

# Neutrino Reconstruction in $hh \rightarrow bbWW^*$

Charlotte Kappler

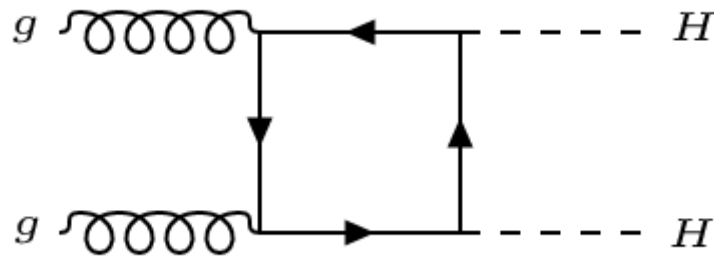
Supervisor: Prof. Dr. Stan Lai

Daily Supervisors: J. Veatch, K. Abeling

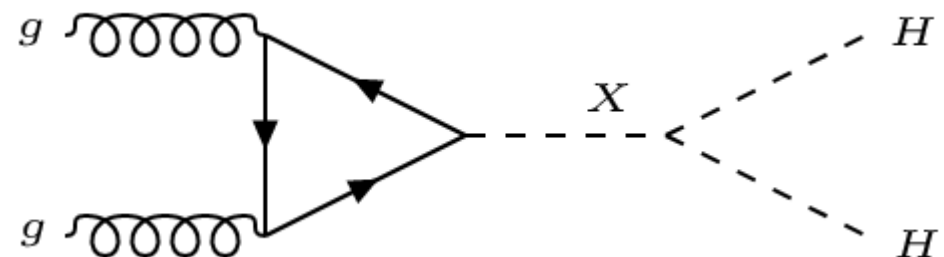
II. Physikalisches Institut



13.07.2018



Non-resonant production (SM)



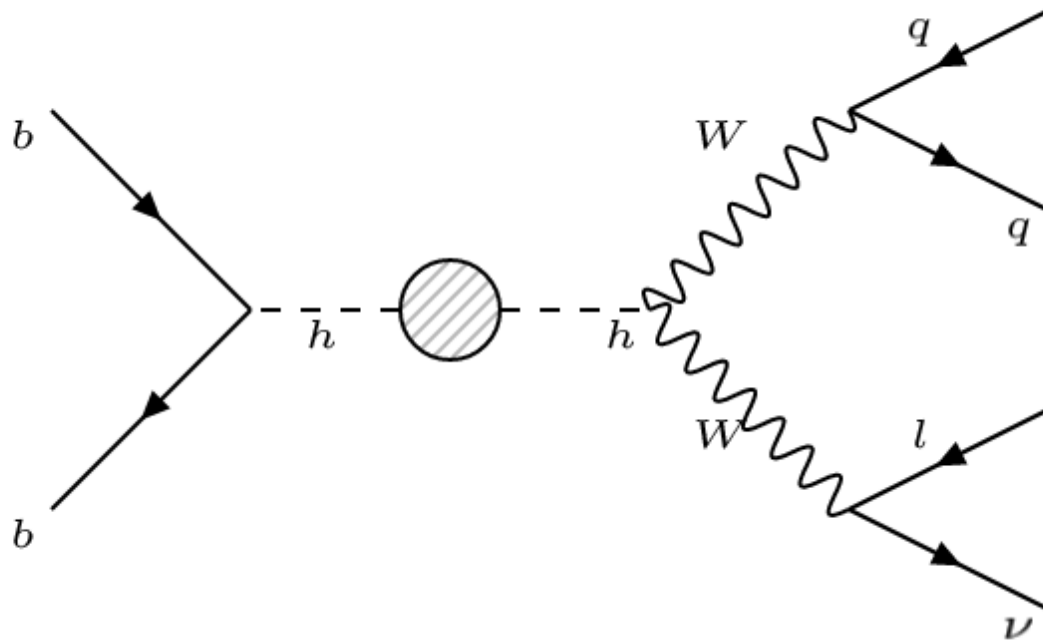
X=H: Non-resonant production (SM)

X other, heavier particle: Resonant production

SM: Higgs self coupling  $v\lambda$

$v$  known,  $m_H = \sqrt{2\lambda}v \Rightarrow \lambda$  indirectly known

BSM: Search for heavy Higgs boson



Branching Ratios:

$hh \rightarrow bbWW^*$  25%

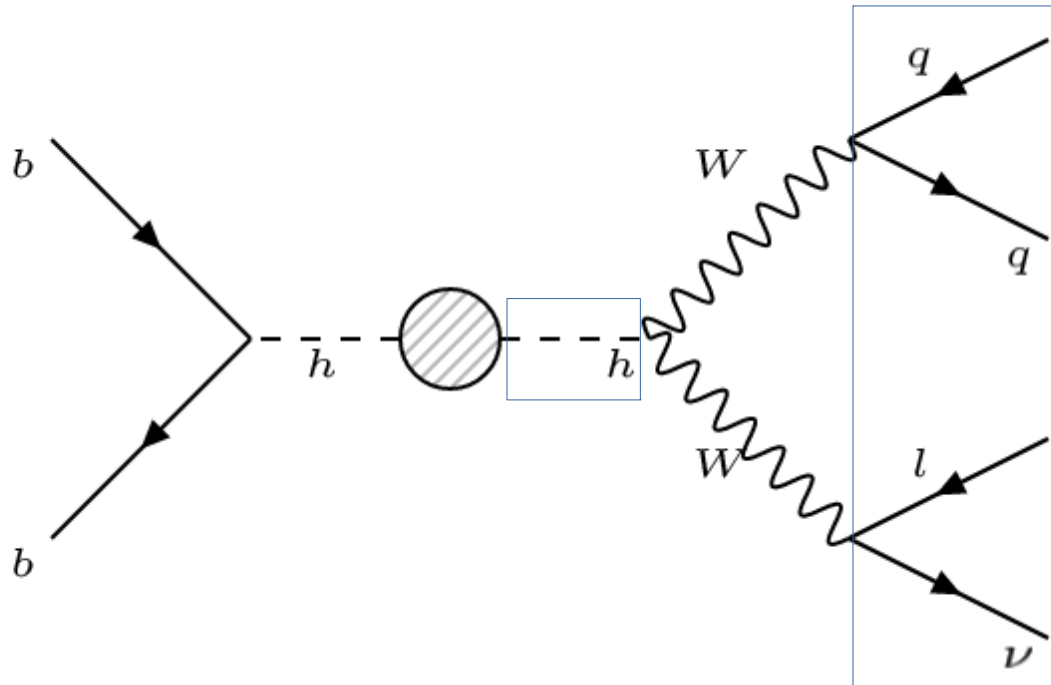
$hh \rightarrow bbbb$  37%

Jet reconstruction:

$p_T > 20$  GeV

Anti- $k_t$ ,  $R=0.4$

MET is neutrino  $p_T$



$$m_H^2 = (p_{Whad} + p_l + p_\nu)^2$$

$p_z$  appears in  $E = \sqrt{p_{t,\nu}^2 + p_{z,\nu}^2}$  and  $p_{z,\nu}$

→ Can have 2, 1 or 0 solutions

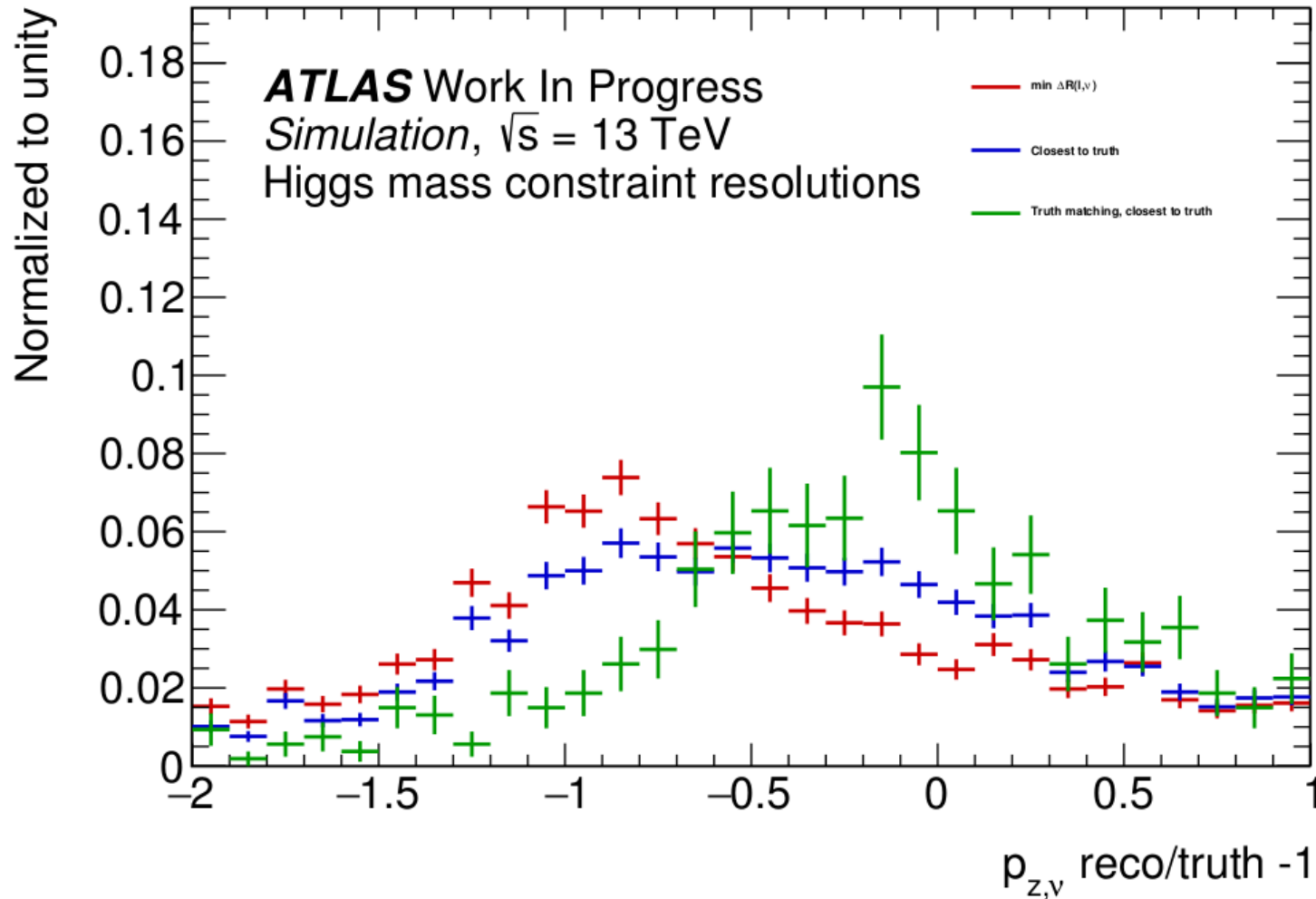
of form  $a \pm \sqrt{r}$

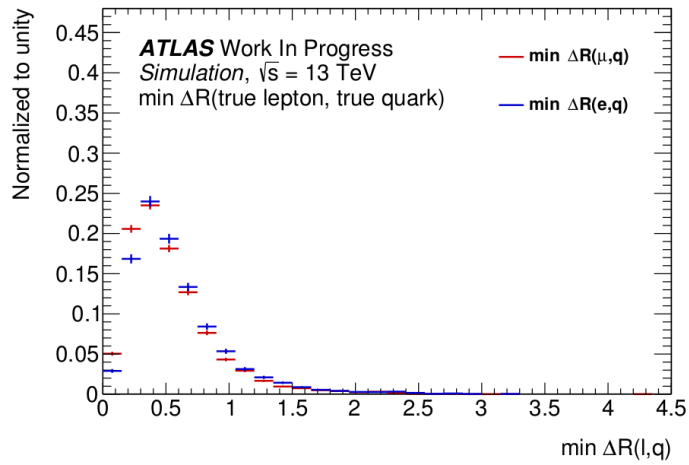
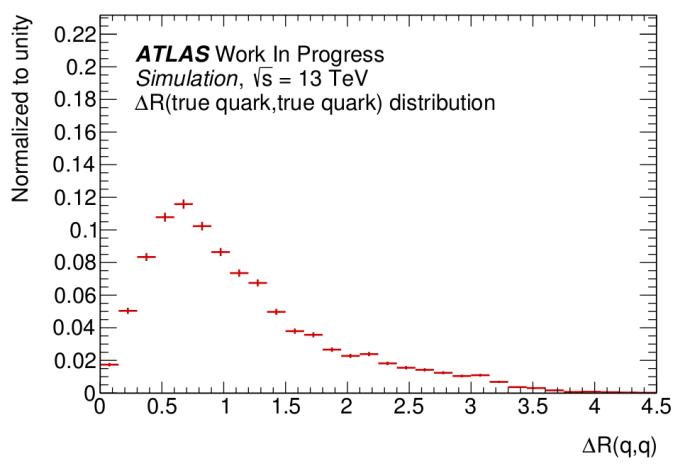
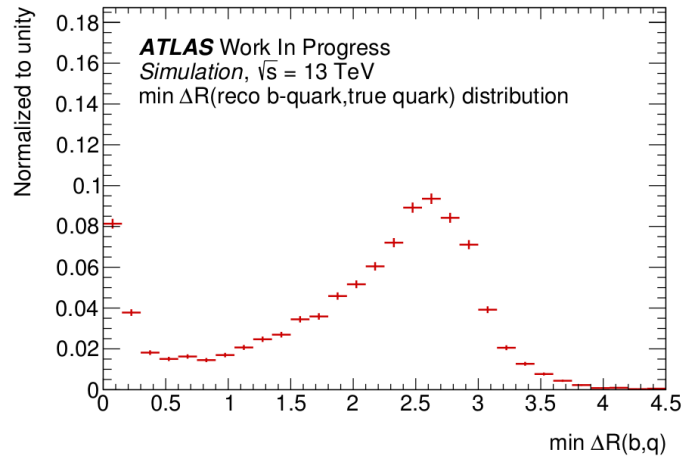
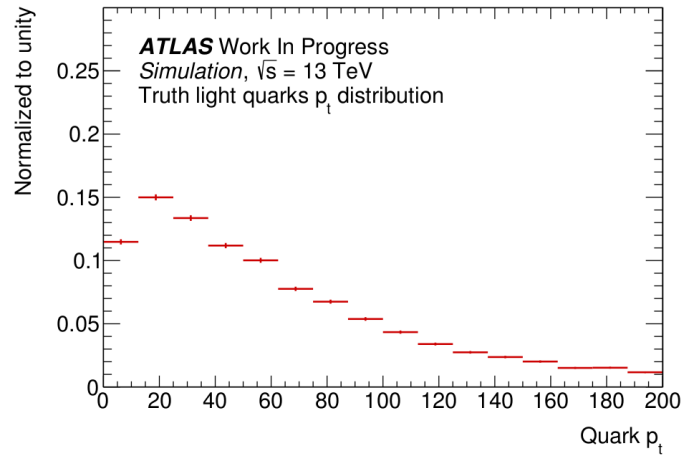
If  $r < 0$  again 0 solutions

If 2 solutions:

Pick, such that  $\Delta R(p_\nu, \ell)$  is smallest

“Min dR method”





Cuts:

$p_z > 20$  GeV

min  $dR(b, q) > 1$

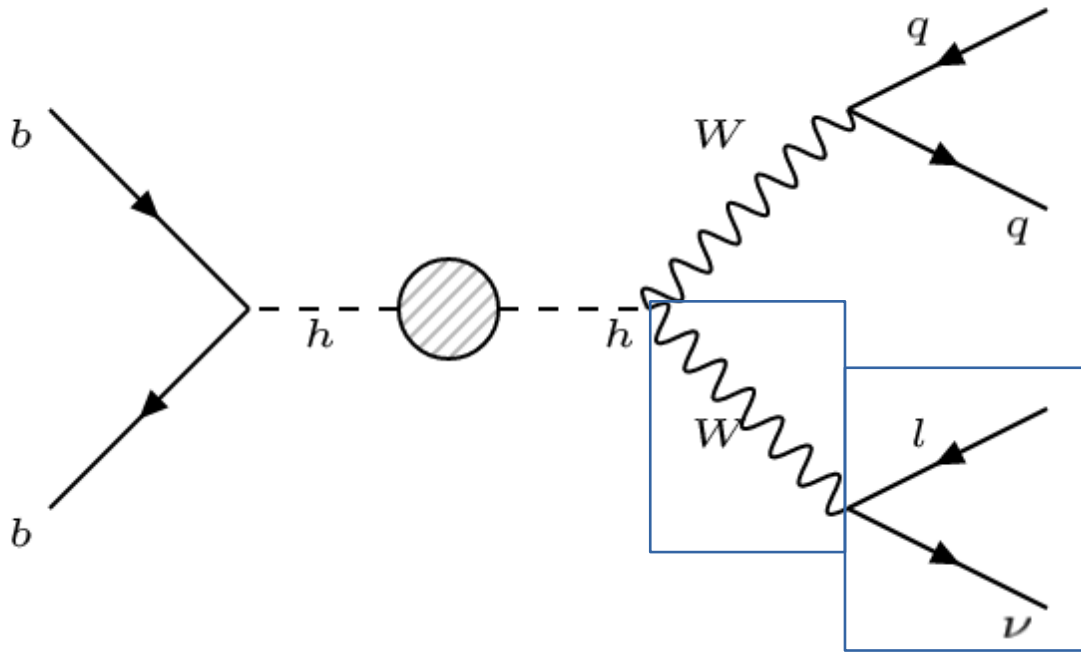
$dR(q, q) > 0.4$

min  $dR(e, q) > 0.4$

min  $dR(\mu, q) > 0.2$

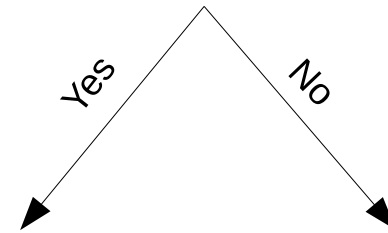
Cutflow step	Absolute number	Truth matching efficiency
All events	14218	11.1%
Positive discriminant	6758	9.7%
Quarks $p_t > 20$ GeV	4380	13.4%
$\min \Delta R(b, q) > 1$	3379	16.9%
$\Delta R(q, q) > 0.4$	2866	19.8%
$\min \Delta R(e, q) > 0.4, \min \Delta R(\mu, q) > 0.2$	2574	21.6%

# Wlep Mass Constraint



$hh \rightarrow WW^*bb$   
One W is off-shell!  
 $m_H = 125 \text{ GeV}$   
 $m_W = 80 \text{ GeV}$

$m_{W^{\text{had}}} < 60 \text{ GeV}?$

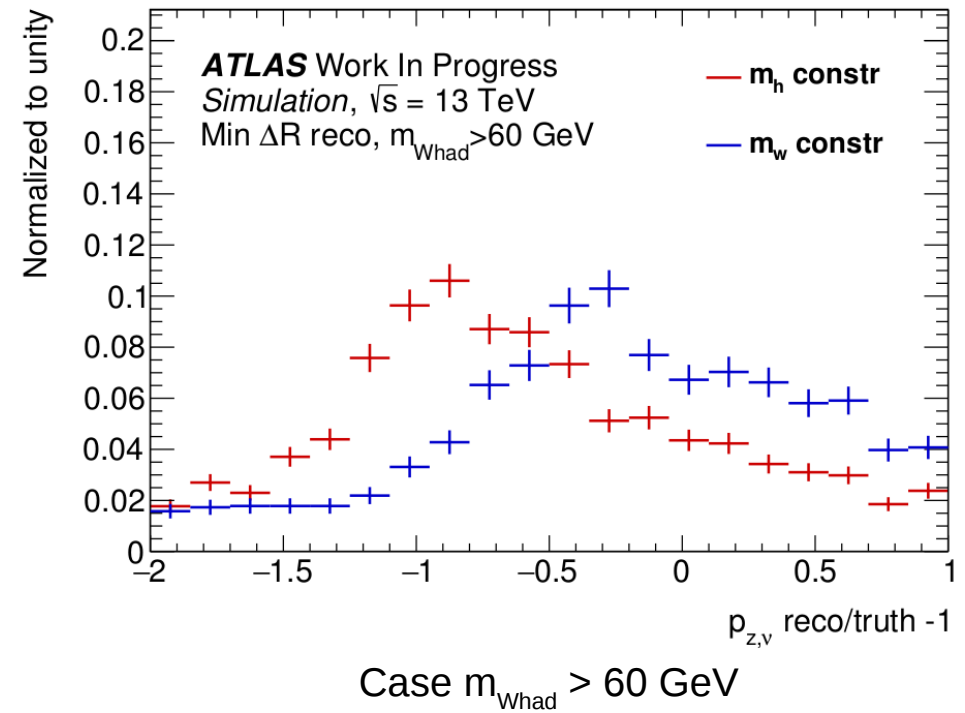
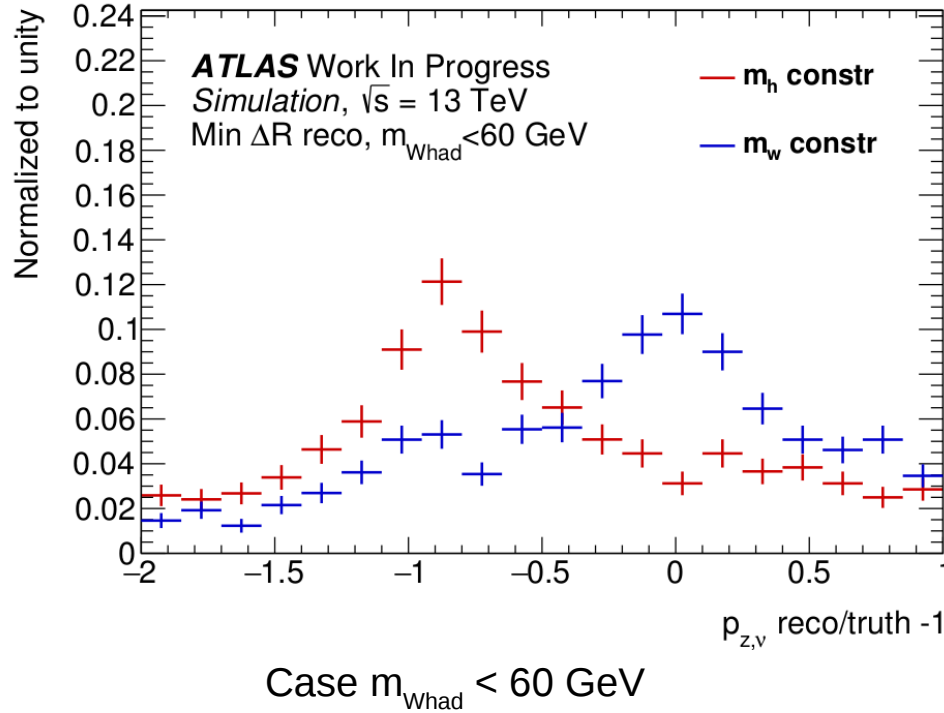


$m_{W^{\text{lep}}} := 80 \text{ GeV}$

$m_{W^{\text{lep}}} := 40 \text{ GeV}$



# Comparison between Constraints



In both cases the Wlep constraint does a better job.

- Further research on why Higgs mass constraint is not working well despite truth matching
- What reconstruction improvement
- Extension to boosted reconstruction
- Implementation of scaling and rotating method