Disclaimer: this is still a (very) incomplete version of this section to show the outline and plans. Feedback and comments are very welcome.

0.1 Simplified Template Cross Sections

The concept of simplified template cross sections was developed as a way to naturally evolve the signal strength measurements used during Run1. While the simplified cross sections at first sight look similar to a differential cross section measurement, they aim to combine the strength of the signal strength measurements and fiducial and differential measurements. They are not designed to take the place of the fiducial and differential measurements, which can only be carried out in a subset of decay channels in the foreseeable future in any case.

The main goals of the simplified template cross section concept are to maximize the sensitivity of the measurements, and at the same time to minimize the theory dependence. This means in particular

- combination of all decay channels
- measurement of cross sections instead of signal strengths, in mutually exclusive regions of phase space
- cross sections are measured in a given production mode
- measurements are performed in abstracted/simplified fiducial volumes
- allow the use of advanced analysis techniques such as event categorization, multivariate techniques, ...

The definition of the exclusive regions of phase space, called "bins" for simplicity, is specific to the different production modes and is motivated by

- minimization of theoretical uncertainties

- isolation of BSM physics

A sketch of the simplified templace cross section measurements is shown in Fig. 1. The analyses are very similar to the Run1 coupling measurements: for each decay channel, the events are categorized, as shown on the left part of the sketch. In general, there are several motivations for categorization. A subset of the categories is defined so that they are enriched in events of a given production mode, usually making use of specific event topologies, which allows the splitting of the production modes by the global fit. Another subset of categories is defined so that they increase the sensitivity of the analysis by splitting events accordings to their expected signal-to-background ratio and/or invariant mass resolution. In other cases, the categories are motivated by the analysis itself, e.g. a consequence of the background being estimated specifically for classes of events. The details of the categorization in the analyses will have to be optimized in order to give good sensitivity to the simplified template cross sections to be measured.

The center of the sketch shows the simplified template cross sections that will be the main results of these measurements: cross sections per production mode, split into exclusive bins for the main production modes. The decays will be treated by fitting ratios of the partial widths.

The simplified template cross sections and the ratios of decay width can then serve as input for subsequent interpretation. This could be the determination of signal strength if wished for compatibility with earlier results, coupling scale factors κ, EFT coefficients or tests of specific BSM models.

To increase the sensitivity to BSM effects, the simplified template cross sections can be interpreted together with e.g. POs in Higgs boson decays. To make this possible, the experimental and theoretical correlations between the simplified template cross sections and the decay POs need to be evaluated and taken into account in the interpretation.

0.1.1 Guiding principle in the definition of the simplified template cross sections

- Reasons to split bins (minimize theory dependence, varying acceptance, ...)
- Discuss staging and practical implementation (separate section?)
  - Stage 0: inclusive cross sections (closest match to Run1)
  - Stage 1: aim for a detailed proposal
  - Stage 2: present ideas for extension

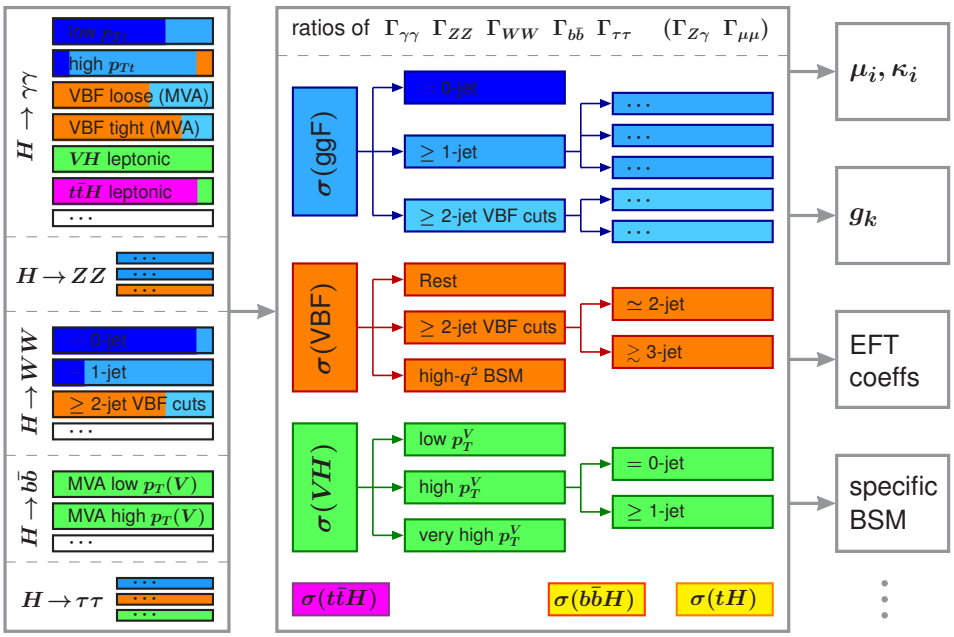

Figure 1: Sketch of the simplified template cross section framework.

- ...

0.1.2 Definition of leptons and jets

The measured cross sections are unfolded (by the global fit to the event categories in all decay channels) to the simplified template cross sections. For this purpose, and for the comparison between measured simplified template cross sections and predictions from analytic calculations or MC simulations, the truth final state particles (for practical purposes in the MC) need to be defined unambiguously. The definition of the final state particles, leptons, jets, and in particular also the Higgs boson are kept simpler, and more idealized, than in the fiducial cross section measurements. Treating the Higgs boson as a final state particle is what allows the combination of the different decay channels.

Still need to see if there are potential issues with certain event generators, e.g. Sherpa.

Higgs boson

As the simplified template cross sections only consider on-shell Higgs bosons, the unfolding should be done to an on-shell Higgs boson. A rapidity cut at 2.5 was discussed as the current measurements have no sensitivity beyond this, and this part of phase space would only be extrapolated by the simulation. On the other hand, it is in principle possible to use forward electrons (up to $|\eta|$ of 4.9) in $H \to ZZ^* \to 4\ell$ and extend the accessible rapidity range.

Jets

Truth jets should be defined as anti-k_t jets with a radius of 0.4, including all stable particles associated to the jet, including neutrinos and leptons from hadron decays. Stable here has the usual definition, with a lifetime greater than 10 ps, i.e. those particles that are passed to GEANT in the experimental simulation chain. Particles from the Higgs boson decay should be removed as they are accounted for by the truth Higgs boson. There should be no restriction on the rapidity of the truth jets. A common p_{T} threshold at 25 or 30 GeV should be used for all truth jets. A lower threshold has the advantage that it splits the events more evenly between the different bins. **Still to be decided, some feedback from the experiments would be useful.**

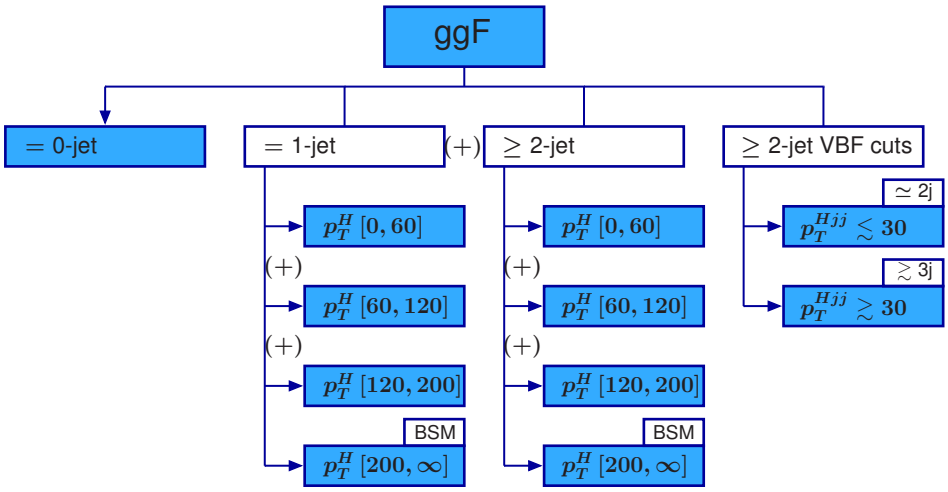

Figure 2: Simplified template cross section definitions for gluon fusion production (stage 1). **Status Jan14 as presented at the workshop.**

Leptons

Electrons and muons should be dressed, i.e. FSR photons should be added back to the electron or muon. τ can be defined from the sum of their decay products. There should be no restriction on the transverse momentum or the rapidity of the leptons.

0.1.3 Treatment of $gg \to H$ production

Add experimental and/or theoretical motivation for each bin.

- ...

0.1.4 Treatment of VBF production

- ...

0.1.5 Treatment of VH production

- ...

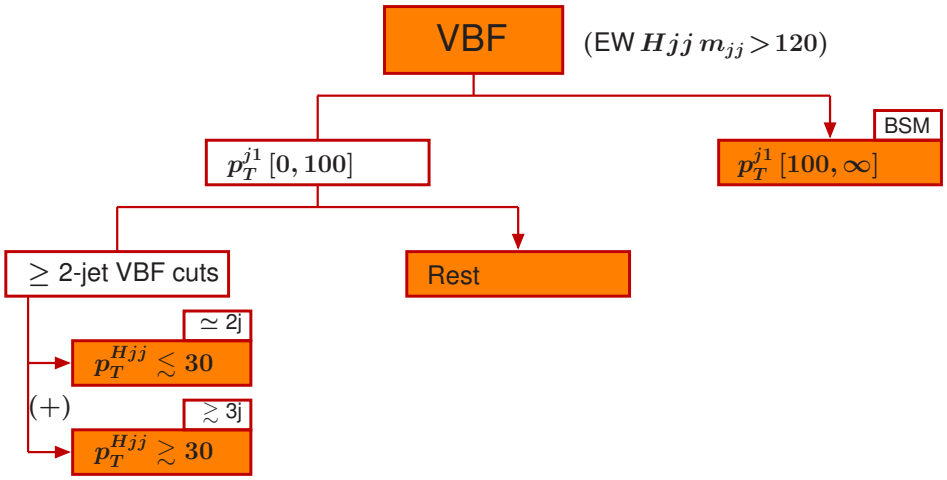

Figure 3: Simplified template cross section definitions for vector boson fusion production (stage 1). **Status Jan14 as presented at the workshop.**

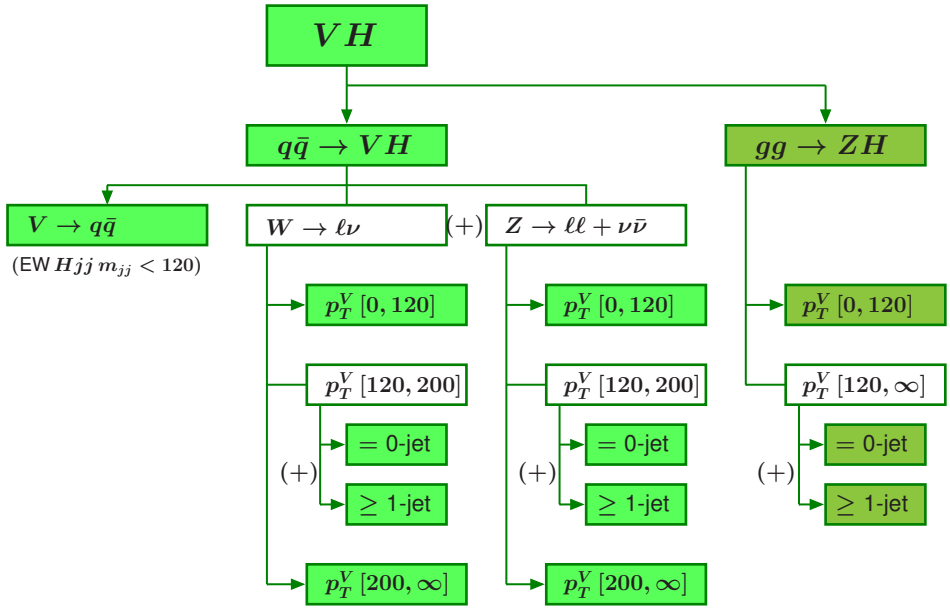

Figure 4: Simplified template cross section definitions for production in association with vector bosons (stage 1). **Status Jan14 as presented at the workshop.**

0.1.6 Treatment of ttH production

- ...

0.1.7 Treatment of bbH and tH production

In the foreseeable future, there will only be one inclusive bin for $b\bar{b}H$ production and only one inclusive bin for tH production.