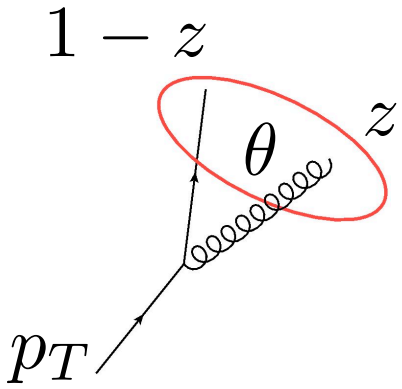
QCD jets: (my) perturbative understanding (I)



$$m^2 = 2p_q \cdot p_g \simeq z(1-\cancel{z})\theta^2 p_T^2$$

$$z > z_{\rm cut}({\rm or}\ f_{\rm cut}) \quad \text{grooming condition} \quad (a)$$

$$R^2 > \theta^2 = \frac{m^2}{z p_T^2} \quad \text{jet with a given mass} \quad (b)$$

(a)+(b): there's a region dominated by hard splittings where you don't groom, i.e. mMDT, soft drop, pruning and trimming should return the ungroomed jet mass for

$$m > \sqrt{z_{\rm cut}} R p_T$$

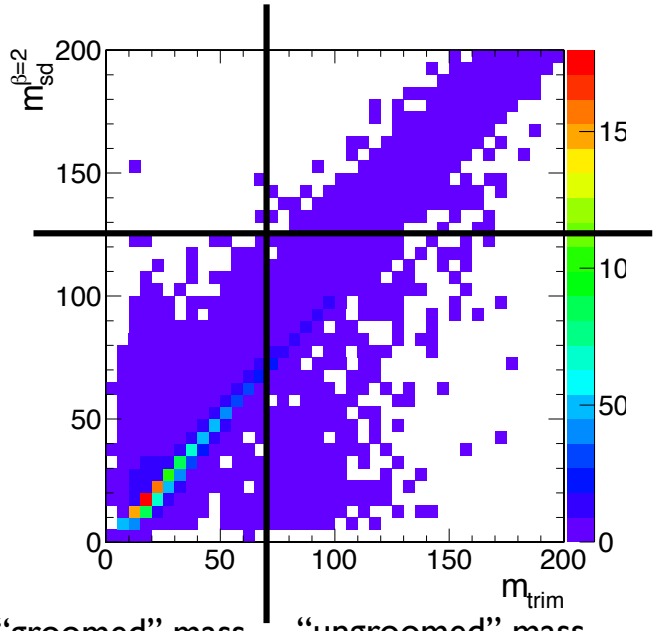
Top-right corner of each of the following plots
mMDT and soft drop masses are larger than pruned and trimmed mass (less so for trimming) in the "ungroomed region". Pruning/trimming are grooming away non-perturbative stuff (UE? no pile-up here). This difference should disappear at large pT.

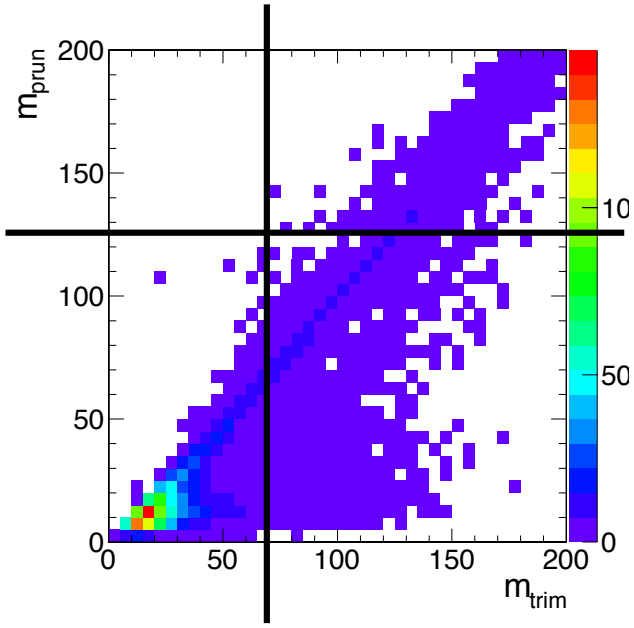
$$500 < p_T < 600\,, \quad AK\ R = 0.8$$

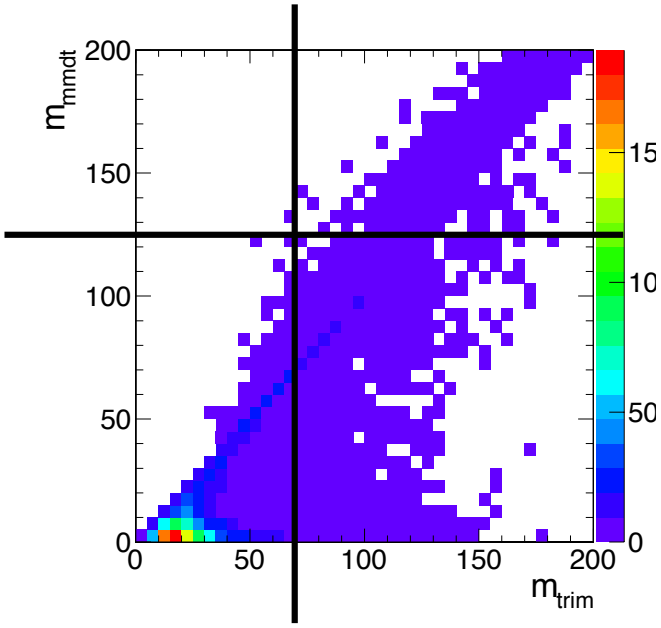
event sample by Marat Freytsis

Pythia 8.176 with MPI (no pile-up)
QQ only

plots by Nhan Tran



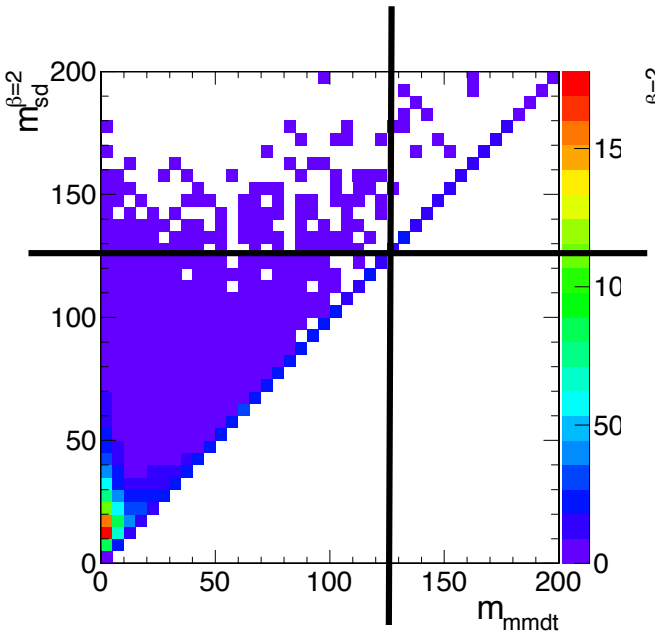


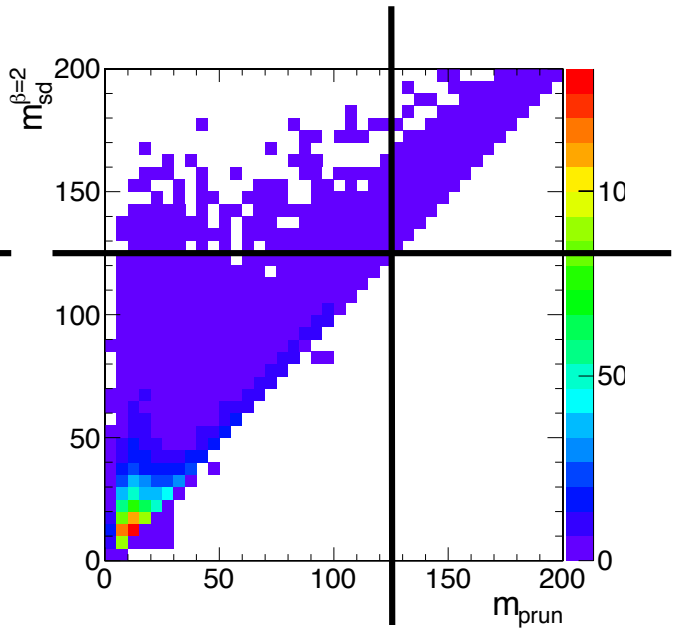


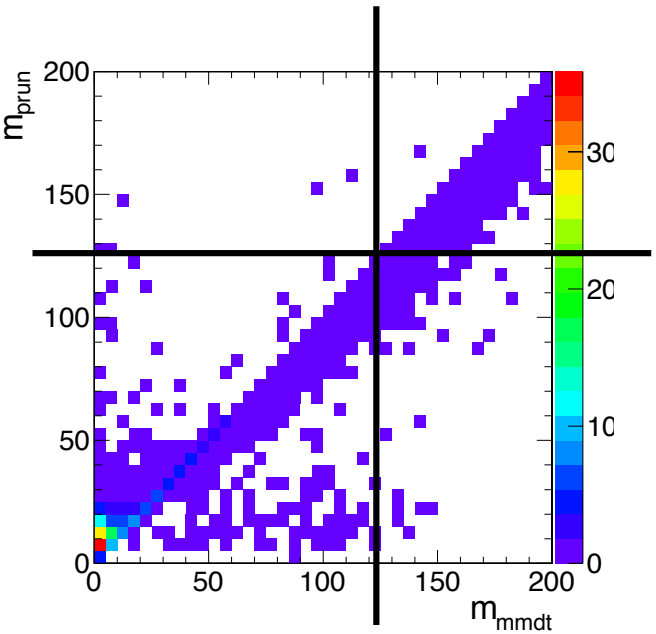
"groomed" mass region

"ungroomed" mass region

these comments refer to perturbative radiation only!!!







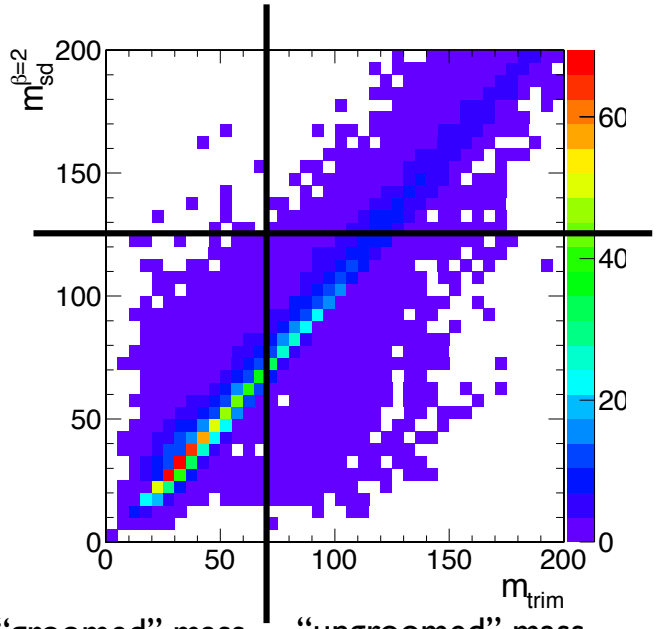
$z_{\rm cut} = 0.1$

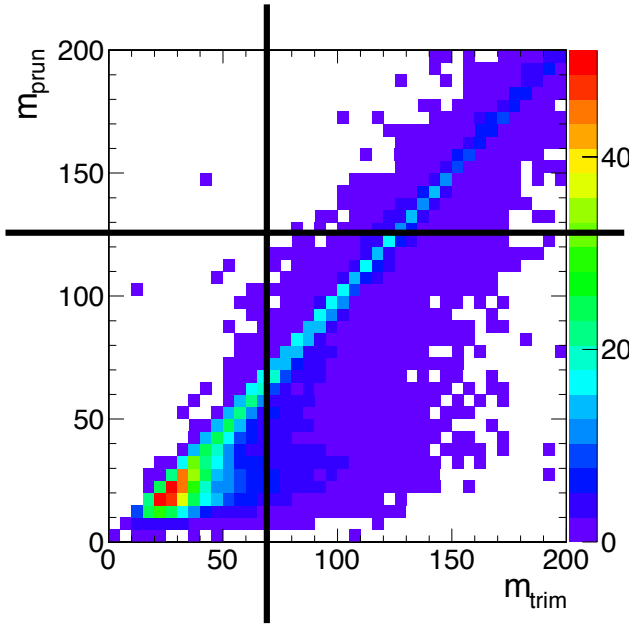
$f_{\rm cut} = 0.03\ , R_{\rm sub} = 0.2$

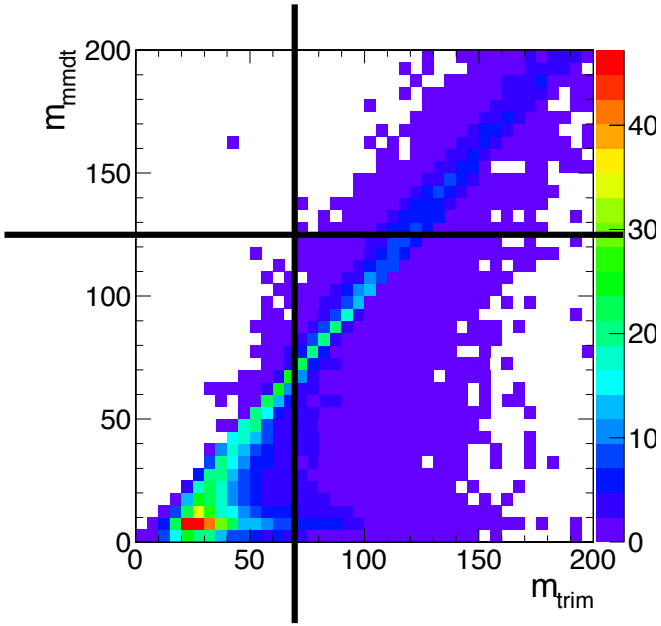
event sample by Marat Freytsis

Pythia 8.176 with MPI (no pile-up)
GG only

plots by Nhan Tran







"groomed" mass region

"ungroomed" mass region

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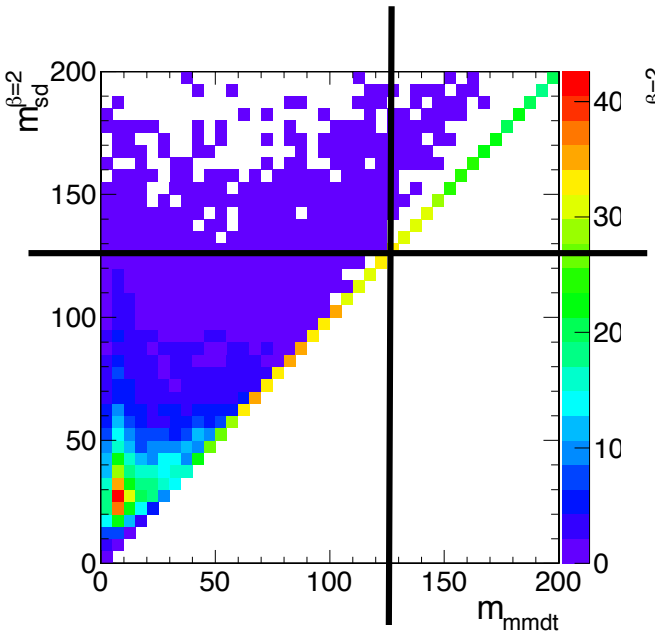
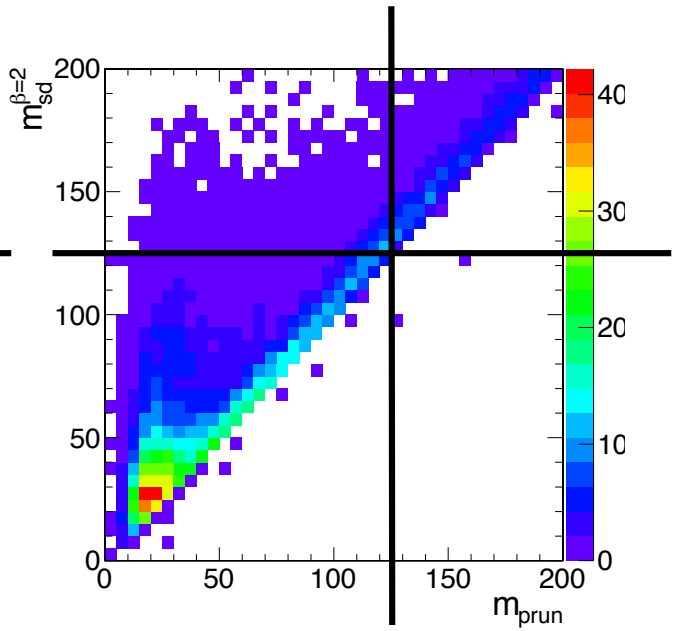
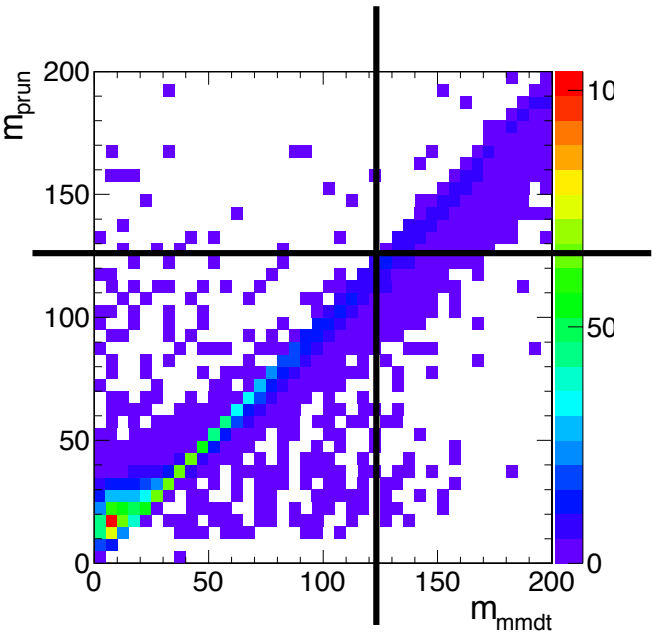






$z_{\rm cut} = 0.1$

$f_{\rm cut} = 0.03\ , R_{\rm sub} = 0.2$

QCD jets: (my) perturbative understanding (II)

$$z \to 0,\ \theta \text{ fixed:} \quad \text{soft}$$
$$\theta \to 0,\ z \text{ fixed:} \quad \text{collinear}$$
$$\theta, z \to 0: \quad \text{soft-collinear}$$

Perturbative action	pruning	trimming	mMDT	SD β>0
$m > \sqrt{z_{\rm cut}} R p_T$	nothing	nothing	nothing	nothing
$m < \sqrt{z_{\rm cut}} R p_T$ $m > a_x p_T$	cuts on soft & soft-collinear	cuts on soft & soft-collinear	cuts on soft & soft-collinear	cuts on soft & partially (β) on soft-collinear
$m < a_x p_T$	cuts partially on soft (?) & partially on soft-collinear	nothing	cuts on soft & soft-collinear	cuts on soft & partially (β) on soft-collinear

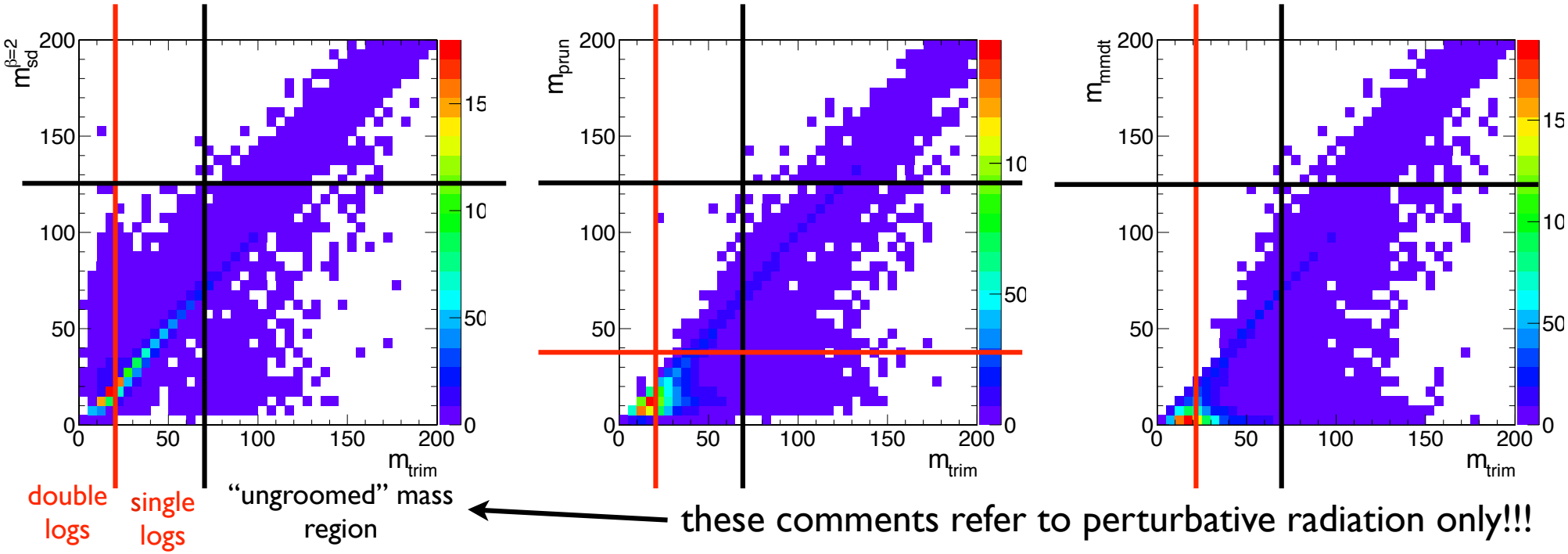
$f_{\rm cut}$ for trimming

$$a_{\rm pruning} = z_{\rm cut} R$$
$$a_{\rm trimming} = \sqrt{f_{\rm cut}} R_{\rm sub}$$

event sample by Marat Freytsis

Pythia 8.176 with MPI (no pile-up)
QQ only

plots by Nhan Tran



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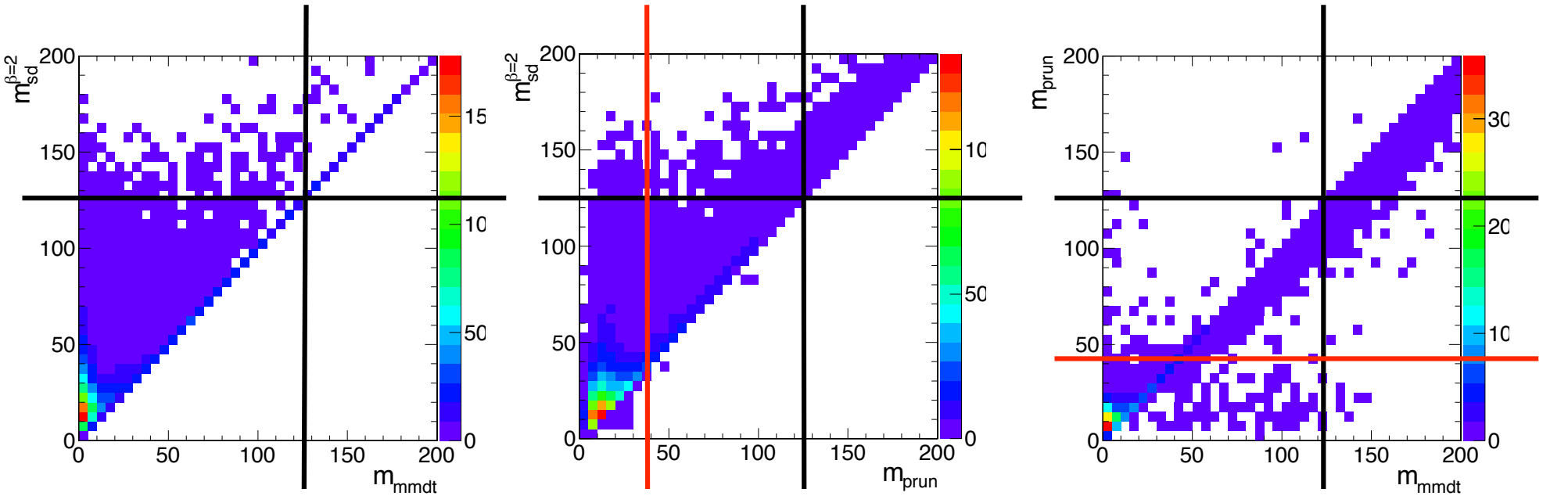

$z_{\rm cut} = 0.1$

$f_{\rm cut} = 0.03\ , R_{\rm sub} = 0.2$

event sample by Marat Freytsis

Pythia 8.176 with MPI (no pile-up)
GG only

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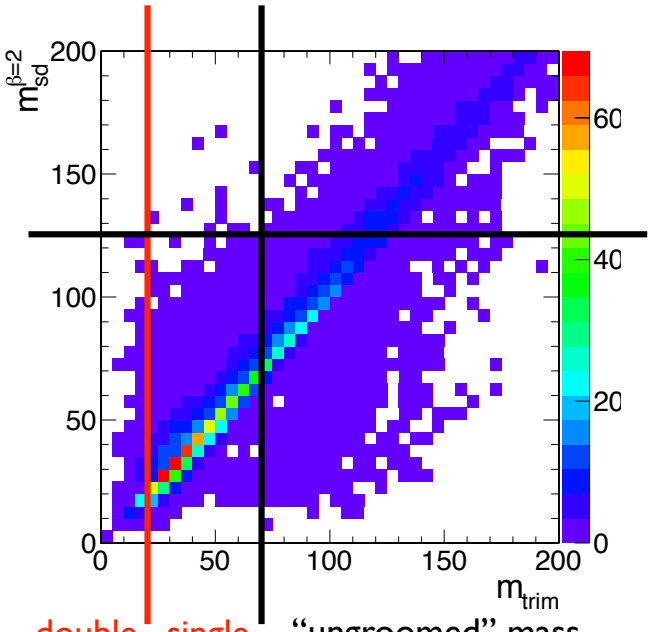

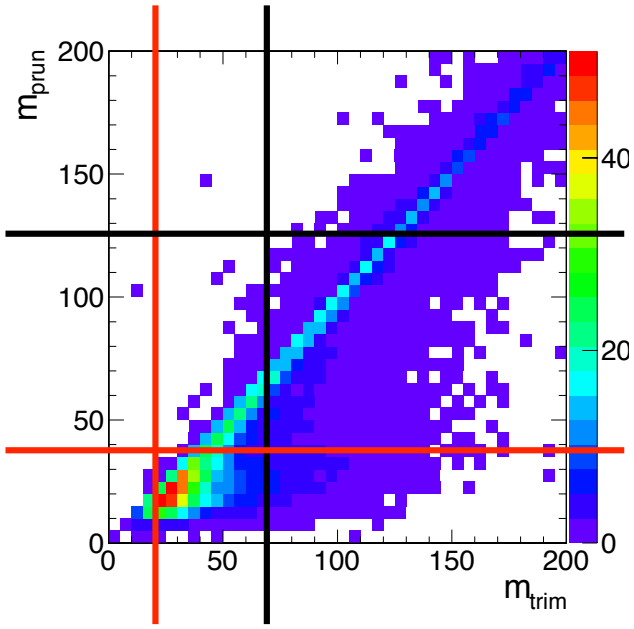

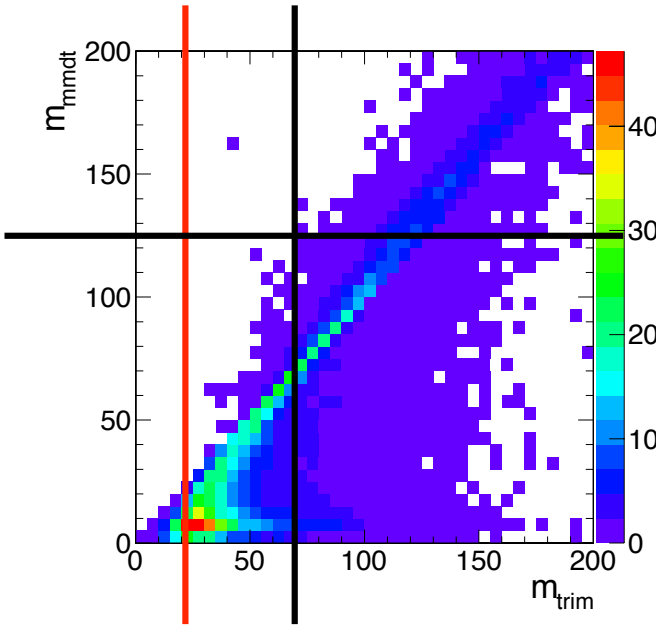

double logs

single logs

"ungroomed" mass region

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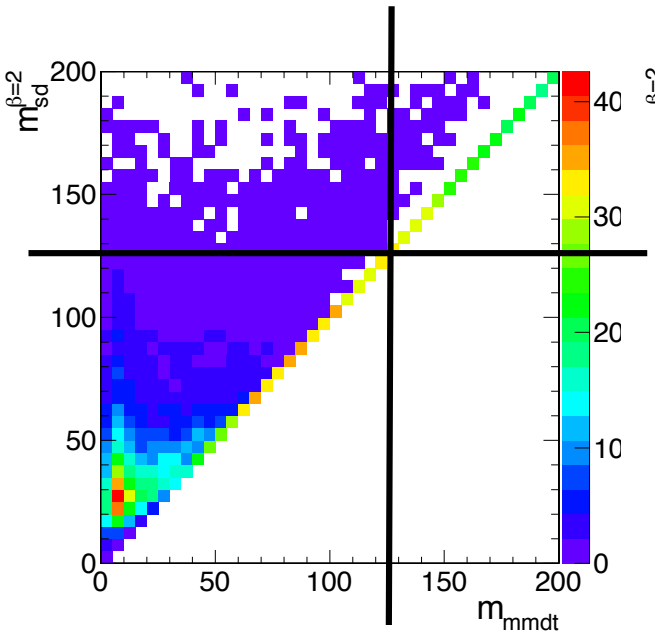

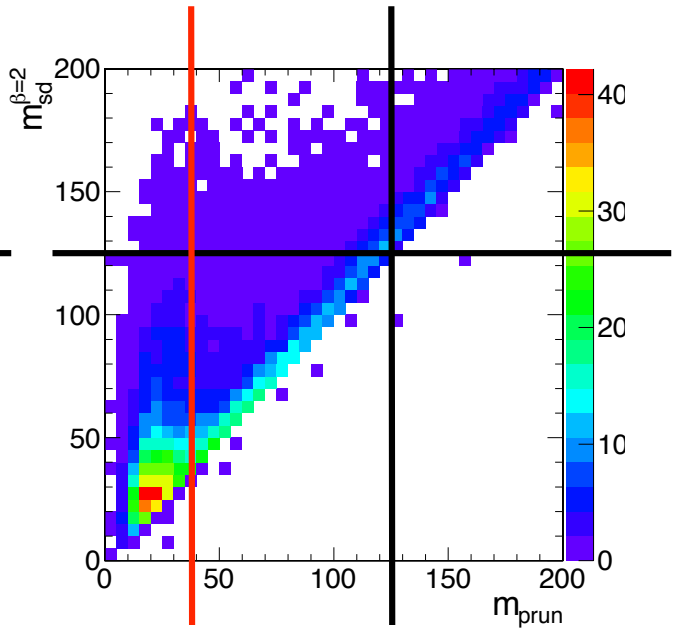

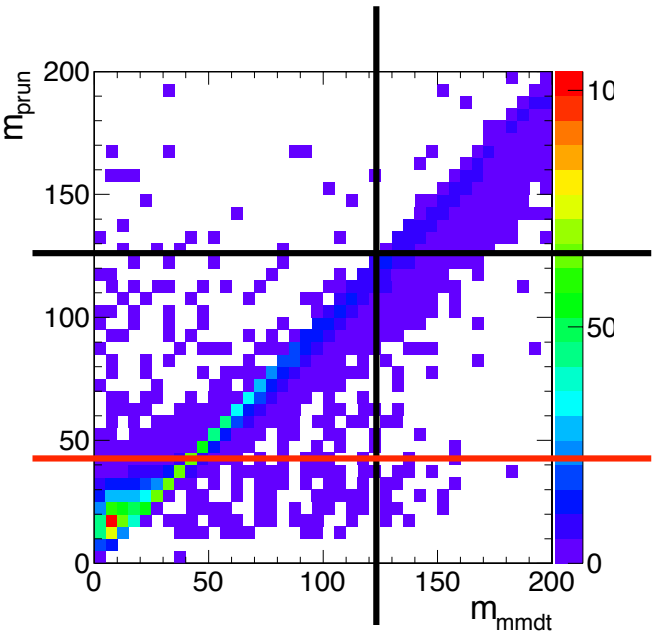

$z_{\rm cut} = 0.1$

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