

Search for a light charged Higgs boson decaying to a W boson and a CP-odd Higgs boson in final states with $e\mu\mu$ or $\mu\mu\mu$ in proton-proton collisions at $\sqrt{s} = 13$ TeV

—Supplemental Material—

The CMS Collaboration

CERN

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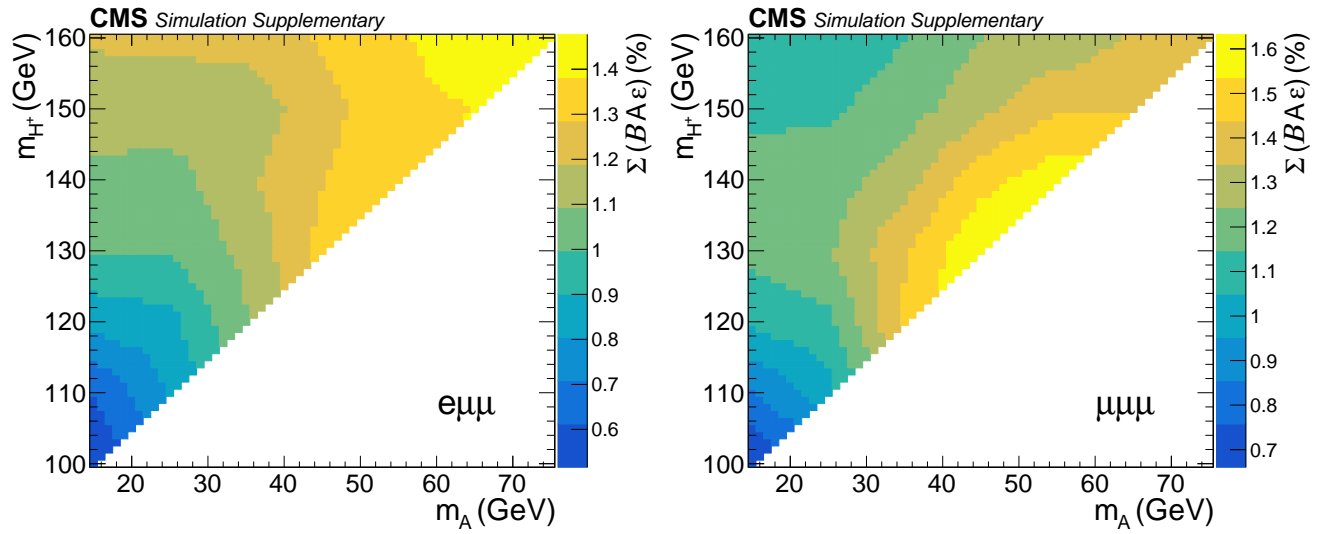


FIG. 1. The fraction of signal events passing the final event selection in the $e\mu\mu$ (left) and $\mu\mu\mu$ (right) final states. The fraction is relative to the yield before the decays of the two W bosons in the signal processes ($t\bar{t} \rightarrow b\bar{b}W^+W^-\mu^+\mu^-$), which include the branching fraction of each decay mode of the two W bosons (\mathcal{B}) and the acceptance (A) times efficiency (ε) of the event selection for the decay mode. All decay modes of the two W bosons are considered in the calculation except the cases where both of the bosons decay hadronically.

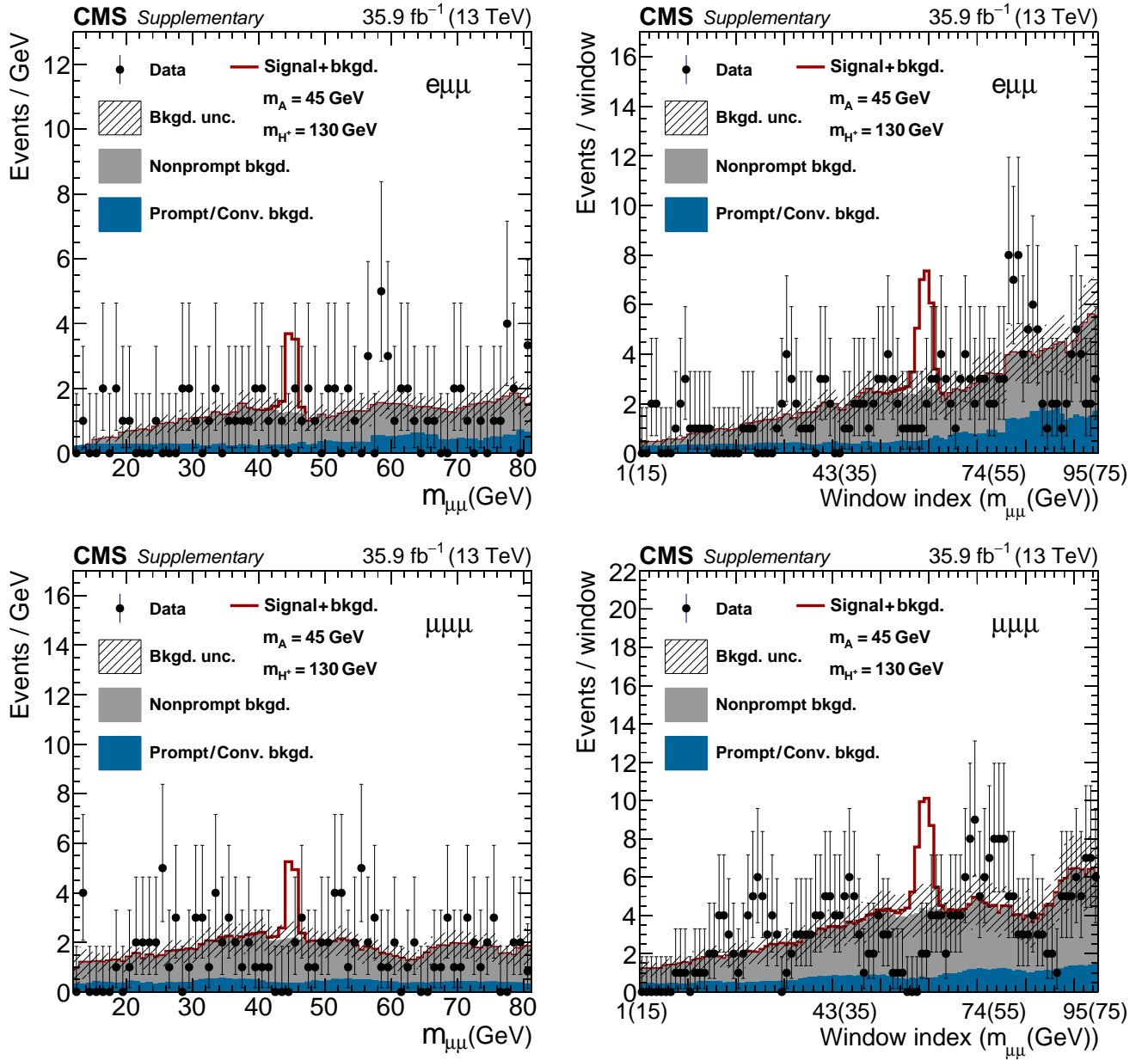


FIG. 2. The $m_{\mu\mu}$ distribution of candidate muon pairs from A bosons (left) and the event yields in each signal window (right) in the $e\mu\mu$ (upper) and $\mu\mu\mu$ (lower) final states. A constant bin size (1 GeV) is used in the left figures except the last bin of [80, 81.2] (GeV). Values of $m_{\mu\mu}$ at centers of the corresponding windows are written in the parentheses on the x axis of the right figures. The expected signal distribution for $m_{H^+} = 130$ and $m_A = 45$ GeV is also shown on top of the expected backgrounds assuming $\sigma(t\bar{t}) = 832$ pb and $\mathcal{B}_{\text{sig}} = 6 \times 10^{-6}$.

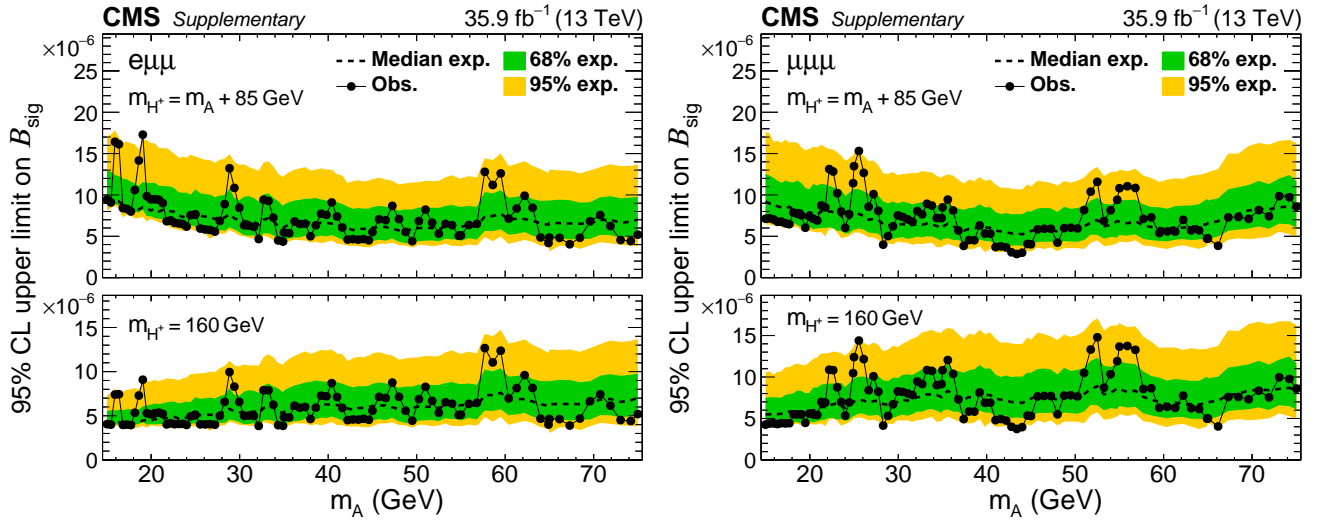


FIG. 3. Upper limits at 95% C.L. on B_{sig} for the 95 m_A values, with an assumption of $m_{H^+} = m_A + 85 \text{ GeV}$ (upper) or $m_{H^+} = 160 \text{ GeV}$ (lower), for individual final states (left: $e\mu\mu$ and right: $\mu\mu\mu$ final states). In the calculation, the same value of $\sigma(t\bar{t})$ as in Fig. 2 is assumed.