Minutes on charm-physics session 4Nov16 (R.Zwicky)

- Overview CKM-hierarchy of cu-Unitarity triangle & contrasting it with bd and bs-triangle
  ⇒ 1) direct CP $O(\lambda^4)$ [$\lambda \sim 0.22$] , 2) dominance of long versus short distance 3) effective GIM

Aspects of ..

1) Mixing

- discussed possibilities of testing 1/mc-expansion [Input: LENZ]
  - $y = 2\Delta\Gamma/\Delta$ problematic as LO (dim 6 operator) GIM-mechanism too effective
    large cancellations lead to difference in prediction and experimental value
    Hence: 1) NLO important, 2) new physics 3) 1/mc does not work at all
  - better to test in $\boldsymbol{\tau}$[D+]/$\boldsymbol{\tau}$[D0] ~ 2.5 ~ (1+#)/(1-#) where # ~0.4 is SU(3) breaking
    problem: since operator have vacuum quantum numbers this is not easy on lattice
    and has so far not been done

2) Non-leptonic decays

- Focused in D -> PP,PV,VV two body final states [Bigi et al: advertised the use of multi-body final states with the motivation: the less inclusive the more CP-violation]

- Same topologies as in B-decays. No secret computation is difficult
  Methods: 1) QCD factorisation O(1/mc) will be large
  2) LCSR a la Khodjamirian (maybe better)
  3) lattice: needs to complete rescattering Hilbert-space
  4) Fit: Jung et al D->PP 25 parameters versus 25 measurements when including linear SU(3)-breaking. Fits determines SU(3)-breaking to be around 30%

- Highlight are sum rules e.g. $A_{CP}(D^+ \to \pi^0 \pi^+) = 0 + O(\lambda^4 \varepsilon_{SU(2)})$
  - any CP $O(\lambda^4)$ & bose symmetry I = 0,2 but then I_3=1 so I=0 excluded
  and therefore CP-asymmetry probes isospin-breaking as well!

3) Rare decays

- $B(D^0 \to ll) = O(10^{-11} (ml/m\tau)^2)$ loop and GUM suppressed (very rare)

- $D \to V\gamma$ 1) dominance of weak annihilation (Lyon, Zwicky) over SD and quark loops
  [WA neither GIM nor loop suppression]
  2) problem of predicting $D^0 \to V^0\gamma$ because of colour suppression of Wilson coeff.
  3) possibility of testing left-right handed long-distance chirality in TDCP
  [important for search of right-handed currents in b->s,d transitions]

- $D \to Vll$ Bigi, Paul, Recksiegel: $A_{FB} \sim 0$ in SM since driven by $O_{10} \sim (cu)_{V-A} (ll)_A$ which is small by effective GIM-mechanism (dominance of long versus short distance)