One number to rule them all: Belle II V_{cb} combination

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The aspiration

Simultaneous determination of CKM angle γ and charm mixing parameters

The LHCb collaboration

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ABSTRACT: A combination of measurements sensitive to the CP violation angle γ of the Cabibbo-Kobayashi-Maskawa unitarity triangle and to the charm mixing parameters that describe oscillations between D^0 and $\bar{D}^0$ mesons is performed. Results from the charm and beauty sectors, based on data collected with the LHCb detector at CERN's Large Hadron Collider, are combined for the first time. This method provides an improvement on the precision of the charm mixing parameter y by a factor of two with respect to the current world average. The charm mixing parameters are determined to be $x = (0.400^{+0.052}_{-0.053})\%$ and $y = (0.630^{+0.033}_{-0.030})\%$. The angle γ is found to be $\gamma = (65.4^{+3.8}_{-4.2})^\circ$ and is the most precise determination from a single experiment.

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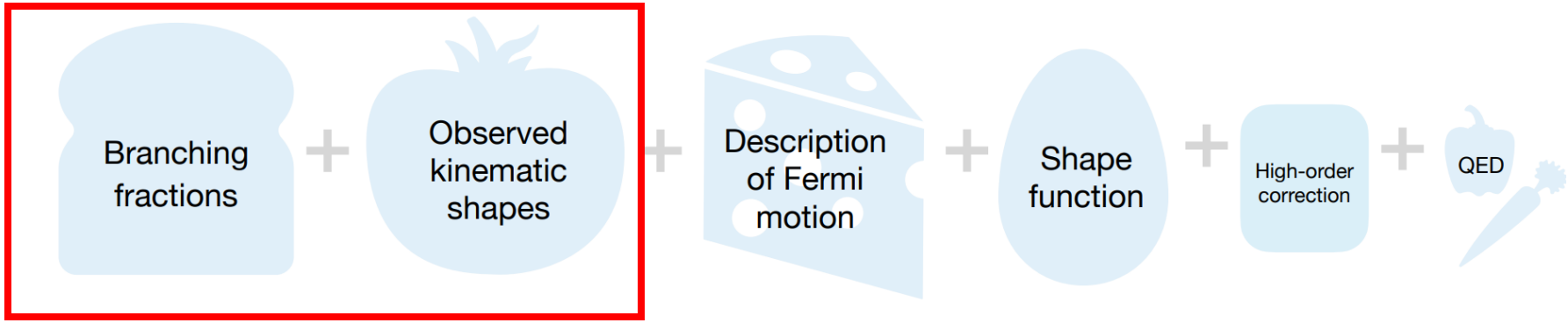
- Why?
  - We are best placed to combine our measurements because of the correlations
  - A single number not to confuse
    - c.f. Zoltan's admonishment for **two** in a single abstract
- But V_{cb} is different to γ
  - not statistically limited
  - large theoretical inputs required
- Also, we may want to focus more on the measurements that really matter than in γ

First factorize: a single exclusive V_{cb} number

- Untagged for BF, i.e., normalization
- Tagged differential analysis for form-factors
  - preferably D and D* combined
- V_{cb} fit to form-factor expansion includes BF and lattice
  - Question: how to define the BGL expansion truncation uncertainty?
  - Answer: partially answered in yesterday's breakout discussion
- Other analyses may contribute to an average
  - Untagged B→D(*)lv fit to four modes
  - Double SL – possibly improve B→Dlv
- Comment: This seems a tractable programme of work for Belle II

First factorize: a single inclusive V_{cb} number

From Lu Cao

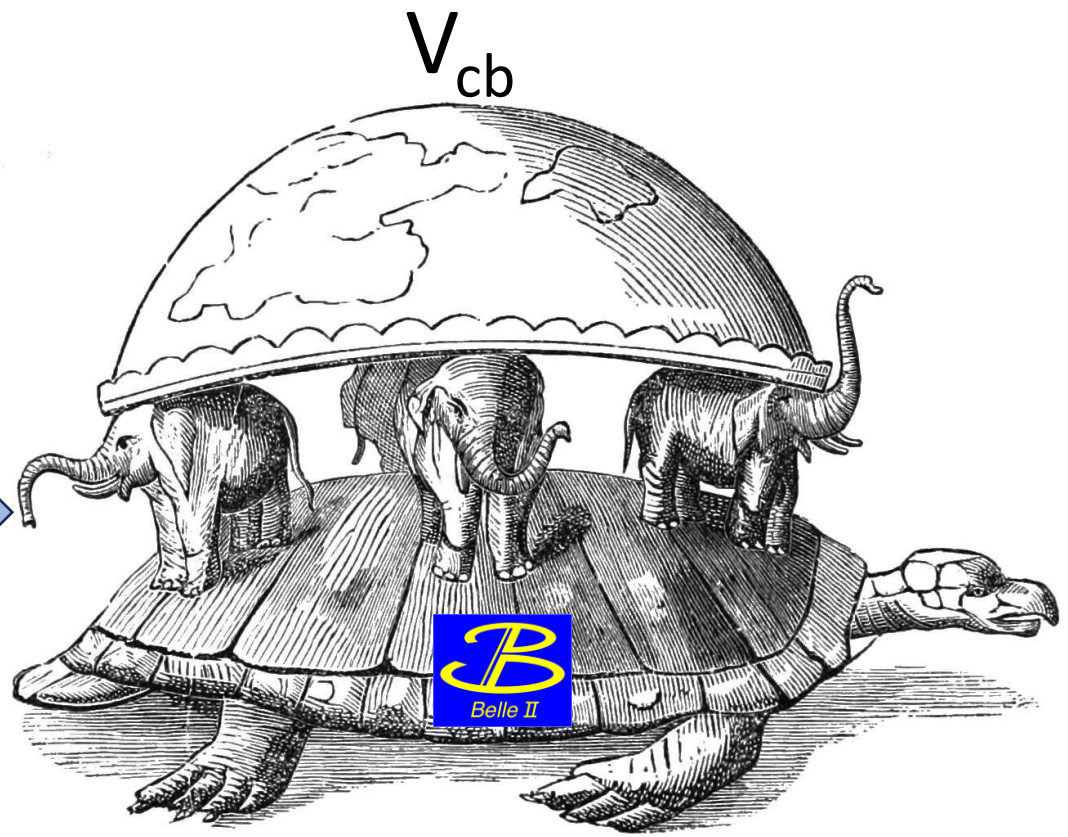


- Experimental inputs
  - Total branching fraction or partial rates
  - Moments in p_l, M_X and q^2

- Theory inputs
  - Calculations to convert these measurements to V_{cb}
  - e.g. arXiv:2310.20324 [hep-ph] Finauri and Gambino, arXiv:2205.10274 [hep-ph] Bernlochner et al.
- Code availability for the fit to be done internally?

Not to be forgotten

- Many supporting measurements that will drive significant systematics we must also control and suitably correlate between the analyses
  - f_{+0}
  - B counting
  - Luminosity
  - D** and gap modes
  - Lepton ID
  - Slow pion reconstruction
  - …..



https://en.wikipedia.org/wiki/World_Turtle