Why measure $\gamma$?

- Non-unitarity of the CKM matrix is a clear sign of physics beyond the Standard Model
- $\gamma$ is the only angle that can be accessed via entirely tree level processes (no loops) pure SM measurement

Direct measurements (from SM tree level processes) \cite{1}:

\[(73.2 \pm 6.3)°\]

Indirect measurements (from global CKM fit, including many loop level measurements of other CKM parameters) \cite{1}:

\[(66.9 \pm 0.9)°\]

- Difference between these measurements would be a sign of New Physics
- Look at as many modes as possible to improve precision

$B^\pm \rightarrow DK^{\pm}$ decays

- Extensively investigated in Run 1 at LHCb
- Sensitivity to $\gamma$ originates from the interference when $D^0$ and $D^+$ decays to the same final state \cite{2}

\[
A(B^0 \rightarrow DK^-) = A_{DK} \\
A(B^- \rightarrow D^0K^-) = A_{DK'}
\]

- Many different D decay modes have been investigated:
  - $D^0 \rightarrow h\pi^\pm\pi^\mp, D^+ \rightarrow h\pi^+$
  - $D^0 \rightarrow K_0^0\pi^\pm, D^+ \rightarrow K^+\pi^0K^0$, and $D^0 \rightarrow K^0\pi^0K^0$

Where $h$ refers to a pion or a kaon

$B \rightarrow D(\pi\pi^0)K$ results from the 3 fb$^{-1}$ analysis of $B \rightarrow D(hh\pi^0)K$ at LHCb \cite{3}.

\[
B \rightarrow D(\pi\pi^0)K
\]

Constraint the $B \rightarrow D(hh\pi^0)K$ analysis places on $r_B = 0.11 \pm 0.03$ \cite{3}

- $r_B$ is the ratio of amplitudes between $B \rightarrow D^0K^-$ and $B^- \rightarrow D^0K^-$
- Asymmetries between yields for $B^+$ and $B^-$ have sensitivity to $\gamma$
- The $hh\pi^0$ mode improves precision on $r_B$, which has subsequent impact on $\gamma$

References

\cite{4} 8th International Workshop on the CKM Unitarity Triangle, Univ. Tech., Vienna, Austria, Sep 2014. LHCb-CONF-2014-004

Run 1 data: 3 fb$^{-1}$

\[Yield: 705 \pm 29\]

Run 2 data: 0.3 fb$^{-1}$

\[Yield: 283 \pm 19\]