Discussion questions for exclusive $|V_{cb}|$ session

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$B \to D^* \ell \nu$

- $|V_{cb}|$ is determined from this decay by extrapolating the experimental data to zero recoil using the CLN parameterization and LQCD calculations of $\mathcal{F}(1)$. The current uncertainties are:

  Exp: 1.3% LQCD: 1.4% QED: 0.5%

  What should be done about radiative corrections?

- The exp. and LQCD errors are small enough that EM effects matter. Is it possible on the exp. side to report results for charged and neutral B meson decays separately?

- What are the prospects for improving the exp. and LQCD errors respectively?

- What are the prospects on the theory side for form factor calculations at nonzero recoil?

- What are the pros and cons of the CLN parameterization vs. using a z-expansion?

- What are the prospects on the experimental side for shape measurements parameterized with the z-expansion?

- Belle II will be able to measure the form factor parameters $\rho^2, R_1(0), R_2(0)$ more precisely. How well do we need to know them?

$B \to D \ell \nu$

- The exp. measurement of $\eta_{EW}\mathcal{G}(1)|V_{cb}|$ has a precision of 3.6%, and the most recent LQCD calculation of $\mathcal{G}(1)$ has an error of 0.8%. What are the prospects for improving the exp. precision at Belle II?

- There now exists an unquenched LQCD calculation of the form factors at nonzero recoil, allowing for a determination of $|V_{cb}|$ from a simultaneous z-fit to the lattice form factors together with experiment. Is there any reason why this shouldn't become the new standard (as in the determinations of $|V_{ub}|$ from $B \to \pi \ell \nu$)?

- The 2009 BaBar measurement quotes a systematic error of 3.3% at low recoil. What are the prospects for improving this error? In addition, what are the prospects for obtaining a systematic error away from the low recoil region?

$B_s \to D_s^{(*)} \ell \nu$

- From a theoretical point of view, what are the advantages of using B_s decay processes for $|V_{cb}|$ determinations?
- How precisely can the corresponding form factors be calculated with LQCD compared to the case of B_d and B_u decays?
- What are the prospects for B_s decay measurements at Belle II?
- Can LHCb contribute in this area?

$\Lambda_b \to \Lambda_c \ell \nu$

- From a theoretical point of view, what are the advantages of using Λ_b decay for a $|V_{cb}|$ determination?
- How precisely can the corresponding form factors be calculated with LQCD compared to the case of B decays?
- What are the prospects for Λ_b decay measurements at LHCb?

Can the z expansion be applied to baryons (Gil Paz slides)

Higher mass states

- How important is it to understand the detailed composition? How much will better knowledge of these higher mass modes improve $|V_{cb}|$ determinations, measurements of $B \to D^{(*)}\tau\nu$, or measurements of the hadronic mass moments in inclusive $b \to c\ell\nu$ decay?

- There is still a gap (now reduced in light of the recent BaBar $D^{(*)}\pi^+\pi^-\ell\nu$ observation) in the sum of exclusive $B \to X_c\ell\nu$ decay relative to the inclusive $b \to c\ell\nu$. Unmeasured modes include $D^{(*)}\eta\ell\nu, D^{(*)}\pi^-\pi^0\ell\nu, \ldots$ What are the prospects for improving this at Belle II?

- Is the 1/2-3/2 puzzle worth pursuing? Can the broad P-wave states be reliably measured at Belle II?

- Charm spectroscopy (as, for example, in Dalitz analyses of exclusive B decays) tends to be done by a different set of experimenters than those who work on semileptonic decays. How hard should we push to have measurements such as $\bar{B} \to D(2S)\pi^-$ (suggested in arXiv:1202.1834) done at LHCb or Belle II?

Absolute D branching fractions

- What are the prospects for improvements in measurements of absolute branching fractions of D^0 and D^+ decay from BES III or elsewhere? Their uncertainties are not far from limiting the accuracy of exclusive $|V_{cb}|$ analyses.