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Subgroup 3: LHC Higgs Off-shell Interpretations Theory Uncertainties

Summary of first meeting, 9 April 2020
ATLAS:
- uses NLO QCD accurate 0-jet and 1-jet final states, and LO 2- and 3-jet final states for qqb->ZZ, merged in Sherpa using MePS@NLO prescription.
- uses NLO EW corrections as a function of mZZ.
- "rho" prescription to take into account the assumption of factorized QCD and EW corrections.
- Theory uncertainties in the gg -> ZZ and qqb -> ZZ processes are 3%-4% and are the largest systematic uncertainties in these analyses.

CMS:
- uses POWHEG samples for NLO qqb-> ZZ, with NNLO corrections applied (as a function of mZZ?)
- Virtual EW corrections applied as functions of s-hat and t-hat.
- Use rho prescription to account for factorized QCD and EW corrections, with conservative error estimate for rho < 0.3.
- EW corrections strongly dependent on mZZ: very small for mZZ < 200 GeV; becomes ~ 20% at mZZ ~ 1 TeV.

Main differences between ATLAS and CMS analyses:

Generation of events:
- comparison plots 1, 2, 3 indicate that the CMS setup has a softer pt spectrum for the ZZ system compared to ATLAS. This is perhaps expected considering that the ATLAS setup will generate more events with 2 or 3 hard jets.
- Also a ~20% difference at mZZ ~ mZ which seems harder to explain (e.g. it is larger than the NNLO correction). For this reason, building a control region from Z->4l region to transfer normalization factors (or a joint fit) does not seem to have corresponding properties to the mZZ>200 GeV off-shell region.

Treatment of EW uncertainties:
- for rho < 0.3, ATLAS assumes no additional uncertainty from factorization of QCD and EW corrections, while CMS uses \deltaEW*\deltaQCD, which sizable.

Future directions:
1. Careful study of event generation using the ATLAS and CMS study.
2. Invited theory talk on uncertainties in merging and matching (speaker TBD)

3. Invited talk by one of the authors of arXiv:1912.00068 on uncertainty from factorized QCD and EW corrections.

4. Progress towards NNLO+PS for VV?