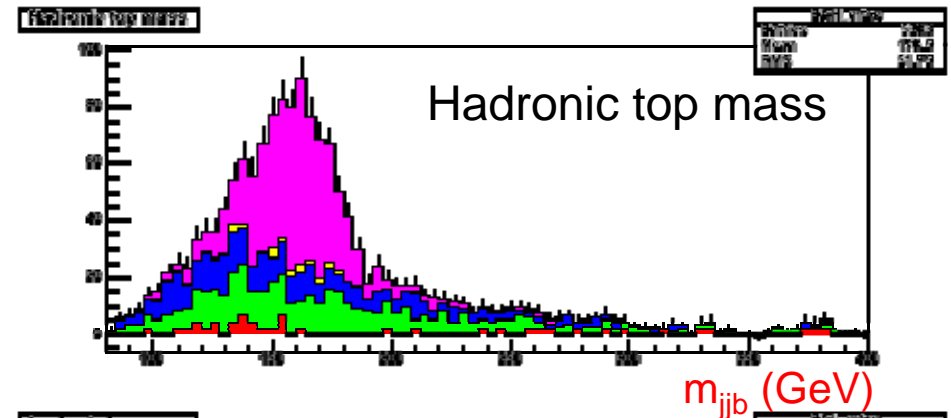
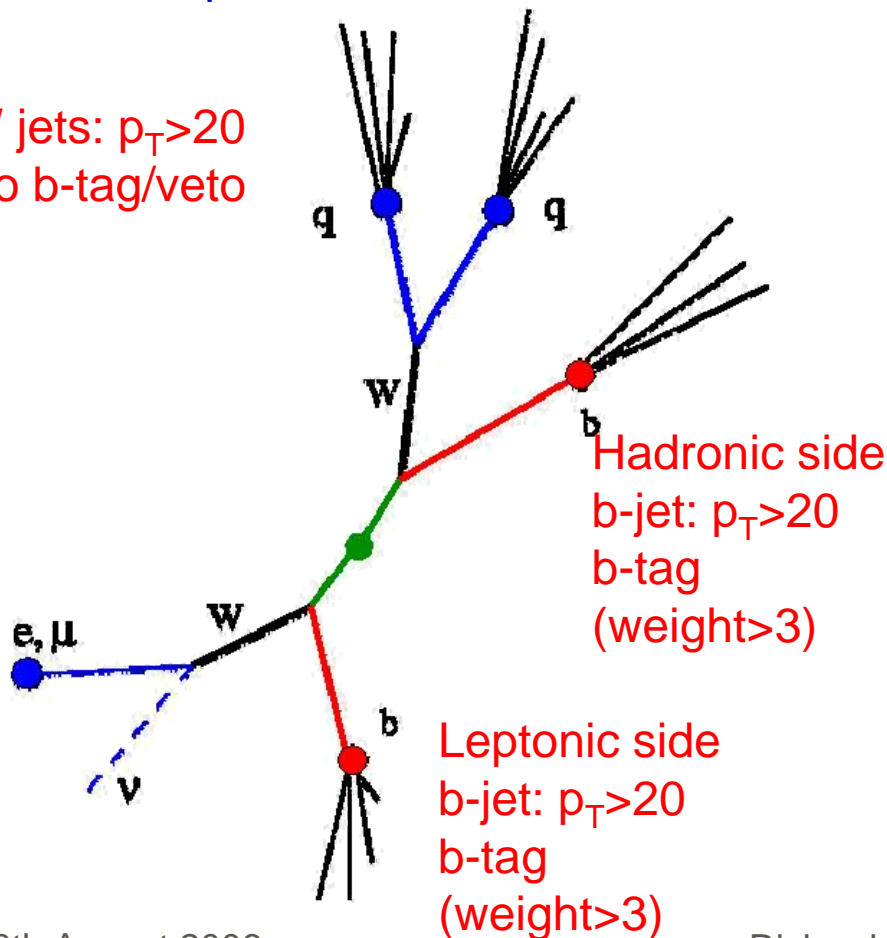


Selection of light quark jets



- Try to do the same to measure tag efficiency on W-jets
 - Composition should be 75% uds, 25% c

W jets: $p_T > 20$
No b-tag/veto

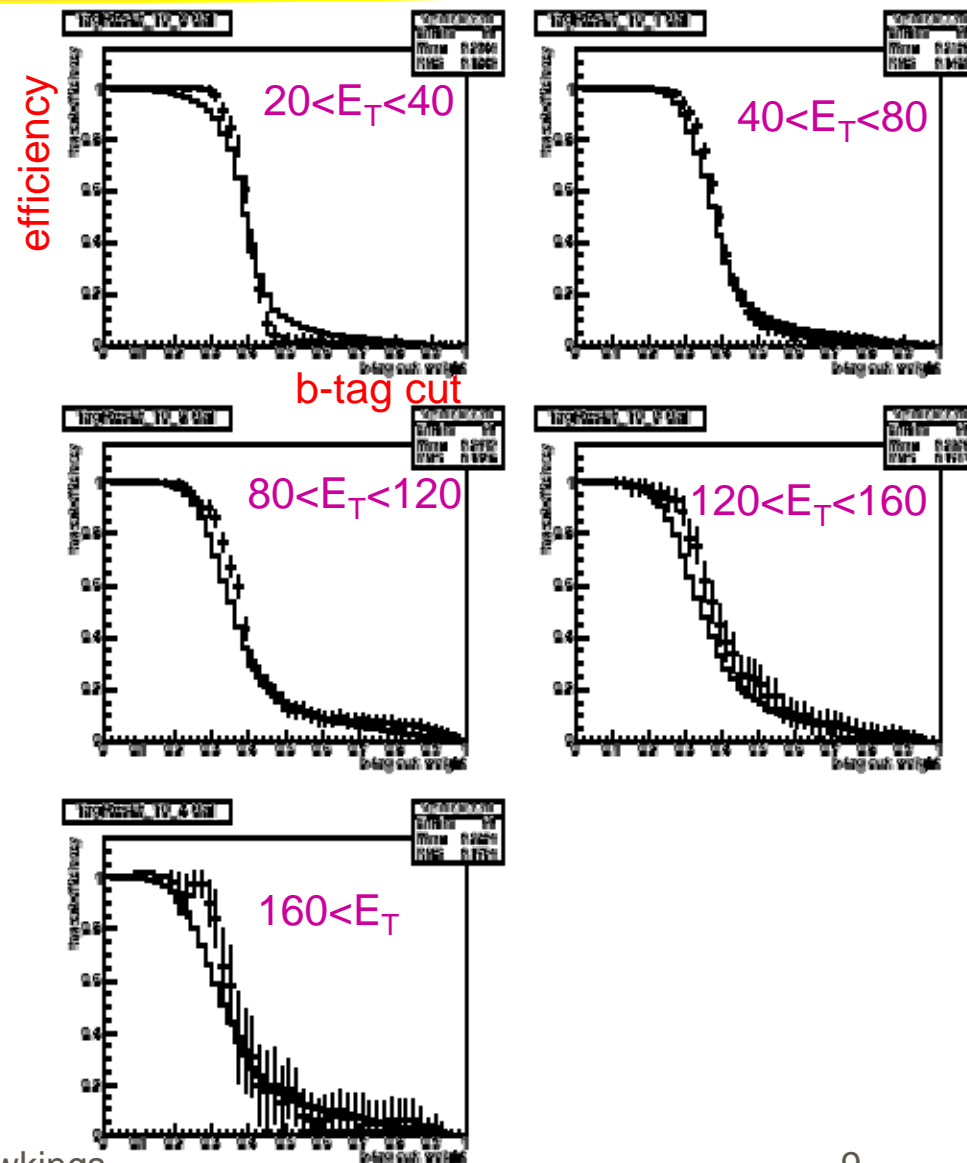




Measuring background efficiency of b-tag

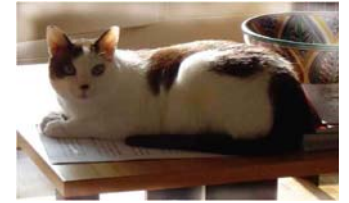


- Again, extract efficiency to 'tag' udsc jet as a function of cut
 - 'Truth' made from combination of uds and charm distributions
 - Get around 800 candidate W jets in 100pb^{-1} after sideband subtraction
 - Works reasonably well, except at very low jet E_T
 - Measuring jet rejection in a 'realistic' environment
 - Most of tagged udsc jets are presumably charm, or uds close to b-jets
 - Can we separate uds / c contributions?
 - Have $W \rightarrow uds$ uds, $W \rightarrow uds$ c but never $W \rightarrow cc$ - can this be exploited?





Next steps



- Basic method seems to work, but ..
 - Needs a lot of statistics, can the selection be optimised?
 - E.g. mass peaks are broad - can we use light jet rescaling to W mass or better calorimeter calibration (just taken from AOD ConeTower4Jet) to improve things?
 - How to determine the background level reliably?
- Try to relate the efficiencies being measured to quantities needed in top cross-section measurement
 - Need an actual 'cross-section' selection we might be using
- One of several methods being studied in ATLAS for b-tagging calibration
 - 'System 8'-type measurements for di-jets, tag counting in ttbar events, ...
- Possible contribution to CSC notes:
 - ttbar event note in flavour tagging group
 - Top group note T3 - properties of b-jets (editor RH)
 - Supposed to consider b-tagging, b-energy measurement, b-quark charge tagging
 - Scope and overlap with other notes not yet clear ...