Chapitre X
Recherche d'un boson de Higgs de haute masse

Sommaire

Citer The CMS Collaboration. « Search for additional neutral MSSM Higgs bosons in the di-tau final state in pp collisions at $\sqrt{s} = 13\,\text{TeV}$ ». *Journal of High Energy Physics* **09**.007 (sept. 2018). DOI : 10.1007/JHEP09(2018)007

et aussi nouvelle version full runII si possible

Citer la thèse de Gaël :

G. TOUQUET. « Search for an additional neutral MSSM Higgs boson decaying to tau leptons with the CMS experiment ». Thèse de doct. Université Claude Bernard Lyon 1, oct. 2019. URL : https://hal.archives-ouvertes.fr/tel-02526393

Citer également la thèse d'Artur ?

A. GOTTMANN. « Global Interpretation of $\tau\tau$ Events in the Context of the Standard Model and Beyond ». Thèse de doct. Fakultät für Physik des Karlsruher Instituts für Technologie (KIT), juin 2020. URL : https://publish.etp.kit.edu/record/22014

Études déjà menées au LEP [4] et au Tevatron [5, 6]

LHC : aussi avec $b\bar{b}$ [7, 8]

ATLAS $\mu\mu$ et $\tau\tau$ [9, 10]

CMS $\mu\mu$ [11] $\tau\tau$ [1, 12, 13]

object reco :

reconstruction τ_h [14, 15]

tauID [16, 17]

For muons selected in the emu and mutau channels additional *Medium muon* requirements as recommended by the Muon POG, are applied.[18]

In addition, electrons are required to pass an identification variable based on a Boosted Decision Tree (BDT) discriminator which uses track quality, shower shapes and kinematic quantities as input. The following variables are used as input to the BDT... [19]

lumi unc. [20]

gen_match	Type de particule	Propriétés de l'objet au niveau générateur
1	électron natif	$\|\text{pdgID}\| = 11$, $p_T > 8\,\text{GeV}$, `IsPrompt == True`
2	muon natif	$\|\text{pdgID}\| = 13$, $p_T > 8\,\text{GeV}$, `IsPrompt == True`
3	$\tau \to e$	$\|\text{pdgID}\| = 11$, $p_T > 8\,\text{GeV}$, `IsDirectPromptTauDecayProduct == True`
4	$\tau \to \mu$	$\|\text{pdgID}\| = 13$, $p_T > 8\,\text{GeV}$, `IsDirectPromptTauDecayProduct == True`
5	$\tau \to \tau_h$	Tau hadronique généré
6	Faux τ_h, τ_h de l'empilement	Tout objet ne rentrant pas dans les catégories 1 à 5

Tableau X.1 – *Valeurs prises par* `gen_match`*, variable de correspondance des taus hadroniques à l'objet généré dans les événements simulés.*

systematics EGamma recommendation [21].

PuppiMET [22] and PFJetsCHs

For the fit we use the implementation of the CL_S method [23] provided by COMBINE, the CMS Higgs combination tool based on RooStats [24].

In the absence of a signal, upper limits on the $\sigma \times \mathcal{B}^{\tau\tau}$ are set using the modified frequentist approach [25, 26].

systematic unc. shifts [27, 28]

1 Introduction

2 Sélection d'événements et catégorisation

2.1 Données

2.2 Simulation

2.3 Catégorisation

3 Chaîne d'analyse

τ_h ID and reco ?

4 Estimation du bruit de fond

4.1 Estimations de bruits de fond à partir de simulations

4.2 Estimations de bruits de fond à partir de données

4.2.1 Méthode de l'encapsulement ou *embedding*

4.2.2 Méthode du facteur de faux ou *fake factor*

5 Incertitudes systématiques

5.1 Incertitudes de normalisation

5.2 Incertitudes de forme

6 Résultats et interprétations

in transverse plane, with all neutrinos as one single particle, with $m \ll E$ for final decays,

$$m^2 = E^2 - p^2 = \left(\sum_{i \in \{ L_1, L_2, \nu \}} E_i \right)^2 - \left(\sum_{i \in \{ L_1, L_2, \nu \}} \vec{p}_{\mathrm{T}}{}^{i} \right)^2 \tag{X.1}$$

$$= \left(E_1 + E_2 + E_{\mathrm{T}}{}^{\mathrm{miss}} \right)^2 - \left(\vec{p}_{\mathrm{T}}{}^{(1)} + \vec{p}_{\mathrm{T}}{}^{(2)} + \vec{E}_{\mathrm{T}}{}^{\mathrm{miss}} \right)^2 \tag{X.2}$$

$$= E_1^2 + E_2^2 + E_{\mathrm{T}}{}^{\mathrm{miss}\,2} + 2 \left(E_1 E_2 + E_1 E_{\mathrm{T}}{}^{\mathrm{miss}} + E_2 E_{\mathrm{T}}{}^{\mathrm{miss}} \right) \tag{X.3}$$

$$- \left(\vec{p}_{\mathrm{T}}{}^{(1)\,2} + \vec{p}_{\mathrm{T}}{}^{(2)\,2} + \vec{E}_{\mathrm{T}}{}^{\mathrm{miss}\,2} \right) - 2 \left(\vec{p}_{\mathrm{T}}{}^{(1)} \cdot \vec{p}_{\mathrm{T}}{}^{(2)} + \vec{p}_{\mathrm{T}}{}^{(1)} \cdot \vec{E}_{\mathrm{T}}{}^{\mathrm{miss}} + \vec{p}_{\mathrm{T}}{}^{(2)} \cdot \vec{E}_{\mathrm{T}}{}^{\mathrm{miss}} \right) \tag{X.4}$$

$$= 2 \left(p_{\mathrm{T}}{}^{(1)} p_{\mathrm{T}}{}^{(2)} (1 - \cos \phi_{12}) + p_{\mathrm{T}}{}^{(1)} E_{\mathrm{T}}{}^{\mathrm{miss}} (1 - \cos \phi_{1m}) + p_{\mathrm{T}}{}^{(2)} E_{\mathrm{T}}{}^{\mathrm{miss}} (1 - \cos \phi_{2m}) \right) \tag{X.5}$$

$$= m_T^{\tau\tau\,2} + m_T^{(1)\,2} + m_T^{(2)\,2} = m_T^{tot\,2} \tag{X.6}$$

7 Conclusion

Références

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