Experimental challenges in exclusive measurements – topic list I

- Review limiting uncertainties in existing measurements
- List assumptions about evolution of outside input (theory, Lattice)
- What is needed from experiment (in particular Belle II)?
  - Lots of recent progress in FF predictions and measurements; important for $|V_{cb}|$
  - Reduce normalization uncertainties
  - Reduce MC statistical uncertainties
  - Reduce uncertainties on uncertainties

- Normalization uncertainties
  - Lepton ID efficiency (control samples, isolation / environment corrections), Kaon ID efficiency
  - tracking efficiency, kinematic fit efficiency
  - B tagging “calibration”
  - B counting (luminosity)
- MC statistics
  - Enters through fit template shapes for signals, cross-feeds, backgrounds as well as in signal efficiency. Need better $N_{MC}/\$$ as sample sizes increase
  - Also enters into reweightings that correct for modeling problems
  - Hard to justify generating huge samples if the modeling is poor, so it also needs to improve

Experimental challenges in exclusive measurements – topic list II

- Large feed-down from $D^* \to D\pi$ decays
  - Simultaneous analysis of $B \to D^*\ell\nu, B \to D\ell\nu$ helps
  - Statistical discrimination between $B \to V\ell\nu$ and $B \to P\ell\nu$ transitions using kinematics works well even if the slow π is ignored
  - Revive $B \to D(X)\ell\nu$ approach
- Content of "gap" not well understood

  $\mathcal{B}(B \to X_c\ell\nu) - \sum_j \mathcal{B}(B \to H_j\ell\nu) \sim 0.8\%$

  Measured; Measured or isospin conj
- Untagged analyses will not be competitive at some point due to higher backgrounds (for $|V_{cb}|$ this is probably at ~few ab^{-1})

- Hadronic tags + $D^{(*)}\ell\nu$
  - M^2_{miss} is a good discriminant against additional missing particles ($D^{**}\ell\nu, D^{(*)}D_s^{(*)-}, c\bar{c}, \ldots$)
  - Had tagging efficiency for $B^+(B^0)$ is $\sim 0.3\%(0.2\%)$
  - Large "calibration factors" needed to correct MC modeling (mostly from modeling large number of un/poorly measured decay modes)
- Double semileptonic decays, $D^{(*)}\ell^-\nu, \overline{D}^{(*)}\ell^+\nu$
  - $\cos\theta_{BY}$ is a weaker discriminant than M^2_{miss}
  - SL tagging efficiency for $B^+(B^0)$ is $\sim 0.9\%(0.5\%)$
  - Dominated by a few decay modes ($D^{(*)}\ell\nu$, a few well-measured $D^0$and D^+ decays); easier to "calibrate" so better for normalization