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Time dependent CP-violation measurements and related studies in B_s decays at LHCb

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The determination of the CP-violating phase ϕ_s in $B_s^0 \to J/\psi\phi$ decays is one of the key goals of the LHCb experiment. Its value is predicted to be very small in the Standard Model but can be significantly enhanced in many models of new physics. To perform the first LHCb analysis of ϕ_s on 2010 data at a centre of mass energy of 7 TeV, many milestones needed to be achieved first, such as for example the measurements of the B hadron lifetimes, the measurement of the polarization amplitudes in $B^0 \to J/\psi K^*$ decays and the measurement of the CP violation in mixing in $B^0 \to J/\psi K_s$ decays.
We will present our latest result of the ϕ_s analysis and related measurements.
One of the challenges for all measurement of time dependent asymmetries in the B_s system is to resolve the extremely fast B_s oscillation. Due to its excellent proper time resolution, the LHCb collaboration was able to performed the world most precise Δm_s measurement based on a data set of 36 pb^{-1} only. One of the key ingredients to this analysis is the flavour tagging. We will present in this talk the status of opposite and same side flavour tagging and the latest Δm_s result.
The LHCb collaboration has performed a first analysis of the CP-violating phase ϕ_s in tree dominated $B_s^0 \to J/\psi\phi$ decays exploiting an angular analysis to separate CP even and CP odd eigenstates.
Additional modes have been studied for complementary analysis, e.g. by using penguin decays or by using decays to CP eigenstates. In this talk we will present the first observation of the decay $B_s \to J/Psif_0$ and of $B_s \to K^*\overline{K^*}$. The potential of these decays an other alternative B_s modes to study CP violation in mixing will be discussed.
We investigate the resonance structure in the pi+pi- system produced in B_s -> J/psipi+pi- decays. Such decays can be used to measure the CP violating phase in B_s decays. This ?final state is known to have large component of scalar f0(980) and a spectrum of additional events at higher masses. While the f0(980) part is a CP eigenstate, higher mass states could also be scalars and be simply added into the analysis. Using pp collisions at 7 TeV centre-of-mass energy collected by the LHCb detector, the angular distributions of the decays are analyzed and the spin-parity of the various components is determined.

Author: Dr LANFRANCHI, Gaia (LNF INFN)

Orateur: M. LINN, Christian

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