Time-dependent CP violation in $B^0 \rightarrow \pi^+\pi^-$ and $B_s^0 \rightarrow K^+K^-$ decays at LHCb

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Abstract
Using an integrated luminosity of 0.69 fb$^{-1}$ collected by LHCb in 2011, we report measurements of direct and mixing-induced CP violation in $B^0 \rightarrow \pi^+\pi^-$ and $B_s^0 \rightarrow K^+K^-$ decays. The measurements of the $B^0 \rightarrow \pi^+\pi^-$ asymmetries are compatible with those from the B factories and yield 3.2σ evidence of mixing-induced CP violation, whereas the $B_s^0 \rightarrow K^+K^-$ asymmetries are measured for the first time ever.

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The $B^0 \rightarrow \pi^+\pi^-$ and $B_s^0 \rightarrow K^+K^-$ decays

- Decay diagrams involve CKM matrix elements related to the γ angle of the Unitarity Triangle
- $B^0$ and $B_s^0$ mixing phases enter the amplitudes via mixing diagrams

Flavour tagging
- Crucial aspect of the measurement:
  - Determination of the flavour of the $B$ at the production
  - Performed analyzing particles from the other $B$ decay
  - Here calibrated using $B^0 \rightarrow K\pi$ decay

$B^0 \rightarrow \pi^+\pi^-$ mass and time fit

$B_s^0 \rightarrow K^+K^-$ mass and time fit

Final results

$B^0 \rightarrow \pi^+\pi^-$ results favour the existing BaBar measurement
$B_s^0 \rightarrow K^+K^-$ results are the world’s first