



$B^0 \rightarrow \eta' K^0$ Time Dependent Analysis at SuperB FastSim Study



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Overview



- Talk Overview
 - One slide of Physics
 - Plan of the analysis
 - PacS2BUser and Feb. Production
 - Overlap with other studies (?)

- This work was started just few weeks ago
- Goal of this talk:
 - Let you know what are we doing
 - Look for overlaps with other analyses
 - Receive your suggestions / requests / “Hey! Be aware of...”

η'K⁰ Physics



$\sin(2\beta^{\text{eff}}) \equiv \sin(2\phi_1^{\text{eff}})$ **HFAG**
 EndOfYear 2009
 PRELIMINARY

$B^0 \rightarrow \eta' K^0$ decay discovered with an unpredicted **high BF** by CLEO, CP Violation first observed in 2006 by BaBar.

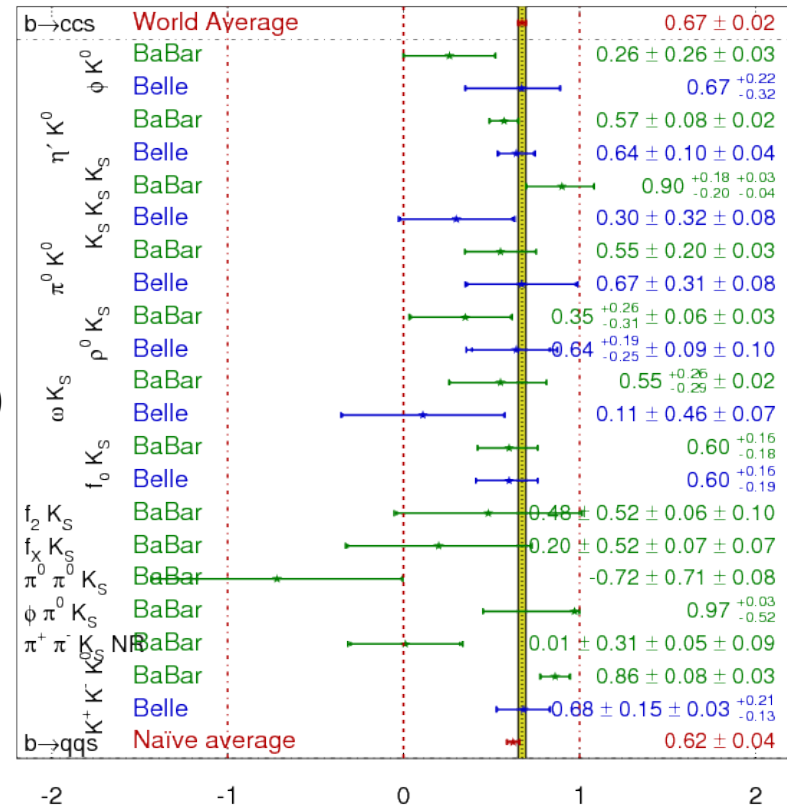
$B^0 \rightarrow \eta' K^0$ is a $b \rightarrow s$ penguin-mediated process: **NP effects may appear** due to heavy particles in the loop

CPV is investigated through **Time-Dependent Analysis**.

$$A_{CP} = \frac{\Gamma(\overline{B}^0 \rightarrow \eta' K) - \Gamma(B^0 \rightarrow \eta' K)}{\Gamma(\overline{B}^0 \rightarrow \eta' K) + \Gamma(B^0 \rightarrow \eta' K)} = S \sin(\Delta m t) + C \cos(\Delta m t)$$

Neglecting Cabibbo-suppressed contributions, S is expected to be equal to the value measured in $B^0 \rightarrow (c\bar{c})K^0 = \sin 2\beta$

Deviations from this value may arise from SM effects and are computed in various approaches



$\eta'K^0$ Analysis



Why $B^0 \rightarrow \eta'K^0$?

- Has large BF with two of the dominant modes with low background
- Theory predicts difference with $(c\bar{c})K^0$ to be up to $\sim 0.03-0.04$

$B^0 \rightarrow \eta'K^0$ at BaBar:

$$S_{\eta'K} = 0.586 \pm 0.078 \pm 0.015 \quad S_{c\bar{c}} = 0.687 \pm 0.028 \pm 0.012$$

- Simultaneous fit to K^0_S and K^0_L samples
- $3 K^0_S \rightarrow \pi^+\pi^-$ modes + $2 K^0_S \rightarrow \pi^0\pi^0$ + $2 K^0_L$ modes = 7 decay modes
- Main systematics are statistical in origin

$B^0 \rightarrow \eta'K^0$ at SuperB:

- Systematics are expected to be pushed down to < 0.01 (see Chih-hsiang Cheng's talk @ Warwick)
- With 75 ab^{-1} modes with $K^0_S \rightarrow \pi^0\pi^0$ (high backgrounds) are not needed
- K^0_L modes may provide an independent measurement (may add another subdecay)

$\eta'K^0$ FastSim Analysis



Analysis Plan

- Investigate expected error, and data needed for 5σ inconsistency with $(c\bar{c})K^0$ (this doesn't mean prêt-à-porter NP, improvements on theory side needed)
- Preliminary results @ Elba and something better for TDR
- K_L^0 is actually not implemented in FastSim

Key points of the analysis [blue dot = Elba, green dot = post-Elba]

- Check that all the kinematics variables are fine
- Check possible bkg contributions at 75ab^{-1}
- Check Δt resolution (overlap with Nicola Neri's ϕK^0 ?)
- Check impact of detector geometry on tagging efficiencies (fwd PID)
- Perform (Pure) Toys to assess statistical error and studies to see how far we can get in reducing systematic
- Provide a conservative and an optimistic error assessment

PacS2bUser and February Production



Configuration .tcl files needed to produce ntuples are included in PacS2bUser package, they are tested to work with PacProduction and committed to the *trunk*.

Request for Feb. Production:

- **Generic background** (as much as possible), especially $B\bar{B}$.
- **Signal** (Optimal (min) is 50(10) independent MC embedded toys, part of these may be produced also in August)
- Detector Geometry: BaBar, SuperB DG0, SuperB DG4

Mode	.dec File	Analysis	Requested Events (optimal)	Requested Events (min)
eta'(epp)Ks	B0B0bar_eta-pg2pi_KS.dec	EtaPK0	50M	10M
eta'(5p)Ks	B0B0bar_eta-5pi_KS.dec	EtaPK0	25M	5M
eta'(rg)Ks	B0B0bar_eta-rho0g_KS.dec	EtaPK0	100M	20M

Overlap with other studies



This analysis potentially overlaps with other TD analyses, we can consider cross-checking, divide efforts to avoid repeating the same things...

- Δt resolution studies
- Tagging algorithm/efficiency/code
- ...

We can also help to test different DG, if needed

Suggestions and feedback are welcome!

Backup slides

