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Search for the standard model Higgs boson decaying into tau pairs produced in association with a W or Z boson

A search of the Standard Model (SM) Higgs boson production in association with a vector boson, W or Z, has been performed at LHC, using data collected with the CMS detector during 2011 and 2012, corresponding, respectively, to an integrated luminosity of 5 fb⁻¹ at a centre-of-mass energy of 7 TeV, and 19.5 fb⁻¹ at 8 TeV. In spite of its lower cross section compared to gluon fusion and vector boson fusion processes, the associated production represents an interesting channel for the low-mass Higgs boson search, thanks to the presence of highly energetic leptons coming from the decay of vector bosons which suppress the most relevant SM backgrounds. The low-mass Higgs decay search is performed in the di- τ decay mode, which has the second highest branching ratio after the decay in b quarks and it is easier to be identified. Each τ can decay into an electron, a muon or hadronically (τh). The final states studied have three or four leptons: in the WH channel the search is performed in $e\mu\tau h$, $\mu\mu\tau h$, $e\tau h\tau h$ and $\mu\tau h\tau h$ final states, where W decays into electron or muon; in the ZH channel, the Z decays into a pair of electrons or muons, and the Higgs boson is searched in the final states $e\mu$, $e\tau h$, $\mu\tau h$ and $\tau h\tau h$. The estimate of the background has been made on data and is based on a fake rate technique. The data analysed show no evidence of Higgs boson and are compatible with the SM expected background. Upper limits at 95% confidence level have been set for the SM Higgs production cross section times the decay branching ratio in the mass range $110 < m_H < 145$ GeV.

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