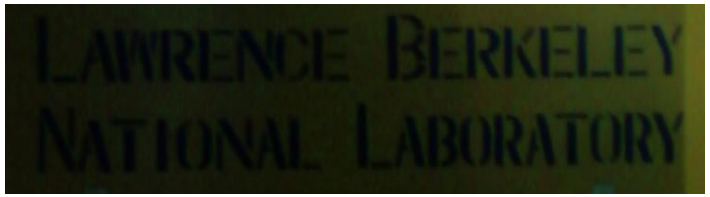
Summary

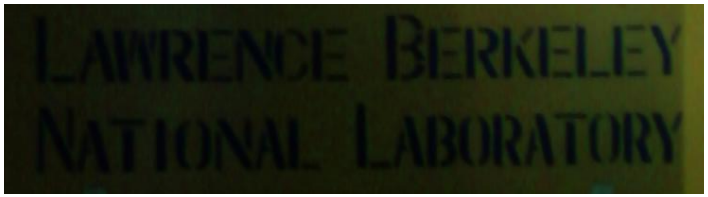
Zoltan Ligeti



Joint Workshop on V_{ub} and V_{cb}
SLAC, Oct 29–31, 2009

Who needs another Summary

Zoltan Ligeti



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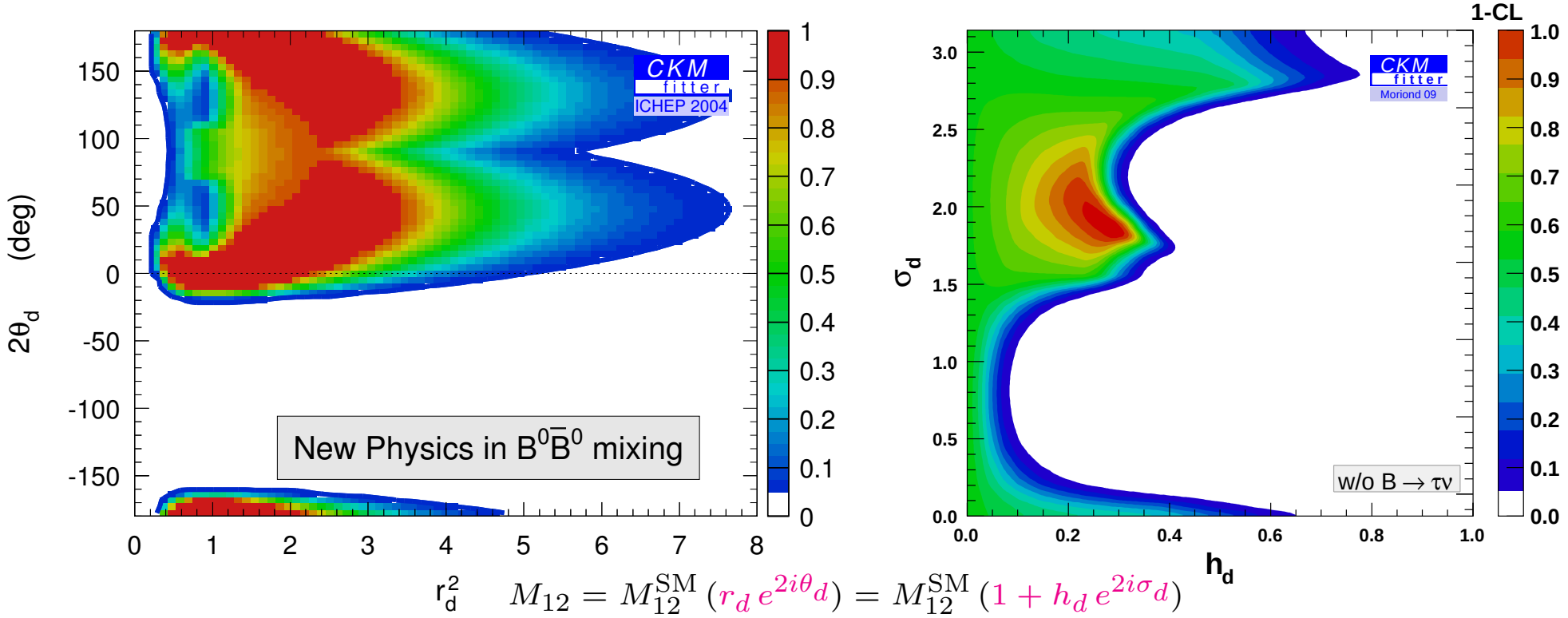
  The “LEP experiments”, “Tevatron experiments”, etc., immediately mean a certain set of results — we should have something better than “BaBar and Belle”...

The one sentence summary (imho)

- Beyond improvement in SM measurements, strong constraints on NP in many FCNC amplitudes — much more progress in this than in error of SM parameters

Qualitative change before vs. after 2004 — in my mind this is the real justification of the Nobel Prize



$$M_{12} = M_{12}^{\rm SM}\,(r_d\,e^{2i\theta_d}) = M_{12}^{\rm SM}\,(1 + h_d\,e^{2i\sigma_d})$$

- Measurements of $|V_{ub}|$ and $|V_{cb}|$ have been crucial to this — tree level constraints

Tremendous progress

- 10 years of BaBar and Belle data taking gave ~ 100 times earlier (e^+e^-) data sets
- In some V_{xb} results, progress may have seemed slower than expected, however:
  - The errors have become a lot more meaningful (both experiment & theory)
  - Better control of some theoretical assumptions (incl. lattice progress)
  - Better control of experimental systematics
  - More cross-checks (theory + experiments)
  - More challenging methods used, to reduce model dependence
- Many of us feel that progress could in principle continue
  - Mature field, still, promising experimental and theoretical ideas keep emerging
  - Much of the B reco results are statistics limited
  - How to deal with averaging / combination questions as BABE era is ending

Some comments on $|V_{cb}|$

- I feel that the lack of understanding of the non-$D^{(*,**)}$ contributions is worrisome
- The $\frac{3}{2} \gg \frac{1}{2}$ (narrow D_1, D_2^*, broad D_0^*, D_1^*) rule relies on saturation by lowest states
  Can radially excited helicity-1 rates be important and not mess up E_ℓ spectrum?
- Modelling continuum only by Goity–Roberts (can one make up another model?)
- Role of $s\bar{s}$ popping? $B \to D_s^{(*)} K \ell\bar{\nu}$, $D^{(*)}\phi\ell\bar{\nu}$, etc. Possibly large impact for $|V_{ub}|$?
- Do we fully appreciate correlated impact on moments, m_b, $|V_{cb}|$ & $|V_{ub}|$ inclusive?

- Inclusive spectra: Several new results waiting to be included in analyses. Based on $\Gamma(B \to X_c \ell\bar{\nu})$, I do not expect surprises; firm up error estimates

  Starting at $1/m_b^4$, can trade $\Lambda_{\rm QCD}/m_b \leftrightarrow \Lambda_{\rm QCD}^2/m_c^2$

$\bar{b}b$	$1/m^2$	$1/m^3$	$1/m^4$
α_s^0	α_s^0	α_s^0	(α_s^0)
α_s	(α_s)	—	—
α_s^2	—	—	—

Some comments on $|V_{ub}|$

- Inclusive / exclusive difference seems even more puzzling than for $|V_{cb}|$
- Importance of parameterizations of $B \to \pi \ell \nu$ form factor?

  Maybe one bin will get competitive?

- New α_s^2 calculation in the SCET region — being implemented in extraction of $|V_{ub}|$
- The $m_X - q^2$ combined cuts seemed to be an outlier — BLNP increases by $\sim 7\%$

  (Large q^2: recall large λ_2 effect in local OPE, not to be confused in a fit with WA)

- What to do if tension between inclusive and exclusive measurements prevails after the last round of analyses?

Some personal hopes and concerns

- Difference of inclusive & exclusive $|V_{cb}|$ is puzzling — Is our lack of understanding of the composition of the inclusive rate just a nuisance or the tip of an iceberg?

- Significant improvements in relating inclusive $B \to X_u \ell \bar{\nu}$ data to $|V_{ub}|$ is possible
  - Modeling $F(k)$ instead of $S(\omega, \mu)$
  - Include everything known; consistent combination of all phase space regions
  - Better explore unknown nonperturbative ingredients & constrain it from data
  - Decouple SF shape variation from m_b variation, constraints from moments

- Should be possible to combine all pieces of data with tractable uncertainties
  - Consistently combine $B \to X_s \gamma$, $B \to X_u \ell \bar{\nu}$, $B \to X_c \ell \bar{\nu}$ data to constrain SFs
  - Inclusive $|V_{cb}|$ uses combined fit; seems desirable for $|V_{ub}|$ too (subleading SF)

- $|V_{ub}|$ is tricky: to draw conclusions about new physics, we'll want ≥ 2 extractions with different uncertainties to agree well (inclusive, exclusive, leptonic)

Final Comments

- Improving accuracy of $|V_{xb}|$ will remain important to constrain non-SM physics

  (Current situation unsettled, PDG in 2008 inflated $|V_{cb}|$ error for the first time)

- The "B reco era": qualitatively new and powerful tool to go after certain physics

  A lot more could be gained if it could continue... Super-B? Super-KEKB?

- Several compelling reasons to want to collect ~ 100 times greater data samples

Let's thank Vera and David for organizing an enjoyable and productive workshop!