

● Hadronic signatures for New Physics?

Searches for new physics in early data using 3rd generation quarks

A non-exhaustive, unordered list of hadronic signatures of New Physics that involve third generation quarks

Littlest Higgs model: $Z_H \rightarrow Zh \rightarrow l^+l^- bb$

(Eur.Phys.J.C39S2:13-24,2005)

Twin Higgs: $W_H \rightarrow tb$

(ATL-COM-PHYS-2008-050)

SUSY cascade decays of squarks

KK excitations in models with Extra Dimensions $g^* \rightarrow tt$

ATL-PHYS-PUB-2006-002

Twin Higgs: cascade $W_H \rightarrow Tb$

(Les Houches 2007, arXiv:0802.3715)



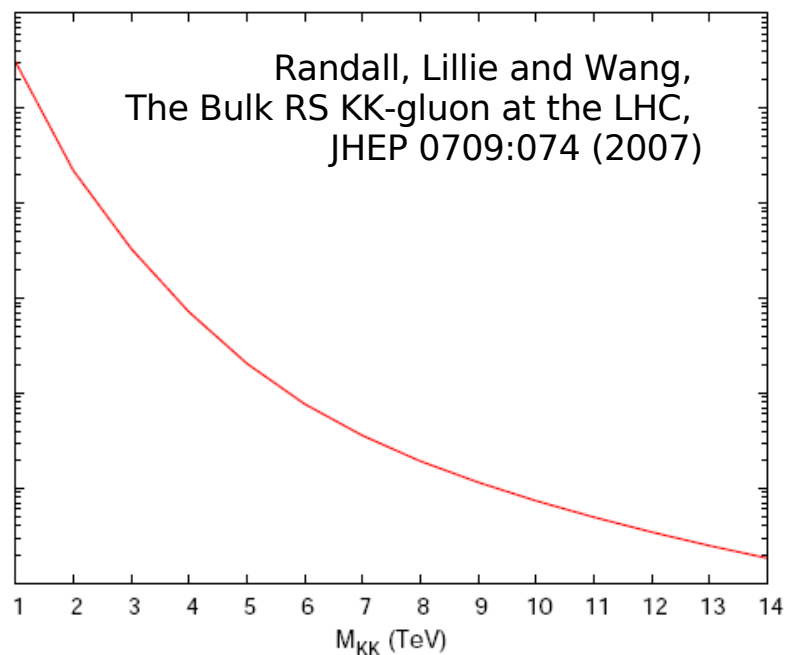
Some early physics

Kaluza Klein excited state of the gluon

Present in models with Large Extra Dimensions where gauge bosons propagate in the bulk.

Strong coupling, large cross-section
Broad resonance into $t\bar{t}$: $\Gamma/M \sim 0.2$

Backgrounds: SM top pair production, W +jets $\sigma(p_T(\text{top}) > 200 \text{ GeV}) \sim 26 \text{ pb}$ (LO, large K-factor)

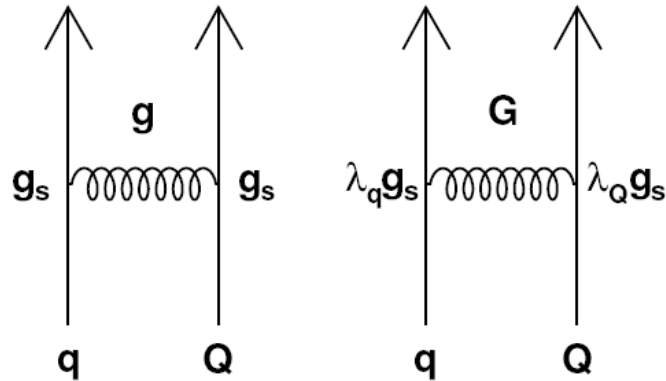


Taking 20 pb^{-1} :
10.000 signal events

$M_{g^*} \text{ (GeV)}$	$\sigma_{g^*} \text{ (pb) @ 10 TeV}$	$\sigma_{g^*} \text{ (pb) @ 14 TeV}$
1 TeV	475	1109

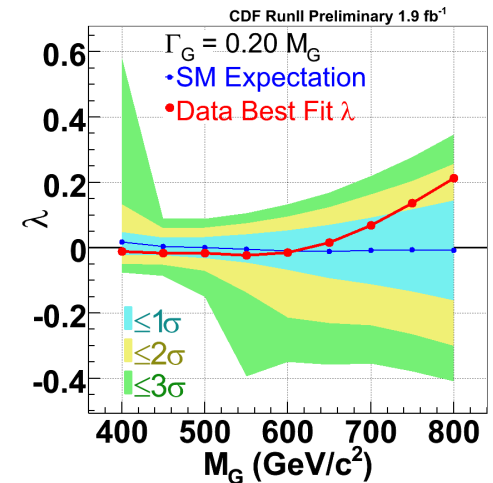
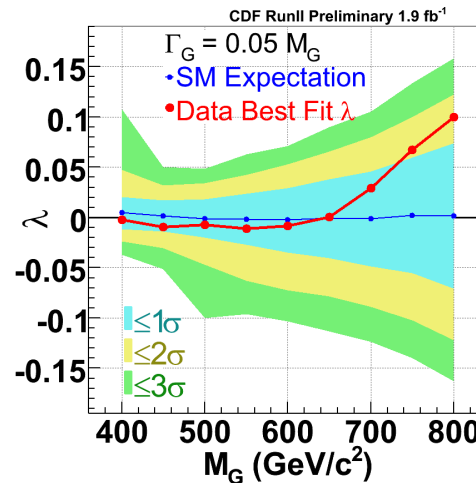
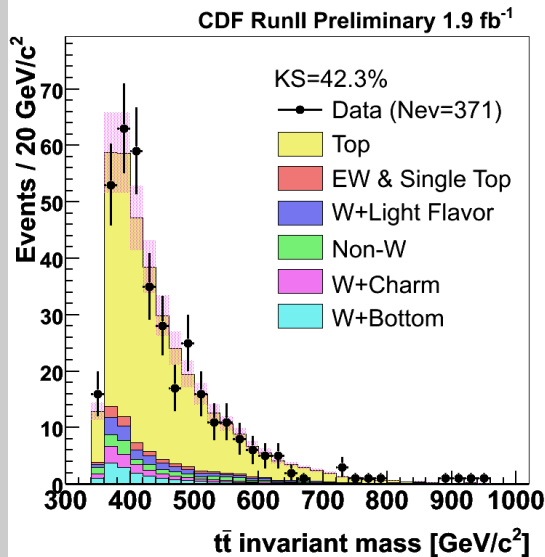
Leading order cross-sections for ADD KK gluon

● Tevatron - CDF



Preliminary results in CDF 9164 of a massive gluon search in 1.9 fb^{-1} finds data are compatible with SM within 1.7σ

Exclusion limits are modest due to the lower Tevatron center-of-mass energy



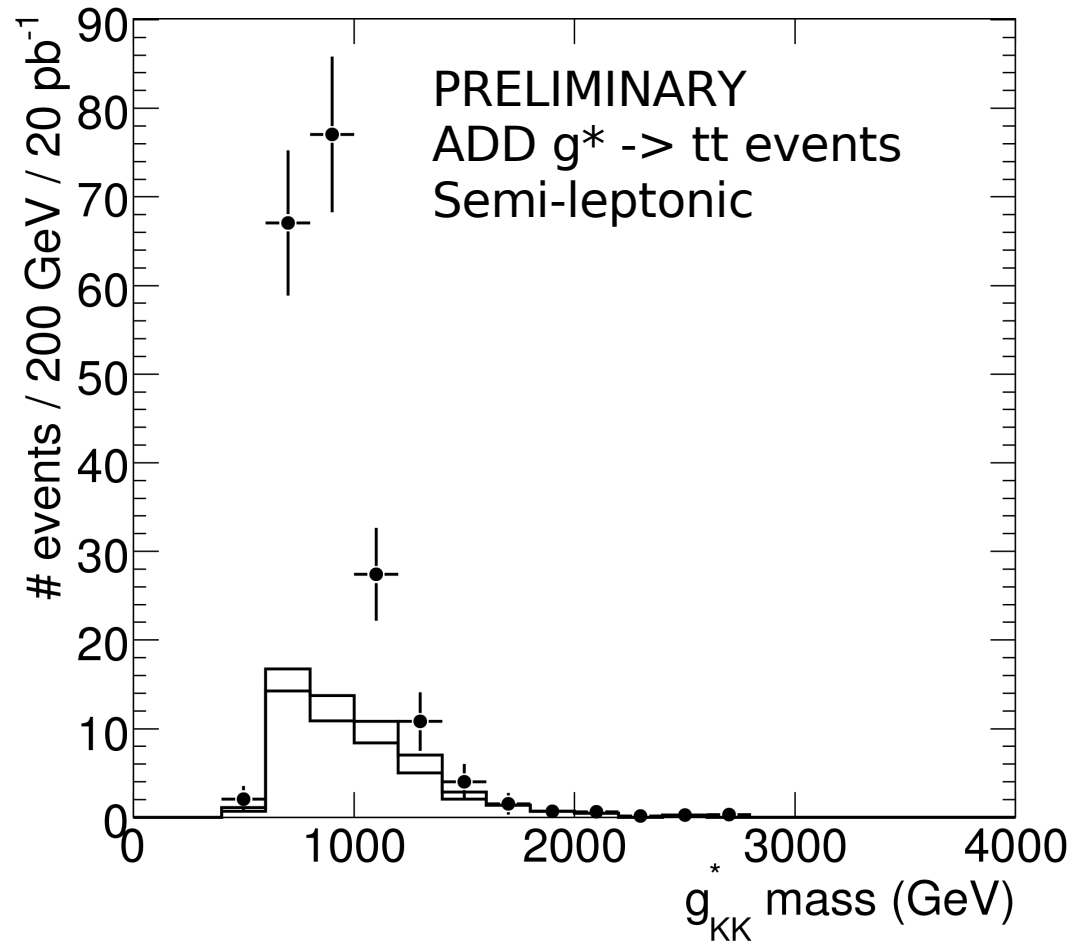
● Early exotic top physics

ATLAS 10 TeV, 20 pb⁻¹ preliminary

Simplified early physics
analysis: **no b-tagging!**

How can we be sure the
signal and background are
really tt?
(flavour tagging)

How do we estimate the
background normalization
from data?



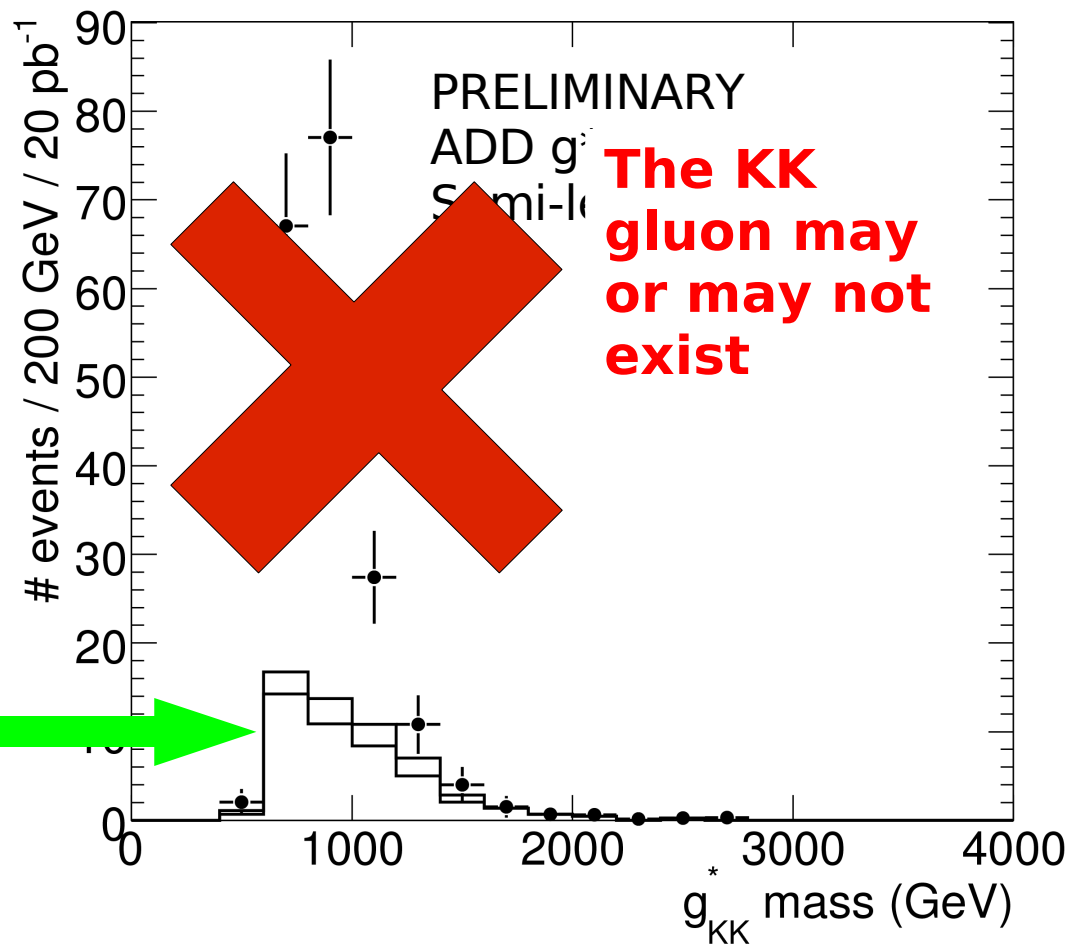
Early exotic top physics

Control of the high p_T top background is a goldmine

Standard Model cross section ($d\sigma/dM$) measurement

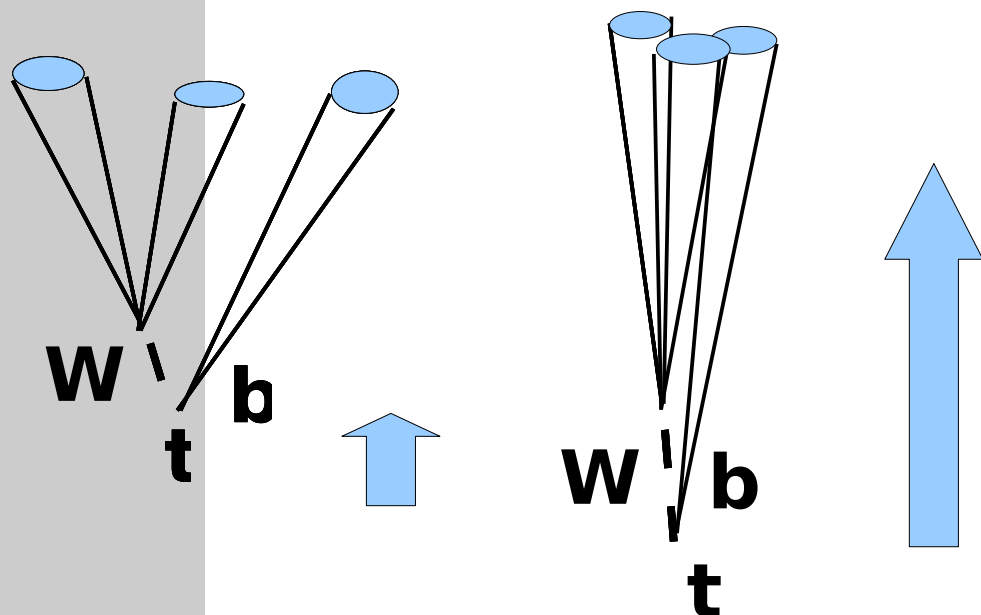
LHC precision physics à la Verzegnassi (Phys. Rev. D71 (2005))

Dominant background for searches (little, twin Higgs, W' , SUSY cascades)



Reconstruction of hadronic top monojets

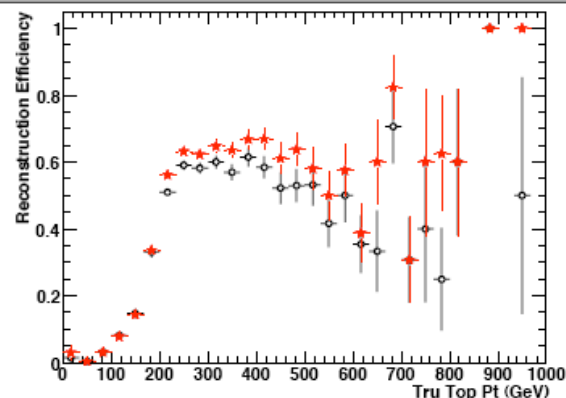
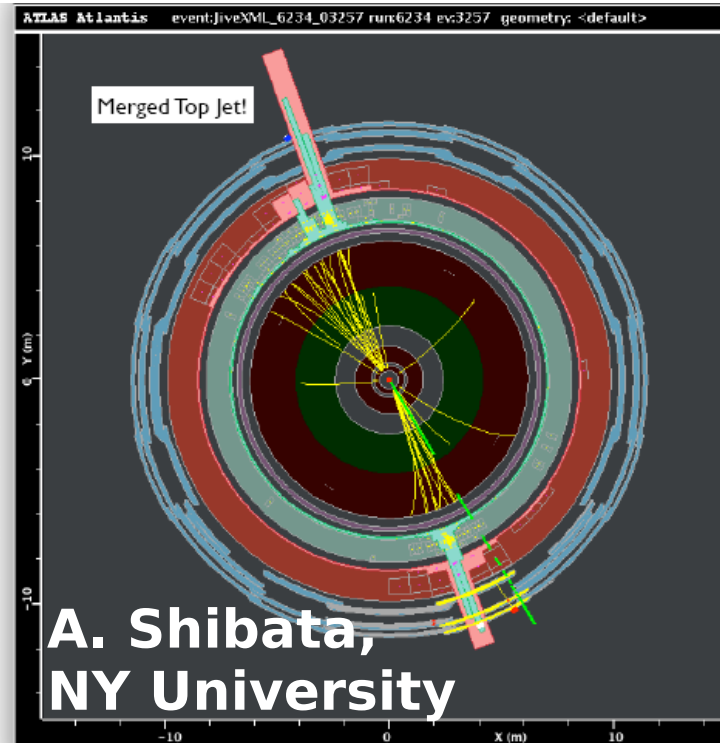
Top “monojet” tagging



$p_T(\text{top}) \sim 0 - 100 \text{ GeV}$

$p_T(\text{top}) > 400 \text{ GeV}$

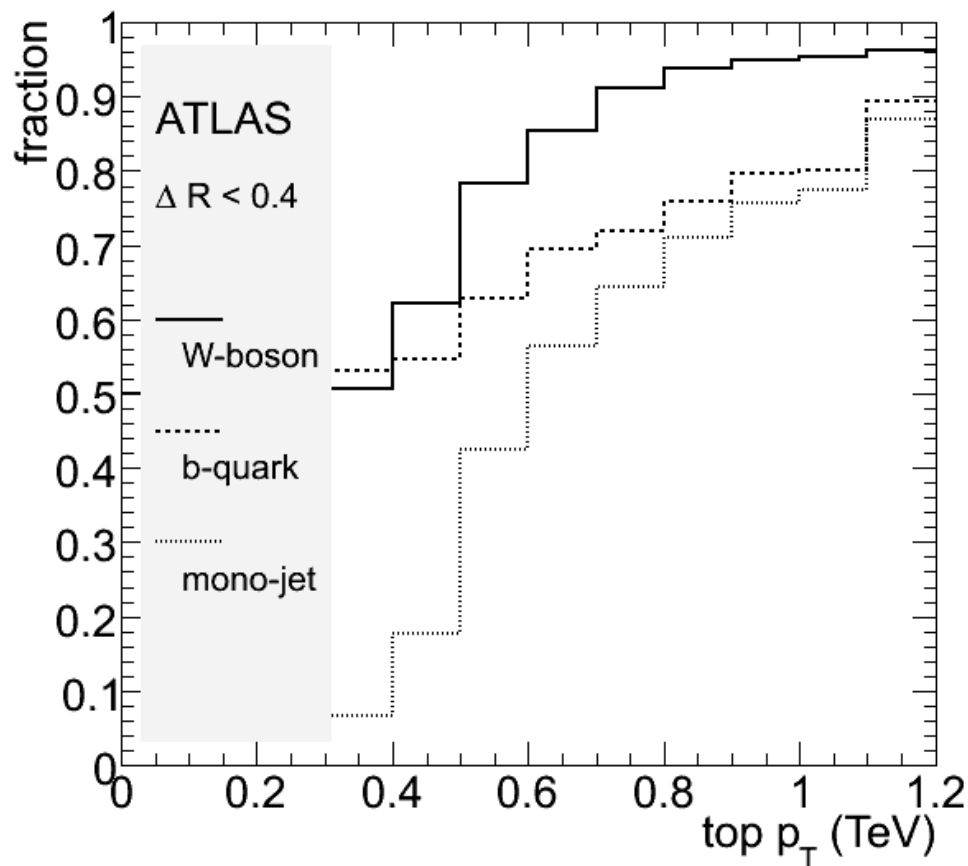
Standard resolved “commissioning style” top reconstruction. Beyond 400 GeV strongly reduced



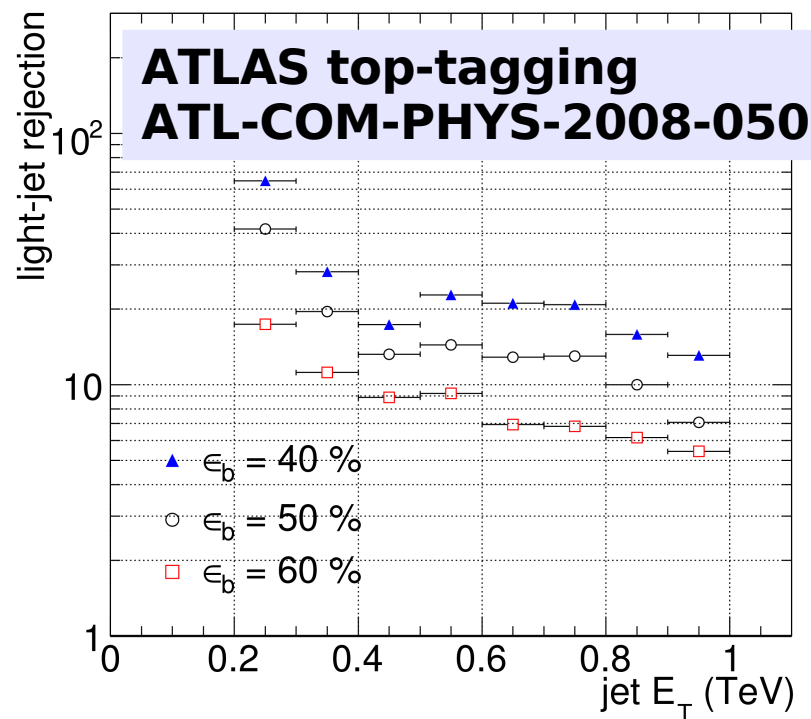
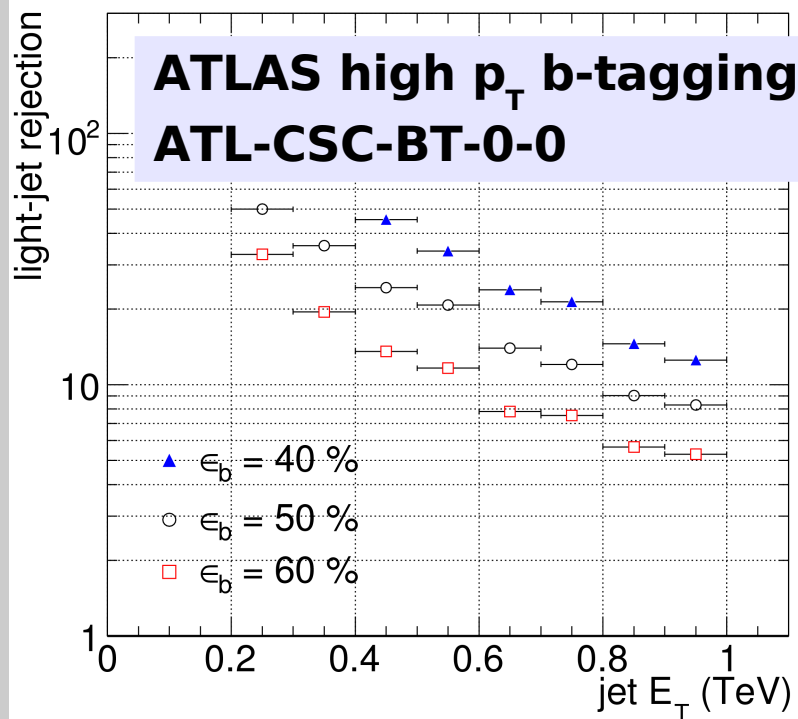
Reconstruction of top monojets

Probability to find top decay products in a small cone around the reconstructed jet

A mono-jet:
reconstructed jet
contains both W and b-
quark (within $\Delta R < 0.4$)



● The lifetime signature



The b-tagging performance for high p_T b-jets (leftmost figure) and hadronic top mono-jets (rightmost figure)

Complemented by: G. Brooijmans, High p_T Hadronic Top Quark Identification
Part 1 : Jet Mass and Ysplitter, ATL-PHYS-CONF-2008-008

● Manpower

People that are actively involved in high p_T top

NIKHEF: M Rijpstra, M. Vreeswijk

W⁺->tb, ATLAS-COM-PHYS-2008-050

U. Columbia: G. Brooijmans, F. Spano

Jet substructure (Les Houches report,)

Harvard: B. Smith

Splitting merged jets

IFIC Valencia: E. Ros, L. March, S. Gonzalez de la Hoz, M.Vos

Lifetime signature, ATLAS-COM-PHYS-2008-029

Top group: D. Pallin (Clermont Ferrand), A. Shibata (NY)

b-tagging: Vivek Jain (Indiana), G. Piacquadio (Freiburg)

Tracking: Michael Wilson (CERN)



IFIC



● Resources: data

- Start analysis on high p_T electron and muon trigger streams, HLT rate as high as 50 Hz
- Prefer non-isolated leptons, μ_{20} rather than μ_{10i}
- What about all-hadronic events?
- First get all top candidates (in common with other analyses).
- At a later stage, skimming(*) of events on the basis of jet energy gives a large reduction of the sample
- Expect 100s of 1000s of events per year, not millions.
- 100 kB/event for full AOD.

● Conclusions

- Even with “just” 10 TeV and low luminosity we will produce very high p_T jets (and possibly signatures of new physics)... better be ready.
- Develop tools: top mono-jet reconstruction, tagging high p_T jets, tracking
- Develop strategies: measure rejection, normalize backgrounds on data
- Resources, data: access to high p_T physics samples: local copy of aggressive skim (using jet ET) of electron and muon data
- Resources, analysis: tier3 machines with relevant ATHENA releases (UI, my desktop). User/group space in /lustre.