https://indico.cern.ch/event/641872/

Notes on DM WG informal discussion of 2HDM models, 24 May 2017

Agenda

Goals for the core group/this effort

(Antonio, Steven, Caterina for the WG)
Decide on the scope of the effort.

- We suggest finding a set of benchmarks that show how different searches fit together—the range of possible signatures, where different types of results are complementary and where certain searches are dominant (e.g. where monoH is the most sensitive analysis, or precision H most constraining, or neither). Ideally, with a small set of benchmark points we can tell some of the story.
- Are there search targets (uncovered signatures, or regions of parameter space missed by our present searches)

Both these topic have open-ended answers. We will need to decide on how to balance

- meeting the needs of the ATLAS and CMS searches still being done on 2015–2016 data, keeping in mind that searches may want to generate MC in a timely fashion.
- thoroughly exploring what the model predicts for the entire Run 2 dataset O(100/fb)

Where we make choices to restrict the scope, we should attempt to explain the reasoning behind these choices and sketch how future work could build on our efforts. The outcome of the effort will be a bottom-up set of recommendations from the ATLAS and CMS participants as well as the theorists. It will be made public, with an authorlist including all those who contribute to the effort.

Discussion

The rest of the meeting consisted of further discussion what ATLAS and CMS presented at the last DM WG meeting. What follows are the details of that discussion and a partial to-do list.

The organizers will schedule another meeting in the coming week or two; please update your regular availability on the doodle.

Git repository

Git project for sharing the cross-sections, parameter cards and details of the generation, set up with Sam Meehan's help:
https://gitlab.cern.ch/lhc-dmwg-material/cross_section-repository
The ATLAS mono-Higgs team has added the cross-sections for the preliminary scan proposal.

Model study developments
(Oleg, Lars, Benedikt, Eiko, Uli, Priscilla, Katharina, Arely, Stanislava, Kevin, others)

Mono-Higgs
- ATLAS presentst two choices: mH = mA + 100GeV, and mH = mA (smaller mono-Higgs sensitivity).
- if the kinematic distributions do not change, one can simply rescale the points (generating truth-level samples)
- comment from Uli: it may make more sense to fix one of the masses (the heavy H or the heavy pseudoscalar) and scan mA and tanBeta. Letting the charged Higgs mass go beyond 1 TeV may present problems with too large width. This also depends on the mixing angle and on tanBeta. Also there may be issues with the perturbativity of trilinear couplings if the masses are not close enough/precision constraints.
- the sensitivity as a function of sinTheta could be quantified. However, there is the risk of hitting non-perturbative limits / precision constraints.
- CMS proposes to have more planes for the scan, the one proposed by ATLAS but also investigating other possibilities.

Action items: investigate and quantify
- MET shapes after cuts for the two cases
- ATLAS can make those plots for simplified analysis
- MET shapes after cuts for varying tanBeta
- widths for the two scenarios investigated by ATLAS
- CMS has these plots
- they can also be found in the paper by No et al.
- sensitivity of monoH->gammagamma (it is statistically-limited, but has a better low MET reach)

ttbar+MET
- sensitivity of monojet or ttbar+MET is generally less than monoH/Z in the benchmarks investigated by the paper. However this statement depends on the systematic uncertainties, ttbar+MET and monojet can be interested for heavier pseudoscalar masses.
- for ttbar+MET the cross-section increases with high

tanBeta.

Action items
- ATLAS and CMS should agree on the details of the generation (see Yoav's talk). Priscilla and Uli will follow up offline on the NLO.
- there is a good mapping in kinematics between the DMF pseudoscalar model and the 2HDM+pseudoscalar. Build a map of xsecs/2HDM parameters (that can rely on the CMS studies) on the truth points used to compare the kinematics that maps to a single DMF pseudoscalar model, and have the cross-sections there as well. At this point we can also check the scenarios that are more favourable to the signature.

What we should get ready is a direct mapping for the points that ATLAS has, and provide xsecs.
- Kevin: kinematics map on pseudoscalar model, so not immediately something to do.
- Uli confirms, this is expected; only tuned place where something may happen is when mh ~= mH, because of interference. Same is true for monojet. For mono-Z/H this is not true.
- further question: are the proposed set of parameters optimal for ttbar, where is the best-case scenario for ttbar?

Mono-Z
Action items
- Test the mono-Higgs grid, propose alternatives.

Mono-jet
Action items
- Confirm the findings on rescaling by the ttbar+MET teams.