

Abstract

Trigger is a crucial item in experiments at hadron colliders. In this thesis, a software profiling tool has been developed, which helps to analyze and improve the performance of the High Level Trigger software of the LHCb experiment. This tool is able to identify spots where the execution time of the trigger application is slow, thereby allowing the optimization of the trigger decision speed and minimizing dead times during data taking.

The highly efficient LHCb trigger allows precision studies of decays of heavy flavoured particles in final states with muons. In this thesis, a study of χ_b production at LHCb is performed on a proton-proton collisions data set, corresponding to 3 fb^{-1} integrated luminosity, collected at center-of-mass energies of $\sqrt{s} = 7$ and 8 TeV . Radiative χ_b transitions to $\Upsilon(1S)$, $\Upsilon(2S)$ and $\Upsilon(3S)$ are reconstructed, where the Υ decays in two muons. The fraction of Υ originating from χ_b decays are measured as a function of Υ transverse momentum in the LHCb rapidity range $2.0 < y^\Upsilon < 4.5$. The analyzed transverse momentum ranges for decays to $\Upsilon(1S)$, $\Upsilon(2S)$ and $\Upsilon(3S)$ are $6 < p_T^{\Upsilon(1S)} < 40 \text{ GeV}$, $18 < p_T^{\Upsilon(2S)} < 40 \text{ GeV}$ and $27 < p_T^{\Upsilon(3S)} < 40 \text{ GeV}$, respectively. The measurement of $\Upsilon(3S)$ fractions in radiative $\chi_b(3P)$ decay is performed for the first time. The obtained $\Upsilon(3S)$ fractions are $42 \pm 12 \text{ (stat)} \text{ }^{+8.9}_{-11.6} \text{ (syst)} \text{ }^{+2.7}_{-3.1} \text{ (syst.pol)}\%$ and $41 \pm 8 \text{ (stat)} \text{ }^{+1.3}_{-8.6} \text{ (syst)} \text{ }^{+2.6}_{-3.1} \text{ (syst.pol)}\%$ for $\sqrt{s} = 7$ and 8 TeV , respectively. The measured $\chi_{b1}(3P)$ mass is $10,508 \pm 2 \text{ (stat)} \pm 8 \text{ (syst)} \text{ MeV}/c^2$.