

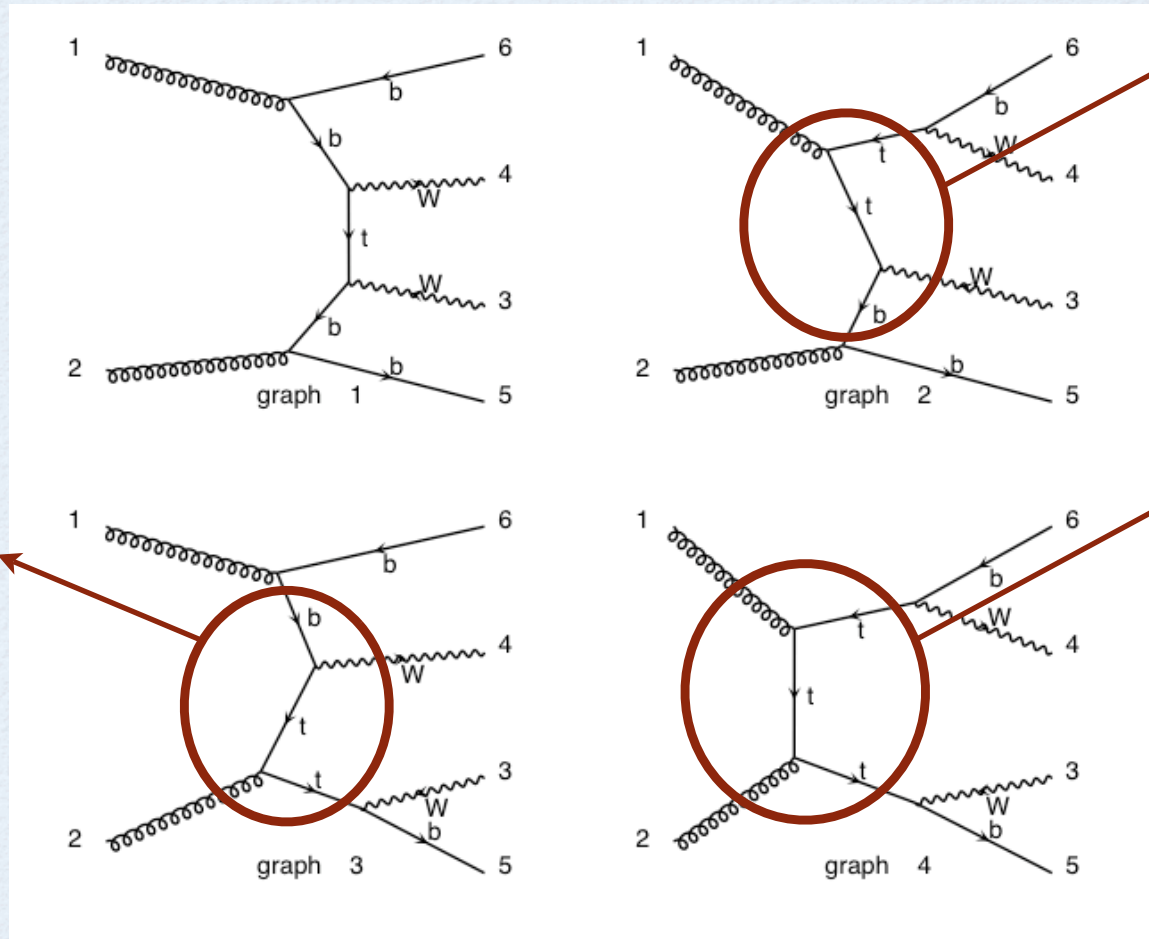
TOP BACKGROUNDS TO
 $GG \rightarrow H \rightarrow WW$

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HOW DO WE THINK ABOUT IT?

$$pp \rightarrow W^+W^-b\bar{b}$$



$$g\bar{b} \rightarrow \bar{t}W^+$$

$$gg \rightarrow t\bar{t}$$

$$bg \rightarrow tW^-$$

FIRST POSSIBILITY

USE: $pp \rightarrow W^+ W^- b\bar{b}$

- The complete set is gauge invariant (e.g. overall width scheme)
- Double-resonant, single-resonant, non-resonant diagrams are present.
- Interference is correctly included

BUT

☹ NLO corrections are not known

☹ Large logs of $m_b / (m_t + m_W)$

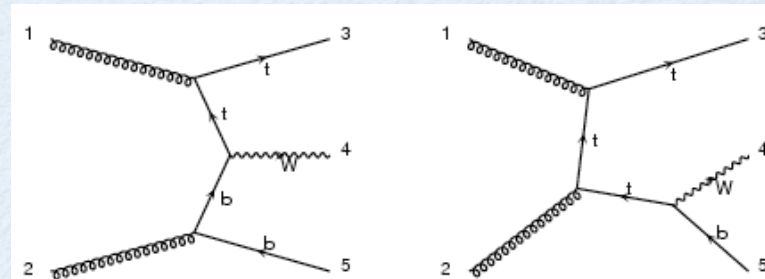
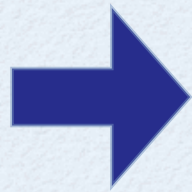
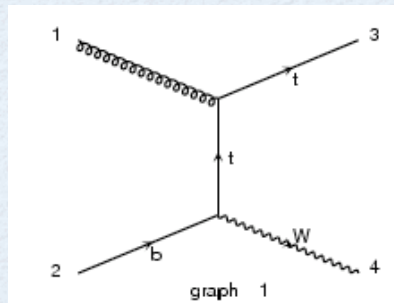
SOLUTION

USE: $t\bar{t} + tW$

- NLO corrections are known for both $t\bar{t}$ and tW (Campbell, Tramontano, be ready soon)
- large logs are resummed into the b-pdf

BUT

☹ NLO tW contains LO $t\bar{t}$!!



Avoid double counting:

1. in a gauge invariant way
2. in a event generator friendly way

SOLUTION

To measure (=define a NLO) tW

- We subtract $t\bar{t}$ point-by-point in the phase space:

$$\sigma(gg \rightarrow tWb)_{\text{single top}} = \sigma(gg \rightarrow tWb)_{\text{total}} - \sigma(gg \rightarrow t\bar{t}) * Br(t \rightarrow Wb) - \text{interf}[\cancel{t\bar{t}} \otimes tWb],$$

- and impose a jet veto on the spectator b .

Features:

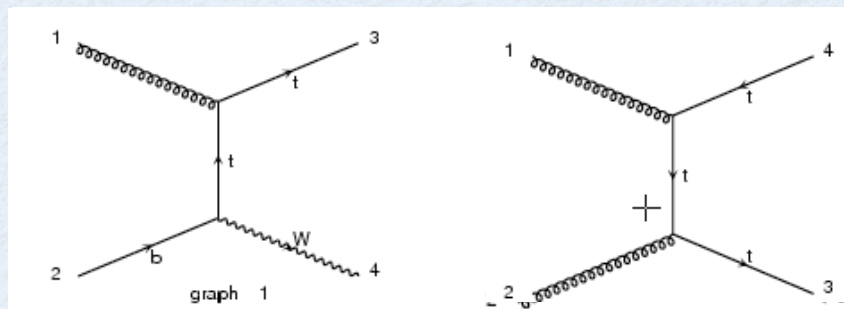
1. this makes the interference $t\bar{t}$ contribution much smaller.
2. the gauge violations are negligible.
3. It can be directly used for estimating the background to the Higgs!

SIMPLER SOLUTION

Scott's proposal:

- Use tt at NLO and $gb > tW$ at NLO, but consistently leave out $\alpha_S^2 \alpha_W$ terms

IN

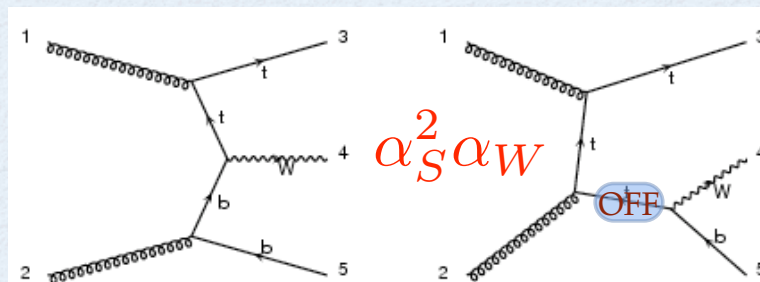


$+\alpha_S$ corrections

$\alpha_S^2 \alpha_W \log$

α_S^2

OUT



$\alpha_S^2 \alpha_W$

OFF

SIMPLER SOLUTION

- Use $t\bar{t}$ at NLO and $g_b \rightarrow tW$ at NLO, but consistently leave out $\alpha_s^2 \alpha_W$ terms

Features

1. Extremely simple to implement
2. Physically the same as the jet veto
3. No interference problem
4. No gauge-invariance problem
5. Available

SIMPLER SOLUTION

- Use $t\bar{t}$ at NLO and $g b \rightarrow tW$ at NLO, but consistently leave out $\alpha_S^2 \alpha_W$ terms

Action Plan

with John and Scott

1. Compare numbers between jet-veto and the new proposal.
2. Check that the neglected contributions are small in various areas of phase space.
3. Provide reference numbers for normalization of backgrounds.

SECOND POSSIBILITY

USE: $t\bar{t} + tW$

Avoid double counting:

1. in a gauge invariant way
2. in a event generator friendly way

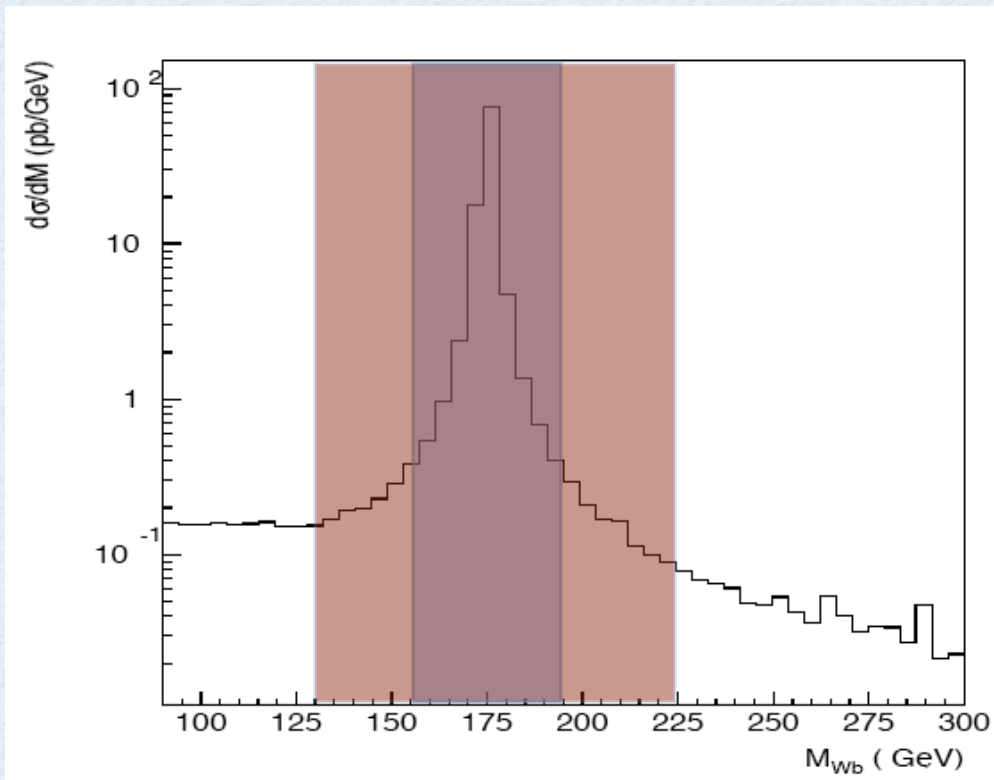
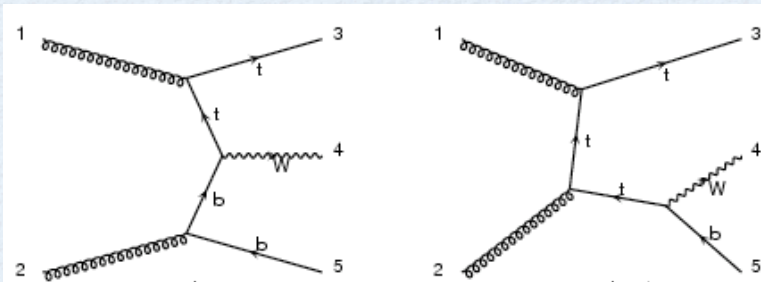
Available proposals are not completely satisfactory:

Tait (2001) : zero width, analytic approach not suitable for event generators.

$$\sigma(gg \rightarrow tWb)_{\text{singletop}} = \sigma(gg \rightarrow tWb)_{\text{total}} - \sigma(gg \rightarrow t\bar{t}) * Br(t \rightarrow Wb) - \text{interf}[t\bar{t} \otimes tWb],$$

Belyaev and Boos (2000): subtraction not gauge invariant if width not zero. Window mass cut is not effective (results depend very much on the window width)

SECOND POSSIBILITY



B&B suggested to use a mass window of about $12 \Gamma_{\text{top}}$ so to reproduce the Tait's zero-width result and have a generator friendly definition.

The problem is that the size of the window, at fixed width, depends on the interference term \Rightarrow gauge dependence

Our conclusion is that this is not an effective way to define tW events!

FIRST POSSIBILITY

$$pp \rightarrow W^+W^-b\bar{b}$$

	tt	tWb	tt+tWb	WbWb	R
NO CUTS	557	37	594	590	1
VETO	6.3	2.4	8.7	9.4	0.93