Theoretical Aspects and Specific Problems of Physics Analysis at super B factories

(PROJECT:B_02 & B_03)

Emi KOU (LAL/IN2P3)

TYL-FKPPL joint meeting: Universite Blaise Pascal

28-30th May 2012

LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

cnrs In2p3

PARTICLE PHYSICS JOINT LAB JAPAN - FRANCE

Members

*responsible

JP

Th.

KEK:
S. Hashimoto*, T. Goto,
Y. Okada, N. Yamada
Universities:
K. Tobe(Nagoya),
Y. Shimizu (Tohoku)

Exp.

KEK:
M.Nakao, K. Hara,
T.Higuchi, R.Itoh,
S.Nishida, Y.Sakai,
K.Trabelsi

FR

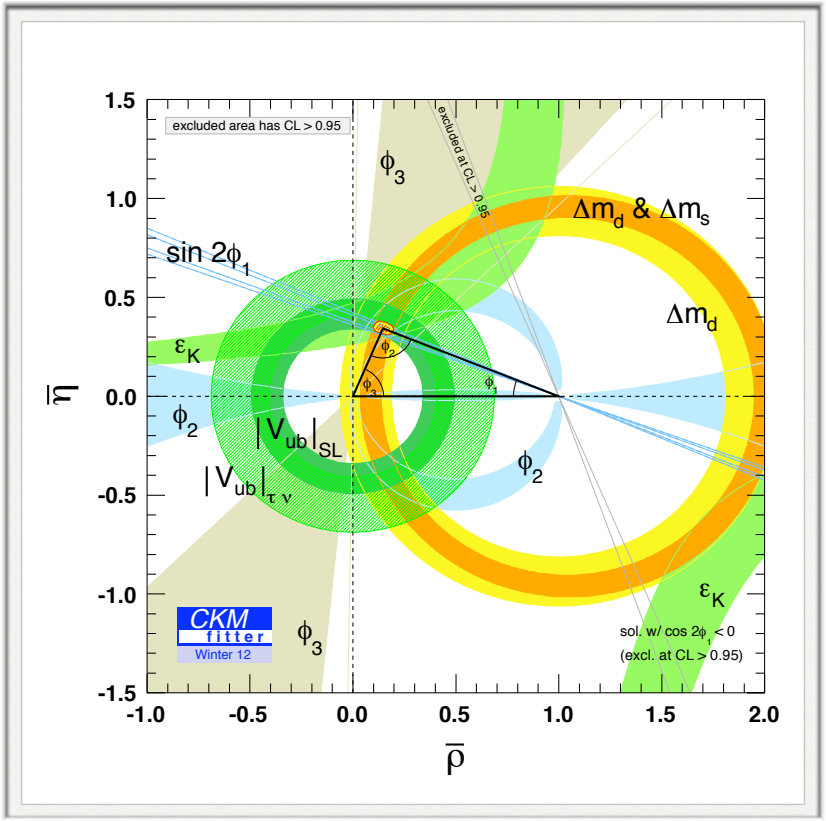
Th.

LAL/IN2P3:
E.Kou*
LPT-Orsay/CNRS:
D. Becirevic, B. Blossier, S.
Descotes-Genon, K. Petrov,
A. Tayduganov, F.Yu

Activity Report for 2011

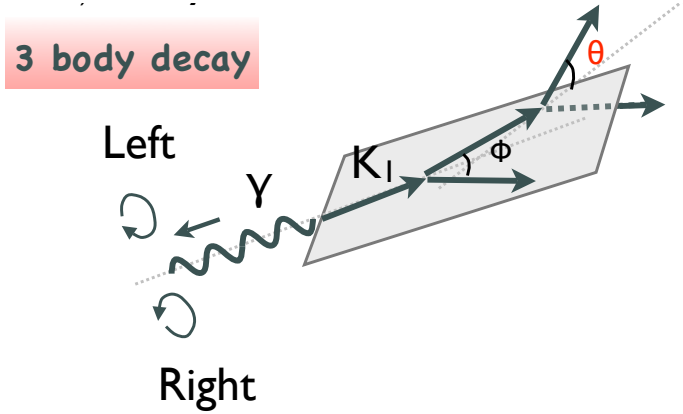
Japanese team activity in France

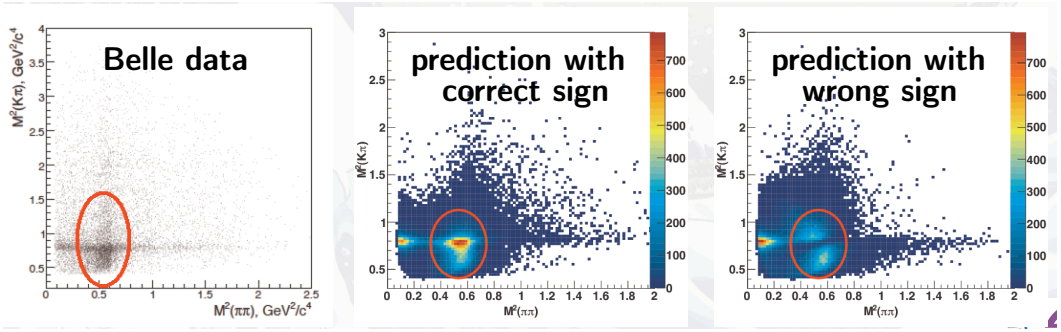
- **T. Higuchi (to LAL 2011):** Seminar on the Belle-II DAQ system (T.H. also works for the Book of Physics of B factories on the DAQ system)
- **T. Higuchi (to LAL 2010):** Seminar on the Outreach activity at KEK (B-lab etc)
- **R. Itoh & K. Trabelsi (to CPPM):** Participation to the CKMfitter collaboration meeting

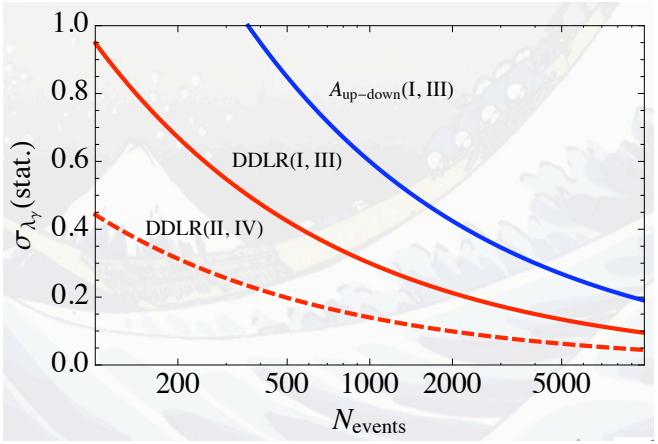


French team activity in Japan I

A. Tayduganov (to KEK): Seminar on the new method of measuring photon polarization of the $B \to X_s \gamma$ process. Informal discussion with the TYL Japanese members. Possibility of applying his method and also further improve his method by using the well-measured control channel $B \to J/\psi K_1$.







French team activity in Japan II

L. Oliver (to KEK):
Invited speaker for "KEK Flavour Factory Workshop" on the problem of B➔D**l nu process. Proposition for computing B➔D** form factor on lattice and for revisiting Belle measurement of Isgur-Wise functions of this process.

** E.Kou also gave a talk at KEKFF workshop.*

Conclusions on the D^{**} "1/2 vs. 3/2 puzzle"

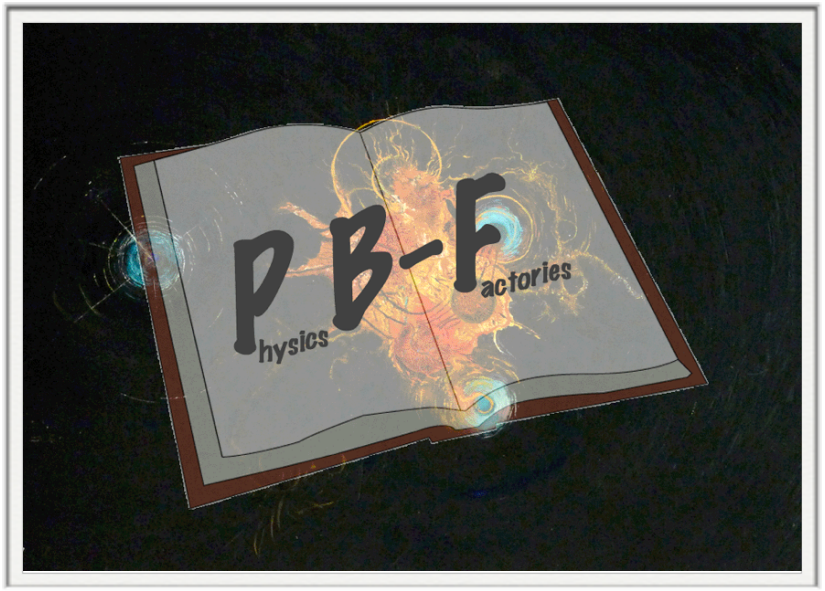
- OPE and Heavy Quark limit strongly suggest $|\tau_{1/2}|^2 << |\tau_{3/2}|^2$
- BT relativistic quark model (Light Front Approach) satisfies theoretical constraints from HQET and $|\tau_{1/2}|^2 << |\tau_{3/2}|^2$
- Unquenched lattice QCD satisfies also these constraints and gives $|\tau_{1/2}|^2 << |\tau_{3/2}|^2$ (for static c quark)
- Assuming factorization, BELLE data on pionic decays $\overline{B} \to D^{**}\pi$ also support the hierarchy $|\tau_{1/2}|^2 << |\tau_{3/2}|^2$
- However, SL data on $\overline{B} \to D^{**}\ell\nu$ from DELPHI, BELLE and BABAR support the opposite hierarchy $|\tau_{1/2}|^2 >> |\tau_{3/2}|^2$ (although there are differences between these experiments)
- It is unlikely that finite mass effects can change the theoretical predictions (cf. Light Front Approach to $\overline{B} \to D^{**}\pi$)
- Data on the decays $\overline{B}_s \to D_s^{**}\ell\nu$ could help to clarify the problem

French team activity in Japan III

- **E. Kou (to KEK):** Lecture on the CP violation and Belle physics to the "TYL Rikejo-Camp" (school for female high school students).

Related activity

M.Nakao, T.Higuchi, R.Itoh, S.Nishida, Y.Sakai, K.Trabelsi (KEK), E. Kou (LAL): Many of us are sub-section co-editors (*) for the book of Physics of B factories. Some common activity is foreseen.



(*) Vertexing, Multivariate discriminant, particle ID, phi1, phi3, Radiative and EW penguin decays, New physics Benchmark scenarios

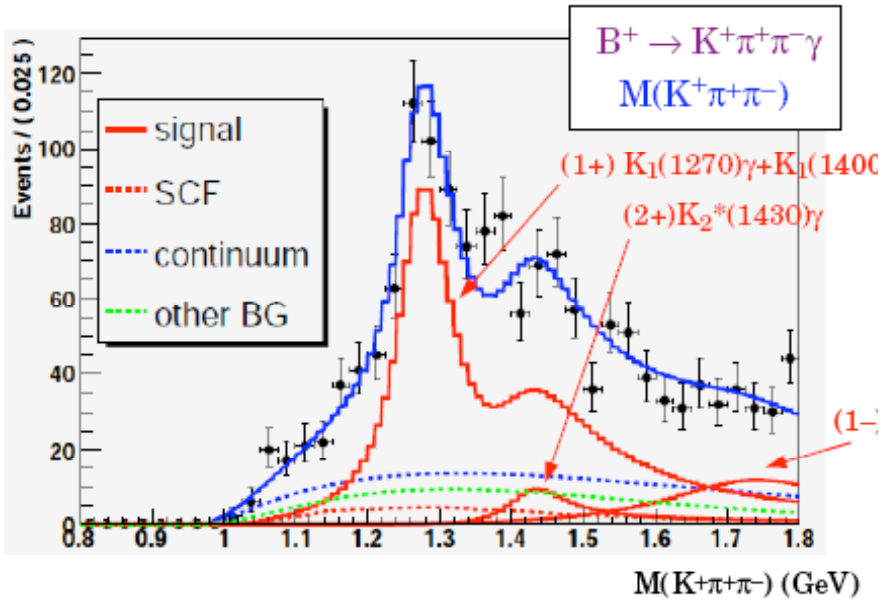
Project and Plan for 2012

~Theoretical Aspects and
Specific Problems of Physics Analysis
at SuperB factories~

Towards detailed simulation for $B \to K_1\gamma$ polarization measurement

M.Nakao, Y.Sakai, K.Trabelsi + E.Kou, **A.Tayduganov**

- Many problems and possible solutions have been discussed last years.
- Detailed simulation with Belle II soft-ware is essential for feasibility study. Some Belle II members show interests working on this process.
- French team is now working on formulating the control channel, $B \to J/\psi K_1$.



Talk by S.Nishida at CKM2008

B➛sγ photon polarization measurement: super BFs v.s. LHCb

M.Nakao, Y.Sakai, K.Trabelsi + D. Becirevic, E.Kou, **A.Tayduganov**, F.Yu

methods

- Method I: Time dependent CP asymmetry in $B_d \to K_S\pi^0\gamma$ $B_s \to K^+K^-\gamma$ (called $S_{KS\pi0\gamma}$, $S_{K+K-\gamma}$)

$$S_{K_S\pi^0\gamma} = \frac{2|C_{7\gamma}^{\rm SM} C_{7\gamma}^{\prime\rm NP}|}{|C_{7\gamma}^{\rm SM}|^2 + |C_{7\gamma}^{\prime\rm NP}|^2} \sin(2\phi_1 - \phi_R) \qquad \phi_R = \arg\left[\frac{C_{7\gamma}^{\prime\rm NP}}{C_{7\gamma}^{\rm SM}}\right]$$

- Method II: Transverse asymmetry in $B_d \to K^* l^+ l^-$ (called $A_T^{(2)}$, $A_T^{(im)}$)

$$\mathcal{A}_T^{(2)}(q^2=0) = \frac{2Re[C_{7\gamma}^{\rm SM} C_{7\gamma}^{\prime\rm NP*}]}{|C_{7\gamma}^{\rm SM}|^2 + |C_{7\gamma}^{\prime\rm NP}|^2} \qquad \mathcal{A}_T^{(im)}(q^2=0) = \frac{2Im[C_{7\gamma}^{\rm SM} C_{7\gamma}^{\prime\rm NP*}]}{|C_{7\gamma}^{\rm SM}|^2 + |C_{7\gamma}^{\prime\rm NP}|^2}$$

- Method III: $B \to K_1(\to K\pi\pi)\gamma$ (called λ_γ)

$$\lambda = \frac{|C_{7\gamma}^{\prime\rm NP}|^2 - |C_{7\gamma}^{\rm SM}|^2}{|C_{7\gamma}^{\prime\rm NP}|^2 + |C_{7\gamma}^{\rm SM}|^2}$$

B➛sγ photon polarization measurement: super BFs v.s. LHCb

M.Nakao, Y.Sakai, K.Trabelsi + D. Becirevic, E.Kou, **A.Tayduganov**, F.Yu

methods

- Method I: Time dependent CP asymmetry in $B^0 \to K_S\pi^0\gamma$ $B_s \to K^+K^-\gamma$ (called $S_{K_S\pi^0\gamma}$, $S_{K^+K^-\gamma}$)

super B Factories
$\sigma_{S_{K_S\pi\gamma}}(0.02)$

$$S_{K_S\pi^0\gamma} = \frac{2|C_{7\gamma}^{\rm SM}C$$ $$|C_{7\gamma}^{\rm SM}|^2 + |C_{7\gamma}^{\rm NP}|^2 \sin(2\phi_1 - \phi_R) \qquad \phi_R = \arg\left[\frac{C_{7\gamma}^{\prime\rm NP}}{C_{7\gamma}^{\rm SM}}\right]$$

- Method II: Transverse asymmetry in $B \to K^*l^+l^-$ (called $A_T^{(2)}$, $A_T^{(im)}$)

LHCb
$\sigma_{A_T^{2(im)}}(0.2)$

$$\mathcal{A}_T^{(2)}(q^2=0) = \frac{2Re[C_{7\gamma}^{\rm SM}C_{7\gamma}^{\prime\rm NP}}{|C_{7\gamma}^{\rm SM}|^2 + |C_{7\gamma}^{\prime\rm NP}|^2} \qquad \mathcal{A}_T^{(im)}(q^2=0) = \frac{2Im[C_{7\gamma}^{\rm SM}C_{7\gamma}^{\prime\rm NP*}]}{|C_{7\gamma}^{\rm SM}|^2 + |C_{7\gamma}^{\prime\rm NP}|^2}$$

- Method III: $B \to K_1(\to K\pi\pi)\gamma$ (called)

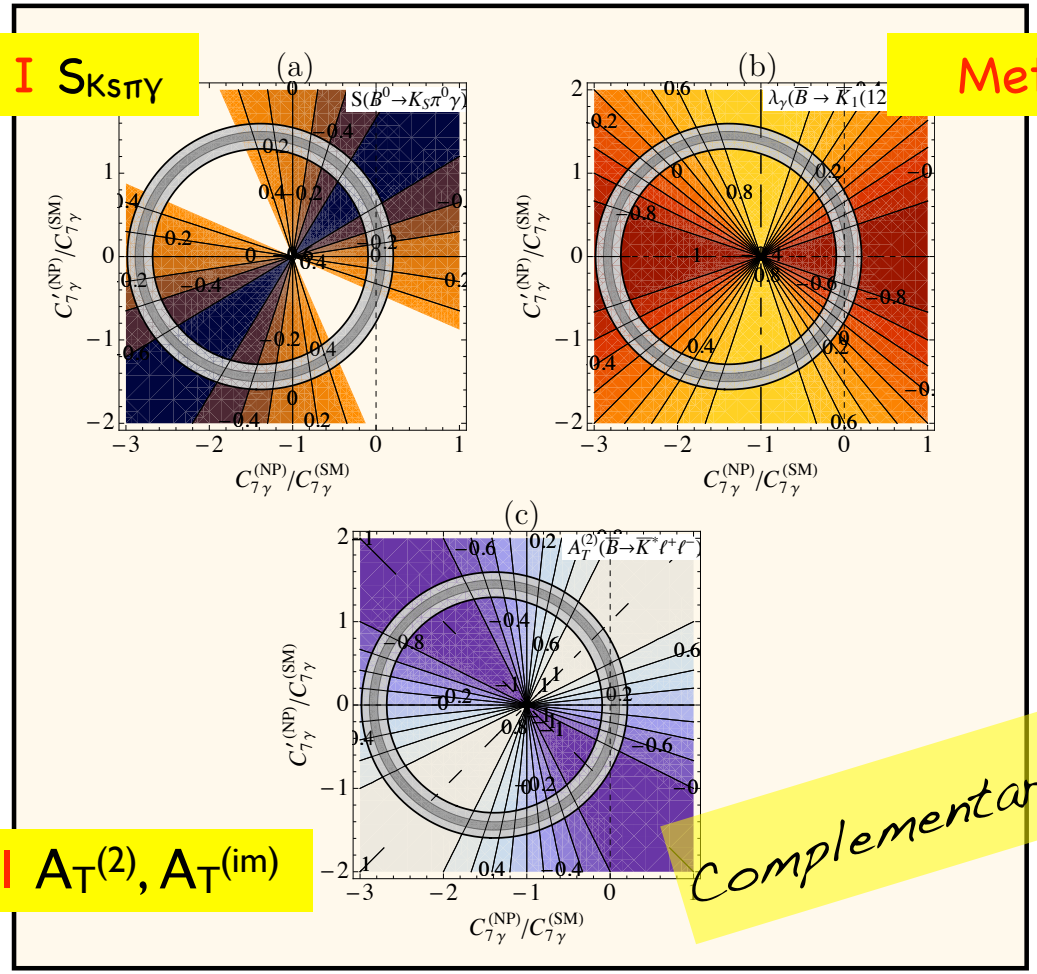
super B Factories/LHCb
$\sigma_\lambda(0.1\text{-}0.2)$

B➛sγ photon polarization measurement: super BFs v.s. LHCb

M.Nakao, Y.Sakai, K.Trabelsi + D. Becirevic, E.Kou, **A.Tayduganov**, F.Yu

Method I $S_{K_S\pi\gamma}$

Method III λ



Method II $A_T^{(2)}$, $A_T^{(im)}$

Complementary!

Discussion on advantages and dis-advantages of three methods for different new physics scenarios.

We are also working on concrete models.

LR symmetric model:
E.K. & F. Yu
SUSY:
E.K. & A.Tayduganov

Other focus subjects in 2012

- **Lattice QCD:** Discussion on the latest result on the α_s computation by French team B. Blossier, S.Hashimoto, N.Yamada.
- **B to D^{**} lν decays:** Discussion on the importance of this channel in terms of the CKM matrix element determination. Possibility of lattice computation of the form factor and discussion on the Belle result. B. Blossier, K.Petrov, S.Hashimoto, N.Yamada, Y.Sakai, M.Nakao
- **CKM triangle:** Discussion on various issues for precise determination of the CKM triangle R.Itoh, K. Trabelsi, S. Descotes-Genon.

Conclusions

- This proposal B_03 & B_02 focuses on the phenomenological aspects of the flavour physics. It is a collaboration between theory and experiment (2010,2011,2012).
  [B_02 (exp: 2006,2007,2008), B_03 (th: 2009)]

- Fruitful discussions have been made during the visits from both sides thanks to the supports by TYL.

- This unique opportunity of TYL has been allowing us to introduce each other's scientific development in Japan and in France in various aspects of flavour physics.