

# Referee response report for SAIP2016 submission 331

We thank the referees for a fair review of the submission – entitled “Constraints on new hypothetical particles in the Higgs sector using LHC Run 1 and 2 data” – to the SAIP2016 book of proceedings.

Please find below my responses to the comments made on the submission.

Regards  
Stefan von Buddenbrock

## **Referee 1:**

*This paper is a BSM theoretical extension, introducing a full Two-Higgs Doublet Model and outlining the potential Run 2 searches which could constrain the parameters of such a model. The search context considers Higgs production in association with missing energy, leptons and large jet multiplicities. Studies of some of the rates and kinematic distributions are presented considering the ATLAS Z+MET search.*

*The paper is very well written, mature clear and polished.*

*Undoubtedly worthy of publication.*

*The use of the word excess is too prolific and ill defined and needs to be sharpened. The language used in discussing deviations and possible new physics should necessarily be measured and conservative, and confined to the precise definitions. As such, an "excess" needs to have a global significance of 3 sigma to qualify for the title "excess". Some looseness of phrasing may be tolerated if the context makes it clear that one is not making a statistically significant claim. However, the word excess appears far too often in the context that the reader could be misambiguated that these are foregone conclusions to be globally statistically significant. The paper does not need to be bolstered by over dramatised sensational style phrasing.*

*This must be corrected.*

*The authors should prefer the word deviation, they should take care that a reader is not misled.*

This is well understood, and will be dealt with according to the prescriptions listed below.

*Page 3 Just before and after the Section 3 heading  
The claim in some cases of a 3 sigma excess should be qualified as local.  
3 sigma --> local 3 sigma significance*

Done.

*Page 1  
replace 3 occurrences of excesses with deviations  
You could rephrase the third occurrence like this ...*

*This short paper explores the result of combining these excesses under the common hypothesis that a heavy scalar  $H$  exists with assumptions on its production mechanism and decay modes. --> This short paper explores the result of combining these deviations under the common hypothesis that a heavy scalar  $H$  exists with assumptions on its production mechanism and decay modes. Such a combined analysis may actually yield an excess.*

Done. Although when referring to the top associated production cross section, I have elected to use the word "enhancement", since the cross section is systematically higher, and "deviation" only implies that it would be different from the expected value.

*Page 2  
replace 3 occurrences of excesses with deviations*

Done.

*Page 6 line 7  
As an example, the use of the word excess here is OK as it is qualified by a significance.*

*Conclusion  
ATLAS and CMS have not claimed any such excess. This is therefore an example where the word is particularly offensive and inaccurate. Change it to deviation.*

Done in all cases. Thank you for the summary.

## Referee 2:

*This submission reports on results available here:<https://arxiv.org/pdf/1606.01674.pdf>, and here:<https://arxiv.org/pdf/1506.00612.pdf>*

*The authors should highlight what is new in this submission*

It is true that many of the same visuals are included in this short paper as those included in the references you have given (one of which has been published, the other has not). This is merely to summarise the spirit in which the idea of the new heavy scalar boson is introduced. The focus of this paper is to mention how the prediction of the model affects a certain final state, i.e. two SFOS leptons and large missing energy as in the SUSY Z+MET search. The difference in this short paper is that a more intentional comparison to the ATLAS data is discussed, whereas the published paper above (<https://arxiv.org/pdf/1606.01674>) only discusses the final state hypothetically. This has been mentioned in the introduction.