Analysis Meeting vol.36

2014.12.3

Shun Watanuki @Tohoku University

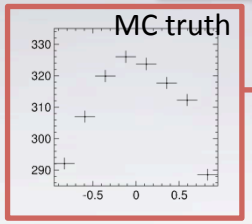
CP-mixture Procedure

DBD sample

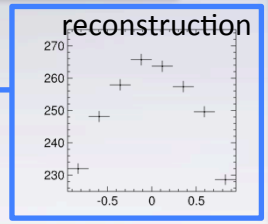
MC

Reco.

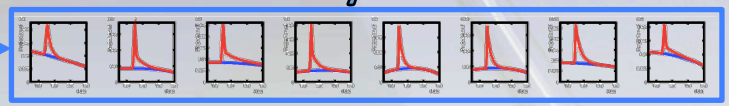
MC truth



reconstruction

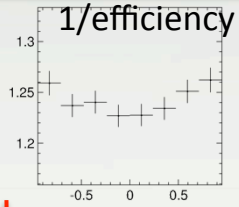


1000 times Toy-MC

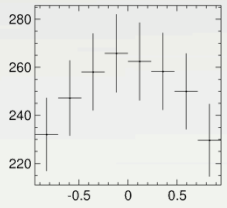


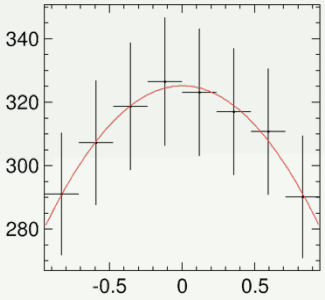
extrapolate number of signal

1/efficiency



efficiency correction



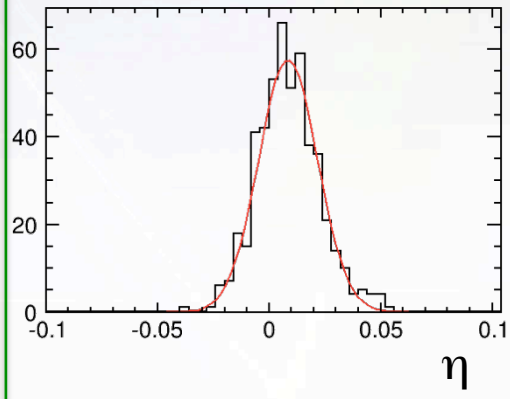


cosθ toy-MC at gen. level

$$\eta = \frac{M_Z^2}{2s}\left[-\frac{16}{\beta}\frac{v_e a_e}{v_e^2+a_e^2} \pm \sqrt{\frac{16^2}{\beta^2}\left(\frac{v_e a_e}{v_e^2+a_e^2}\right)^2 - \frac{4s}{M_Z^2}\frac{p_1}{p_2}}\right] = 0.06654\times\left[1.21 - \sqrt{1.465 - 30.06\times\frac{p_1}{p_2}}\right]$$

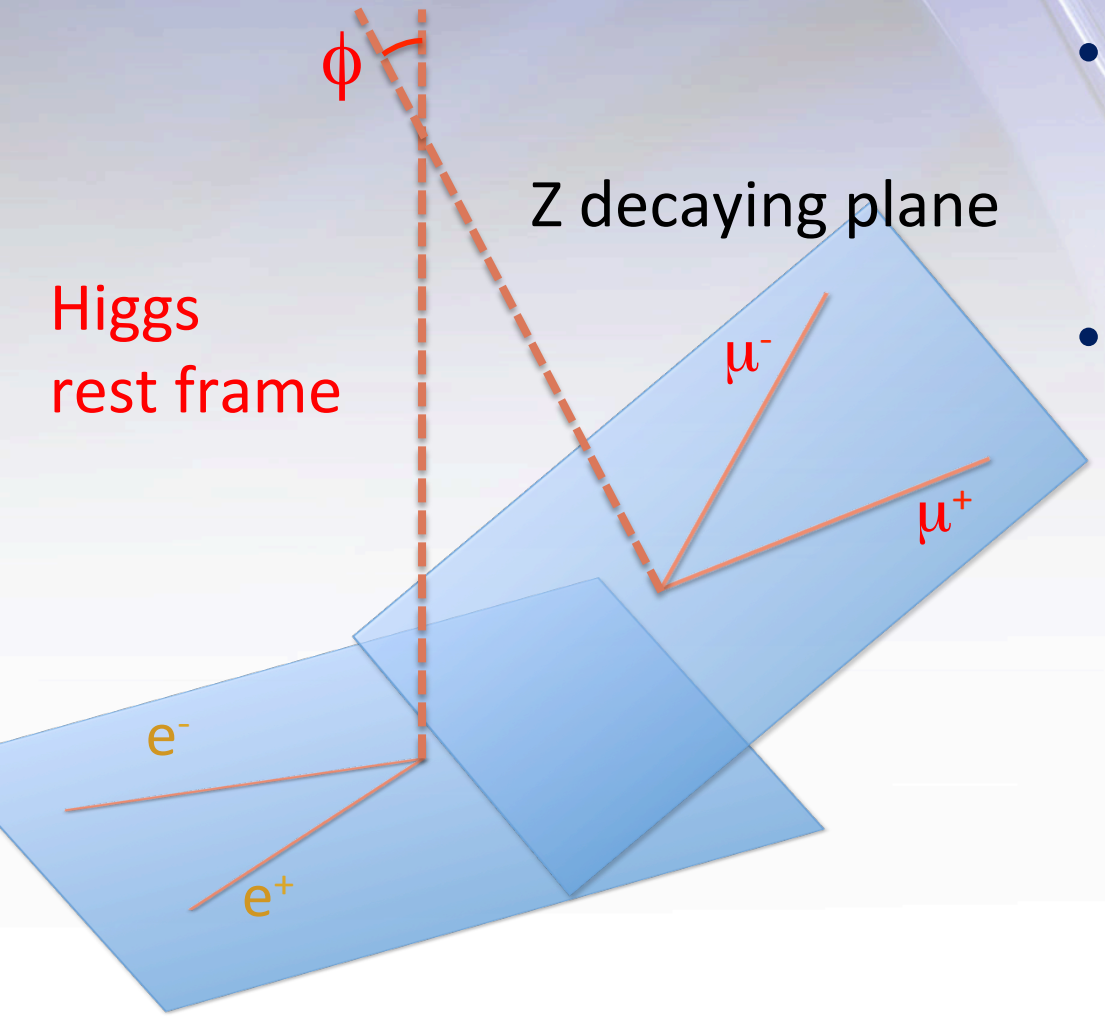
Calculate η from fit parameters

500 times η calculations

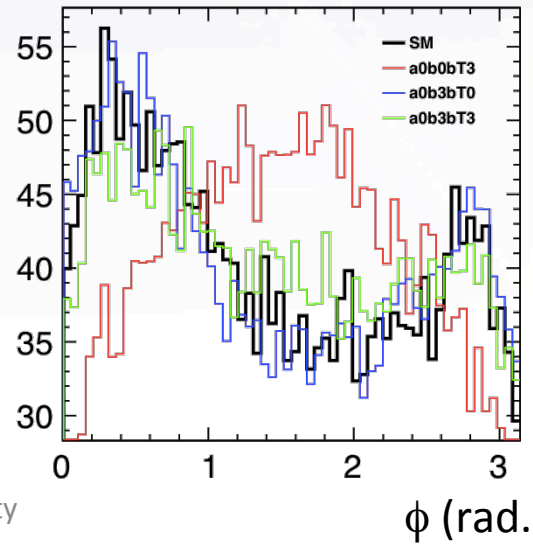


η_{SM} = 0.00846 ± 0.01326

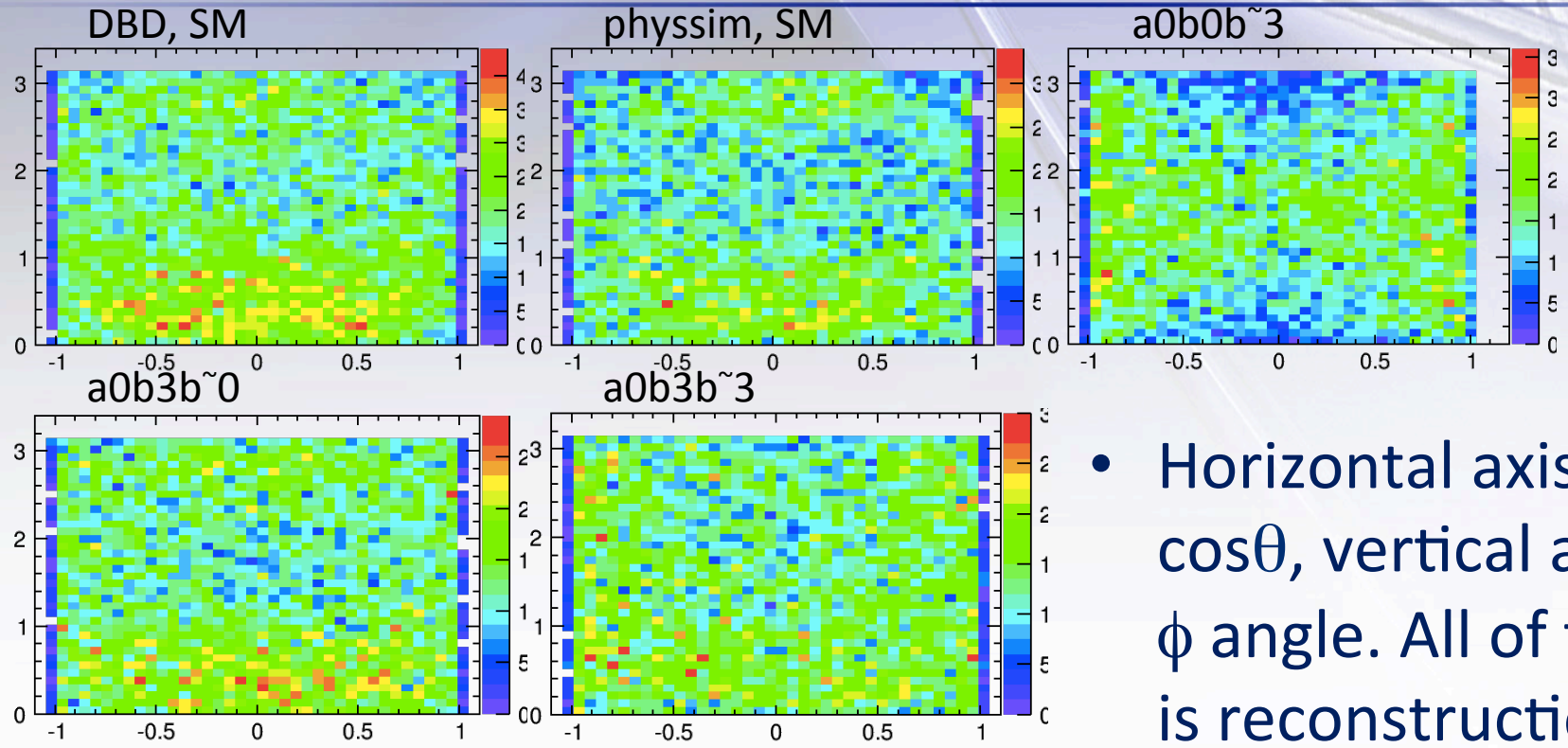
ϕ angle



- Parameters a, b, b˜ may be expressed also using ϕ angle.
- a0b0b˜3 sample has different distribution from SM sample.

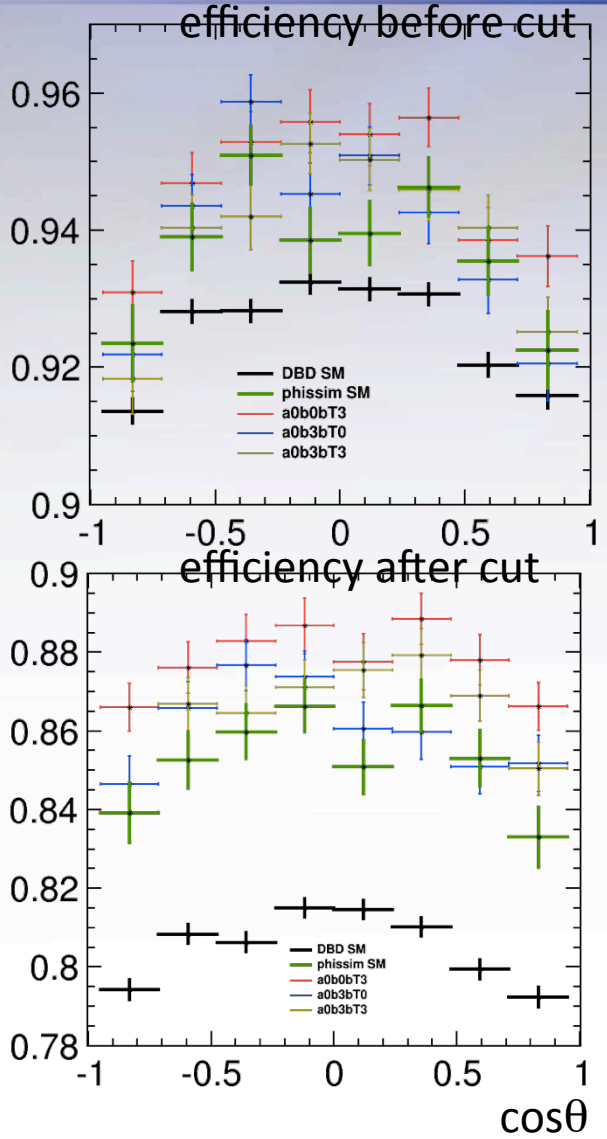


Correlation between cosθ and ϕ



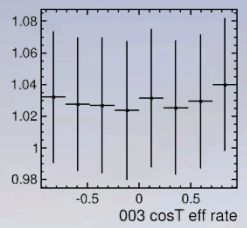
- Horizontal axis is cosθ, vertical axis is ϕ angle. All of them is reconstruction.

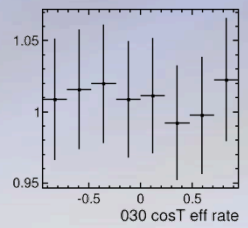
Study with BSM Samples

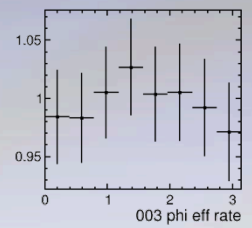


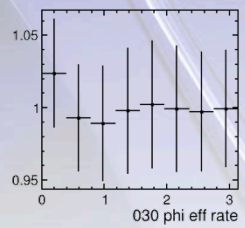
- Efficiency from DBD sample is unavailable for study with BSM samples (difference comes from physsim, ISR?).
  - If each efficiencies of BSM samples are same distribution or not should be checked.
- It seems that physsim sample has fluctuated efficiency.
  - Statistical fluctuation or some other reason?
  - I will check 2D efficiency for $\cos\theta$ and ϕ, which is angle between Z production plane and decay plane.

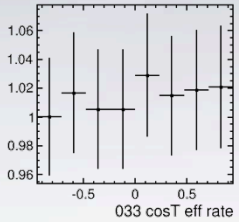
Efficiency Sameness



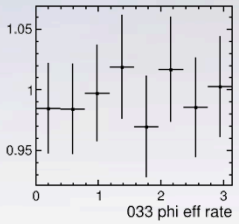




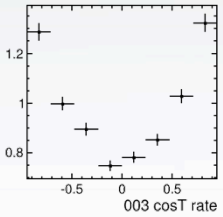


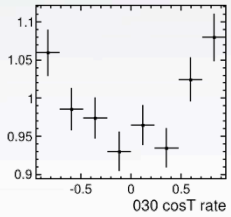


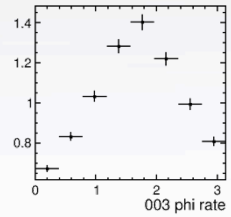
cosθ eff rate

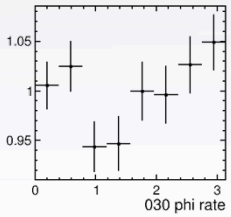


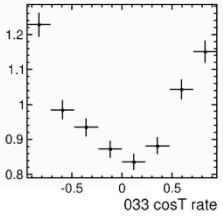
ϕ eff rate



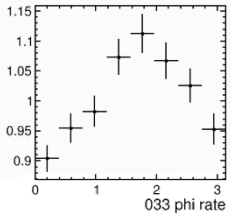








cosθ rate



ϕ rate

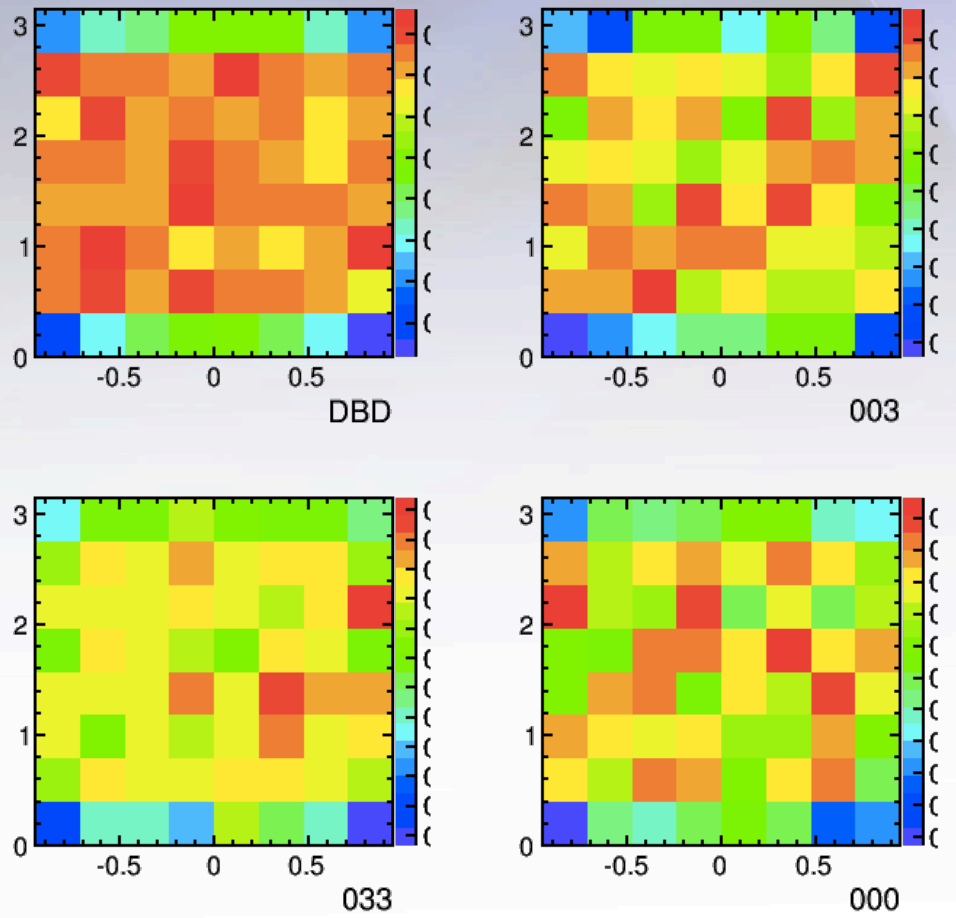
- These are cosθ and ϕ rate ; BSM/SM
- Uppers are efficiency rate, downers are rate of cosθ or ϕ.
- Efficiency fluctuation seems to be OK.
- But…👉

BSM Sample Efficiency Correction with SM Sample

cosθ	-0.95							0.95
# of sig (MC)	368	307	282	245	258	280	313	375
reconstructed # of sig (/eff_{SM})	380	316	290	251	266	287	322	390

- Red number shows number of signal in a0b0b˜3 sample after correction with efficiency from a0b0b˜0 (SM) sample.
- As shown in previous page, since a0b0b˜3 efficiency is larger than SM one for each bins, results have larger number of signal.
- Cause should be investigated.
  - Efficiency has dependence on some other quantities?

Correlation between cosθ and ϕ Efficiency

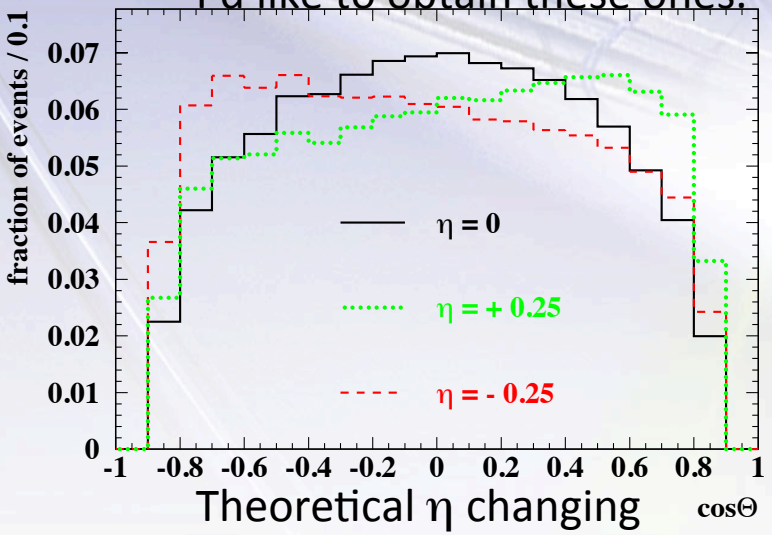


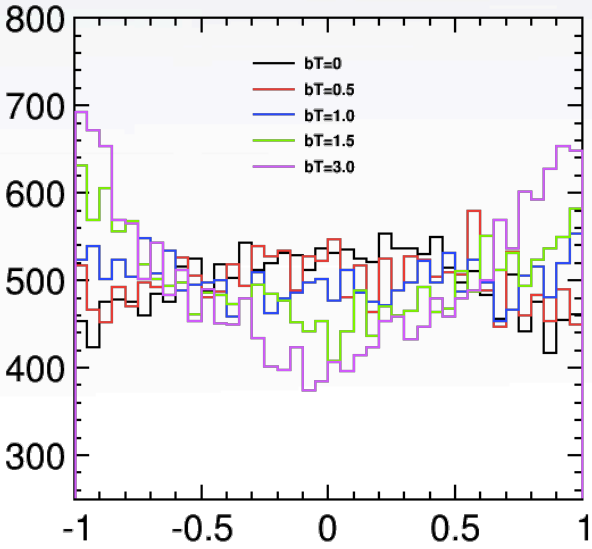
- If these have some correlation, and if it causes difference of efficiency distribution, how can I correct it?

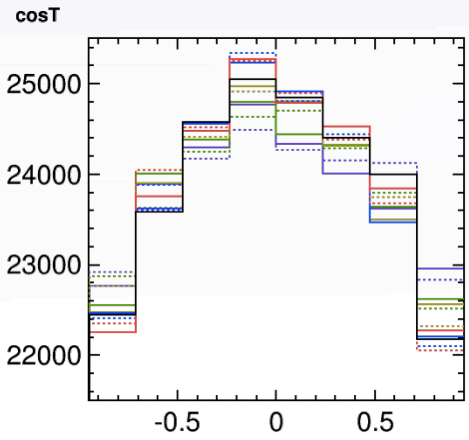
To Calculate η from b, b~

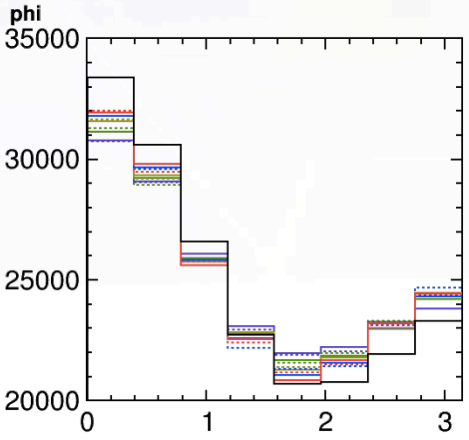
- People in KEK said that b~ corresponds to η.
- So can η be expressed only by b~? : η=f(b~)
- As I have reported, b~ varying (0, 0.5, 1, 1.5, 3.0) seems to change only cosθ curvature and η is not calculated.
- Smaller varying (0, ±0.1, …, ±0.5) is also tried, but change is smaller and asymmetry does not seem to exist.

I'd like to obtain these ones.



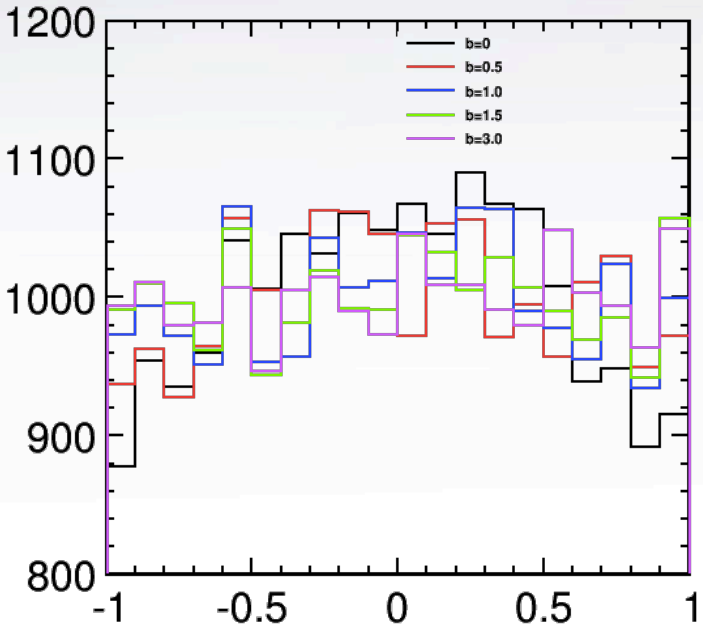


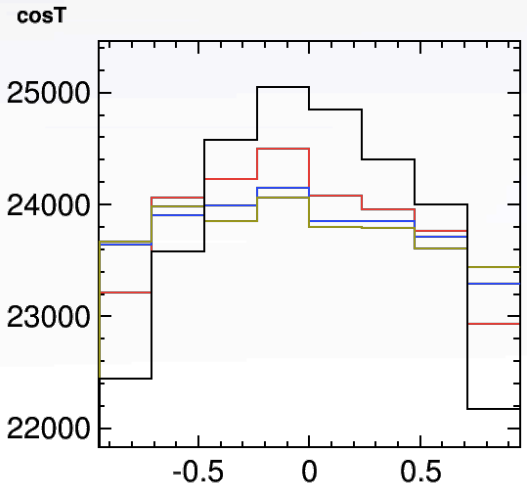


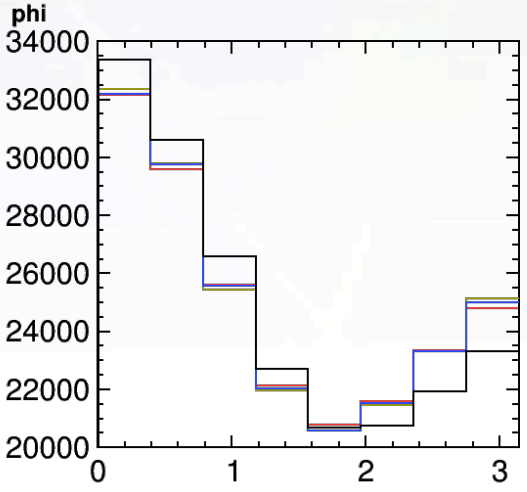


To Calculate η from b, b~

- On the other hand, b parameter may generate cosθ forward backward asymmetry(?) rather than b~.
- In right 2figures, b varies (0, 0.5, π/4, 1)







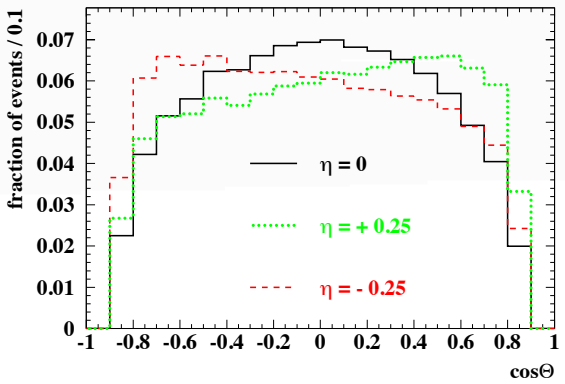
Asymmetry of Distributions

AFB := $(N_{sig\ cos\theta<0} - N_{sig\ cos\theta>0}) / (N_{sig\ cos\theta<0} + N_{sig\ cos\theta>0})$

|b~| =	0	0.1	0.2	0.3	0.4	0.5
$10^3 x A_{FB}(b\tilde{}) =$	1.14	1.75	4.03	3.39	3.84	4.18
$10^3 x A_{FB}(-b\tilde{}) =$		6.13	5.85	2.68	0.435	-1.02

b =	0.5	p/4	0.1	10
$10^3 x A_{FB}(b) =$	6.70	5.14	4.86	3.25

b or b~ =	-3	0	0.5	1.0	1.5	3.0	5.0
$10^3 x A_{FB}(b) =$	3.65	1.96	3.20	-7.15	-6.25	-9.55	-9.50
$10^3 x A_{FB}(b\tilde{}) =$	0.650	1.96	2.30	3.75	12.9	-6.80	-2.50



⬅ Probably $A_{FB}(\eta=\pm0.25) \sim O(10^{-1})$

To Calculate Non-zero η Fluctuation

- How about using theoretical distribution?
- Here is suggestion…
  1. Look theoretical asymmetric parabola.
  2. Make its 8bins Toy-MC with reconstructed N_{sig} (can I use SM sample?).
     => Obtain $N_{sig\_BSM}[8]$ in each regions of $\cos\theta$.
  3. Introduce signal recoil mass distribution with $N_{sig\_BSM}[i]$ from PDF(GPETxNV) from SM sample.
  4. After that same procedure with SM case.

Next Plan

- It may be difficult to use a, b, b~.
  - People in KEK and Kanemura-san said b~ corresponds to η.
  - But current BSM samples have cosθ distribution which can not be expressed by η parameter (valley for example) and can not create asymmetric distribution.
  - Jan-san said that it may be miss convergence, otherwise some bugs of physsim.
- Anyway b~ seems to be hopeless.
- How about use of toy distribution from theoretical expression?