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Associated charged Higgs and W boson production in the MSSM at the CERN Large Hadron Collider

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We investigate the viability of observing charged Higgs bosons (H^\pm) produced in association with W bosons at the CERN Large Hadron Collider, using the leptonic decay $H^\pm \rightarrow \tau^\pm + \nu_\tau$ and hadronic W-decay, within different scenarios of the Minimal Supersymmetric Standard Model (MSSM) with both real and complex parameters. Performing a parton level study we show how the irreducible Standard Model background from $W + 2 \text{ jets}$ can be controlled by applying appropriate cuts and find that the size of a possible signal depends on the cuts needed to suppress QCD backgrounds and misidentifications. In the standard maximal mixing scenario of the MSSM we find a viable signal for large $\tan \beta$ and intermediate H^\pm masses ($\sim m_t$) when using optimistic cuts whereas for more pessimistic ones we only find a viable signal for very large $\tan \beta$ (> 50). We have also investigated a special class of MSSM scenarios with large mass-splittings among the heavy Higgs bosons where the cross-section can be resonantly enhanced by factors up to one hundred, with a strong dependence on the CP-violating phases. Even so we find that the signal after cuts remains small except for small masses ($\leq m_t$) with optimistic cuts. Finally, in all the scenarios we have investigated we have only found small CP-asymmetries.

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