



Πανεπιστήμιο
Κύπρου

ΤΜΗΜΑ ΦΥΣΙΚΗΣ

Το Τμήμα Φυσικής του Πανεπιστημίου Κύπρου
σας προσκαλεί την

Πέμπτη, 8 Μαΐου 2019, ώρα 10:00
στην αίθουσα B228, στο κτίριο 13 στην Πανεπιστημιούπολη

στην παρουσίαση της Διδακτορικής Διατριβής της Ελένης Ηροδότου

«Search for an exotic decay of the Higgs boson to a pair of light pseudoscalars in the final state of two muons and two τ leptons in proton-proton collisions at $\sqrt{s} = 13$ TeV».

This PhD study presents the search of the exotic decay of the Higgs boson (125 GeV) to a pair of light pseudoscalars with final states two muons and two tau leptons. The results exploit the data collected by the CMS detector during the LHC Run-2, in proton-proton collisions with a center-of-mass energy 13 TeV and an integrated luminosity 35.9 fb^{-1} .

The combination of data collected during LHC Run-1 at center-of-mass energies 7 and 8 TeV by the CMS Experiment constrains the branching fractions of the Higgs boson to particles beyond the Standard Model (SM) to be less than 34% at 95% confidence level (CL). Many well motivated-exotic decays of the Higgs boson are proposed in theories beyond the SM. The analysis is performed in the two Higgs-doublet model extended with a complex scalar singlet framework (2HDM+S), where seven physical states are predicted: one of the scalars can be compatible with the discovered Higgs boson (125 GeV), while one of the pseudoscalars, α , can be light enough so that $h \rightarrow \alpha\alpha$ decays are allowed. The decay channel studied has the largest branching fraction in the 2HDM+S Type III model for large values of $\tan\beta$. Masses of the pseudoscalar boson between 15.0 and 62.5 GeV are probed. An additional signal process is included in this analysis when the SM Higgs-like boson decays to a pair of light pseudoscalars with final states four taus. This process can also enter the signal region if a pair of taus decays to a dimuon pair.

The analysis scans the reconstructed dimuon mass spectrum for a characteristic resonance structure. Four different final states are studied to cover the different possible τ -lepton decay modes: $\mu\mu+e\mu$, $\mu\mu+\tau_h$, $\mu\mu+\mu\tau_h$ and $\mu\mu+\tau_h\tau_h$ where τ_h denotes hadronically τ lepton decay. Monte Carlo (MC) samples have been produced for the signal processed via Madgraph generator. The background contribution for this decay channel is separated in two categories: the irreducible and the reducible.

The results are extracted from an unbinned fit of the dimuon mass spectrum. No significant excess of data is observed above the prediction of the standard model. Upper limits at 95% confidence level on the branching fraction $B(h \rightarrow \alpha\alpha \rightarrow 2\mu 2\tau)$ are as low as 1.2×10^{-4} for $m_\alpha = 60 \text{ GeV}$, assuming the SM production cross section for the Higgs boson, which are the most stringent limits obtained so far for the final state of two muons and two τ leptons for masses above 15 GeV, improving previous limits by more than a factor of two. They provide the tightest constraints in this mass range on exotic Higgs boson decays in the 2HDM+S Type III model where pseudoscalar bosons decay to leptons.