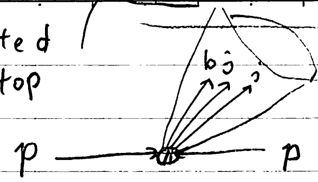
1412.75~~04~~40

3 sub-j -- good discrim. from QCD

boosted top

single-jet



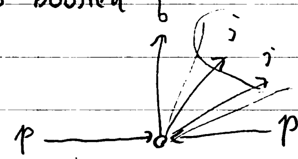
$t \to bW \to bjj$

⇒ top ID with subjet-analysis

$R \sim 2m/p_T$

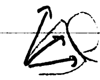
not-so-boosted

single jet

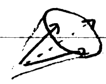


"partially-reconstructed objects"

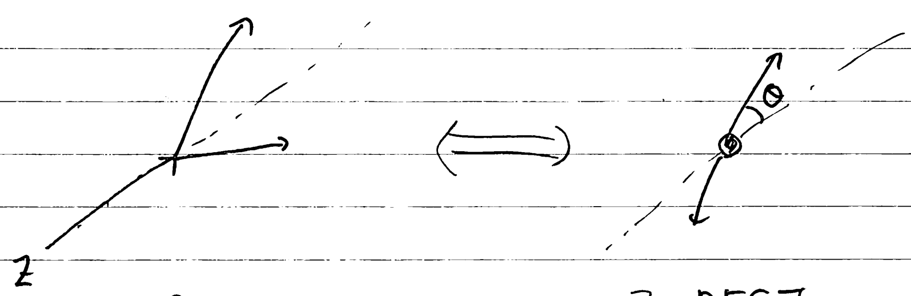
∘ not so boosted top



∘ $A \to$ SM + missing



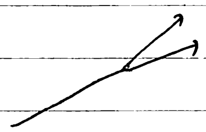
◦ kinematics



LAB ⟺ Z-REST

θ ~ π/2

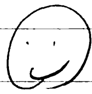
In LAB



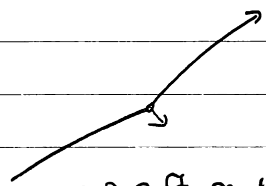
similar momenta

⇓

single jet



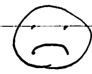
θ ~ 0



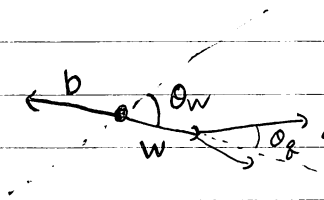
◦ a soft particle going away

◦ a hard particle on the original dir.

"partially"

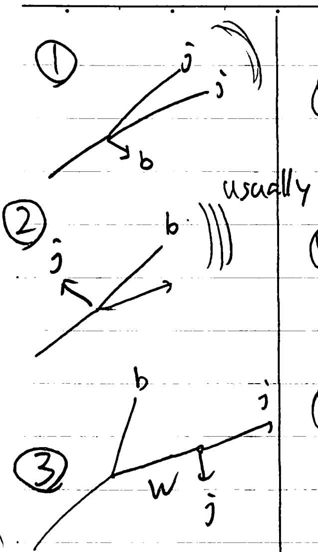


◦ In $t \to Wb \to jjb$



← defined for "forward" quark.

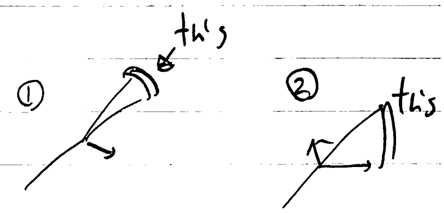
top-REST



$\theta_W \sim 0 \Rightarrow$ boosted W : tagged $\Rightarrow$ t - not ~~tagged~~ tagged ✗
soft b : fail to see

$\theta_W \sim \pi \Rightarrow$ hard b
soft $W \to 2$ hard j … go away $\Rightarrow$ ✗

$\theta_q \sim 0 \Rightarrow$ X
(π)
or



let's
$\Rightarrow$ Discriminate QCD v.s. "partial" top!

- $n_{jet}^{sub} \neq 3$

∘ tagging Algorithm

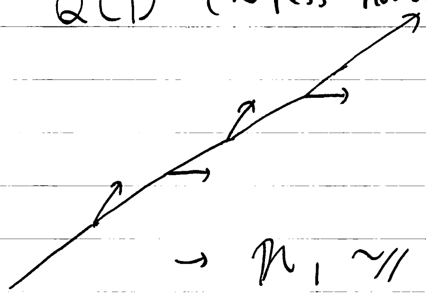
$$\tau_1^{(\beta)} = \frac{1}{p_T^{tot}} \sum_{i \in jet} p_{T,i} \left(\min_n \Delta R_{n,i} \right)^{\beta}$$

$$\sim \min \sum \frac{p_{Ti}}{p_T^{tot}} \theta_i^{\beta} \quad \text{for all small } \theta$$

$\tau_1^{(1)}$: n is chosen as $n \parallel p_T$ most energetic

$\tau_1^{(2)}$: in the narrow-jet limit. $n \parallel$ jet-axis itself

QCD (~less hard split) TOP ~ hard split



lean ~ $O(1)$

$\rightarrow n_1 \sim\parallel n_2$

Δn_{1-2} ~ jet lean

N-subjettiness $\tau_N = \frac{1}{d_0} \sum_k p_{T,k} \min_n (\Delta R_{n,k}) = \frac{\sum_k p_T(k) \min_n \Delta R_{n,k}}{\sum_k p_{T,k} R_{orig}}$

$$\frac{\sum_{j \in jets} p_T(j)}{\sum_{j \in jets} p_T(j) R_{ORIG}^{\beta}}$$

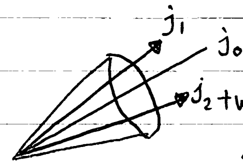
τ_N

1112.4441 | • History of tagger

Seymour | 1994 : "tree-shape clustering" in jet ID [before : put all in a cone]

k_T w. $R = 1.0$

↳ W-tagging



two hardest subjet w.

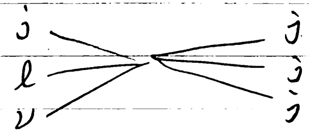
$\Delta_{0i} < 0.81$, $\Delta_{12} > 0.25$, $E_j > 17_{GeV}$

to satisfy $m_{12} - m_W < 10_{GeV}$

Not good in the presence of UE.

• How to suppress UE / PU ?

Butterworth
Cox Forshaw | 2002 : • $t\bar{t}$-pair : SEMI-LEPT. [1.8 TeV, 150 GeV -- not so boosted]



[No b-tag] → χ^2 - fit w. $m_{j\ell\nu} = m_{jjj} = m_t$

$m_{jj} = m_W$.

1011.2268

∘ N-subjettiness

$$\tau_N = \frac{1}{d_0} \sum_{k:\text{jet constituent}} \min\left(d(q_1, p_k), \cdots, d(q_N, p_k)\right)$$

$\begin{cases} d: \text{distance measure} \\ d_0: \text{normalization} \\ q_1 \sim q_N: \text{Reference vector} \end{cases}$

Example: $d(q_i, p_k) = p_T(k) \cdot [q_T(i)]^\alpha [\Delta R_{i,k}]^\beta$

$$d_0 = \max_{i=1\cdots N} \{(q_T(i))^\alpha\} (R_0)^\beta \sum_k p_T(k)$$

∘ IR-safe $\Leftarrow$ d linear in $p_T(k)$

∘ Collinear-safe $\Leftarrow$ 〃 $\wedge\ \beta \geq 0$

Determine $\{q_i\}$

∘ can be chosen s.t. minimizing τ_N … computationally difficult

∘ can be (practically) chosen as jets by exclusive-k_T algorithm.