MIAPP topical workshop
- B2TiP Report -

to be published to PTEP (Progress of Theoretical and Experimental Physics)

Emi KOU (LAL-IN2P3)

MIAPP workshop, 27th October 2016

Outline

- What is B2TiP and where are we?
- What is B2TiP report ?
- MIAPP topical workshop on B2TiP report
- Quick overview of the report chapters
- Conclusions

What is B2TiP?

FEB 2014 : approved at the executive board at Belle II collaboration

KEK where Belle II is hosted is the natural gathering point where flavour physics experts meet to discuss and develop topics of flavour physics for Belle II.

What's new in Belle II compared to Babar/Belle?

- ➡ Efficiencies and precision of the new hardware
- ➡ New analysis softwares and methods

What's new in theory after Babar/ Belle & LHCb result?

- ➡ Progresses in QCD
- ➡ New physics models and their constraints
- ➡ New observables

NEW IDEAS

Deliverable: "KEK green report" (B2TiP report)

Goal of B2TiP Report

- Focus mainly on the recent developments.
- A coherent "book" providing **useful** information for new Belle II members and graduate students.
- **Roadmap** for the future measurements should be discussed. The priorities from theorists' point of view should be well stated.
- The report should be completed before the data taking starts (~ early 2017).

B2TiP report and MIAPP workshop

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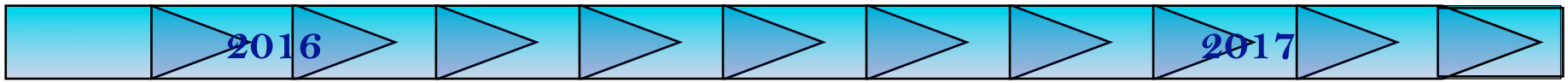


Series of 4 workshops
KEK, Europe, US

03/08/16
Deadline for
Version 1

23/09/16
Soft review
return to WGs

11/11/16
Hard review
by all authors

01/01/17
Deadline for
Final version

01-02-03/17
Final edition

01/04/17
Journal Submission
Ready-to-submit version

28/10/16
Deadline for
Version 2

15-17/11/16
MIAPP
B2TiP workshop!

**** one week delay from the original schedule due to the server relocation*

B2TiP review plan

Version 1

Include all the contributions, edited by the conveners, agreed between theorist/ experimentalist conveners (see **checklist**)

Version 2

Include all the corrections recommended by the **soft-review**

Final Version

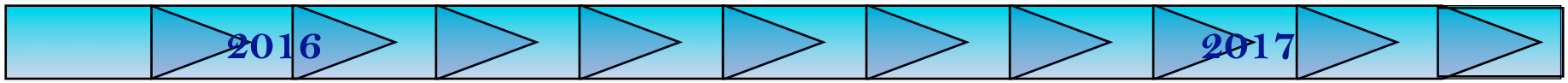
Include all the corrections recommended by **hard-review** (including MIAPP workshop)
Numbers and Figures are frozen at this point

Ready-to-Submit Version

Include the **final edition** by B2TiP organizers

B2TiP report and MIAPP workshop

https://confluence.desy.de/display/BI/B2TiP+ReportStatus



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B2TiP review plan

Version 1

Include all the contributions, edited by the conveners agreed between theorist/ experimentalist conve

Include all the correc

Include all the corrections recom
Numbers and

Ready-

Include the **final edit**

Outcome of the MIAPP workshop (if it is not covered in the B2TiP report) should be proposed to be included in B2TiP report!!

MIAPP topical workshop

14th - 17th November 2016

- ✓ local organizers : Thomas Kuhr & Christoph Bobeth

  http://indico.universe-cluster.de/indico/conferenceDisplay.py?ovw=True&confId=3666

- ✓ each WG presents the synthesis and the highlight of their chapter
- ✓ detailed discussions to improve each chapters by all participants
- ✓ discussions on the milestone/roadmap of Belle II
- ✓ discussions on after B2TIP Report
- ✓ **IMPORTANT**: all the participants must read the relevant WG chapters before arriving to MIAPP.

One session dedicated to proposals from the MIAPP workshop

MIAPP topical workshop

14th - 17th November 2016

✓ local organizers : Thomas Kuhr & Christoph Bobeth

nferenceDisplay.py?ovw=True&confId=3666

We will distribute the version 2 document next week so that all the participants can read and prepare their comments!

the highlight of their chapter

chapters by all participants

✓ eal issues

ons on the milestone

Contributions from graduate student are most welcome!

ns on after B2T

TANT: all the p

apters before arriving to

If you are leaving before the 4th week, please leave your comments to the MIAPP organizers or simply write to me !!

9 working groups

WG1: Leptonic/Semi-leptonic WG2: Radiative/Electroweak WG3: $\phi 1(\beta)/\phi 2(\alpha)$
WG4: $\phi 3$ (γ) WG5: Charmless/hadronic B decays WG6: Charm
WG7: Quarkonium(like) WG8: Tau & low multiplicity WG9: New Physics

WG1	G. De Nardo, A. Zupanic, M. Tanaka, F. Tackmann, A. Kronfeld, R. Watanabe
WG2	A. Ishikawa, J. Yamaoka, U. Haisch, T. Feldmann
WG3	T. Higuchi, L. Li Gioi, J. Zupan, S. Mishima
WG4	J. Libby, I. Watson, Y. Grossman, M. Blanke
WG5	P. Goldenzweig, M. Beneke, C.-W. Chiang, S. Sharpe
WG6	G. Casarosa, A. Schwartz, A. Kagan, A. Petrov
WG7	R.Mizuk, R.Mussa, C.Shen, B. Fulsom, Y.Kiyo, A.Polosa, S.Prelovsek. Ch.Hanhart
WG8	K. Hayasaka, T. Feber, E. Passemar, J. Hisano
WG9	R.Itoh, F.Bernlochner, Y.Sato, U.Nierste, L.Silvestrini, J.Kamenik, S. Simula, V.Lubicz

First task for WGs...

https://confluence.desy.de/display/BI/B2TiP+B2TIPGoldenModes

Group	Observables	Mode	SM or CKM Fit Expectation	Belle 2014	Babar 2014	Belle II 5 /ab	Belle II 50/ ab	LHCb 2014	LHCb 8/fb	LHCb 50/fb
ϕ_1/ϕ_2 WG page	$\sin(2\phi_1)$	$B \to J/\psi K_S$		$0.667 \pm 0.023 \pm 0.012(1.4^\circ)$		0.7°	0.4°		1.6°	0.6°
	S	$B \to \phi K^0_S$		$0.90^{+0.09}_{-0.19}$		0.053	0.018		0.2	0.04
		$B \to \eta' K^0_S$		$0.68 \pm 0.07 \pm 0.03$		0.028	0.011			
		$B \to K^0_S K^0_S K^0_S$		$0.30 \pm 0.32 \pm 0.08$		0.100	0.033			
	ϕ_2	$B \to \pi\pi$, $B \to \rho\pi$, $B \to \rho\rho$		$(85 \pm 4)^\circ$ (Belle + Babar)		2°	1°			
ϕ_3 WG page	ϕ_3	$B \to D^{(*)}K/\pi$ (total)		$(68 \pm 14)^\circ$		6°	1.5°			
	ϕ_3	$B \to D^{(*)}K/\pi$ (CP eigenstate)								
	ϕ_3	$B \to D^{(*)}K/\pi$ (CB/DCS decays)								
	ϕ_3	$B \to D^{(*)}K/\pi$ (Self-conjugate)								
	ϕ_3	$B \to D^{(*)}K/\pi$ (SCS decays)								
Hadronic B WG page	A	$B \to K^0_S\pi^0$		$-0.05 \pm 0.1 \pm 0.05$		0.07	0.04			
		$B \to K^*\pi$								
		$B \to K\rho$								
		$B \to K^*\phi$								
		$B \to K^*\rho$								
		$B \to K_S K^+ K^-$								
		$B \to K^+K^-\pi^0$								
		$B \to K^+\pi^0\pi^0$								
		$B \to K_S\pi^+\pi^0$								
Semileptonic & Leptonic WG page	$V_{cb}[10^{-3}]$ inclusive	$B \to X_c\ell\nu$		$41.6(1 \pm 0.024_{fit})$		1.2%				
	$V_{cb}[10^{-3}]$ exclusive	$B \to D^*\ell\nu$		$37.5(1 \pm 0.030_{exp} \pm 0.027_{th_y})$		1.8%	1.4%			
	$V_{ub}[10^{-3}]$ exclusive	$B \to \pi\ell\nu$ (Hadronic tag)		$3.52(1 \pm 0.095_{fit})$		4.4%	2.3%			
	$\mathcal{B}[10^{-6}]$	$B \to \tau\nu$ (Hadronic tag)		$96(1 \pm 0.26)$		10%	5%			
	$\mathcal{B}[10^{-6}]$	$B \to \mu\nu$				20%	7%			
	$\mathcal{R}$	$B \to D\tau\nu$ (Hadronic tag)			$0.440(1 \pm 0.165)$	5.6%	3.4%			
	$\mathcal{R}$	$B \to D^*\tau\nu$ (Hadronic tag)			$0.332(1 \pm 0.090)$	4.4%	2.3%			
Radiative & Electroweak WG page	A_{CP}	$B \to X_{s+d}\gamma$		$2.2 \pm 4.4 \pm 0.8$ %		1.0%	0.5%			
	ΔA_{CP}	$B \to X_s\gamma$		not measured yet	$+5.0 \pm 3.9 \pm 1.5$ %	1.7%	0.7%			
	$\mathcal{B}[10^{-6}]$	$B \to X_d\gamma$		not measured yet	$9.2(1 \pm 0.22 \pm 0.25)$	x.x%	x.x%			
	$\mathcal{S}$	$B \to K^0_S\pi^0\gamma$		$-0.10 \pm 0.31 \pm 0.07$		0.11	0.035			
	$\mathcal{S}$	$B \to \rho\gamma$		$-0.83 \pm 0.65 \pm 0.18$		0.23	0.07			
	$\mathcal{B}[10^{-6}]$	$B \to K\nu\bar{\nu}$		< 40						
	$\mathcal{B}[10^{-6}]$	$B \to K^*\nu\bar{\nu}$		< 55						
	$\mathcal{R}_{Xs}$	$B \to X_s\ell^+\ell^-$		20%		7%	2.0%			
Charm WG page	$\mathcal{B}[10^{-3}]$	$D_s \to \mu\nu$		$5.31(1 \pm 0.053 \pm 0.038)$		2.9%	0.9%			
	$\mathcal{B}[10^{-3}]$	$D_s \to \tau\nu$		$5.70(1 \pm 0.037 \pm 0.054)$		3.5%	2.3%			
	$\mathcal{B}[10^{-6}]$	$D^0 \to \gamma\gamma$		< 1.5		30%	25%			
	$A_{CP}[10^{-4}]$	$D^0 \to K^+K^-$		$-32 \pm 21 \pm 9$		11	6			
	$A_{CP}[10^{-2}]$	$D^0 \to \pi^0\pi^0$		$0.03 \pm 0.64 \pm 0.10$		0.29	0.09			
	$A_{CP}[10^{-2}]$	$D^0 \to K^0_S\pi^0$		$-0.21 \pm 0.16 \pm 0.09$		0.08	0.03			
	A_Γ			$-0.03 \pm 0.21 \pm 0.08$		0.1	0.03			
	$x[10^{-2}]$	$D^0 \to K^0_S\pi^+\pi^-$		$0.56 \pm 0.19^{+0.07}_{-0.13}$		0.14	0.11			
	$y[10^{-2}]$	$D^0 \to K^0_S\pi^+\pi^-$		$0.30 \pm 0.15^{0.05}_{0.08}$		0.08	0.05			
	$abs(q/p)$	$D^0 \to K^0_S\pi^+\pi^-$		$0.90^{+0.16\,+0.08}_{-0.15\,-0.06}$		0.10	0.07			
	ϕ	$D^0 \to K^0_S\pi^+\pi^-$		$-6 \pm 11^{+4}_{-5}$		6°	4°			
Tau WG page	$\mathcal{B}[10^{-9}]$	$\tau \to \mu\mu\mu$		< 21		< 3.0	< 0.3			
		$\tau \to K_S\pi^0\nu$								
		$\Upsilon(3S) \to$ missing energy								

-- Main.PhillipUrquijo - 2015-05-14

This topic: B2TiP > WebHome > B2TIPGoldenModes
Topic revision: r4 - 2015-08-

Each group was asked to list maximum of 5 Golden Channels and study in details.

WG1: Leptonic & Semi-Leptonic B decay

Section convenors: A. Kronfeld, G. De Nardo, F. Tackmann, R. Watanabe, A. Zupanc

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1.3 Semitauonic decays **5**
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1.3.3 $B \to X_c\tau\nu$ 10
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1.5 Inclusive semileptonic **16**
1.6 (Semi-)leptonic B_s decays **17**
1.7 Conclusions **18**
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+ G. Ricciardi and P. Urquijo

WG2: Electroweak & Radiative B decay

Section editors: T. Feldmann, U. Haisch, A. Ishikawa and J. Yamaoka

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WG3: Time-dependent CPV: ϕ1, ϕ2

Section author(s): A. Gaz, S. Lacaprara, L. Li Gioi, S. Mishima, J. Zupan

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1.2 Determination of ϕ_1 1
1.2.1 $\sin 2\phi_1$ from $b \to c\bar{c}s$ 1
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WG4: Determination of $\phi 3$

Section author(s): M. Blanke, Y. Grossman, J. Libby, I. Watson

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1.4 Auxiliary measurements 3
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+ K. Trabelsi

WG5: Charmless hadronic B decay

Section author(s): M. Beneke, C-W. Chiang, P. Goldenzweig, S. Sharpe

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WG6: Charm

Section author(s): G. Casarosa, A. Kagan, A. Petrov, A. J. Schwartz

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WG7: Quarkonium

Section author(s): B. Fulsom, S. Godfrey, C. Hanhart, Y. Kiyo, R. Mizuk, R. Mussa, A. Polosa, S. Prelovsek, C-P. Shen

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WG8: Tau and low multiplicity

Section author(s): H. Czyz, T. Teubner, D. Nomura, J. Hisano, E. Passemar, T. Ferber, K. Hayasaka, C. Hearty, B. Shvartz

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+ E. Kou

WG9: New Physics

Section author(s): F. Bernlochner, R. Itoh, J. Kamenik, V. Lubicz, U. Nierste, Y. Sato, L. Silvestrini

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Belle II Roadmap

- ✓ Belle II Roadmap: highlight at 1, 5(10), 50 /ab of data (2020, 2021, 2024)±1 year.
- ✓ Impact plot: make plots with reduced experimental error. Central value is still under discussion (but something optimistic :-)).
- ✓ **IMPORTANT:** the results will be used heavily by the Belle II collaborations !

**** Phone meeting going on every other Mondays.*
Contact Florian Bernlochner!

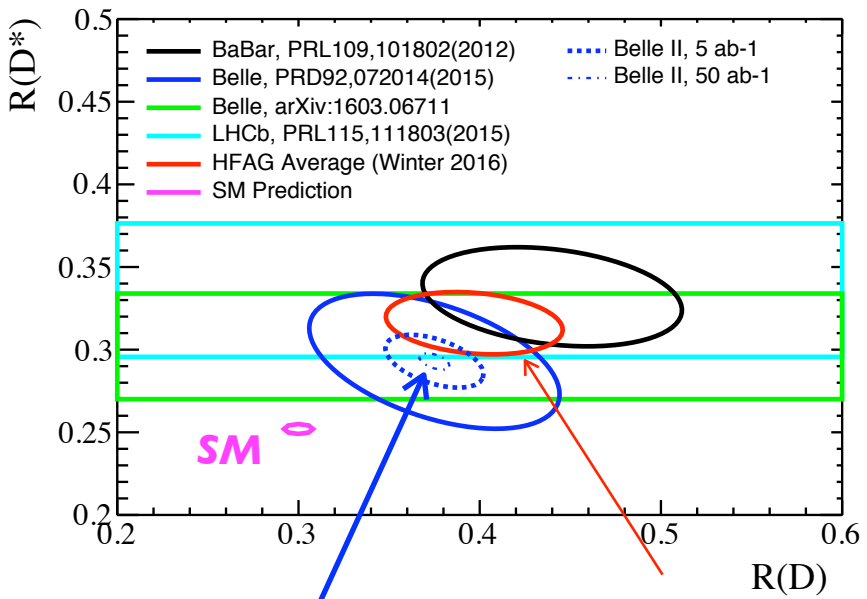
Belle II impact plot

Current 2-3σ deviations will be clarified: new physics effect or just statistical fluctuations?!

Example of B->D(*)τν

Currently the deviation is ~3σ...

K. Hara for B2TiP LAL NP-workshop



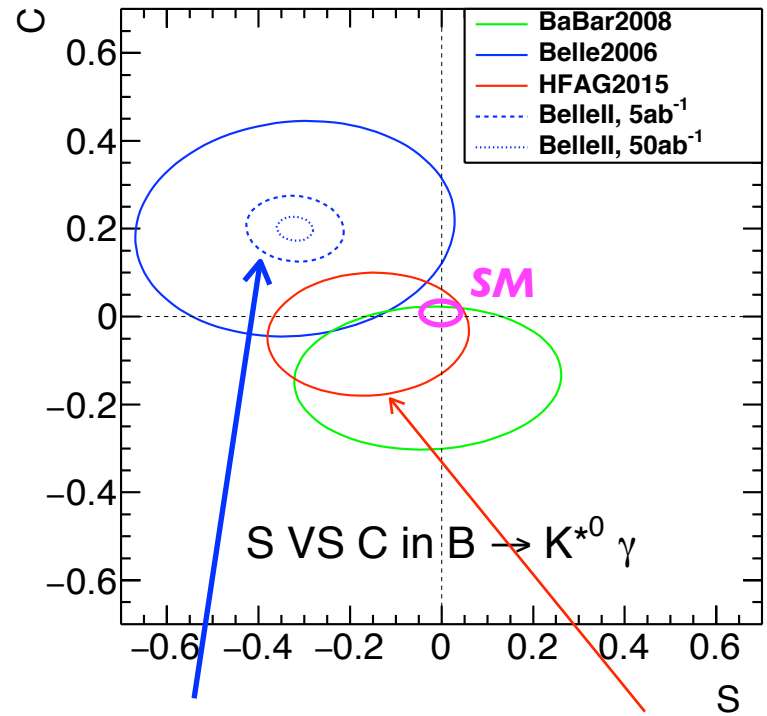
~ currently 3σ deviation?

Belle II prospect
(with the current Belle central value)
14(6)σ deviation with 50(5)ab^{-1} of data!

Example of CPV in B->K*γ

Currently SM (#) consistent...

A. Ishikawa for B2TiP LAL NP-workshop



Belle II prospect
(with the current Belle central value)
16(6)σ deviation with 50(5)ab^{-1} of data!

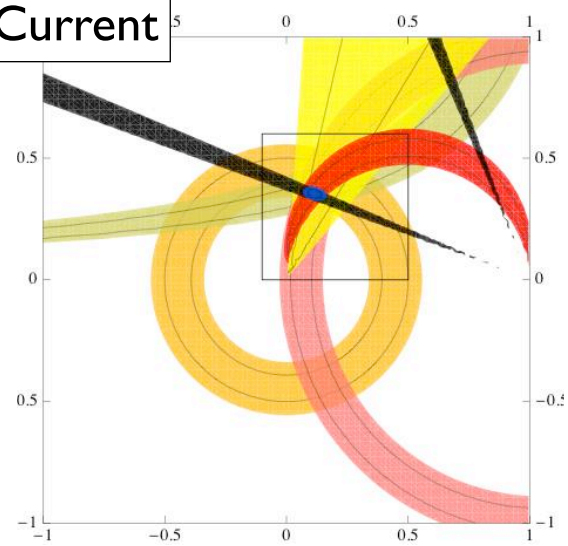
currently SM consistent?

*(#) SM prediction of CPV in B->K*γ is still under discussion in B2TiP...*

Belle II impact plot

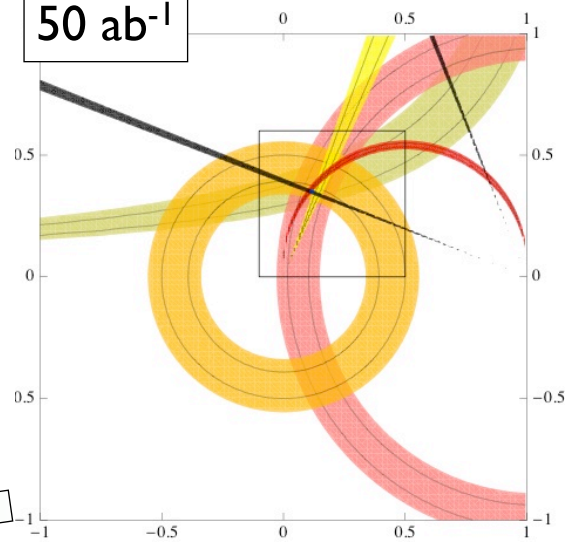
What do we expect in the future? New Physics can manifest itself in the Unitarity Triangle?

Current

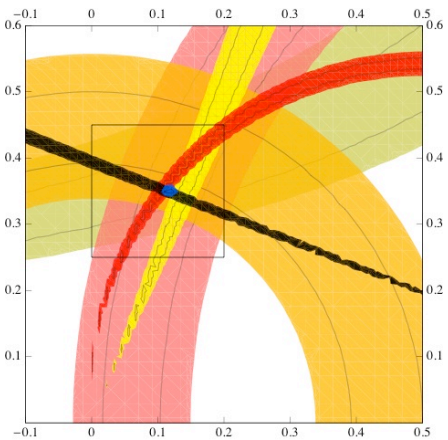


Let us reduce the errors in $\Phi_1\Phi_2\Phi_3$ (α,β,γ) by keeping the central value as it is now.

50 ab^{-1}



zoom



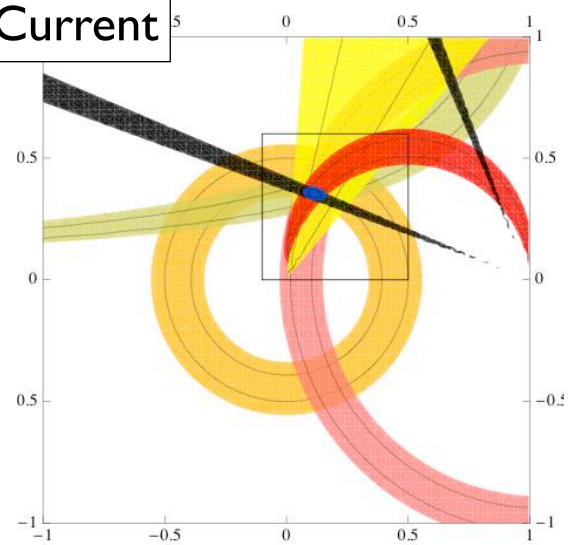
SM agree

E. Kou for B2TiP LAL NP-workshop

Belle II impact plot

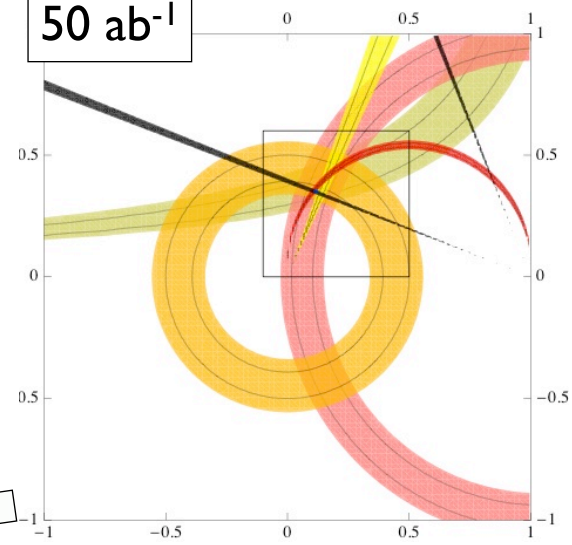
What do we expect in the future? New Physics can manifest itself in the Unitarity Triangle?

Current



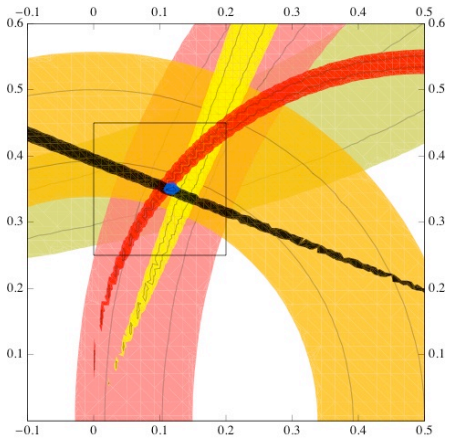
Let us reduce the errors in $\Phi_1\Phi_2\Phi_3$ (α,β,γ) by keeping the central value as it is now.

50 ab^{-1}



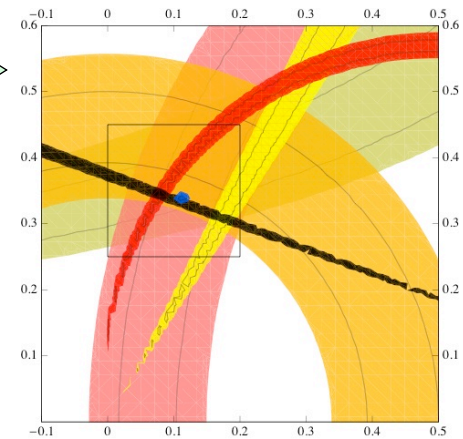
zoom

E. Kou for B2TiP LAL NP-workshop



SM agree

But if the 3 central values are all slightly lower (within 1σ range)...



8σ deviation!

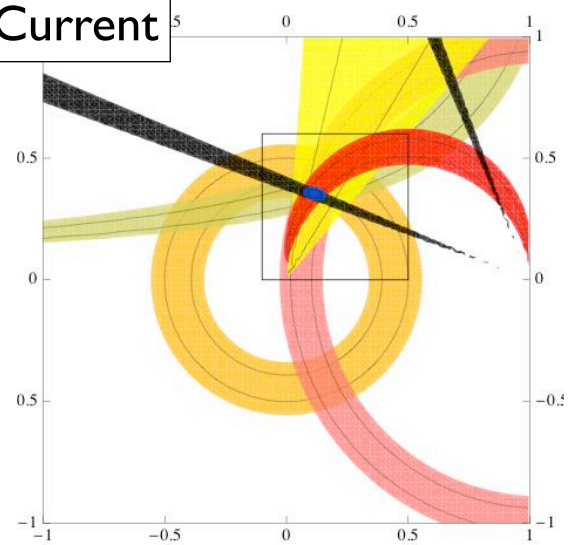
This is not an odd case, we find that the chance to have >5σ deviation is ~50 % for now!

E. Kou and F. Le Diberder, Preliminary

Belle II impact plot

What do we expect in the future? New Physics can manifest itself in the Unitarity Triangle?

Current



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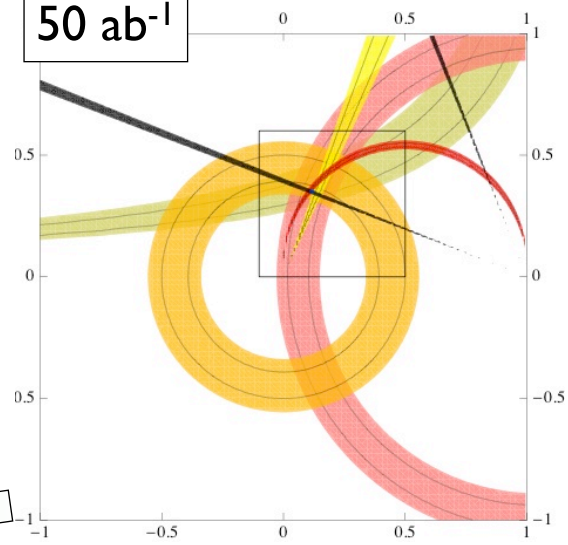
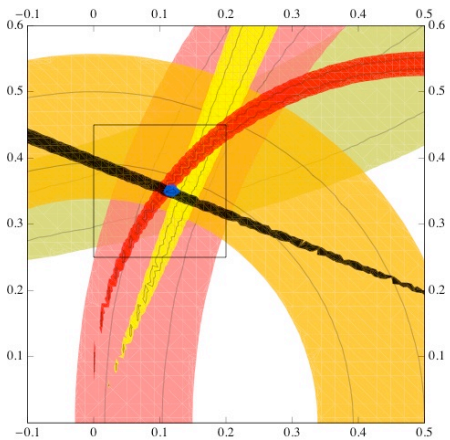


zoom

E. Kou for B2TiP LAL NP-workshop



SM agree

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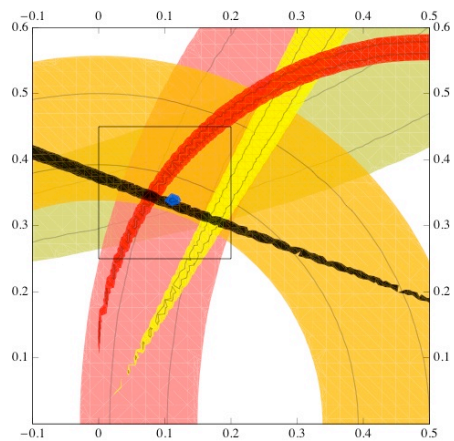
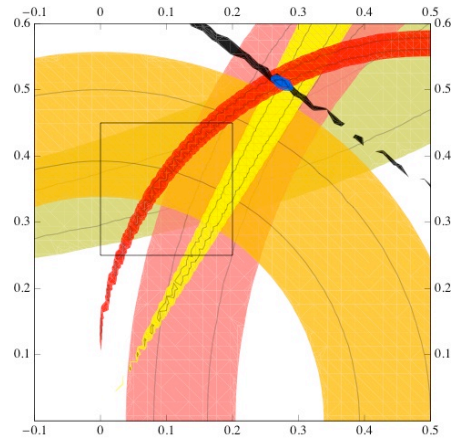


8σ deviation!

Then, $\Phi_1(\beta)$ might actually be much larger?



New physics in box???

Conclusions

- ✓ Topical workshop on B2TiP report : 15th --- 17th Nov.

  http://indico.universe-cluster.de/indico/conferenceDisplay.py?ovw=True&confId=3666

- ✓ The B2TiP report version 2 will be available during the next week (but let me know if you want it in advance).

- ✓ All the participants of the MIAPP topical workshop will receive the link to the full document by the next week to read and prepare comments for the relevant chapters before coming to MIAPP.

- ✓ If you can not come to the topical workshop, please leave your comments to the MIAPP organizers or the B2TiP organizers (P. Urquijo/E. Kou)!