VBF update on cross section at 13.6 TeV

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13.6 TeV update - inclusive

- NLO EW corrections **ready**. Provided by **Alexander Mück**
  - using *Hawk* [Denner, Dittmaier, Kallweit, Lang, Mück]
- N3LO QCD corrections **ready**. Provided by **Alexander Karlberg**
  - using *proVBFH* [Cacciari, Dreyer, Karlberg, Salam, Zanderighi]
  - bug to be **fixed** (at least below per mille).
- Combination for inclusive prediction **done** following Yellow report 4.

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- Add-on: Inclusion of non-factorisable corrections based on [Asteriadis, Brønnum-Hansen, Melnikov; 2305.08016].
  - First results **received** (today). **Request** on scan possibility.

Follow up, systematic study at differential level

Big boost in Les Houches last month!

1. Provide state-of-the-art predictions at the differential level at fixed order
   - NNLO QCD + NLO EW
   - double/triple differential and STXS binning
   - physical understanding of various approximations (*kill several birds with one stone*)
   - **size of irreducible background**
   - **non-factorisable corrections**
2. First step toward systematic estimate of PS uncertainty in VBF
   - same set-up as for fixed order
   - use Powheg/Sherpa with different parton showers
   - **uncertainty in non-perturbative part, in particular UE, hadronisation, MPI etc.**

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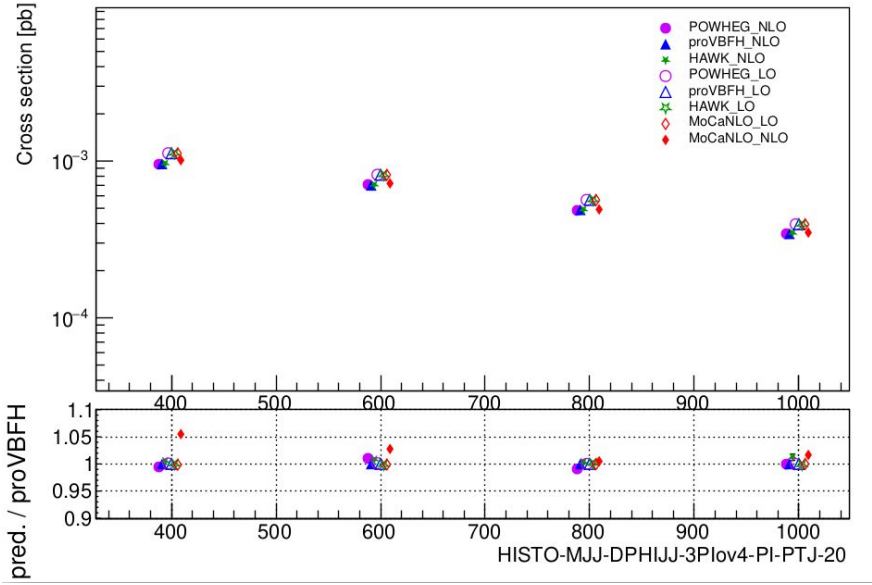
Codes: Hawk, proVBFH, MoCaNLO, Powheg, Sherpa, Pythia, Herwig, MG_aMC@NLO

Follow up, systematic study at differential level (Fixed order)

1. Tuned comparison of various fixed-order codes (**with different approximations**)
   - data produced at LO and NLO QCD
   - Fine for fiducial set-up -> Input OK.
     investigating for STXS set-up

2. Interpretation of physical result
   - provided refined estimate of uncertainties (EW corrections, VBF approximation, …)
   - understand differences and make recommendations



Follow up, systematic study at differential level (PS)

1. Comparison of different parton shower
   - alline with set-up of fixed-order study
   - agreement on what combinations to run
   - comparison with different parton shower (different physics)

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1. VBF_H in POWHEG-BOX-V2, showered with                    [powheg event generation by Silvia Ferrario]

   1.1 PYTHIA8, dipole shower                               [shower by Christian Preuss]
   1.2 PYTHIA8, vincia shower                               [shower by Christian Preuss]

   1.1 HERWIG7, angular-ordered shower                      [shower by Silvia Ferrario]
   1.1 HERWIG7, dipole shower                               [shower by Silvia Ferrario]                    [~~~~~~~~~~~~~~~~]


2. EW HJJ in POWHEG-BOX-RES, showered with                  [powheg event generation by Silvia Ferrario]

   2.1 PYTHIA8, dipole shower                               [shower by Christian Preuss]
   2.2 PYTHIA8, vincia shower                               [shower by Christian Preuss]

   2.1 HERWIG7, angular-ordered shower                      [shower by Silvia Ferrario]
   2.1 HERWIG7, dipole shower                               [shower by Silvia Ferrario]                    [~~~~~~~~~~~~~~~~]


3. VBF_H in MG5, showered with HERWIG7 AO,                  [Marco Zaro]

4. Standalone Herwig7 VBFH runs, with VBFNLO matrix elements  [input cards by Silvia Ferrario, runs by Yacine Haddad]
   4.1 POWHEG + angular-ordered shower                                                                  [~~~~~~~~~~~~~~~~]
   4.2 POWHEG + dipole shower                                                                           [~~~~~~~~~~~~~~~~]
   4.3 MC@NLO + angular-ordered shower                                                                  [~~~~~~~~~~~~~~~~]
   4.4 MC@NLO + dipole shower

5. Standalone Herwig7 EW HJJ runs, with HJETS matrix elements   [input cards by Silvia Ferrario, runs by Yacine Haddad]
   5.1 POWHEG + angular-ordered shower                                                                  [~~~~~~~~~~~~~~~~]
   5.2 POWHEG + dipole shower                                                                           [~~~~~~~~~~~~~~~~]
   5.3 MC@NLO + angular-ordered shower                                                                  [~~~~~~~~~~~~~~~~]
   5.4 MC@NLO + dipole shower

6. Standalone Sherpa VBFH runs with MC@NLO matching and:
   6.1 default shower
   6.2 dire shower                                                                                      [~~~~~~~~~~~~~~~~]

7. Standalone Sherpa HJJ EW runs with MC@NLO matching and:
   7.1 default shower
   7.2 dire shower                                                                                      [~~~~~~~~~~~~~~~~]
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Follow up, systematic study at differential level (PS II)

2. Make some statements about parton shower uncertainty

   -> following recommendations of [Buckley et al.; 2105.11399]

3. Study of non-perturbative physics in PS

   Could wrong PS recoil have biased tunes?

-> Meeting in 10 days to keep momentum

Write up an article and published it
timeline: a couple of months …
… if nothing unexpected happen (for now, not the case)