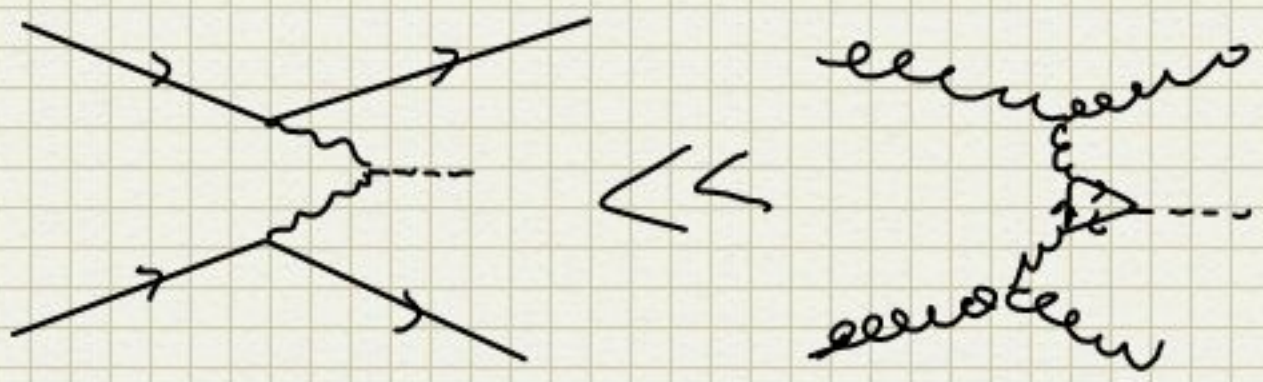
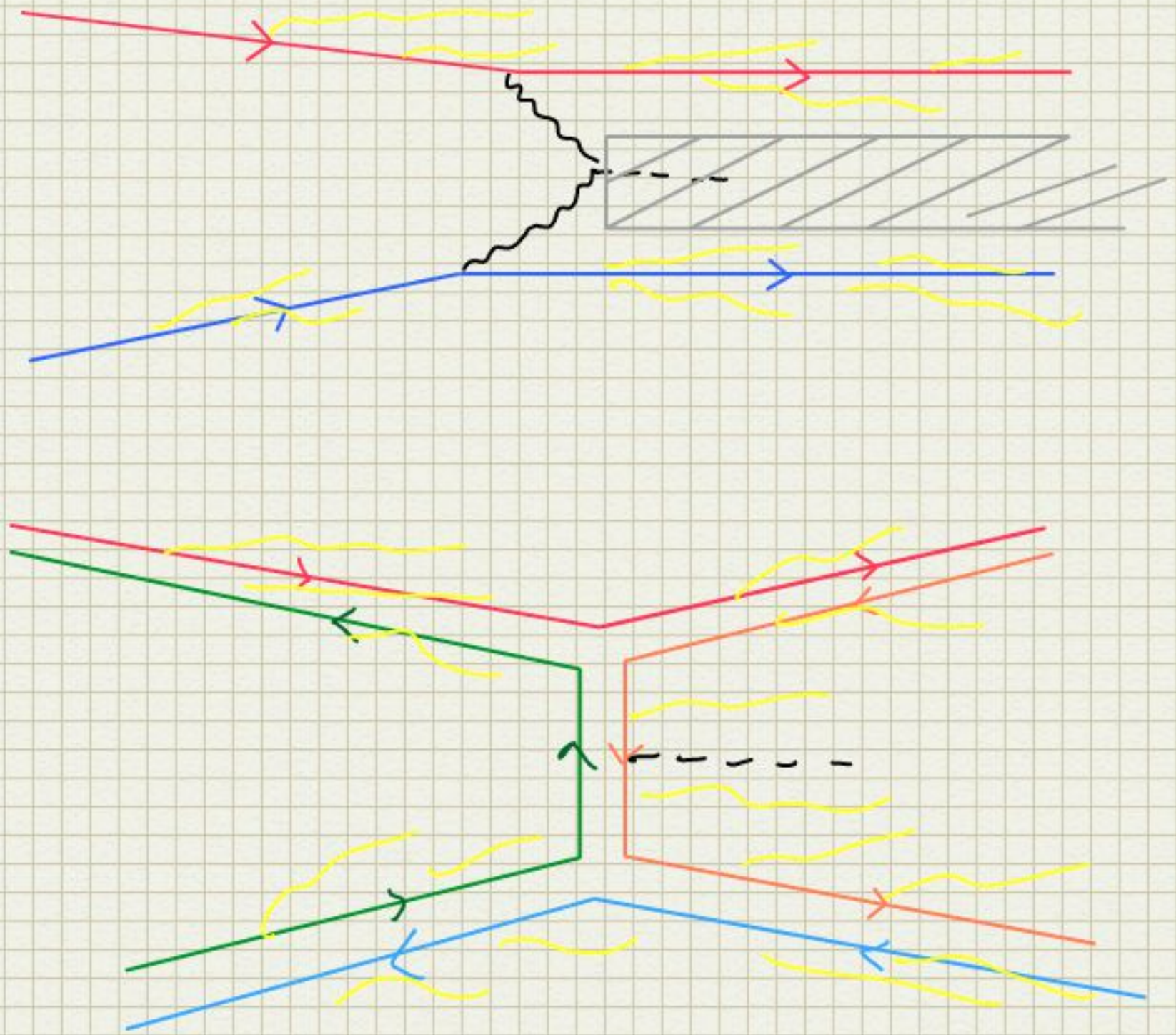
Vector - Boson - fusion

Why VBF?

* 2nd Largest xsec @ LHC
* Direct access to WWH and ZZH couplings
  - ⇝ Test of SM
  - ⇝ Unitarity!
* Distinctive experimental signature
  - ⇝ 2 foward jets
  - ⇝ little central jet - activity
* Allows to tag candidate H-events
  - ⇝ reduce backgrounds
  - ⇝ search for rare decays.
* $H\ p_T \neq 0$ @ LO
  - ⇝ cf. ggF.
  - ⇝ easier to find invisible decays with large $\not{E}_T$.



⇝ VBF is buried under ggF.



Can distinguish VBF and ggF by looking at radiation pattern.

⇝ Require 2 forward jets and little central jet activity.

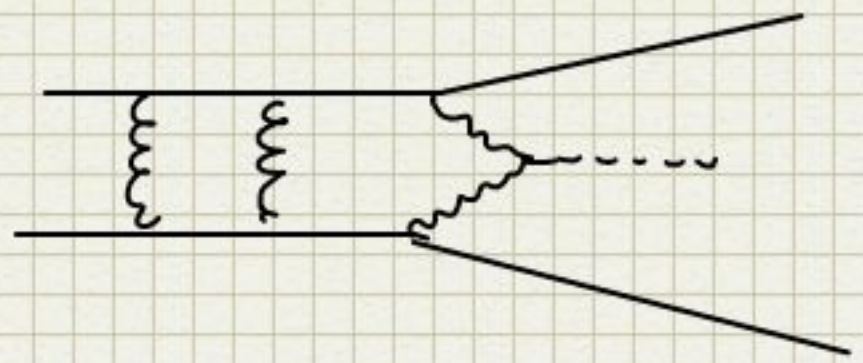
⇝ 'VBF' cuts: e.g.

- at least 2 jets with $p_T > 25$ GeV
- 2 hardest jets

$|y| < 4.5$ $\quad \Delta y_{j_1 j_2} < 4.5$ $\quad m^2_{j_1 j_2} > (600\,\text{GeV})^2$

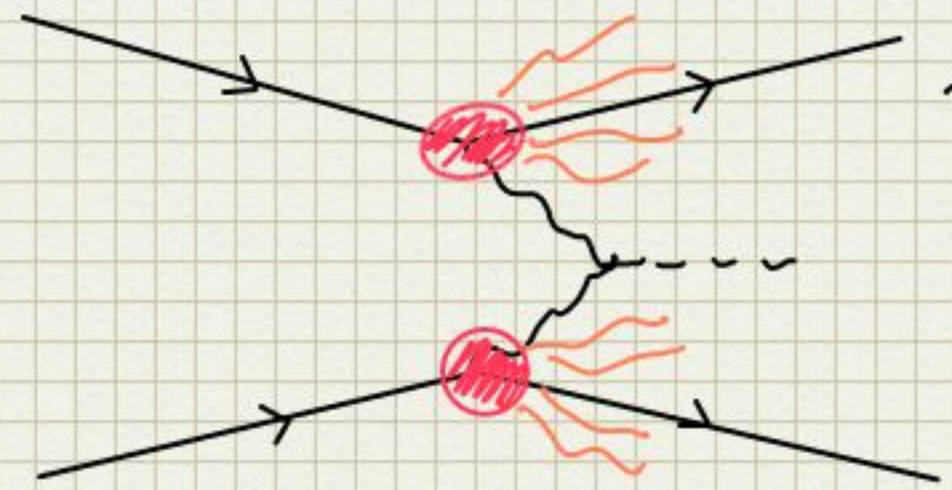
⇝ After VBF cuts, contamination from ggF reduced to ~10%.

VBF @ NNLO would require Pentaboxes with internal masses



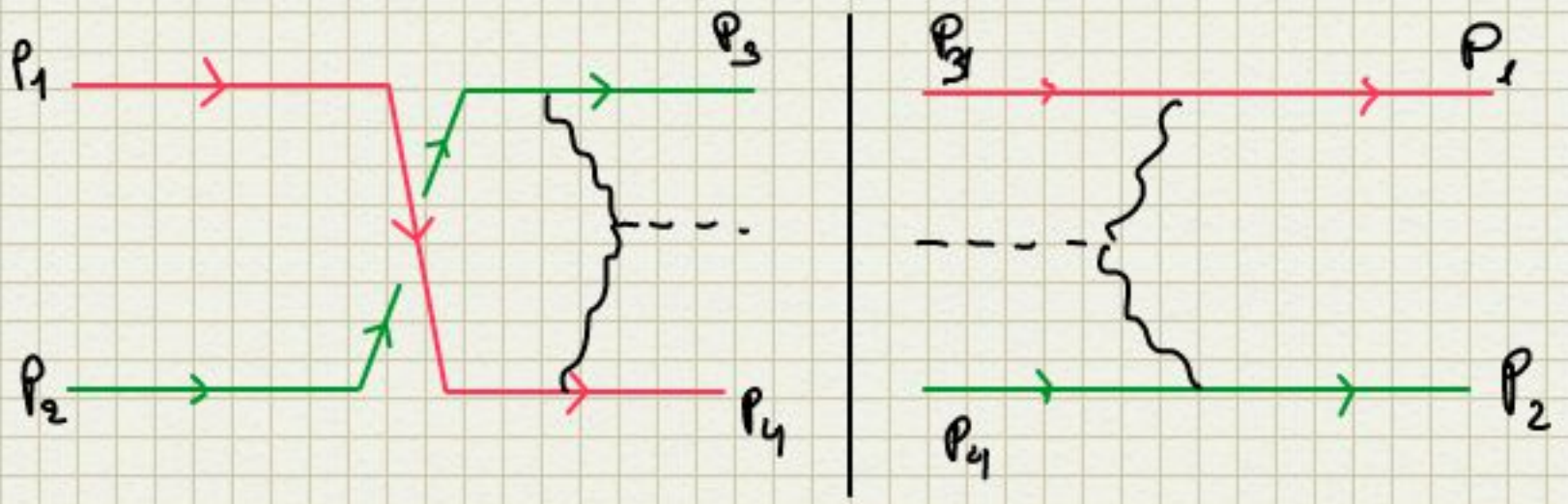
⇝ beyond reach of current technology.

<u>Approximation</u>: No color exchange between upper and lower line (Form factor approach).



⇝ Each blob is a DIS form factor

* Exact @ LO and NLO



Color does not match at NLO!

⇝ diagram must vanish

More formally:

$$T^{a}_{i_1 i_3}\; T^{a}_{i_2 i_4}\; \delta_{i_1 i_3}\; \delta_{i_2 i_4} = T_R \left(T^a\right)^2 = 0$$

* Beyond NLO, these diagrams are suppressed by color and kinematics

- By color :

$\sim N_c^2$

NS:

$\sim N_c^4$

- By kinematics: emissions are preferentially in the direction of the emitter (cf. angular ordering)
  ⇝ large angle emission suppressed

VBF is known in the form factor approach @ NNLO

- inclusively ⇝ small corrections
- differentially ⇝ up to 10% corrections after VBF cuts.