Summary of Working Group III for the Durham CKM03 Proceedings

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We summarize the activities of Working Group III which took place during the 2nd Workshop on the CKM Unitarity Triangle, held at the Institute for Particle Physics Phenomenology, University of Durham, 5–9 April 2003.

1 Topics scheduled for discussion

Working Group III was devoted to the following topics:

- Update on results on the Unitary Triangle parameters using different statistical methods and a common set of inputs;
- Comparison of indirect and direct determinations of $\sin 2\beta$ and γ;
- New Physics from the Unitary Triangle
  - General strategies and sensitivity;
  - Tests of compatibility of fit inputs;
  - Interpreting results in scenarios beyond the Standard Model;
- Cross checking New Physics signals
  - From UT fits to rare decays;
  - From UT fits to direct sensitivity at Tevatron and LHC;
- Other topics, such as new flavour structures and textures.

2 Summary

The Standard Model (SM) has only one independent CP-violating quantity and, as a result, it is incisively probed by an analysis of the Unitarity Triangle (UT).

The UT analysis is based, at present, on the measurements of $|V_{ub}/V_{cb}|$, ΔM_d, the experimental bounds on ΔM_s, the CP-violating measurement of ϵ_K in the neutral kaon system and the measurement of the CP asymmetry in the decay $B_d \to J/\psi K_S$ ($a_{J/\psi}$). The extraction of the relevant CKM elements from these measurements is affected, except for $a_{J/\psi}$, by theoretical uncertainties.

The fact that all these measurements were in very good agreement provided a confirmation of the Cabibbo-Kobayashi-Maskawa mechanism of CP violation, which is embedded within the SM. Conversely, assuming the validity of the SM, it represented an important test of the calculations based on the OPE, HQET and Lattice QCD approaches which were used to extract the CKM parameters.

Although the resulting picture is remarkably consistent, precise quantitative determinations depend on the uncertainties assigned to the theoretical inputs and on the specific statistical approach adopted in the analyses. One of the outstanding achievements of the first CKM Workshop was precisely a serious comparison between the different analysis of the UT, which involved the development of a common set of input parameters based on the available theoretical and experimental information and the discussion of their statistical interpretation [1]. This work has been updated here by V Lubicz [2] who also discussed the sensitivity of the UT analysis to New Physics effects. Two items have been addressed: the sensitivity of future and improved measurements of $\Delta M_s, \beta$ and γ and the compatibility of the present UT analysis with significant New Physics contributions using a simplified model independent approach.
A new UT analysis based on a simplified frequentist approach has been presented by K Schubert [3].

This Working Group discussed some CP-violating features of general classes of models. GC Branco pointed out the relevance of models with spontaneous CP violation [4]; within SUSY, A Masiero highlighted the relevance of EDM's, if the SUSY breaking is flavour blind, and the severe constraints arising in theories where SUSY breaking introduces new sources of flavour [5]. A more specific model with Universal Extra Dimensions was discussed by AJ Buras [6]. In this model the only new parameter is the compactification radius R and consequently enhancements and suppressions of various rare branching ratios with respect to the SM can be uniquely predicted as a function of R.

Some specific decays were also considered, with special emphasis on the recent hint that the extraction of $\sin 2\beta$ from $B_d \to \phi K_S$ may not coincide with its extraction from $B_d \to \psi K$. SUSY schemes accommodating such a feature were presented by S Khalil [7] and L Silvestrini [8], and will soon be tested through ΔM_s and further B_d decays.

Although the B-factories have focused the community's interest on the B_d system, there is still a lot to be learned from the kaon system, a fact highlighted by G. Isidori who discussed the impact of $K \to \pi\nu\bar{\nu}$ on the CKM parameters [9].

Similarly, there is a lot to be learned from the B_s system, besides the upcoming ΔM_s measurement. GC Branco highlighted the importance of the $B_s - \bar{B}_s$ mixing phase χ as a further probe on the CKM mechanism [4]. Other aspects related to Supersymmetry have been discussed in [2,8]. R Fleischer [10] showed how the Silva-Wolfenstein [11] extraction of $\sin 2\alpha$ through a U-spin comparison of $B_d \to \pi^+\pi^-$ with $B_d \to K^+\pi^-$ can be improved by using instead $B_s \to K^+K^-$. He also introduced several methods to get at γ through $B \to D$ decays; one interesting consequence for experimentalists is that those decays involved in the classic Gronau-London-Wyler [12], Aleksan-Dunietz-Kayser [13] and Dunietz's [14] methods can be utilized in novel ways.

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References

1. M. Battaglia, A. J. Buras, P. Gambino and A. Stocchi, eds. Proceedings of the *First Workshop on the CKM Unitarity Triangle*, CERN, Feb 2002, hep-ph/0304132
2. M. Ciuchini, E. Franco, F. Parodi, V. Lubicz, L. Silvestrini and A. Stocchi, arXiv:hep-ph/0307195.
3. K. Schubert, these proceedings.
4. G. C. Branco, arXiv:hep-ph/0307277.
5. M. Ciuchini, E. Franco, A. Masiero and L. Silvestrini, arXiv:hep-ph/0308013.
6. A. J. Buras, A. Poschenrieder, M. Spranger and A. Weiler, arXiv:hep-ph/0307202.
7. S. Khalil and E. Kou, arXiv:hep-ph/0307024.
8. L. Silvestrini, these proceedings, see [5]
9. G. Isidori, arXiv:hep-ph/0307014.
10. R. Fleischer, arXiv:hep-ph/0306270.
11. J. P. Silva and L. Wolfenstein, Phys. Rev. D **49**, R1151 (1994).
12. M. Gronau and D. Wyler, Phys. Lett. **B265**, 172 (1991); M. Gronau and D. London, Phys. Lett. **B253**, 483 (1991).
13. R. Aleksan, I. Dunietz, and B. Kayser, Z. Phys. **C54**, 653 (1992).
14. I. Dunietz, Phys. Lett. B **427**, 179 (1998).