



Contribution ID : 237

Type : Oral presentation

Polarized top and Charged Higgs boson

Saturday, 5 July 2014 17:15 (15)

The charged Higgs boson is quite common in many new physics models. In this study we examine the potential of observing a heavy charged Higgs boson in its decay mode of top-quark and bottom-quark in the Type-II Two-Higgs-Doublet-Model. In this model, the chirality structure of the coupling of charged Higgs boson to the top- and bottom-quark is very sensitive to the value of $\tan\beta$. As the polarization of the top-quark can be measured experimentally from the top-quark decay products, one could make use of the top-quark polarization to determine the value of $\tan\beta$. We perform a detailed analysis of measuring top-quark polarization in the production channels $g\bar{b}\to tH^-$ and $g\bar{b}\to \bar{t}H^+$. We calculate the helicity amplitudes of the charged Higgs boson production and decay. Our calculation shows that the top-quark from the charged Higgs boson decay provides a good probe for measuring $\tan\beta$, especially for the intermediate $\tan\beta$ region. On the contrary, the top-quark produced in association with the charged Higgs boson cannot be used to measure $\tan\beta$ because its polarization is highly contaminated by the t-channel kinematics.

Summary

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Session Classification : BEH Physics

Track Classification : Brout-Englert-Higgs physics