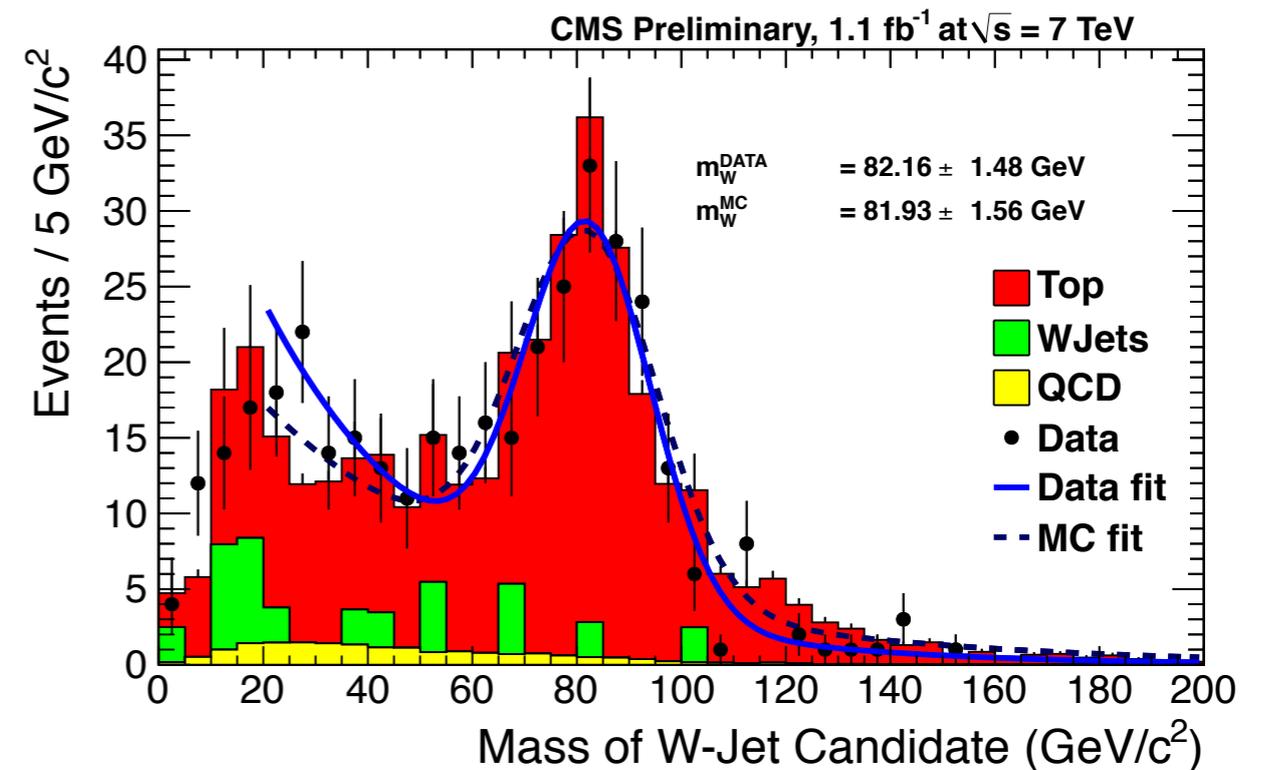
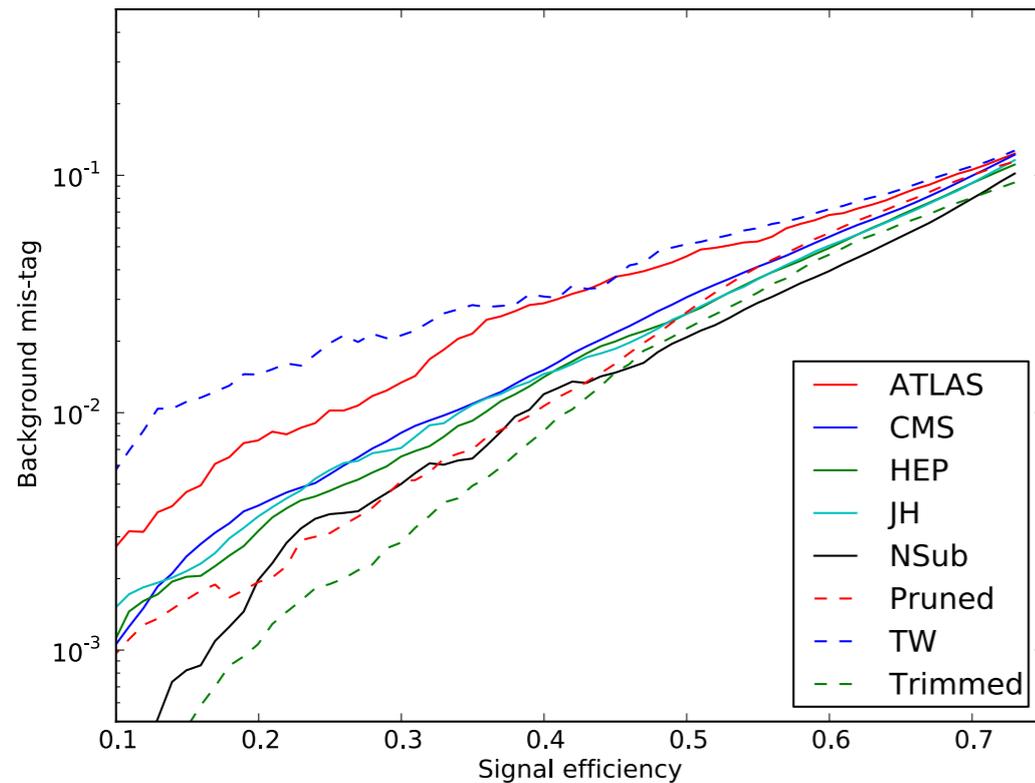


BOOST 2012: How did we get here?

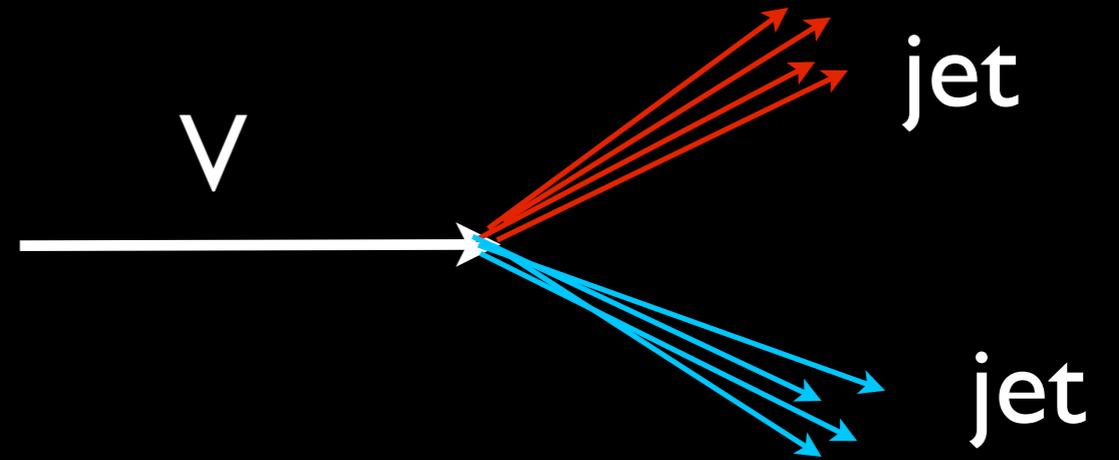
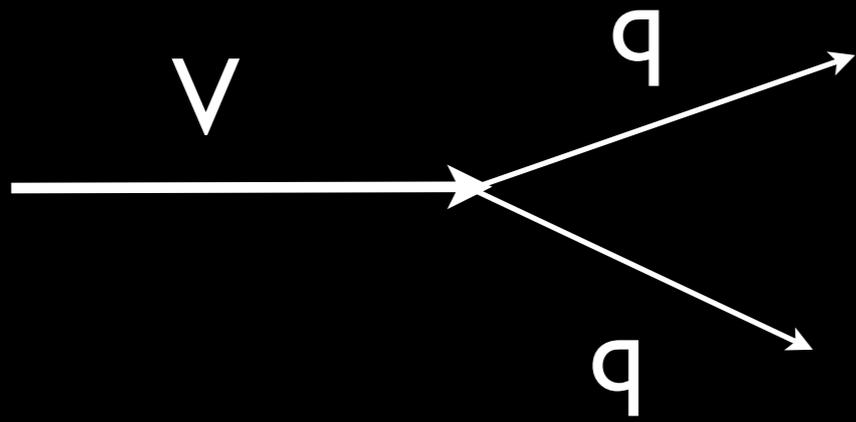


Christopher Vermilion
IFIC Valencia
23/7/2012

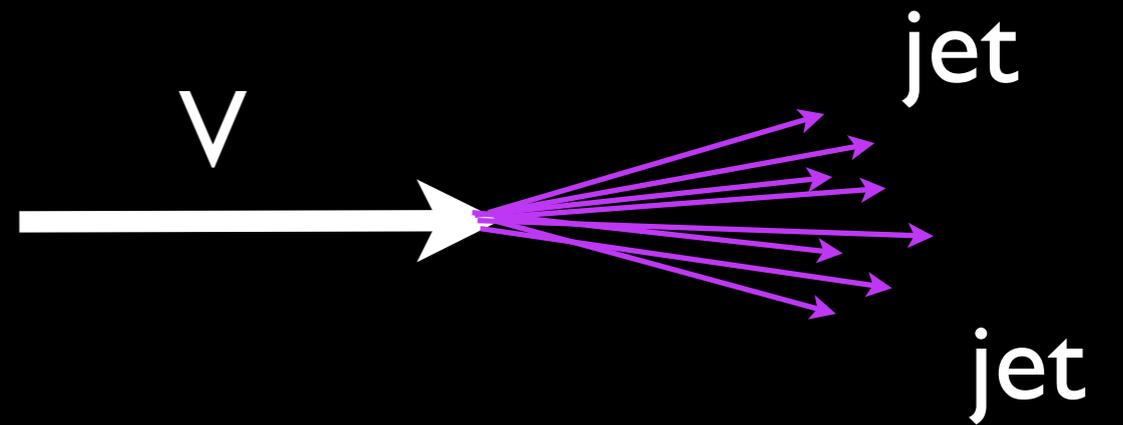
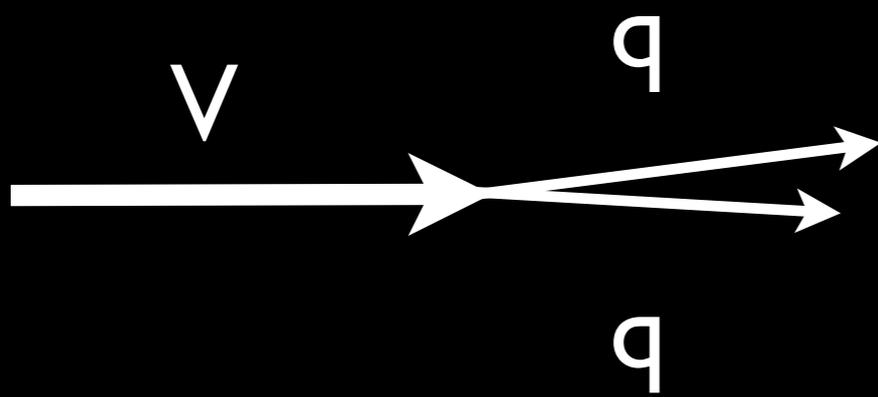




Low- p_T boson decay



High- p_T boson decay



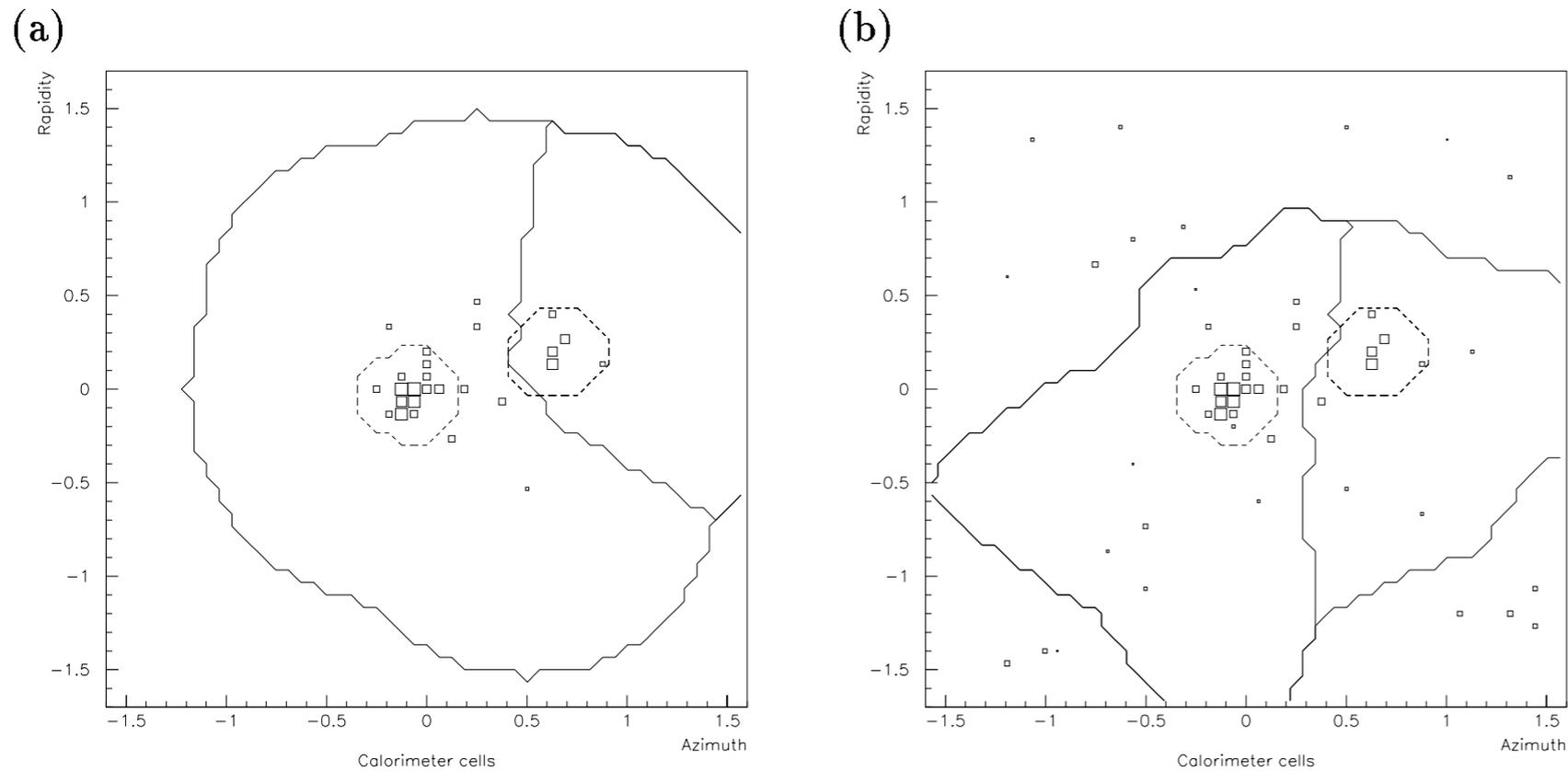


Figure 2: A hadronic W decay, as seen at calorimeter level, (a) without, and (b) with, particles from the underlying event. Box sizes are logarithmic in the cell energy, lines show the borders of the sub-jets for infinitely soft emission according to the cluster (solid) and cone (dashed) algorithms.

LU TP 93-8

Searches for New Particles Using Cone and Cluster Jet Algorithms: A Comparative Study

Michael H. Seymour
 Department of Theoretical Physics, University of Lund,
 Sölvegatan 14A, S-22362 Lund, Sweden

Mike Seymour

Z. Phys. C62 (1994) 127

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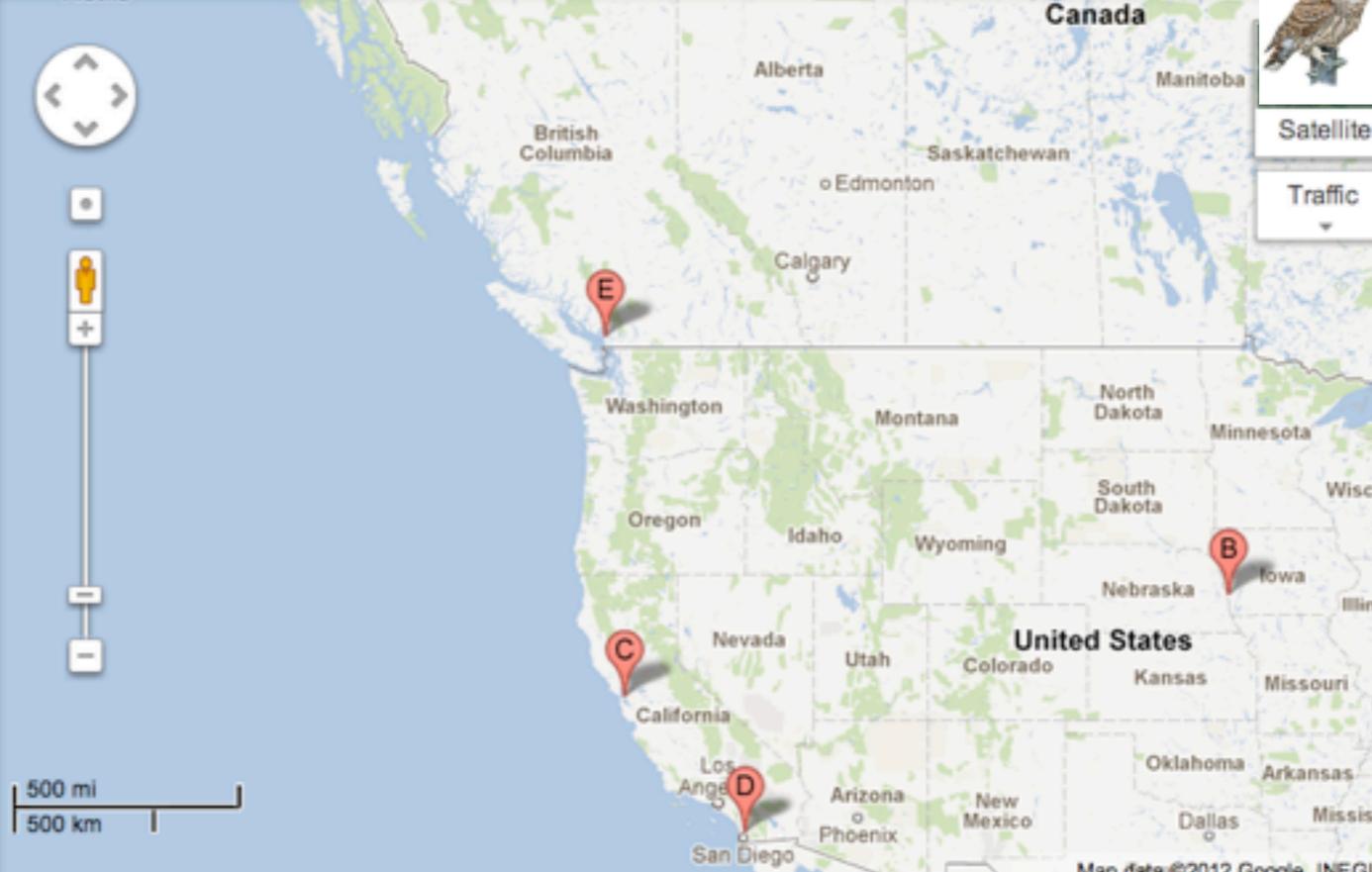
superconducting super collider

Search the web for **superconducting super collider** Top web result shown

Superconducting Super Collider - Wikipedia, the free encyclopedia
The **Superconducting Super Collider (SSC)** (also nicknamed the Desertron) was a particle accelerator complex under construction in the vicinity of Waxahachie, ...
en.wikipedia.org

A Ice Cave Technology -
5600 Lake Otis Parkway, Anchorage, AK
(907) 771-0543 · icecavetechnology.com
"Super Conducting Super Collider. PowerPoint presentation. Television commercial. Computer kiosk. Data visualization and animation. Web sites and marketing" - icecavetechnology.com

B Cryo Nebraska Inc -

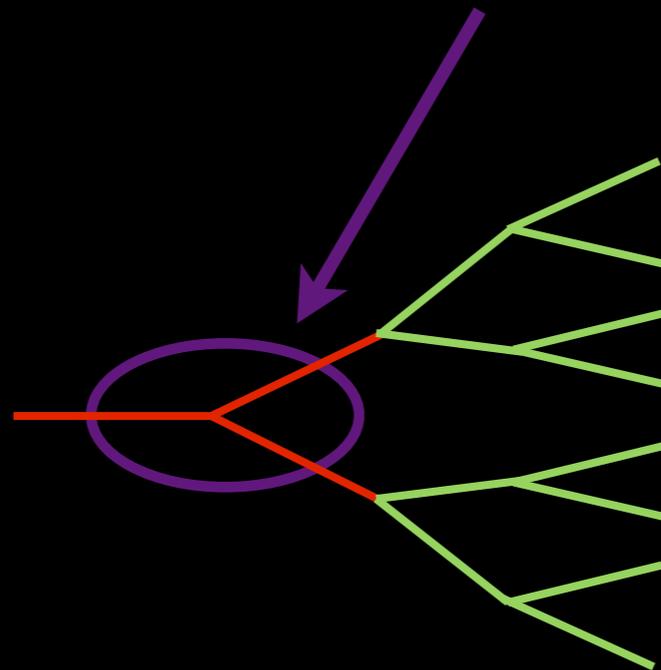


Several further papers on boosted W's in the run-up to the LHC

hep-ph/0201098, hep-ph/0702150

ATLAS Y-Splitter (ATL-PHYS-CONF-2008-008): Same variable, applied to tops

Look at kT merging scale here



$$d_{ij} = \min(p_{Ti}^2, p_{Tj}^2) R_{ij}^2$$

“Breakthrough” paper: Butterworth, Davison, Rubin, Salam (0802.2470)

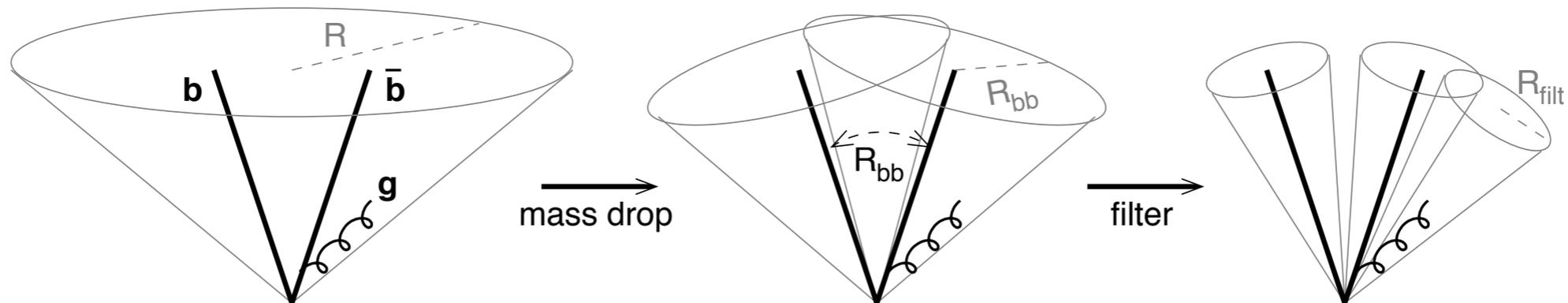


FIG. 1: The three stages of our jet analysis: starting from a hard massive jet on angular scale R , one identifies the Higgs neighbourhood within it by undoing the clustering (effectively shrinking the jet radius) until the jet splits into two subjets each with a significantly lower mass; within this region one then further reduces the radius to R_{filt} and takes the three hardest subjets, so as to filter away UE contamination while retaining hard perturbative radiation from the Higgs decay products.

Two steps:

Mass drop identifies hard splitting within clustering history

Filtering “zooms” in and only keeps three hardest subjets

The dam breaks

[Johns Hopkins] Top Tagging (Kaplan, Rehermann, Schwartz, Tweedie; 0806.0848)

3-body kinematic variables (Thaler, Wang; 0806.0023)

New jet shapes (Almeida, et al.; 0807.0234, 0810.0934)

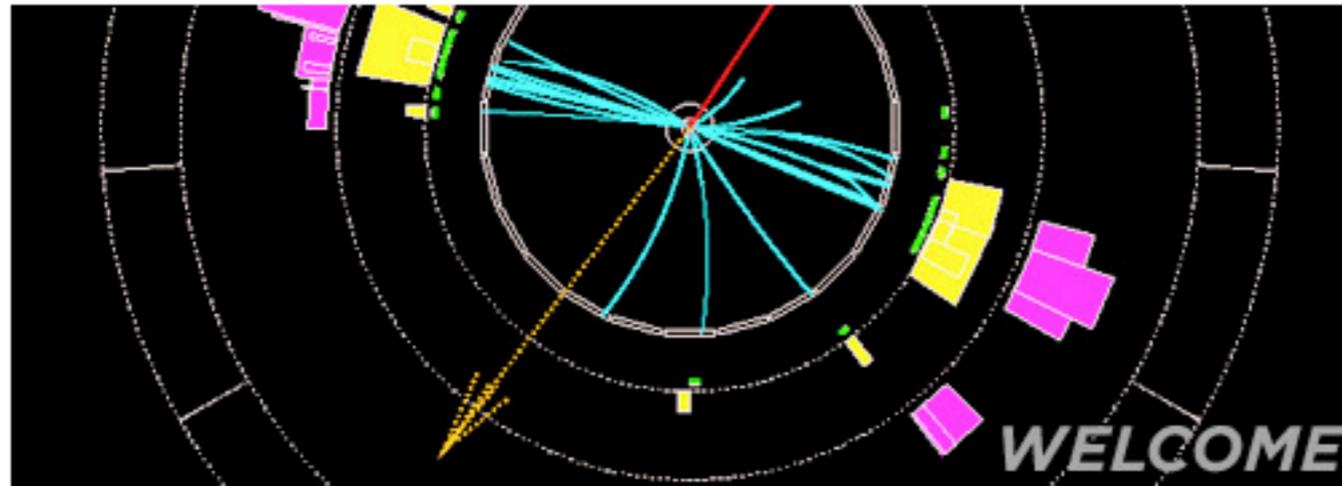
Pruning (Ellis, Vermilion, Walsh; 0903.5081)

BOOST 2009

GIVING NEW PHYSICS A BOOST

SLAC NATIONAL

- Home
- Registration
- Participant List
- Agenda
- Accommodations
- General Information
- Travel and Directions
- Visa Information
- Social Event
- Contact



Giving New Physics a Boost

Thursday and Friday, July 9-10, 2009 from 8:00 am to 5:00 pm.

Kavli Auditorium

SLAC National Accelerator Laboratory

Menlo Park, California

<http://www-conf.slac.stanford.edu/Boost2009/default.asp>

Check out the indico page for a fascinating look at boosted physics in 2009...

Another year of boosted physics

Jet Trimming (Krohn, Thaler, Wang; 1912.1342)

CMS Top Tagging (0909.4894)

More jet shapes (Chekanov, Proudfoot, Levy, Yoshida; 1002.3982, 1009.2749)

Template overlap (Almeida et al.; 1006.2035)

Jet Pull (Gallicchio, Schwartz; 1001.5027)

HEP Top Tagger (Plehn, Salam, Spannowsky; 0910.5472)

Quite a few more!

BOOST 2010

<http://www.physics.ox.ac.uk/boost2010/index.asp>



arXiv:1012.5412

Really great idea:
follow-up report!

**Boosted objects: a probe of
beyond the standard model
physics** *

A. Abdesselam¹, A. Belyaev^{2,3}, E. Bergeaas Kuutmann⁴,
U. Bitenc⁵, G. Brooijmans⁶, J. Butterworth⁷, P.
Bruckman de Renstrom⁸, D. Buarque Franzosi⁹, R.
Buckingham¹, B. Chapleau¹⁰, M. Dasgupta¹¹, A.
Davison⁷, J. Dolen¹², S. Ellis¹³, F. Fassi¹⁴, J. Ferrando¹,
M.T. Frandsen¹⁵, J. Frost¹⁶, T. Gadfort¹⁷, N. Glover¹⁸,
A. Haas¹⁹, E. Halkiadakis²⁰, K. Hamilton²¹, C. Hays¹, C.
Hill²², J. Jackson³, C. Issever¹, M. Karagoz¹, A. Katz²³,
L. Kreczko²⁴, D. Krohn²⁵, A. Lewis¹, S. Livermore¹,
P. Loch²⁶, P. Maksimovic²⁷, J. March-Russell¹⁵, A.
Martin²⁸, N. McCubbin³, D. Newbold²⁴, J. Ott²⁹,
G. Perez³⁰, A. Policchio¹³, S. Rappoccio²⁷, A.R.
Raklev³¹, P. Richardson¹⁸, G.P. Salam^{25,32,33}, F.
Sannino³⁴, J. Santiago³⁵, A. Schwartzman¹⁹, C.
Shepherd-Themistocleous³, P. Sinervo³⁶, J. Sjoelin^{37,38},
M. Son³⁹, M. Spannowsky⁴⁰, E. Strauss¹⁹, M. Takeuchi⁴¹,
J. Tseng¹, B. Tweedie^{27,42}, C. Vermilion⁴³, J. Voigt²⁹,
M. Vos⁴⁴, J. Wacker¹⁹, J. Wagner-Kuhr²⁹, and M.G.
Wilson¹⁹

M. Karagoz, G. P. Salam, M. Spannowsky, M. Vos (editors)



Outcome I: Survey of motivation

What signals involve boosted heavy particles?

Which techniques have been suggested for each of these signals?

Outcome II: Survey of techniques

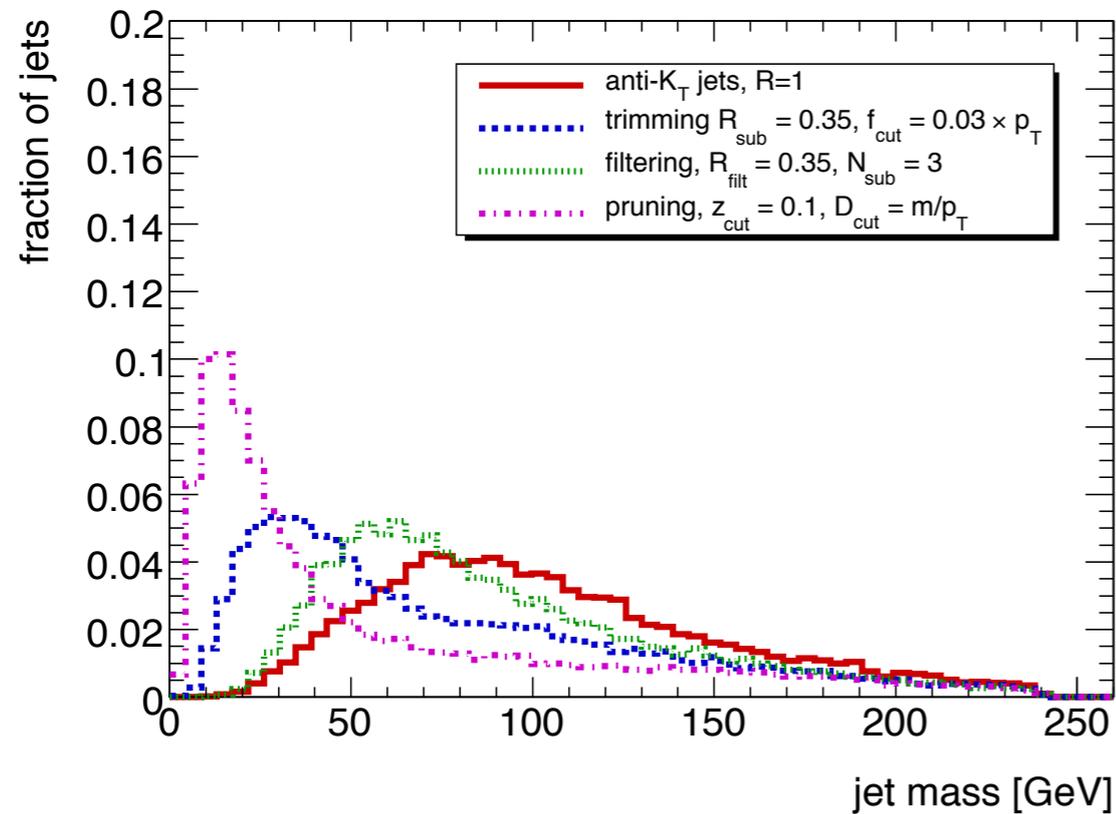
This time organized by strategy, not target

Allowed some degree of comparison between techniques.

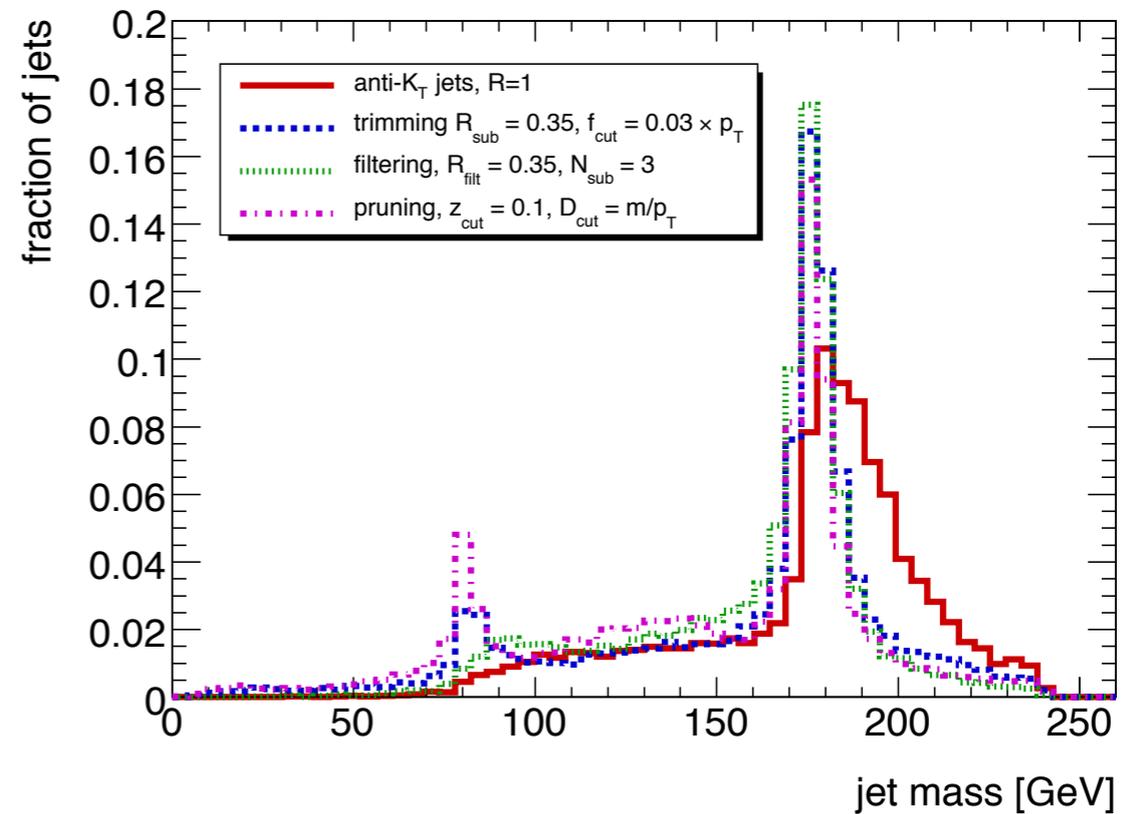
Outcome III: Survey of experimental results

First survey of its kind -- starts from the beginning!

Outcome IV: Monte Carlo studies (with public samples)



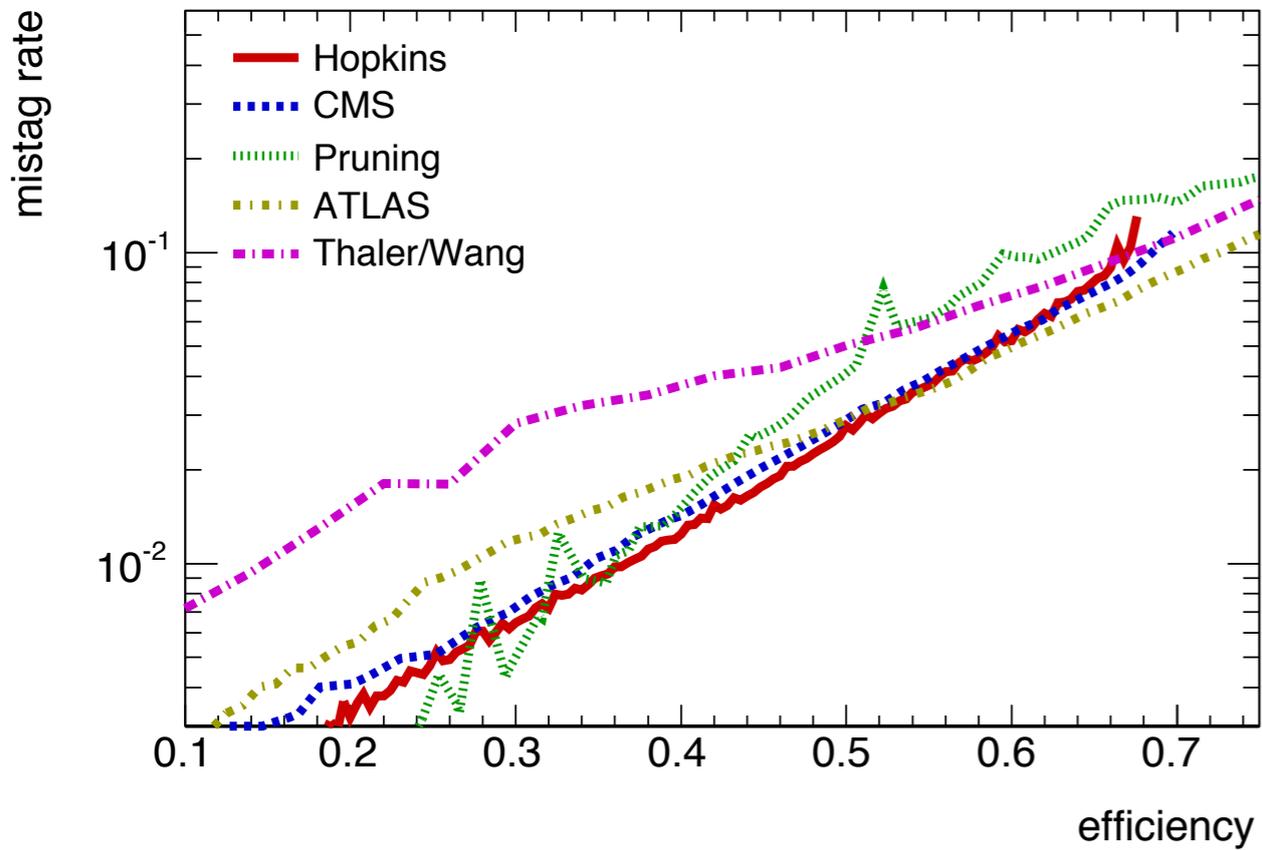
(a) dijets, 500–600 GeV



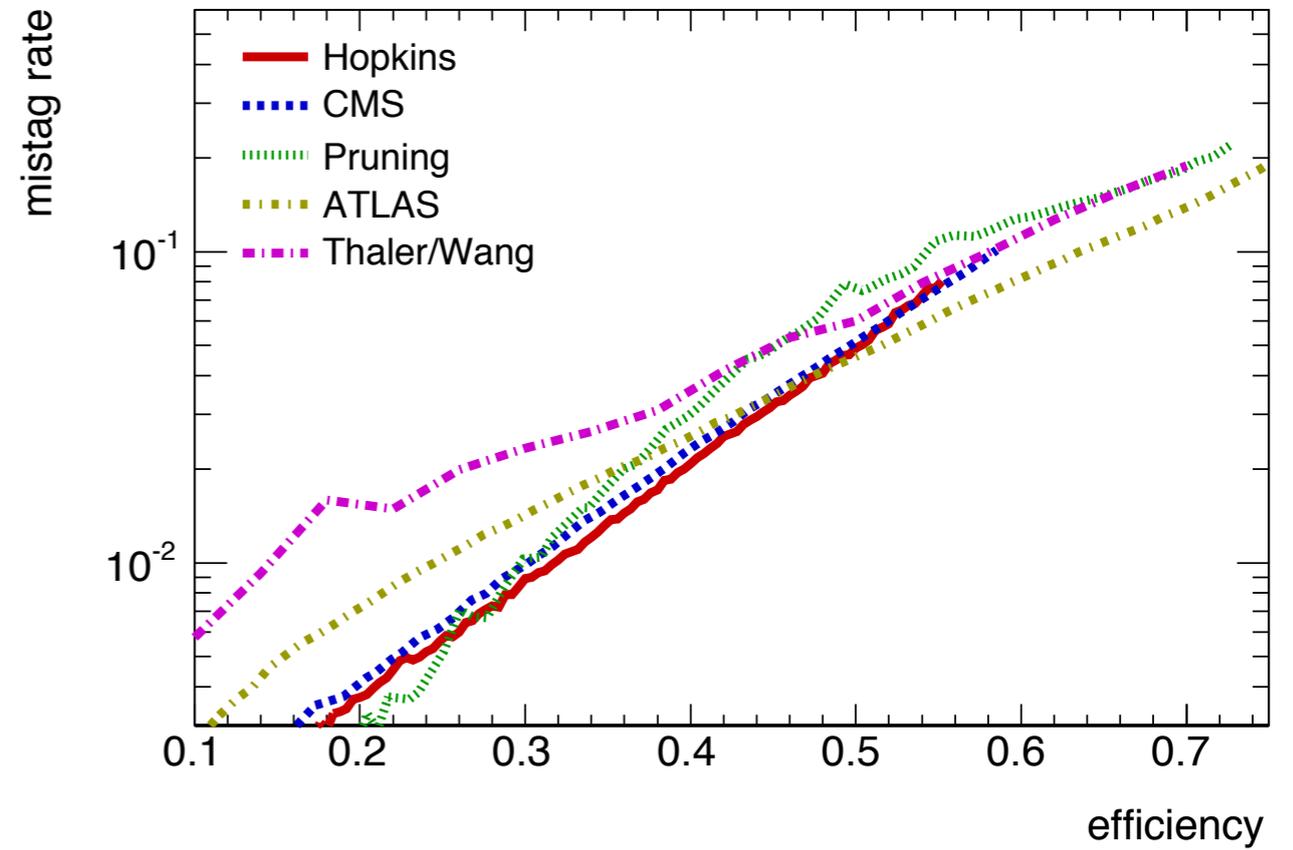
(b) $t\bar{t}$, 500–600 GeV

Jet masses after grooming

See the report for a nice discussion of the different behaviors at low mass!



(d) 500–600 GeV



(b) all p_T samples

Comparative efficiencies for distinguishing tops, QCD

Several results I'm skipping over

Dependence on MC, UE, calorimeter clustering

Other pT ranges

Limitations of 2010 comparisons

Only tops vs. QCD

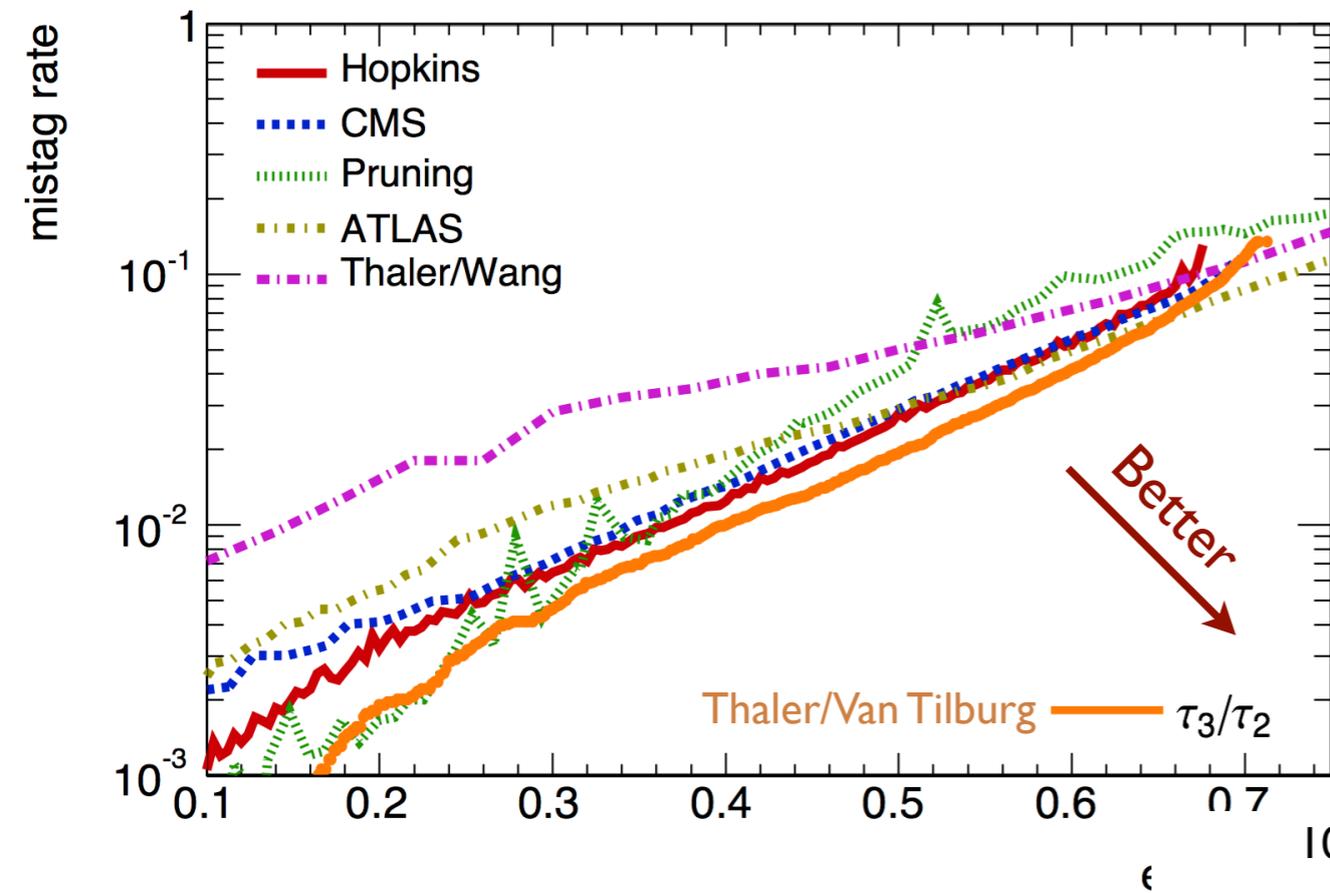
No pile-up dependence

Only “available” techniques

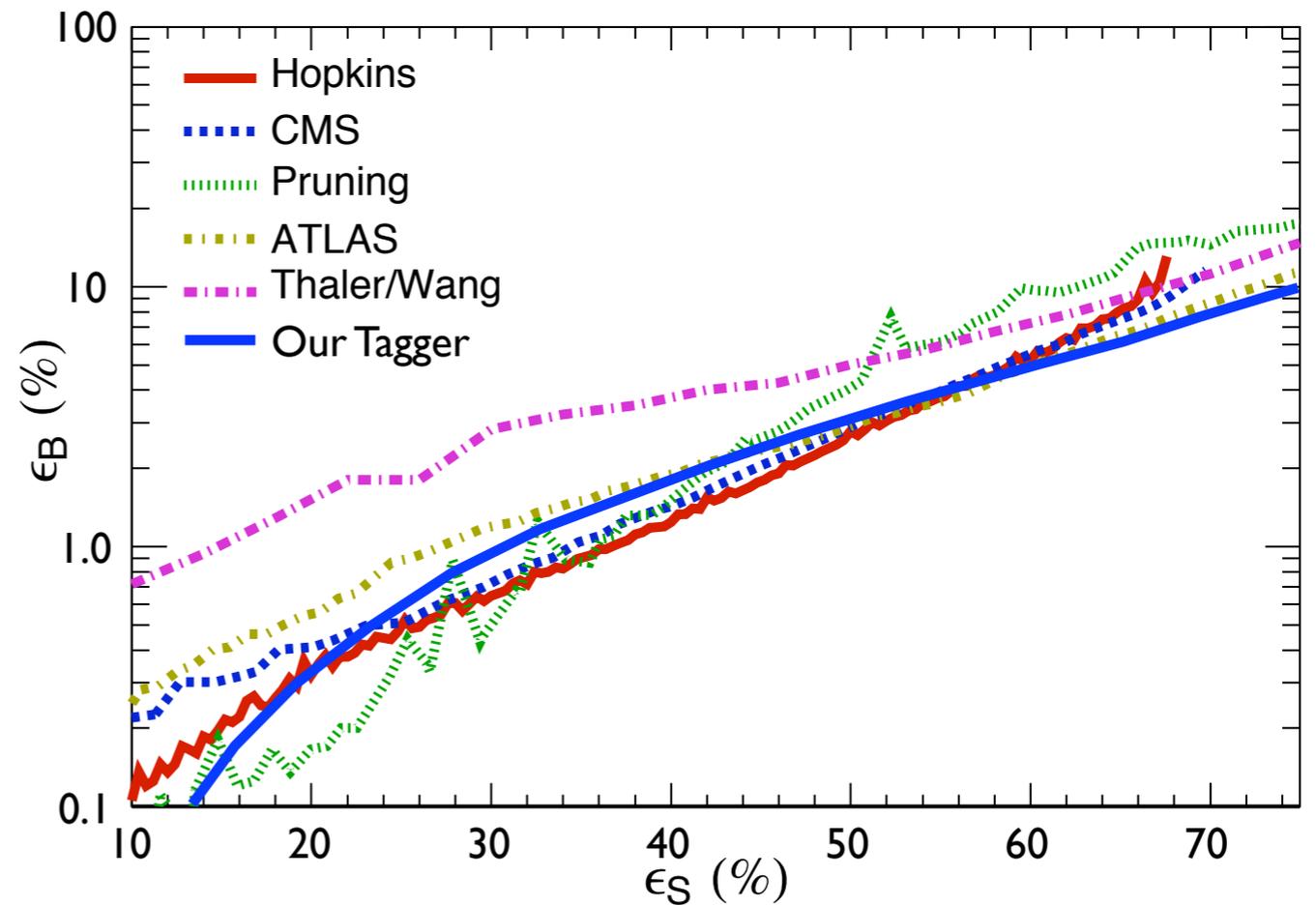
Each analysis implemented independently!

Some of these were remedied in 2011 report,
some are still on the to-do list!

500 GeV < p_T < 600 GeV



NSubjettiness



“Substructure without trees” / angular correlation functions

anti-kT, R=1.0, 500 GeV < p_T < 600 GeV

Meanwhile...



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About 249,000,000 results (0.43 seconds)



SafeSearch



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Related searches: [meanwhile book](#)

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Past week

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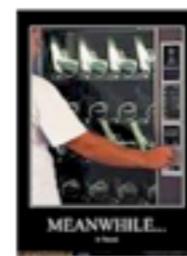
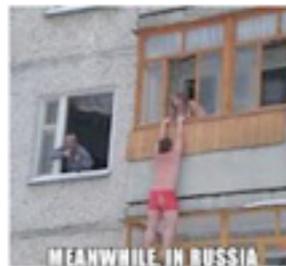
Any size

Large

Medium

Icon

Larger than





MEANWHILE, IN RUSSIA



MEANWHILE, IN FINLAND

MEANWHILE IN



ALABAMA

MEANWHILEIN.ORG



Meanwhile in Spain...

N-Subjettiness (Thaler, Van Tilburg 1011.2268; Kim 1011.1493)

Dipolarity (Hook, Jankowiak, Wacker; 1102.1012)

“Jet substructure without trees” (Jankowiak, Larkoski; 1104.1646)

Shower deconstruction (Spannowsky, Soper 1102.3480)

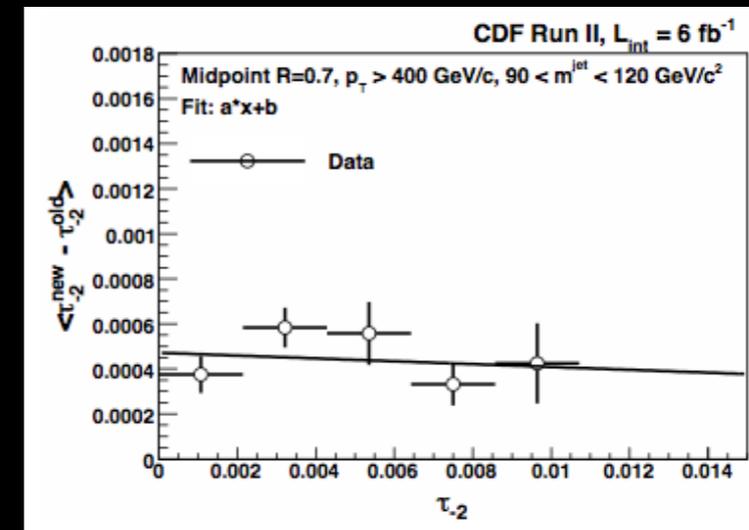
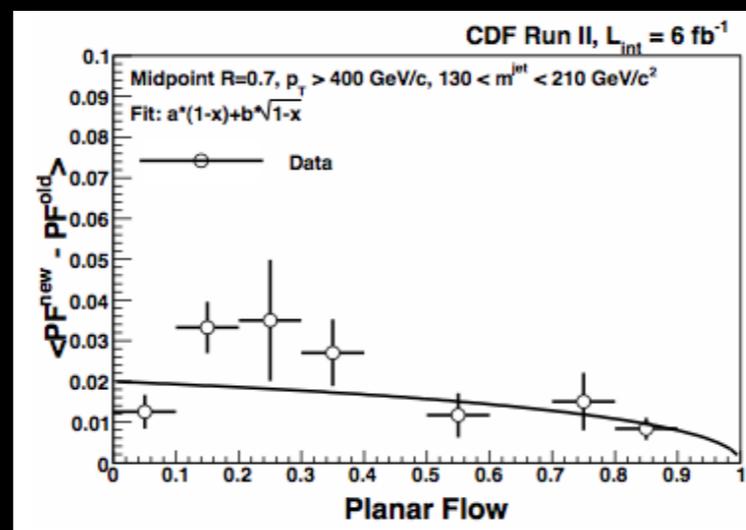
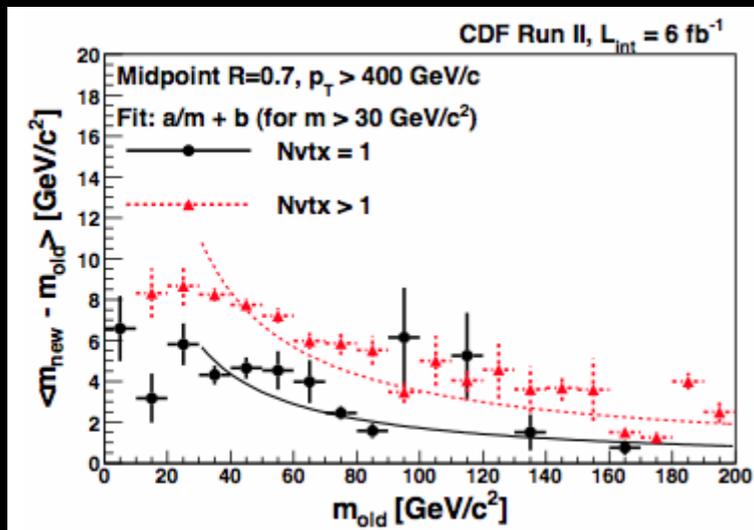
HEP Top Tagger++ (Plehn, Spannowsky, Takeuchi, Zerwas; 1006.2833...)

Multivariate quark/gluon discrimination (Gallicchio, Schwartz; 1106.3076)

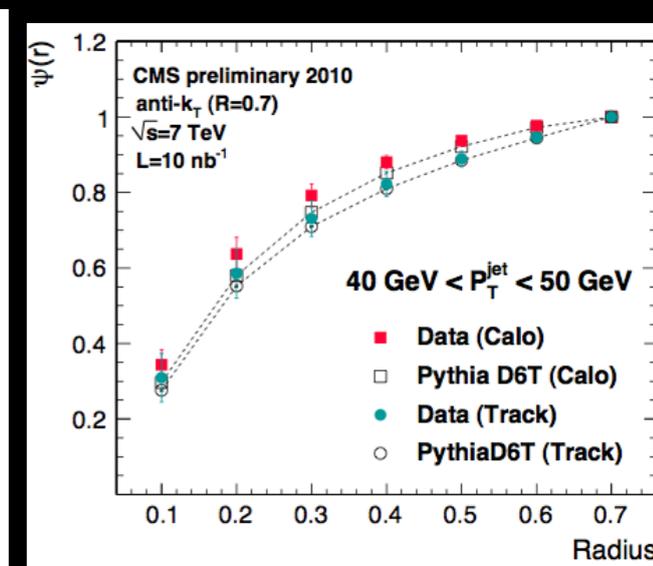
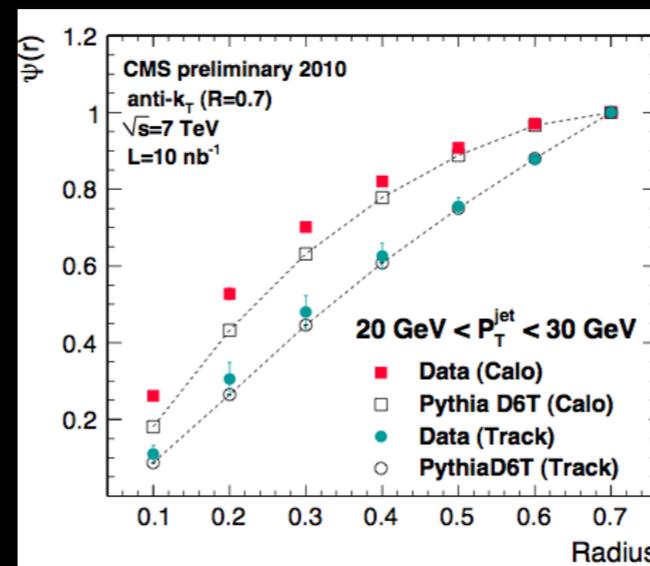
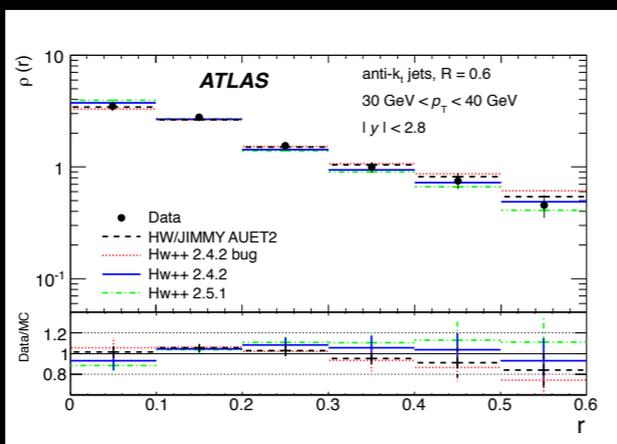
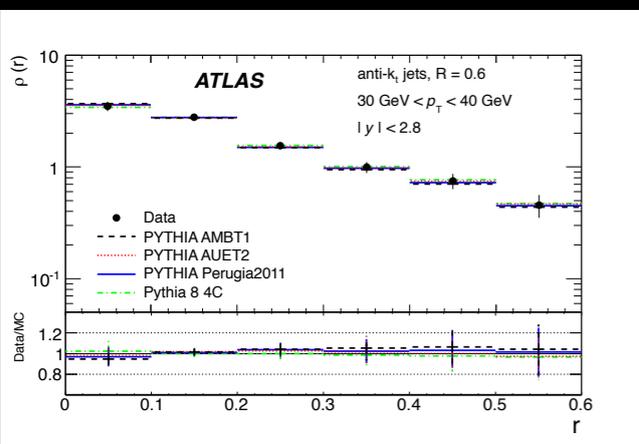
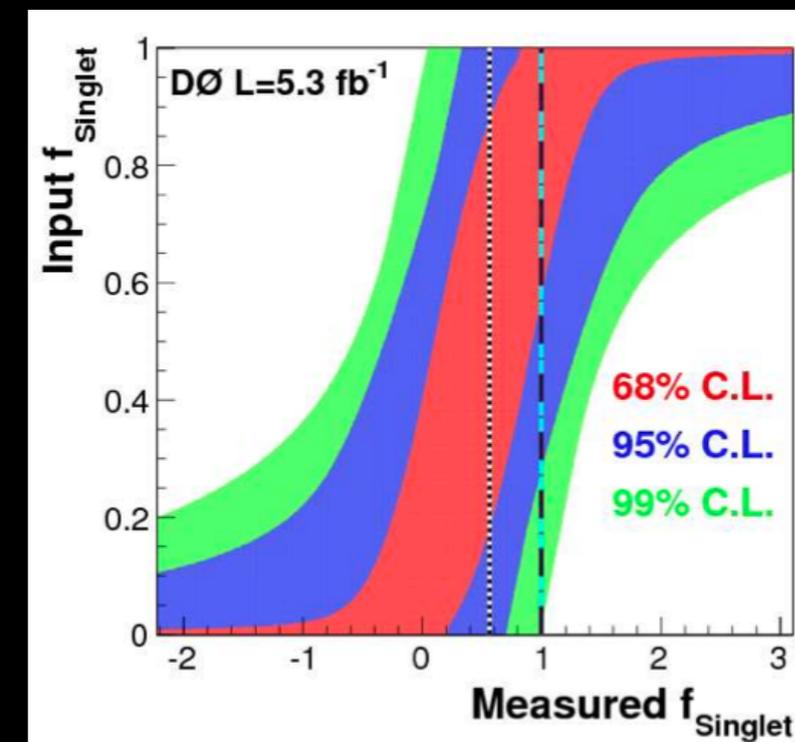
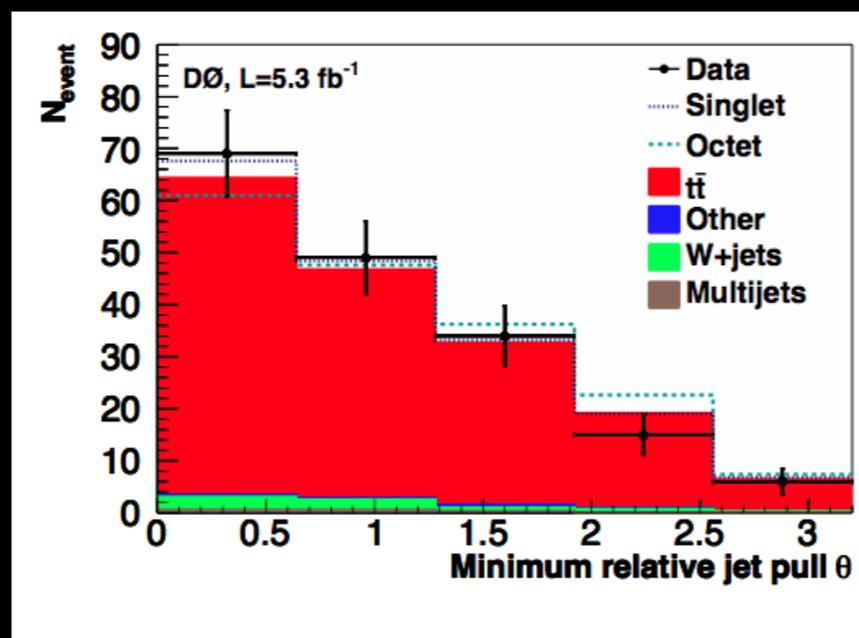
ISR tagging (Krohn, Randall, Wang 1101.0810)

New physics multi-tagging (Kribs, Martin, Roy, Spannowsky; 0912.4731, 1006.1656)

And more...!



BOOST 2011 Datastravaganza!



Goals for 2011 report

Summarize progress

Establish theory/experiment goals

Extend comparisons

Publish tools

Theory wish list

Jet mass (in $V+j$, jj , multijet; multi-differential useful)

Jet shapes: N -subjettiness ($N=1,2,3$; $\beta=1,2$), planar flow,
subjettiness multiplicities

Groomed observables (all of the above)

Event shapes: 0/1-jettiness, Y_{23}

Comparisons

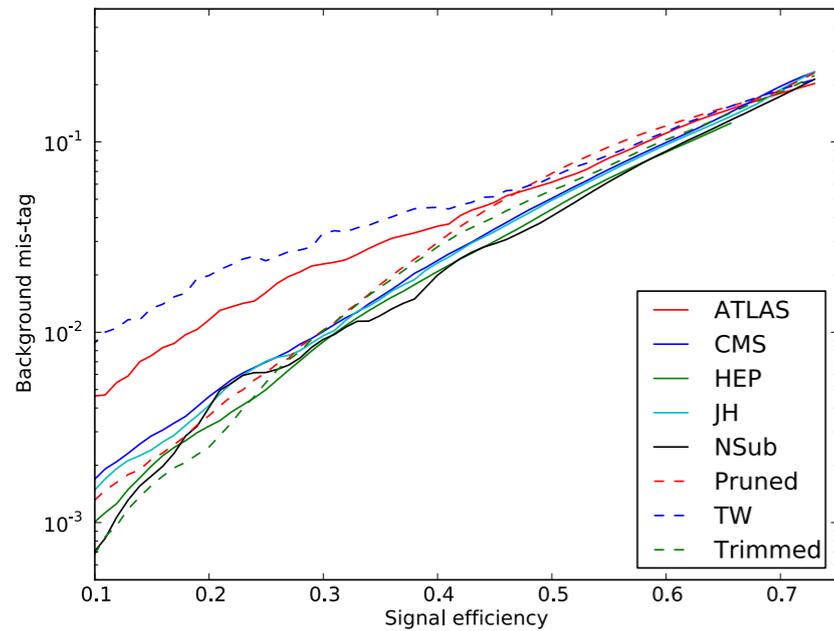
Extend last yet with:

more methods

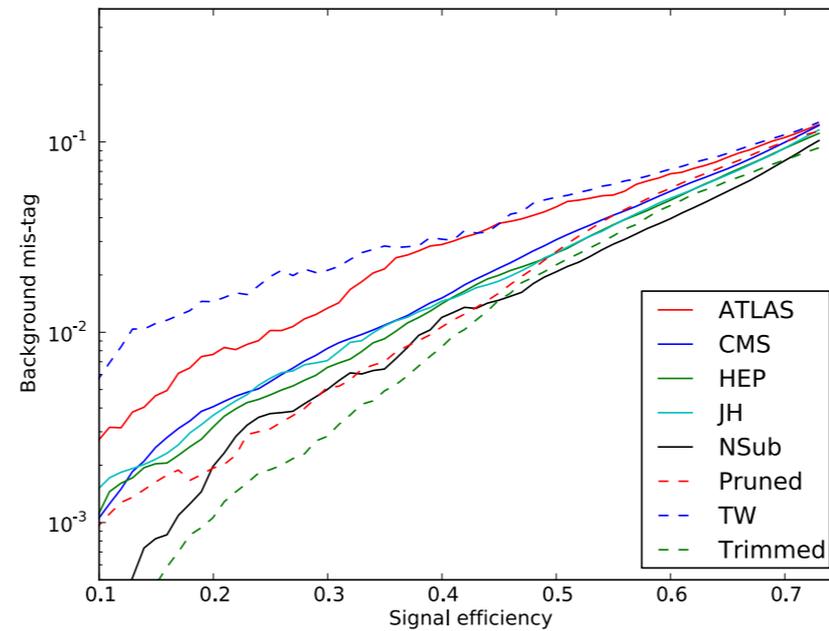
more MCs

standardized, published tools

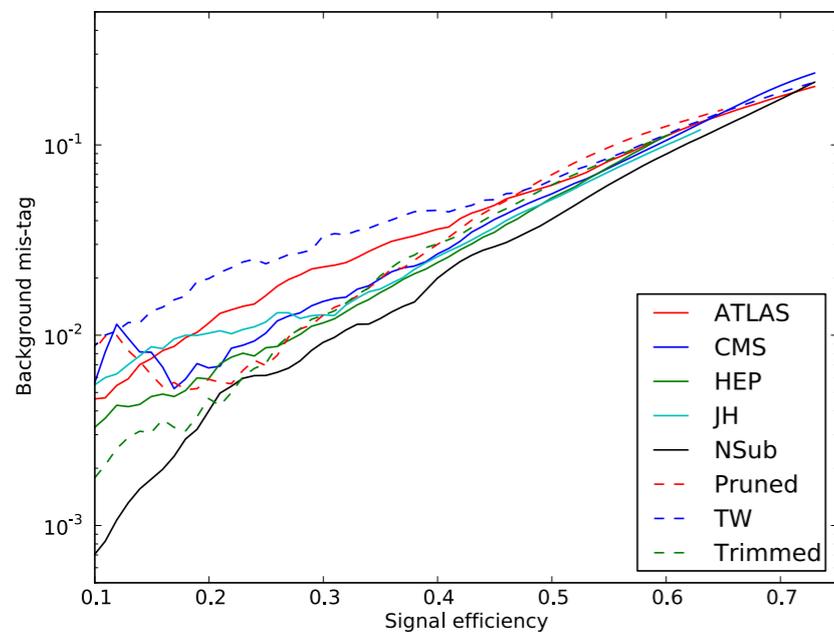
tops
vs.
QCD,
pt. 2



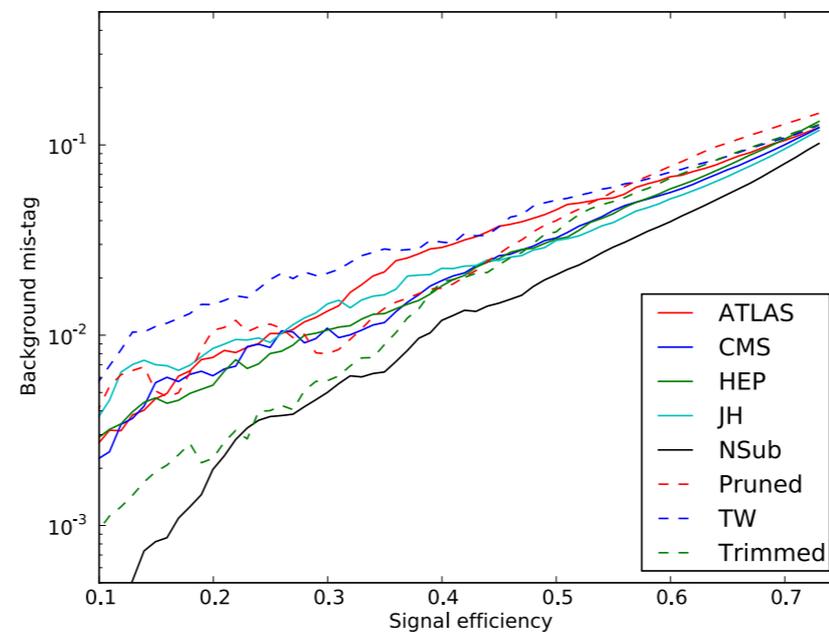
(a) all p_T , optimised



(b) p_T 500–600 GeV, optimised



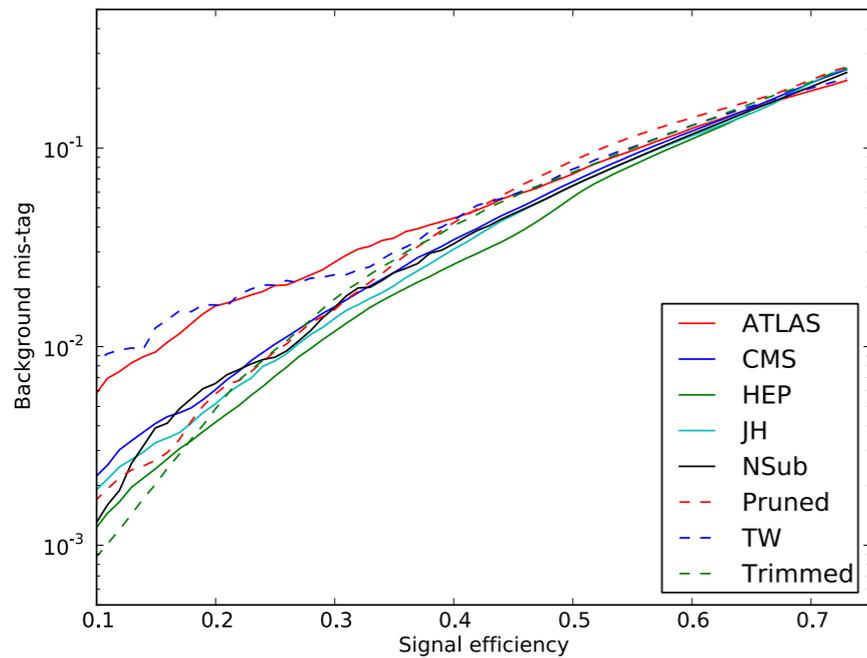
(c) all p_T



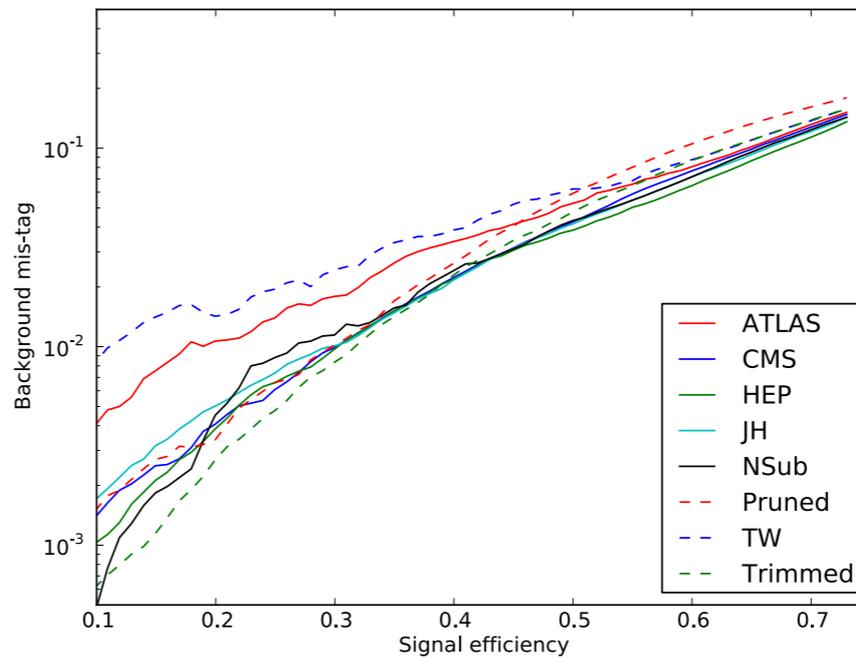
(d) p_T 500–600 GeV

Figure 14. Mis-tag vs. efficiency for several top tagging methods, as tested on HERWIG 6.5 $t\bar{t}$ and dijet samples. For Figures (a) and (b), the input parameters are optimised for each efficiency point. The input parameters for the unoptimised scans are taken from the 35% efficiency point in Figure (b).

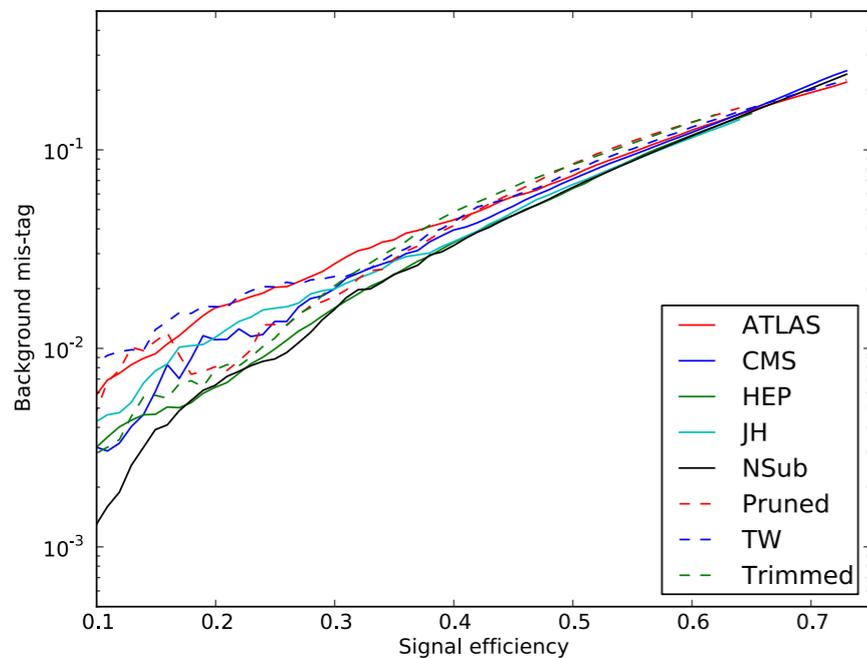
Herwig 6.5



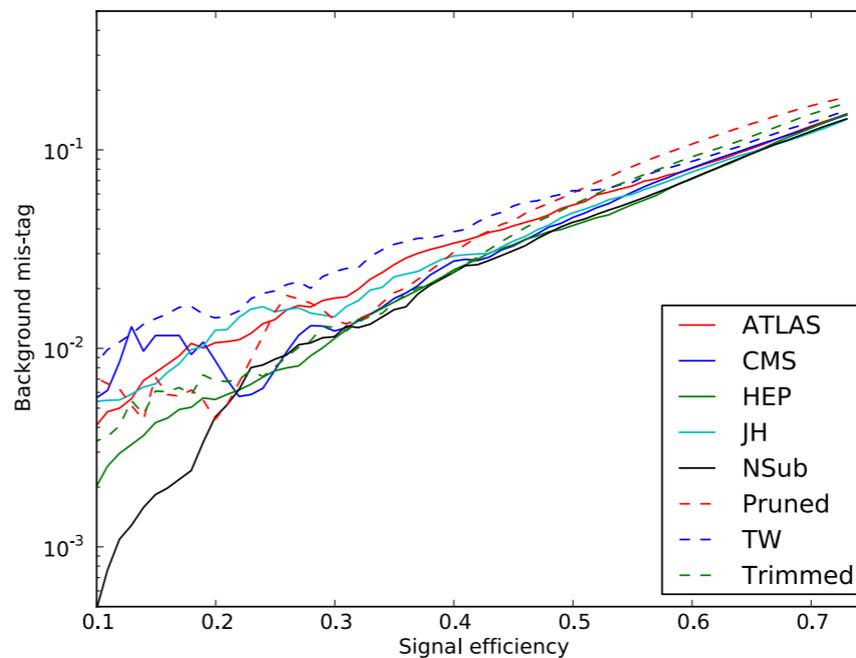
(a) all p_T , optimised



(b) p_T 500–600 GeV, optimised



(c) all p_T



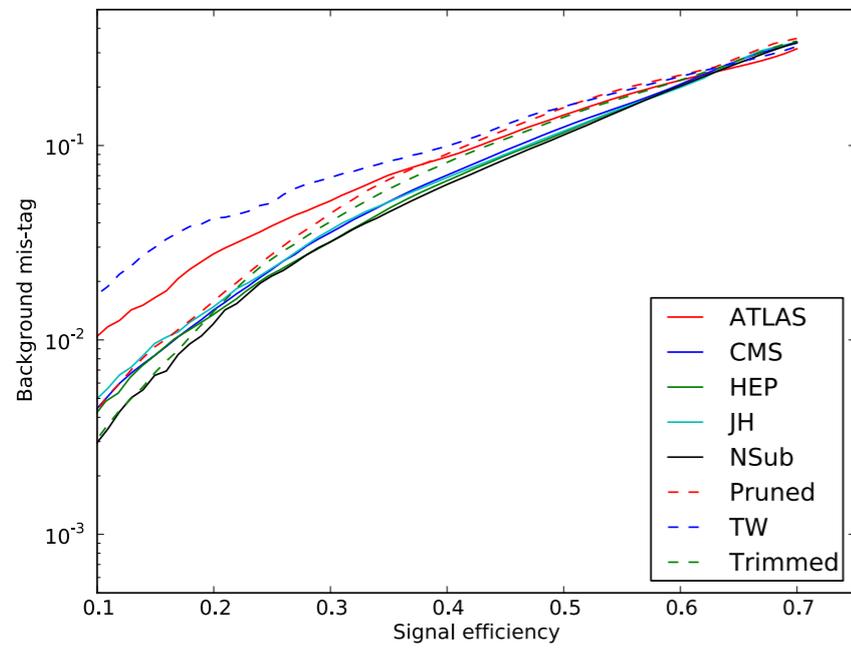
(d) p_T 500–600 GeV

Figure 15. Mis-tag vs. efficiency for several top tagging methods, as tested on HERWIG++ $t\bar{t}$ and dijet samples. For Figures (a) and (b), the input parameters are optimised for each efficiency point. The input parameters for the unoptimised scans are taken from the 35% efficiency point in Figure (b).

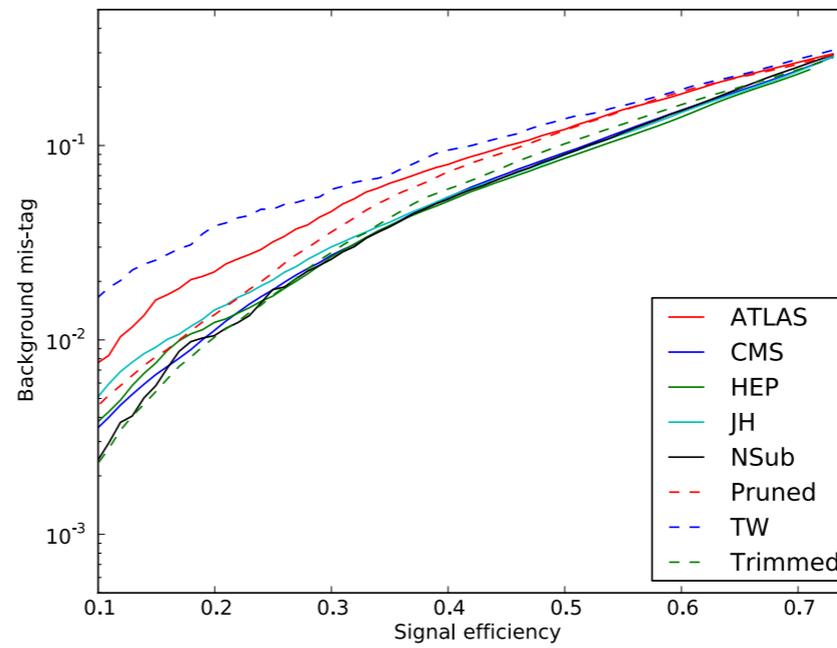
tops
vs.
QCD,
pt. 2

Herwig++

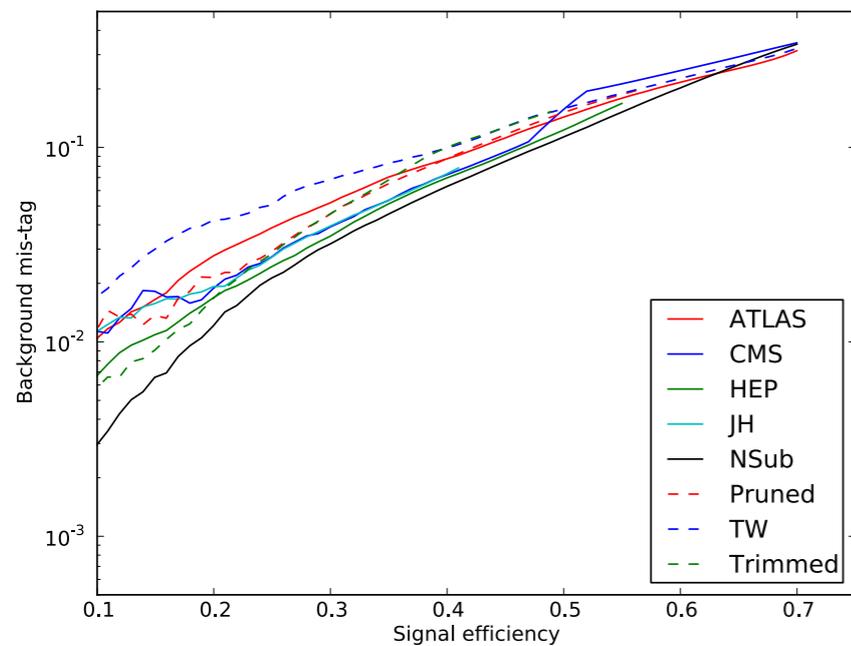
tops
vs.
QCD,
pt. 2



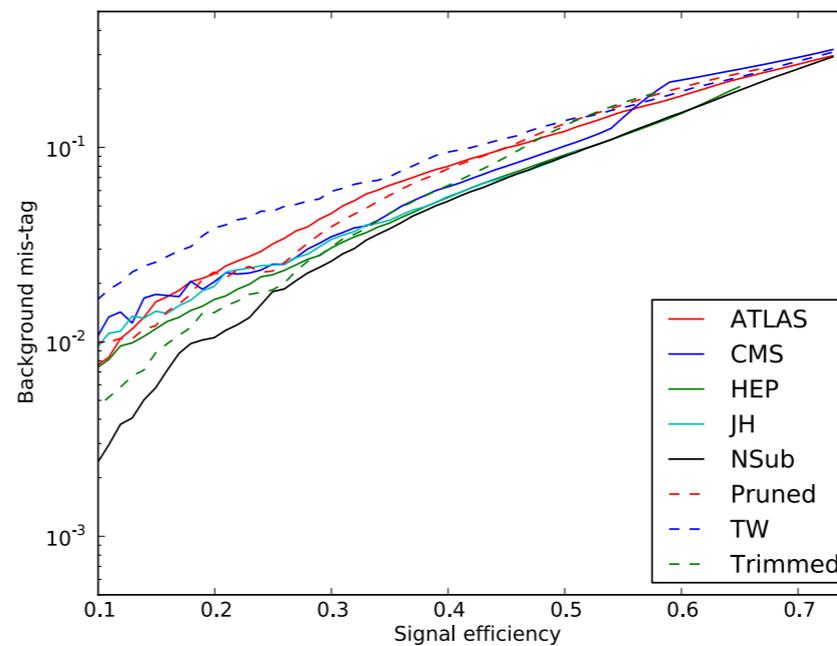
(a) all p_T , optimised



(b) p_T 500–600 GeV, optimised



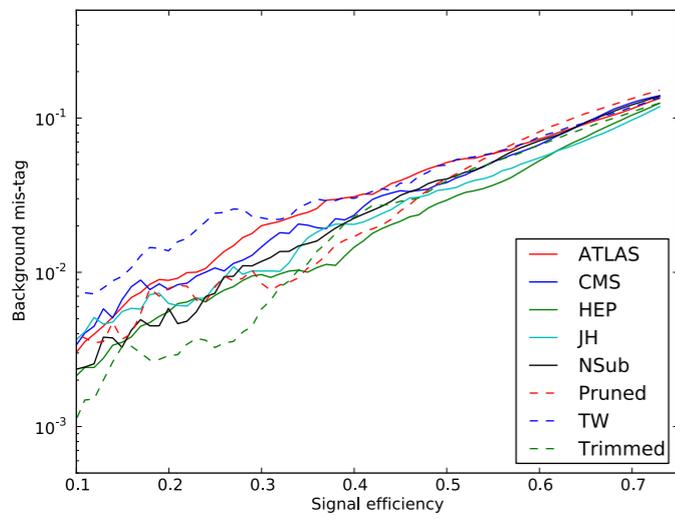
(c) all p_T



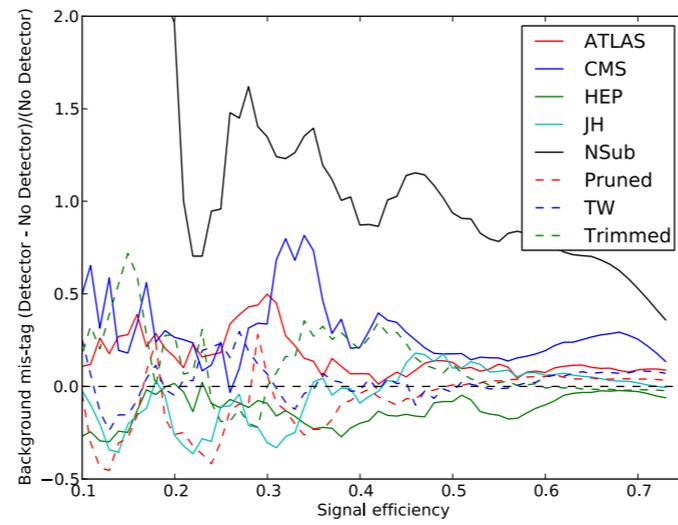
(d) p_T 500–600 GeV

Figure 16. Mis-tag vs. efficiency for several top tagging methods, as tested on SHERPA matched $t\bar{t} + \text{jets}$ and multijet samples. For Figures (a) and (b), the input parameters are optimised for each efficiency point. The input parameters for the unoptimised scans are taken from the 35% efficiency point in Figure (b).

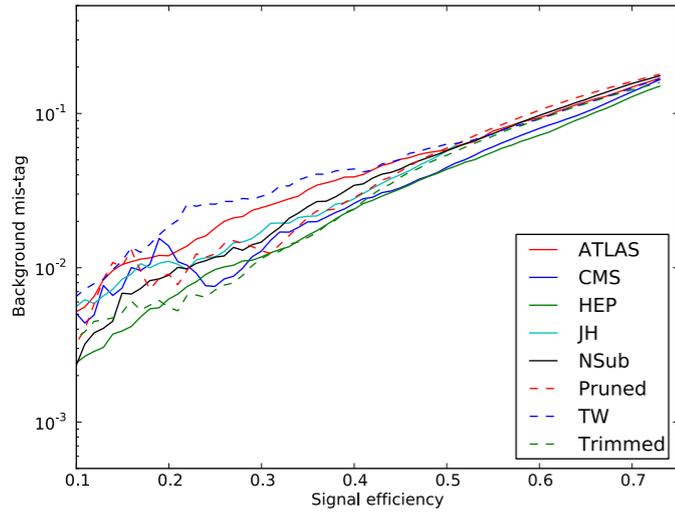
Sherpa



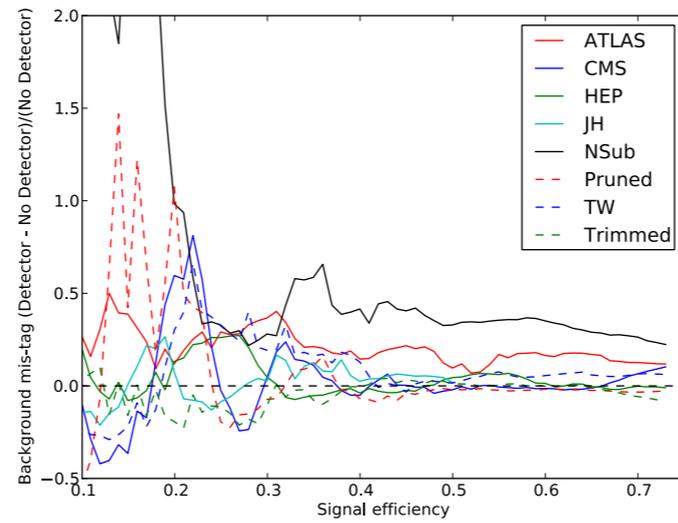
(a) HERWIG



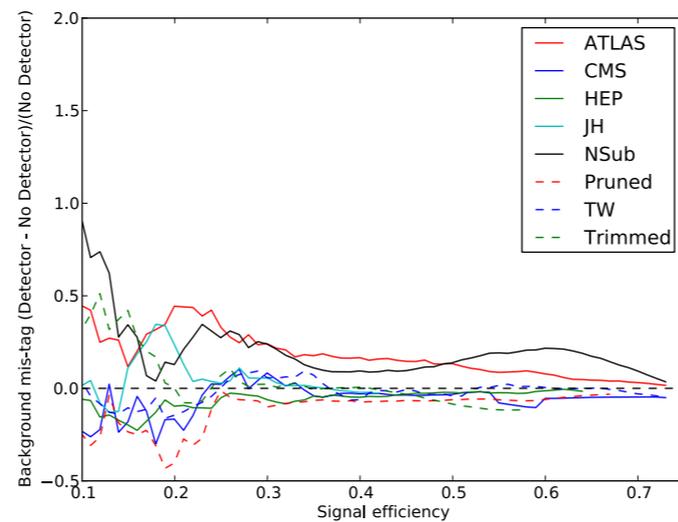
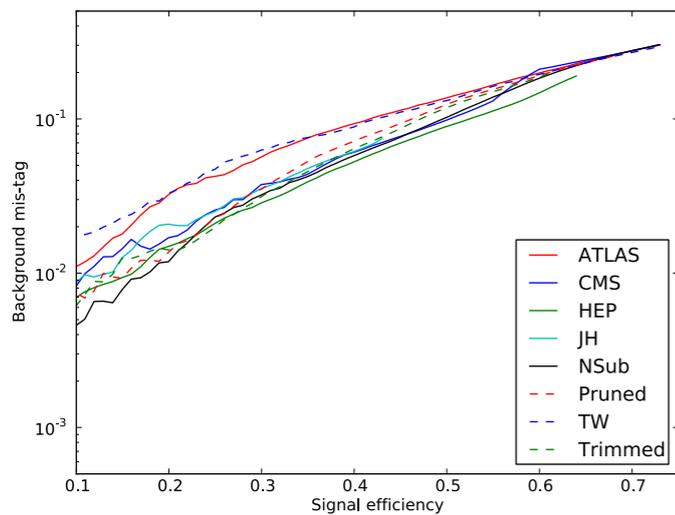
(b) HERWIG, fractional difference



(c) HERWIG++



(d) HERWIG++, fractional difference



tops
vs.
QCD,
pt. 2

Detector
effects

Big picture: These comparisons are a *baseline!*

<http://boost2011.org>

All tools implemented in SpartyJet: see Wed. tutorial!!

Long term: “fastjet/contrib”

BOOST: The home game

This is the whole point!



Lots of questions left unanswered!

Other signals?

Pile up?

Theory synthesis?

Complicated topologies?

More interesting p_T ranges?

Assignment: Answer these questions!

More tasks for this week:

What are our priorities/goals for next year?

What haven't we done?

Should we write another report??

How? What should it contain?

Thank you!





dipolarity



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About 71,200 results (0.29 seconds)

Web

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<https://researchspace.auckland.ac.nz/handle/2292/567>

by MD Brimblecombe - 2000 - [Cited by 1](#) - [Related articles](#)

The Christian doctrine of the Trinity is about one God in three divine persons, with one of these three becoming human (without ceasing to be divine) in Jesus of ...

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[Jet Dipolarity: Top Tagging with Color Flow](#)

[arxiv.org](#) › [hep-ph](#)

by A Hook - 2011 - [Cited by 5](#) - [Related articles](#)

4 Feb 2011 – Abstract: A new jet observable, **dipolarity**, is introduced that can distinguish whether a pair of subjects arises from a color singlet source.

Shopping

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[The dipolarity/polarisability of 1-alkyl-3-methylimidazolium ionic ...](#)

[xlink.rsc.org](#) › [Journals](#) › [New Journal of Chemistry](#)

by R Lungwitz - 2010 - [Cited by 25](#) - [Related articles](#)

Based on the developed tool to measure Kamlet–Taft polarity parameters α (hydrogen bond donating ability), β (hydrogen bond accepting ability), and π^* ...

Show search tools

