Measuring γ in $B^{\pm} \to (K^+K^-\pi^+\pi^-)_D K^{\pm}$ decays

Martin Tat

Oxford LHCb

21st November 2020

Outline

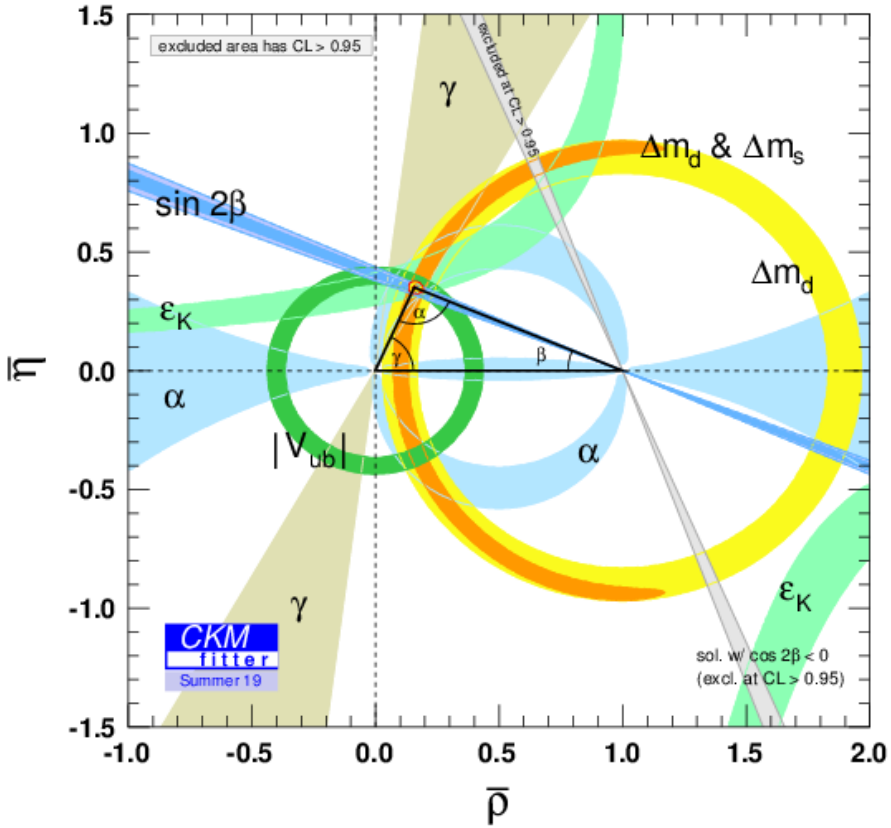
Background

- 4-year MPhys in Oxford
  - Performance of monolithic CMOS sensors
  - Prof Daniela Bortoletto
- CERN Summer Student 2019
  - Beam loss reduction in TT20 transfer line
  - Dr Yann Dutheil, Dr Matthew Fraser
- Oxford Summer Student 2018
  - Study of PDF uncertainties in W-boson mass measurement
  - Prof Chris Hays
- RAL Summer Student 2018
  - Bending magnets in accelerator simulations (Dr Chris Rogers)

γ and the unitary triangle

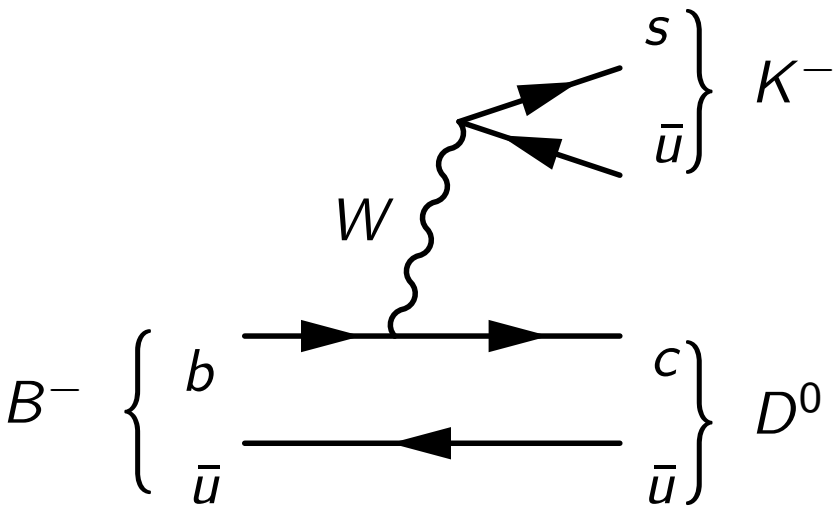
Unitarity of CKM matrix: $V_{ud}V_{ub}^* + V_{cd}V_{cb}^* + V_{td}V_{tb}^* = 0$

Define $\gamma = \arg\left(-\frac{V_{ud}V_{ub}^*}{V_{cd}V_{cb}^*}\right)$

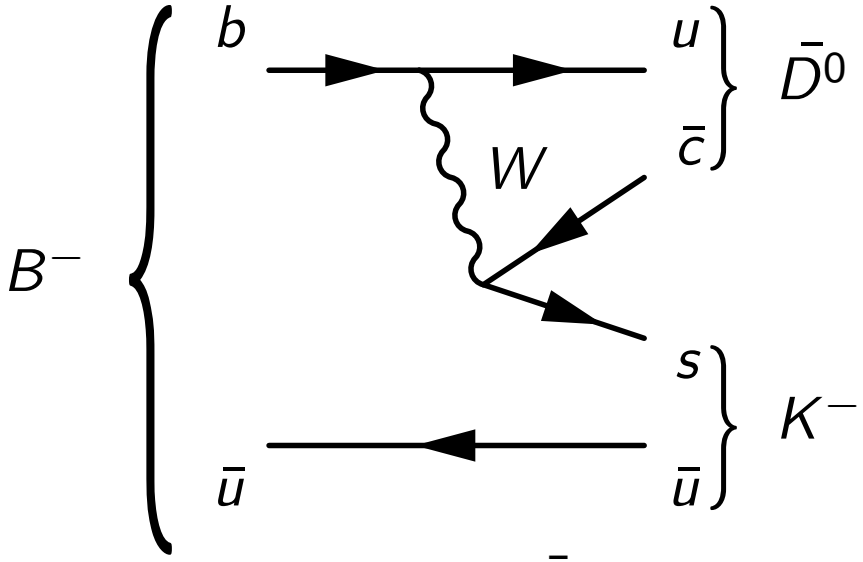


CKMfitter Group (J. Charles et al.), Eur. Phys. J. C41, 1-131 (2005)

$b \to u$ and $b \to c$ interference



(a) $B^- \to D^0 K^-$



(b) $B^- \to \bar{D}^0 K^-$

Similar diagrams for $B^+ \to DK^+$, with $\gamma \to -\gamma \implies$

Inteference when D^0 and $\bar{D}^0$ decay into a common final state

Single most precise measurement: $\gamma = (68.7^{+5.2}_{-5.1})^\circ$ (arXiv:2010.08483)
$B^\pm \to DK^\pm$, $B^\pm \to D\pi^\pm$, $D \to K^0_S h^+ h^-$

The $D \to K^+K^-\pi^+\pi^-$ decay

- First described by Guy Wilkinson and Jonas Rademacker (arXiv:hep-ph/0611272)
  - Estimated precision: 14° with 1000 events
  - Amplitude analysis: Isobar model

The chemistry packages

We focus on two LaTeX chemistry packages:

The chemfig package

This package provides the command which draws molecules. Created by Christian Tellechea, a detailed user guide can be found here:

`www.tex.ac.uk/ctan/macros/generic/chemfig/chemfig_doc_en.pdf`

The mhchem package

The `mhchem` package provides simple commands for typesetting chemical molecular formulae and equations. Created by Martin Hensel, a detailed user guide can be found here:

`http://mirror.ox.ac.uk/sites/ctan.org/macros/latex/contrib/mhchem/mhchem.pdf`

Chemical equations with `mhchem`

- The `mhchem` package lets you write chemical equations in LaTeX with the minimum of effort.
- The example below shows how the standard representation of a reaction (on the left) is created from the simple code on the right:

$\ce{CO2 + C -> 2CO}$ is created with `\ce{CO2 + C -> 2CO}`

- More complicated reactions are still easy to write:

$\ce{SO4^2- + Ba^2+ -> BaSO4 v}$

is created with

`\ce{SO4^2- + Ba^2+ -> BaSO4 v}`

Where to go next...

- This short example was designed to introduce you to using Overleaf for scientific presentations.
- This is made possible by the many great packages that have been developed for LaTeX, including the two we focused on here (plus the `Beamer` package used for the overall presentation style).
- For more help on using LaTeX, see the links on the Overleaf help page: `www.overleaf.com/help` or check out our free introductory course: `www.overleaf.com/blog/7`.

Follow @overleaf on Twitter for all the latest news and updates.

Happy LaTeXing!