Validation of CheckMATE Implementation of ATLAS-HIGG-2013-03

A.C.Freegard
acf1g14@soton.ac.uk

March 2021

Abstract

This note details the validation of CheckMATE[1] analysis of the 8 TeV ATLAS search[2] for invisible Higgs decays in association with a leptonically decaying Z boson. The events used for the validation were generated with CalcHEP[3], with 100000 events produced for the benchmark point, $MH = 125.5$ GeV. Leptonic decays of Z production were also specified in CalcHEP to improve efficiency, which were then showered with CheckMATE's built-in Pythia 8[4] module. Detector effects are also applied via CheckMATE's Delphes[5] module.

Cut	Acc	Weighted	Change	MadAnalysis	Change	Official	Change
01 Initial	1.00	838.9		838.9			
02 OS leptons	0.40	336.1	60%	256.2	69%		
03 Zwindow	0.38	317.7	5%	244.1	5%	243	
04 MET> 90	0.15	122.8	61%	105.1	57%	103	58%
05 dilepton-MET separation	0.12	104.3	15%	91.7	13%		
06 lepton-lepton separation	0.10	86.4	17%	82.9	10%		
07 pTmiss-MET separation	0.10	81.5	6%	76.5	8%		
08 pTll-MET similarity	0.07	60.4	26%	63.2	17%		
09 jetveto	0.06	51.1	15%	54.8	13%	$44 \pm 1 \pm 3$	

Table 1: Cutflow table for benchmark point of the process $HZ \to \nu\nu\nu\nu\ell\ell$, for $M_H = 125.5$ GeV

References

[1] Daniel Dercks, Nishita Desai, Jong Soo Kim, Krzysztof Rolbiecki, Jamie Tattersall, and Torsten Weber. CheckMATE 2: From the model to the limit. *Comput. Phys. Commun.*, 221:383–418, 2017.

[2] G. Aad, T. Abajyan, B. Abbott, J. Abdallah, S. Abdel Khalek, O. Abdinov, R. Aben, B. Abi, M. Abolins, O. S. AbouZeid, and et al. Search for invisible decays of a higgs boson produced in association with azboson in atlas. *Physical Review Letters*, 112(20), May 2014.

[3] Alexander Belyaev, Neil D. Christensen, and Alexander Pukhov. CalcHEP 3.4 for collider physics within and beyond the Standard Model. *Comput. Phys. Commun.*, 184:1729–1769, 2013.

[4] Torbjörn Sjöstrand, Stefan Ask, Jesper R. Christiansen, Richard Corke, Nishita Desai, Philip Ilten, Stephen Mrenna, Stefan Prestel, Christine O. Rasmussen, and Peter Z. Skands. An Introduction to PYTHIA 8.2. *Comput. Phys. Commun.*, 191:159–177, 2015.

[5] J. de Favereau et al. DELPHES 3, A modular framework for fast simulation of a generic collider experiment. *JHEP*, 1402:057, 2014.