$H \rightarrow bb$ Subgroup Meeting: Overview and Discussion of Charge

Jim Olsen

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Overview

- The charge is posted to this agenda. The work for 2011 is divided into production (mostly THY) and decay (mostly EXP) subgroups.
  - Relevant production modes: VH, ttH, bbH (?)
  - Relevant decays: H → bb, H → bbγ (?)
- We continue to focus on 7 TeV CM energy.
- The LHC Higgs Combination WG was formed in Dec 2010 to normalize methods for combining results across experiments. We should follow any issues related to H → bb modes.
- Target for Phase 2: one or two publications by the end of 2011.
  - Should have first results at BNL, May 2011. http://www.bnl.gov/hcs/

Higgs Signal

- Compute cross sections within plausible acceptance cuts
  - First round of minimal cuts organized last year (on twiki page). Is it enough? How detailed do we want to get here? My opinion:
    - The goal of this group should NOT be to converge on a "common analysis" between ATLAS/CMS/LHCb.
    - Rather, this should be a forum to discuss common issues that can be answered using common, publicly available tools.
    - Part of our work should be to identify these common issues in the context of VH(bb) and ttH(bb) production/decay.

Higgs Signal (cont)

- Possible common issues:
  - Differential K-factors from (N)LO to (N)NLO after cuts; investigate as a function of the cut
    - Work in VH context has begun in CMS (Doug Wright)
  - Study effects of jet veto and/or b-tagging on different K-factors. Higgs and jet pT shapes vs. cuts.
    - Here we are starting to get into “common analysis” issues, so I would propose that this work focus on possible THEORY issues that could be resolved in coordination with our theorist colleagues
    - For the jet veto, the link is clear (compare higher-order calculation to estimate systematics); for b-tagging, it’s not so clear to me that there are common issues to solve.
- Compare NLO MC, and NNLO calculations that might provide differential distributions some day
  - We should gather together on a twiki page a list of common tools for this effort: POWHEG, MC@NLO, SHERPA, what else?

SM Background

- Here there is a very precise prescription offered in the charge (I paraphrase here and there):
  1. Define the model control region in which we can measure backgrounds in data; check how the K-factor is changing with cuts in that region
     - Again, I expect different experiments to define different control regions as they prefer, so we should keep it simple.
  2. Determine the precision with which the SM bkg will be measured, and the available THY precision. Is it sufficient?
     - Dominant backgrounds in VH: V+bb, ttbar, VV
  3. How does the THY uncertainty map onto the error in extrapolating backgrounds between control and signal regions?

SM Background (cont)

4. As for the Higgs signal, use the most advanced NLO MCs available. Fold in NNLO calculations where available/appropriate.
5. Compute interference between signal and background at LO. Investigate how this will change at NLO.
   - I have to admit, I have no idea what this means. Is it relevant for $H \rightarrow bb$? If not, we can knock off one action item already!
6. For the SM bkg that cannot be measured with data-driven techniques, the THY uncertainty should be evaluated in the signal region.
   - Can we bound potential systematic uncertainties using theory only? Even if useful control regions do not exist for some backgrounds, can we check theory in some other way? (We are not completely ignorant, theory/MC can/will be used to set systematic uncertainties.)

Theory Uncertainties

- We (LHC WG, not the bb sugroup) are expected to provide the theory uncertainty (THU) for each LHC experiment and possible combination at LHC.
  - I assume this means that, where experiments have different cuts/methods, individual THUs will be available. We should check this.
- We should follow closely the relevant theory sub-group meetings, and provide rapid feedback/ideas relevant for our work.