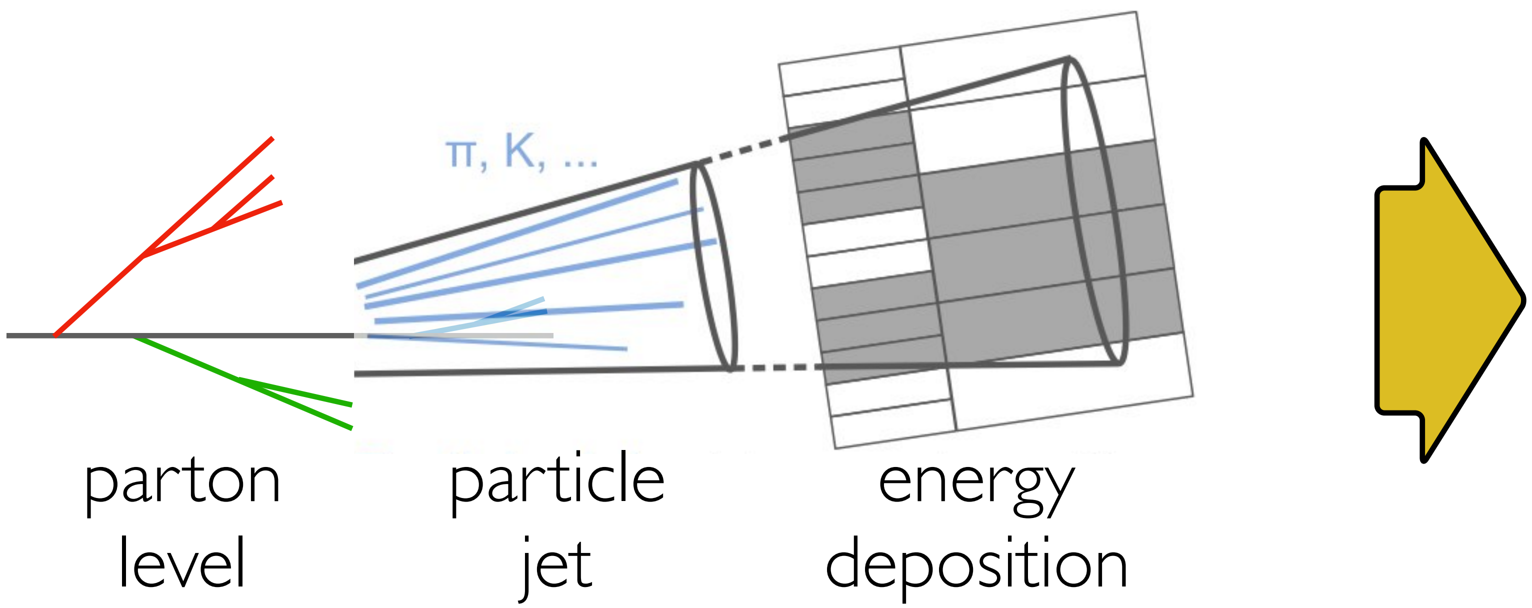
SOFTDROP

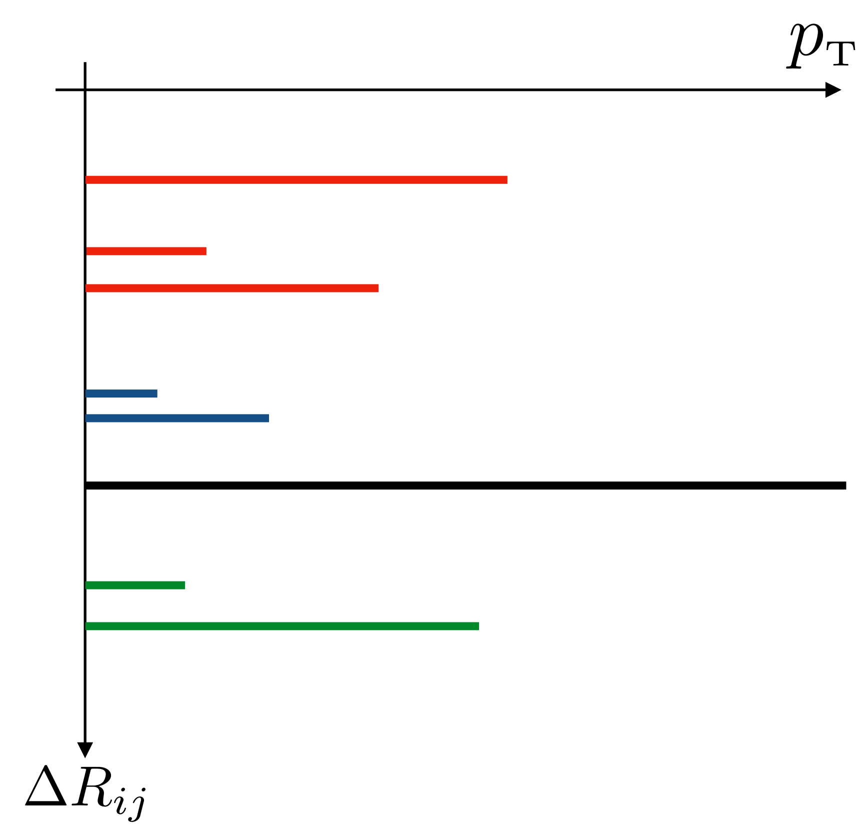
EMMI Rapid Reaction Task Force
14 August 2019, GSI, Darmstadt

Summary: Steps of the procedure

1. jet finding [anti-k_t, R=0.4]
2. jet re-clustering [C/A]
3. SoftDrop procedure
4. (recursive SoftDrop)

I. FINDING THE JET





1) Distance measure

$$d_{ij} = \min(p_{\mathrm{T}i}^{2\alpha}, p_{\mathrm{T}j}^{2\alpha})\Delta R_{ij}^2/R^2$$

$$\Delta R_{ij}^2 = (y_i - y_j)^2 + (\phi_i - \phi_j)^2$$

2) Recombination scheme

- E-scheme (add up 4-momenta)
- winner-take-all (WTA) scheme

First step: identify a jet with p_{T} using anti-k$_t$ ($\alpha = -1$), R=0.4

Grooming

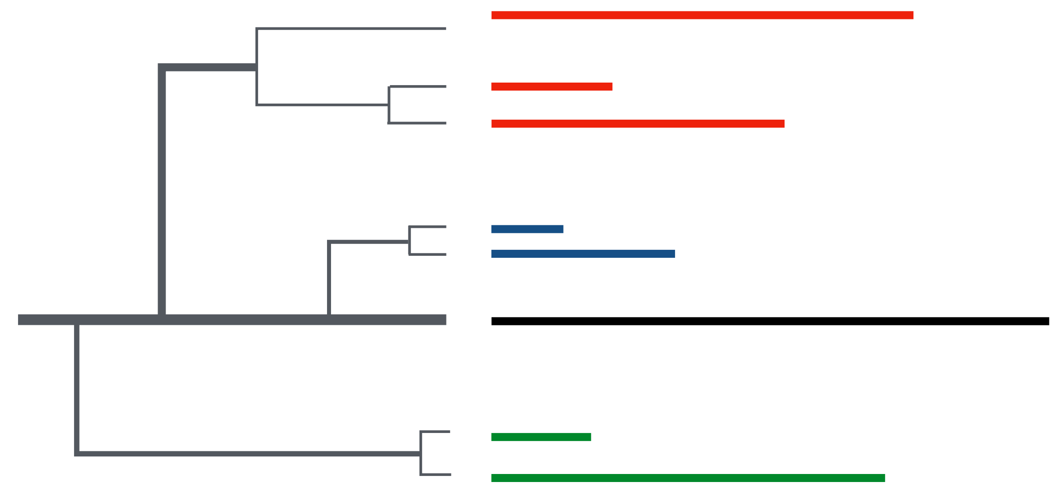
- trimming & filtering
  - recluster jets with $R_{\text{sub-jet}} < R$
  - keep only a few sub-jets (fixed number, determined by a energy fraction f_{cut})
- pruning & (recursive) SoftDrop
  - decide "dynamically" which branches to keep

We should actively try out different grooming strategies!

2. Recluster the jet

1) re-cluster jet with C/A algorithm
2) at each branching (node) collect ($p_{\mathrm{T}i} > p_{\mathrm{T}j}$) variables $\{\Delta R_{ij}, k_t, z\}$.

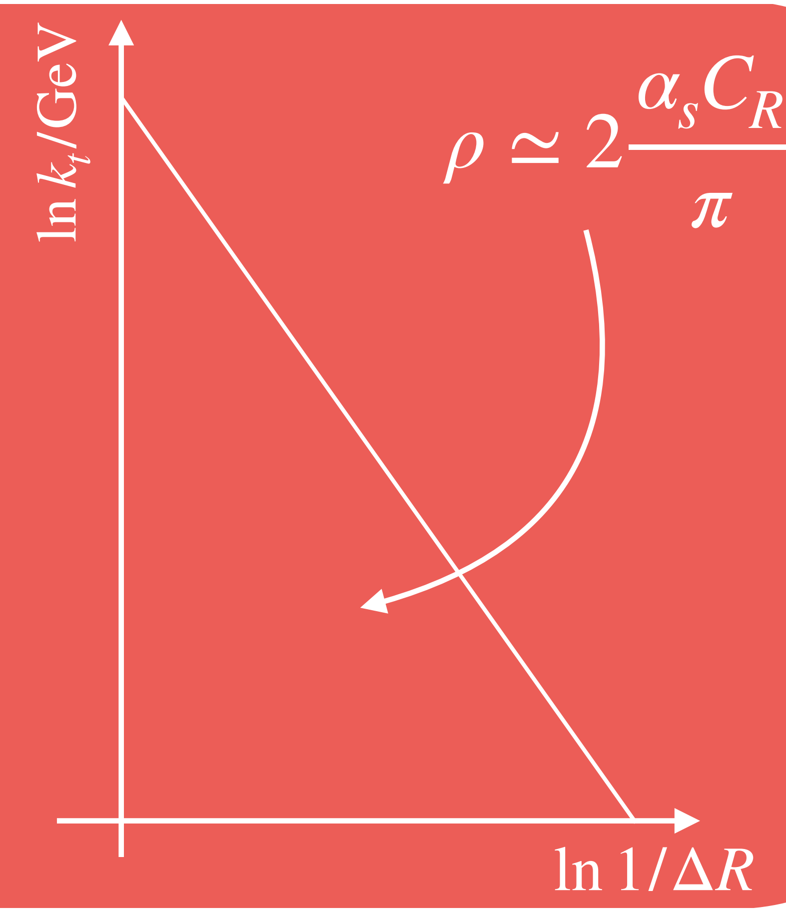
$$k_t = p_{\mathrm{T}j}\Delta R_{ij} \qquad z = \frac{p_{\mathrm{T}j}}{p_{\mathrm{T}i} + p_{\mathrm{T}j}}$$



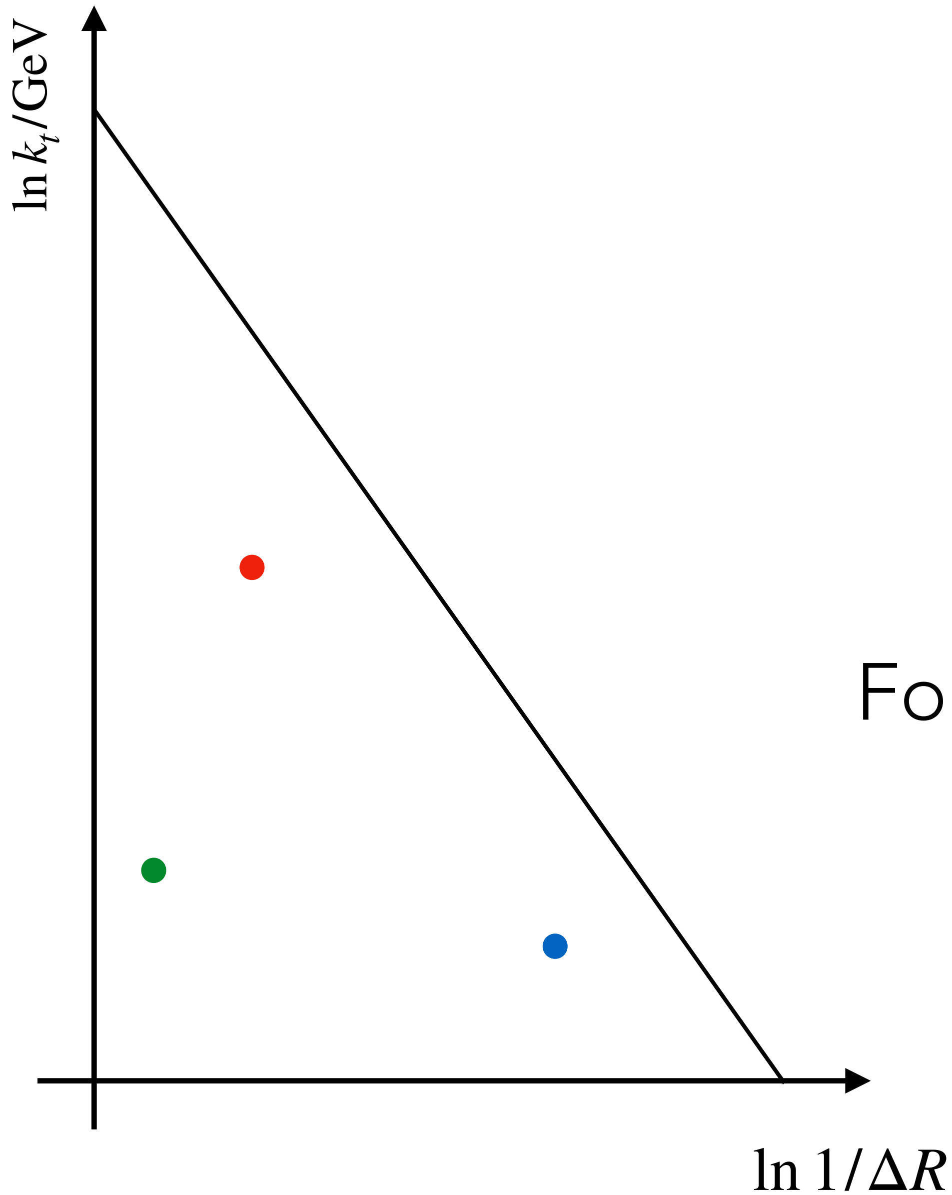
Primary Lund plane:

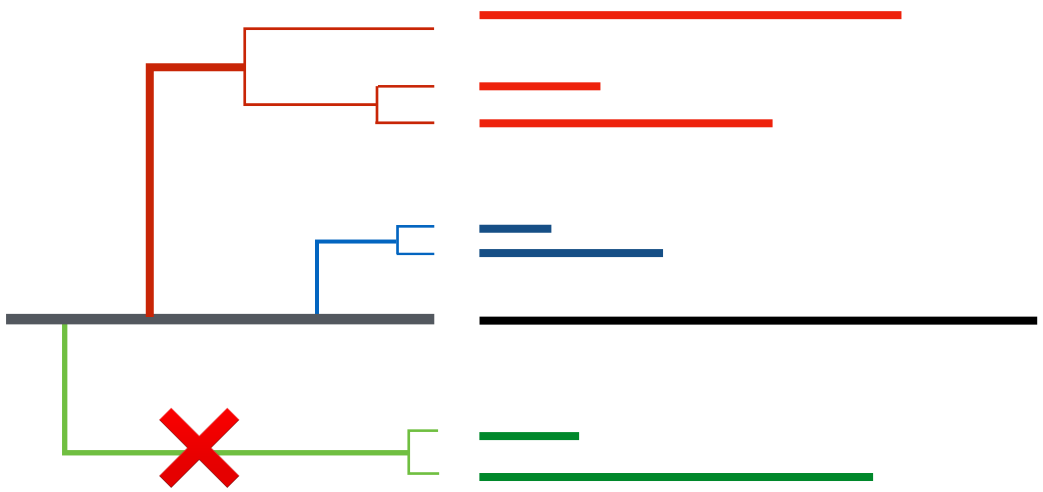
- following the hardest branching, collect the variables $\{\ln(1/\Delta R_{ij}), \ln(k_t/\mathrm{GeV})\}$
- plot the density

$$\rho^{(\mathrm{prim})}(\Delta R, k_t) = \frac{1}{N_{\mathrm{jet}}}\frac{\mathrm{d}n_{\mathrm{emission}}}{\mathrm{d}\ln k_t \, \mathrm{d}\ln 1/\Delta R}$$



mMDT/SoftDrop



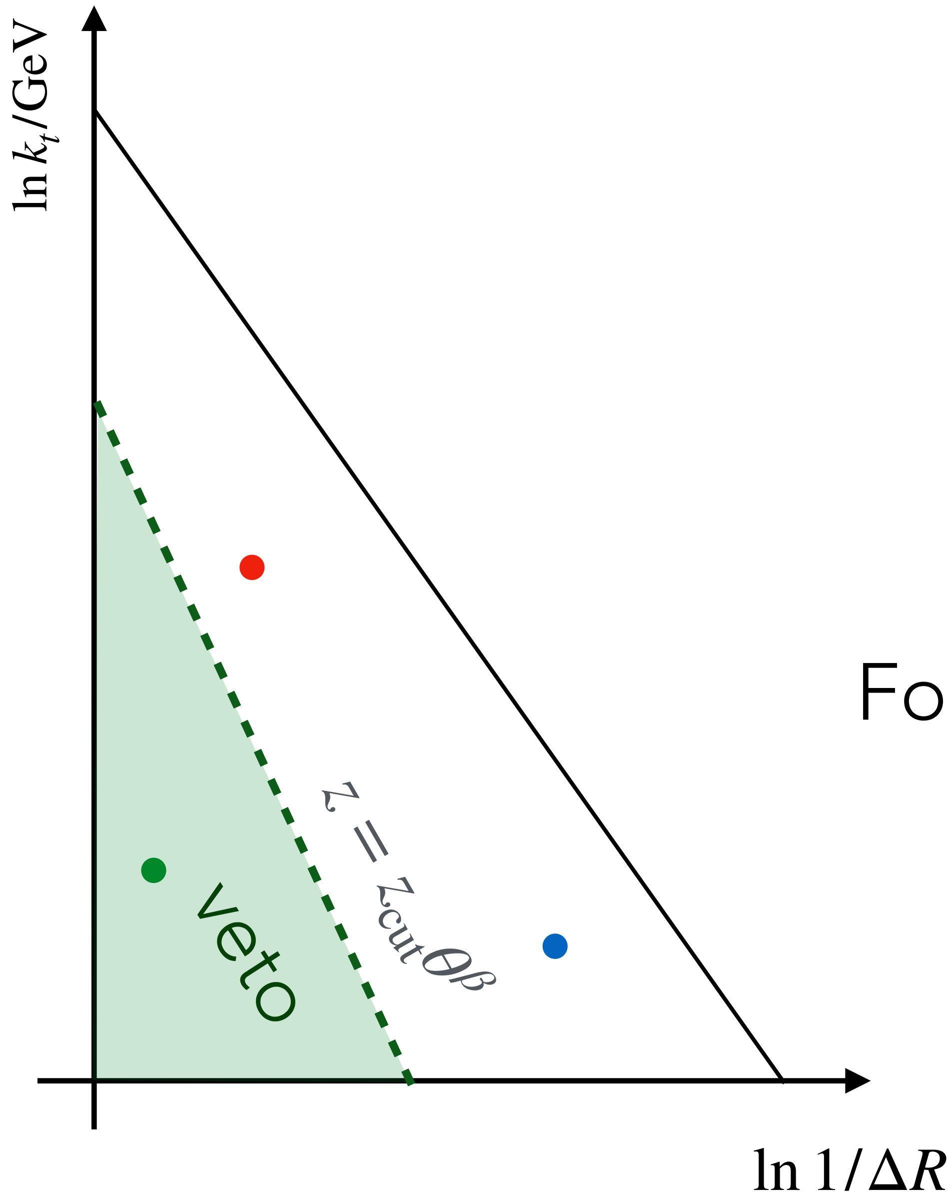


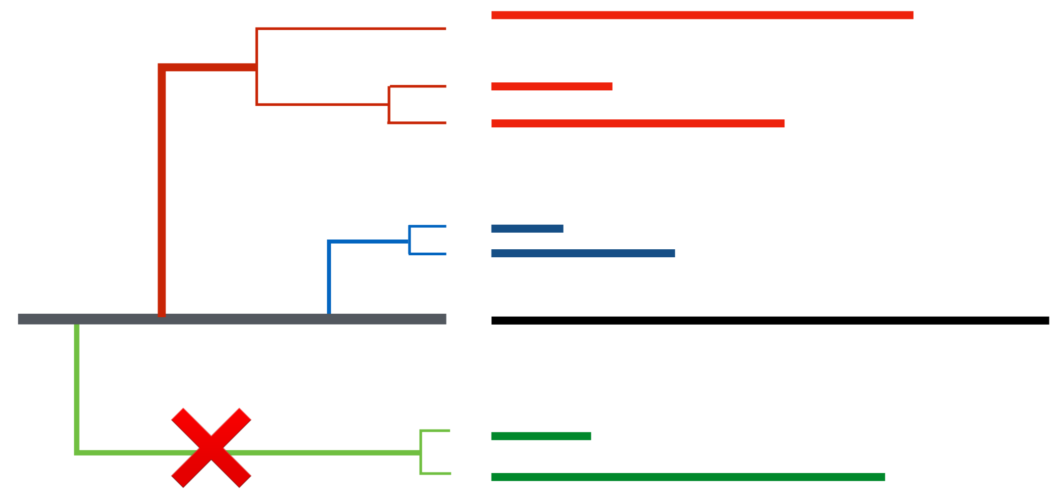
Following the hardest branch, find the first node that satisfies:

$$z > z_{\mathrm{cut}}\theta^{\beta}$$

[Recursive SD: for the two hard branches, continue the procedure for additional N-1 steps.]

mMDT/SoftDrop





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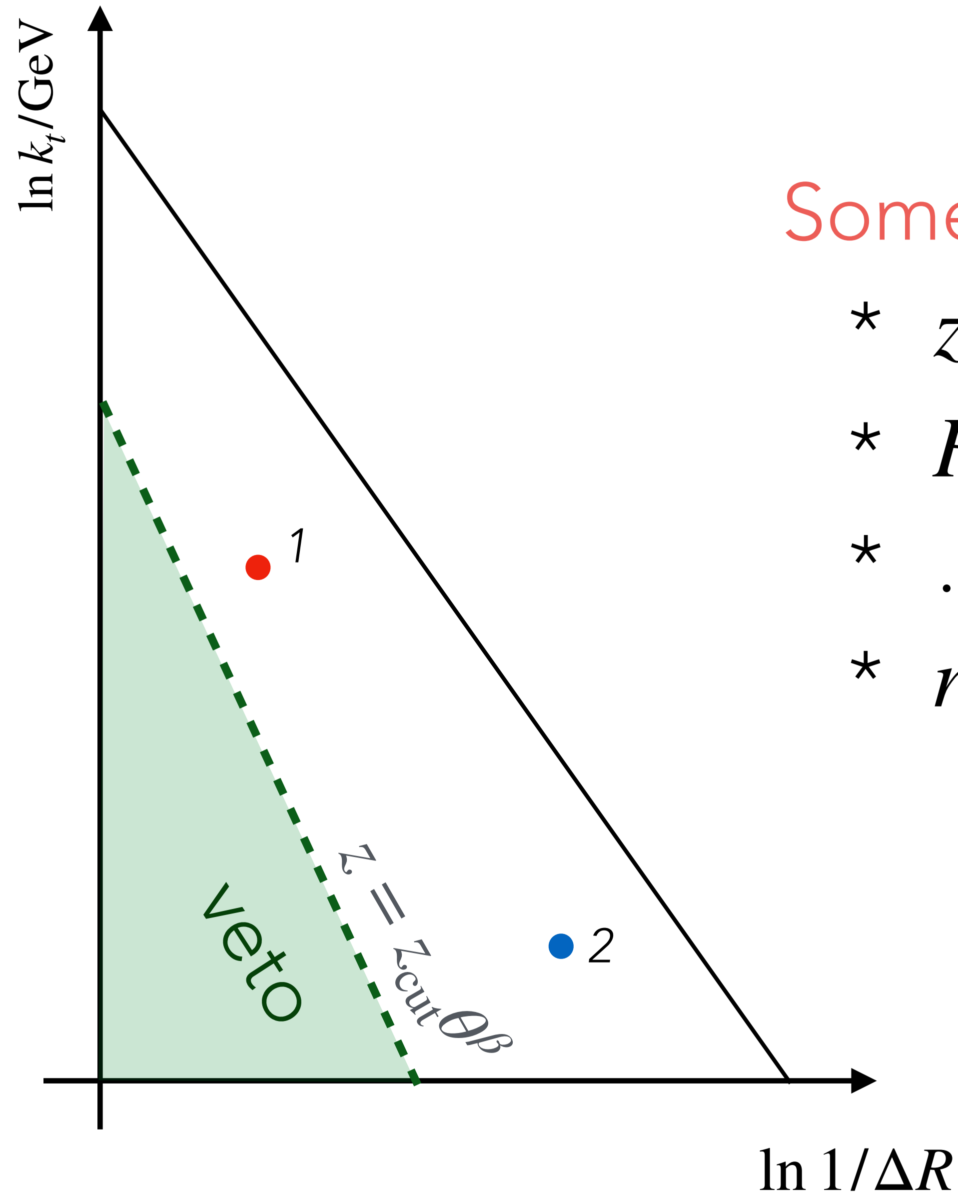
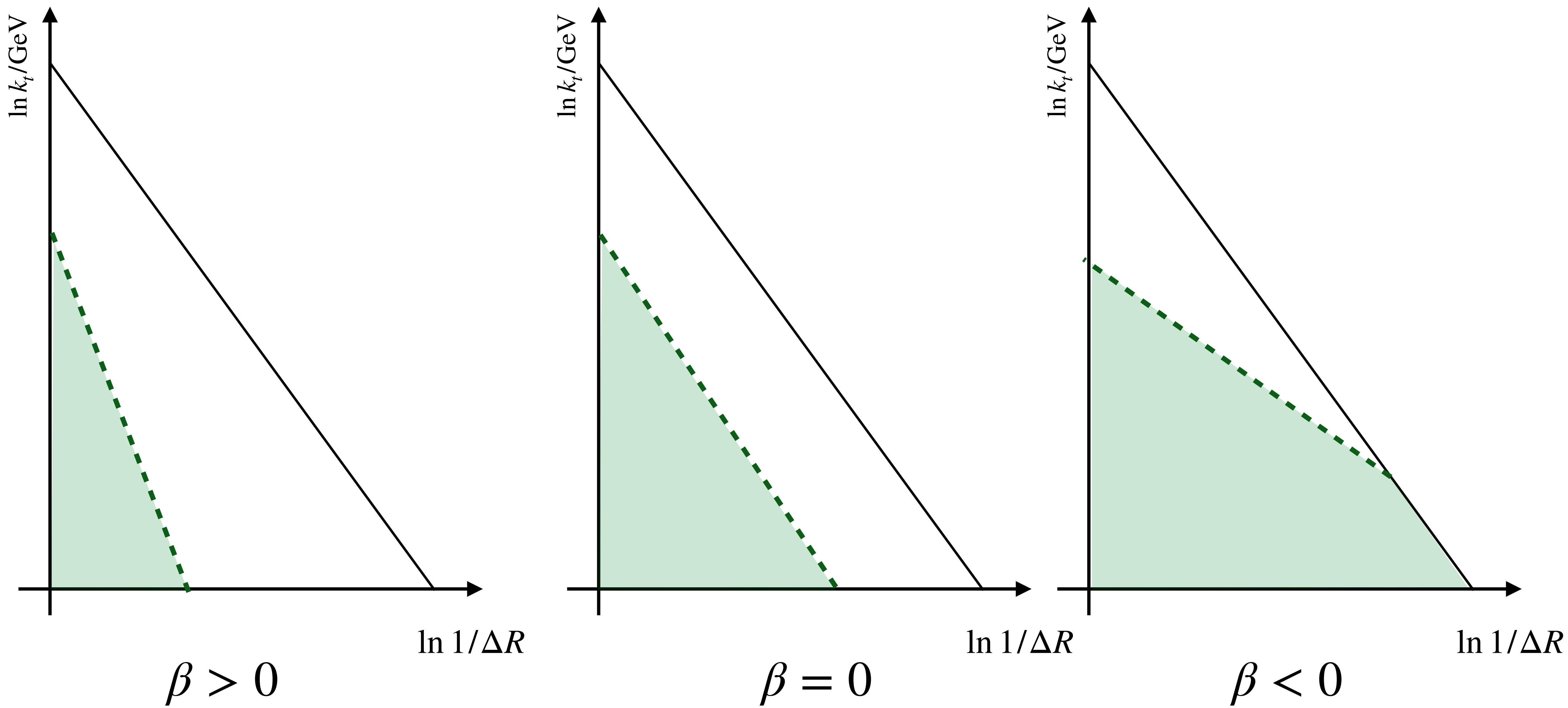
Groomed observables



Some examples:

* z_g: momentum fraction of *first* splitting
* R_g: angle of *first* splitting
* …or a combination of the two
* n_{SD}: number of hits on the primary LP

Different options



For groomed observables, these cuts generally lead to:

IR/Sudakov safe Sudakov safe IRC safe

PREVIOUS CHOICES

CERN workshop, Andrews et al. 1808.03689