IL NUOVO CIMENTO **40 C** (2017) 20
DOI 10.1393/ncc/i2017-17020-y

COLLOQUIA: IFAE 2016

ATLAS and CMS results on Mono Higgs

G. MINIELLO(1)(2)

(1) *INFN, Sezione di Bari - Bari, Italy*
(2) *Dipartimento di Fisica, Università degli Studi di Bari - Bari, Italy*

received 17 October 2016

Summary. — This contribution will present updates on Mono-Higgs analyses (with $H \to b\bar{b}$ and $H \to \gamma\gamma$) using data collected by ATLAS and CMS experiments in proton-proton collisions at 8 TeV. The benchmark models used are simplified models (mainly the Z'-two-Higgs-doublet model) and models from the Effective Field Theory.

1. – The Mono Higgs analysis

Many Dark Matter (DM) candidates (indicated from now on with χ) have been proposed in the Beyond Standard Model scenario on electroweak symmetry breaking scale. After the Higgs boson discovery, one of the most promising idea is to use it as a probe for searching for dark matter signature.

The Mono-Higgs signature consists of a final state including a Higgs boson plus a high missing transverse energy (MET). The main advantage with respect to the other Mono-X analyses is the ISR suppression due to the small coupling of the Higgs to quarks [1]. Two kinds of models are used for this analysis, one based on Effective Field Theory (EFT), which uses non-renormalizable operators and generate an H + MET final signature without specifying underlying UV physics, and the other based on simplified models (such as Z'-2HDM) in which a *new* vector, scalar or pseudo-scalar massive particle mediates the DM-H interaction [2].

2. – The analysis strategy

ATLAS and CMS experiments [3, 4] performed two Mono-Higgs analyses exploting the $H \to b\bar{b}$ and $H \to \gamma\gamma$ final states. The data considered for both the analysis have been collected from proton-proton collisions at a center-of-mass energy $\sqrt{s} = 8\,\text{TeV}$ corresponding to an integrated luminosity of $20.3\,\text{fb}^{-1}$ in the case of the ATLAS detector at the LHC.

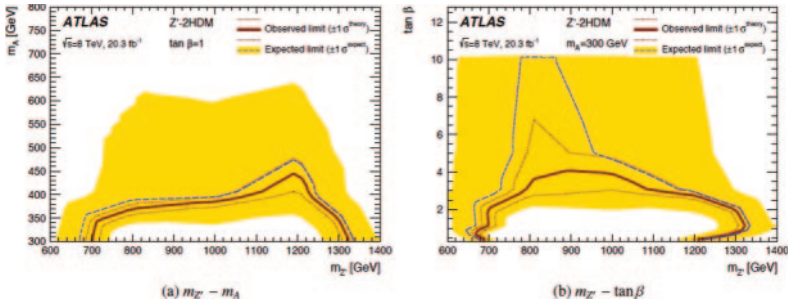

Fig. 1. – The Z'-2HDM exclusion contour in the (a) $m_{Z'}$-m_A plane for tanβ = 1 and (b) $m_{Z'}$-tanβ plane for $m_A = 300\,\text{GeV}$ for the resolved channel in Mono-Higgs, $H \to b\bar{b}$.

For the final state $H \to \gamma\gamma$+MET, the selected events are required to have a Higgs boson candidate consisting of two photons with $105 < m_{\gamma\gamma} < 160\,\text{GeV}$, $p_T^{\gamma} > 0.35(0.25)m_{\gamma\gamma}$ of the leading (subleading) photon, $MET > 90\,\text{GeV}$ and $p_T^{\gamma\gamma} > 90\,\text{GeV}$.

To avoid any loss in acceptance, two Higgs reconstruction techniques have been used for the final state $H \to b\bar{b}$: resolved and boosted. The resolved technique reconstructs the Higgs candidate from pairs of nearby $anti - k_t$ jets, ensuring a good efficiency for $150 < p_T < 450\,\text{GeV}$ of the Higgs, while the boosted one is used for Higgs $p_T > 450\,\text{GeV}$. In this analysis 95% CL limits on Λ as a function of DM mass for EFT operators have been calculated along with exclusion boundaries for Z'-2HDM model.

Figure 1 shows Z'-2HDM exclusion contour for a mass of the pseudoscalar mediator $m_{A_0} = 300\,\text{GeV}$ for Mono-Higgs with $H \to b\bar{b}$. The expected limit is given by the dashed blue line and the yellow bands indicate its uncertainty within $\pm 1\sigma$ while the observed limit is given by the solid red line and the uncertainty within $\pm 1\sigma$ is given by the red dotted line. The parameter spaces below the limit contours are excluded at 95% CL.

For more details about the selection cuts, the main backgrounds and the results of these analyses see [5, 6].

3. – Conclusions

For the ATLAS experiment boundaries and 95% CL exclusion limits for the Dark Matter search associated with a Higgs boson decaying into two photons and two bottom quarks have been calculated using data collected during RUN I corresponding to a luminosity $\mathcal{L} = 20.3\,\text{fb}^{-1}$ at $\sqrt{s} = 8\,\text{TeV}$ in pp collisions at LHC. For the CMS experiment the same analyses are currently under approval.

REFERENCES

[1] Carpenter L. *et al.*, *Phys. Rev. D*, **89** (2014) 075017.
[2] Abercrombie D. *et al.*, arXiv:1507.00966.
[3] ATLAS Collaboration, *JINST*, **3** (2008) S08003.
[4] CMS Collaboration, *JINST*, **3** (2008) S08004.
[5] ATLAS Collaboration, *Phys. Rev. Lett.*, **115** (2015) 131801.
[6] ATLAS Collaboration, *Phys. Rev. D*, **93** (2016) 072007.