TDCPV WG status

35th B2GM

04/02/2020

Stefano Lacaprara

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Outline

- **Status of TDCPV WG:**
  - **B^0 lifetime measurement** (see Reem's talk)
  - **Mixing measurement** (and Flavour tagger) (see Fernando's talk)
  - $\sin(2\varphi_1)$ measurement from $B^0 \to J/\psi K^0_S$
    - Signal extraction
    - Tag-side and CP-side Vertex studies
    - Δt resolution studies
    - Hadronic sample studies
    - MC reweight approach
  - $B^0 \to J/\psi K^0_L$
  - $B^0 \to \eta' K^0_S$
- **Open tasks**
- **Goals for Moriond / ICHEP**

$B^0 \to J/\psi K^0_S$ signal extraction

- Signal reconstruction is ready since this summer

Mode	Belle II, 2019 data		Belle II, MC expectation		Belle, 2001 data [2]	
	2.62 fb^{-1}	1 fb^{-1}	2.62 fb^{-1}	1 fb^{-1}	10.5 fb^{-1}	1 fb^{-1}
$B^0 \to J/\psi K^0_S$	26.9 ± 5.2	10.3 ± 2.0	27.5	10.5	123	11.7

- Extrapolated to 10/fb ~ **O(100)** events
- Redone with proc10

VOLUME 86, NUMBER 12 PHYSICAL REVIEW LETTERS 19 MARCH 2001

Measurement of the *CP* Violation Parameter $\sin 2\phi_1$ in B^0_d Meson Decays

A. Abashian,[44] K. Abe,[8] K. Abe,[36] I. Adachi,[8] Byoung Sup Ahn,[14] H. Aihara,[37] M. Akatsu,[19] G. Alimonti,[7] K. Aoki,[8]

We present a measurement of the standard model CP violation parameter $\sin 2\phi_1$ (also known as $\sin 2\beta$) based on a 10.5 fb^{-1} data sample collected at the $\Upsilon(4S)$ resonance with the Belle detector at the KEKB asymmetric e^+e^- collider. One neutral B meson is reconstructed in the $J/\psi K_S$, $\psi(2S)K_S$, $\chi_{c1}K_S$, $\eta_c K_S$, $J/\psi K_L$, or $J/\psi\pi^0$ CP-eigenstate decay channel and the flavor of the accompanying B meson is identified from its charged particle decay products. From the asymmetry in the distribution of the time interval between the two B-meson decay points, we determine $\sin 2\phi_1 = 0.58^{+0.32}_{-0.34}(\text{stat})^{+0.09}_{-0.10}(\text{syst})$.

Selection criteria

Basically same as proc9 data analysis.

Event shape variables R2 < 0.3

J/ψ:
- |d0| < 0.5 cm, |z0| < 2.0 cm
- electron: electronID > 0.1 at least 1 daughter
- muon: muonID > 0.1 at least 1 daughter
- 2.8 GeV/c^2 < $M_{\ell\ell}$ <3.2 GeV/c^2

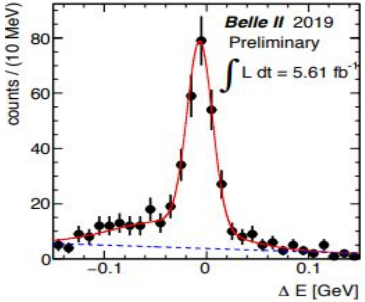
$K^{\pm}$:
- kaonID > 0.1

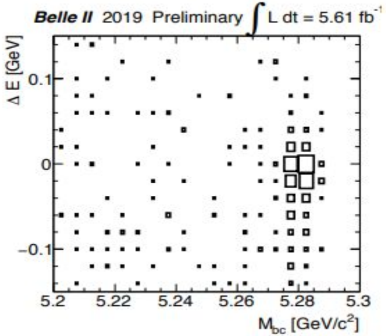
K^0_S:
mergedKshorts → stdKshort from stdV0s
(many warning message after changing to release-4)
0.45 GeV/c^2 < $M_{\pi\pi}$ <0.55 GeV/c^2

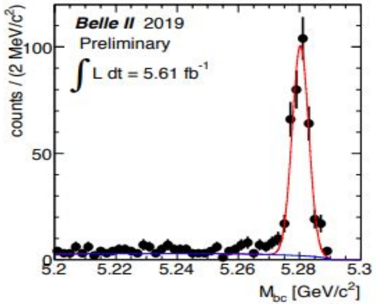
Signal region is defined to be M_{bc}>5.27 GeV/c^2, |ΔE|<40 MeV.

Yusa-san
Niigata Univ

$B^+ \to J/\psi K^+$ from proc10 data







$B^+ \to J/\psi(\to \mu^+\mu^-)K^+$
efficiency = 47.6%
(45.6%) (proc9)

Yields in signal region

Mode	Signal	Background	Expected signal
proc10 5.61 fb^{-1}			
$B^+ \to J/\psi K^+$, $J/\psi \to e^+e^-$	85.5 ± 9.0	3.2 ± 0.5	91.5
$B^+ \to J/\psi K^+$, $J/\psi \to \mu^+\mu^-$	183.0 ± 12.7	2.2 ± 0.3	169.9
$B^+ \to J/\psi K^+$, $J/\psi \to \ell^+\ell^-$	265.2 ± 15.0	4.7 ± 0.5	261.4
proc10 2.62 fb^{-1}			
$B^+ \to J/\psi K^+$, $J/\psi \to e^+e^-$	33.2 ± 5.3	1.0 ± 0.2	42.7
$B^+ \to J/\psi K^+$, $J/\psi \to \mu^+\mu^-$	79.9 ± 8.5	1.5 ± 0.3	79.3
$B^+ \to J/\psi K^+$, $J/\psi \to \ell^+\ell^-$	110.5 ± 9.7	2.5 ± 0.4	122.0
proc9 2.62 fb^{-1}			
$B^+ \to J/\psi K^+$, $J/\psi \to e^+e^-$	31.1 ± 5.3	1.7 ± 0.3	60.9
$B^+ \to J/\psi K^+$, $J/\psi \to \mu^+\mu^-$	34.0 ± 5.7	1.4 ± 0.3	75.1
$B^+ \to J/\psi K^+$, $J/\psi \to \ell^+\ell^-$	65.2 ± 8.0	2.9 ± 0.5	136.0

(Since no official MC of $B^+ \to J/\psi(\to e^+e^-)K^+$, expected signal for electron mode is from muon mode by applying efficiency ratio from $B^0 \to J/\psi K^0_S$ MC)

- Yield in proc10 increases more than integrated luminosity
- Yield discrepancy Data-MC in proc9 not present anymore.

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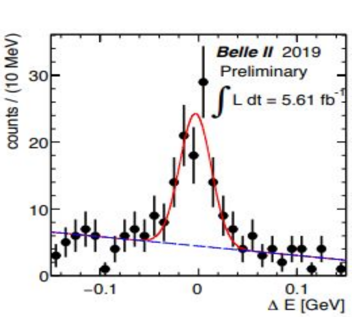
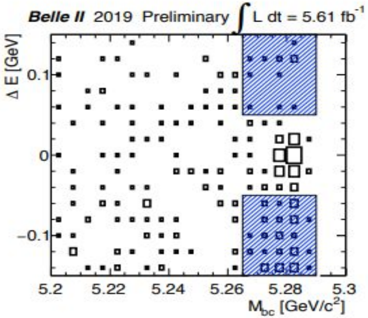
Niigata Univ

$B^0 \to J/\psi K^0_S$ from proc10 data



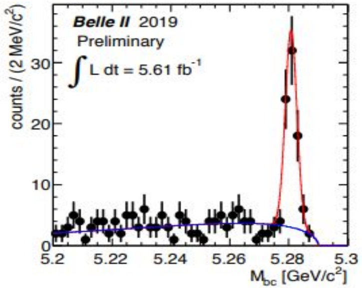


$B^0 \to J/\psi(\to e^+e^-)K^0_S$

efficiency = 23.7%
(26.1%) (proc9)

$B^0 \to J/\psi(\to \mu^+\mu^-)K^0_S$

efficiency = 44.0%
(32.2%) (proc9)



Yields in signal region

Mode	Signal	Background	Expected signal
proc10 5.61 fb^{-1}			
$B^0 \to J/\psi K^0_S,\ J/\psi \to e^+e^-$	23.6 ± 5.2	4.5 ± 0.5	24.1
$B^0 \to J/\psi K^0_S,\ J/\psi \to \mu^+\mu^-$	55.3 ± 7.7	5.1 ± 0.7	44.8
$B^0 \to J/\psi K^0_S,\ J/\psi \to \ell^+\ell^-$	78.9 ± 9.4	9.6 ± 0.9	68.9
proc10 2.62 fb^{-1}			
$B^0 \to J/\psi K^0_S,\ J/\psi \to e^+e^-$	11.4 ± 3.5	1.9 ± 0.4	11.2
$B^0 \to J/\psi K^0_S,\ J/\psi \to \mu^+\mu^-$	30.4 ± 5.8	2.4 ± 0.4	20.9
$B^0 \to J/\psi K^0_S,\ J/\psi \to \ell^+\ell^-$	41.0 ± 6.6	4.5 ± 0.6	32.1
proc9 2.62 fb^{-1}			
$B^0 \to J/\psi K^0_S,\ J/\psi \to e^+e^-$	8.2 ± 2.9	0.9 ± 0.2	12.3
$B^0 \to J/\psi K^0_S,\ J/\psi \to \mu^+\mu^-$	18.4 ± 4.3	0.5 ± 0.1	15.2
$B^0 \to J/\psi K^0_S,\ J/\psi \to \ell^+\ell^-$	26.9 ± 5.2	1.4 ± 0.2	27.5

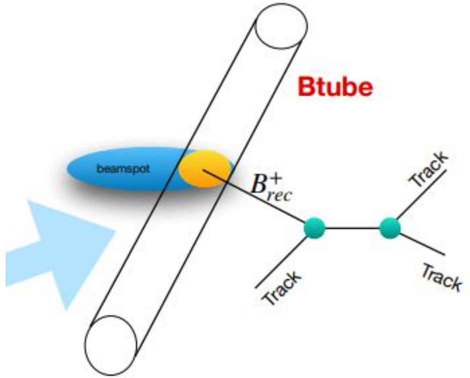
Yield = **14.1 ev/fb^{-1} (Belle II - Proc10)**
11.7 ev/fb^{-1} (Belle 2001)
10.3 ev/fb^{-1} (Belle II - 2019)
Increased more than Luminosity

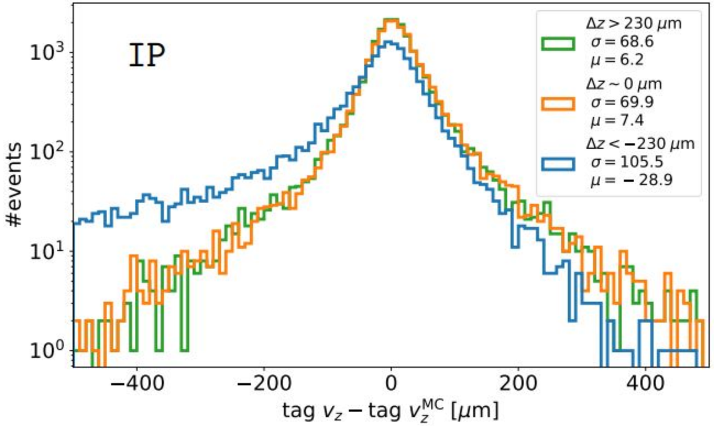
- Yield in proc10 is consistent with MC prediction
- Drop of efficiency in e^+e^- channel due to kinematic selection
  - Mostly ΔE cut, possibly problem in brem recovery

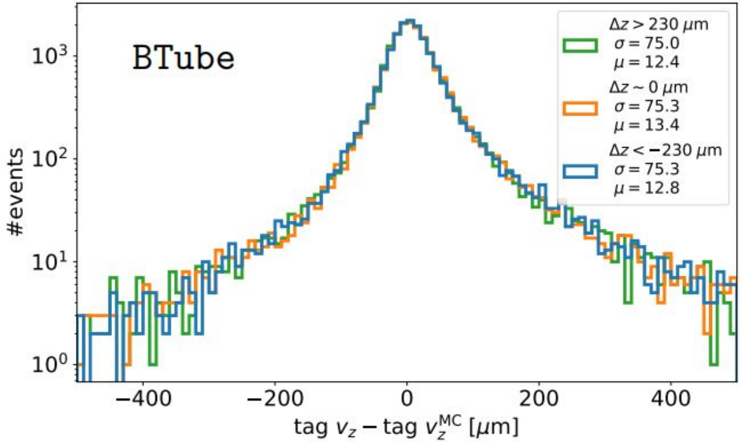
Tag Vertex issues

Thibaud
MPI

- Current algo is TagV, based on RAVE (CMS).
    - **Thibaud agreed to maintain and develop RAVE**
    - Discussion with software/analysis this B2GM
- IP constraint bias TagV z if B tag-side decays far (Δz<0)
- **New Btube** constraint: available on **light-icarus**
    - Use B_{SIG} reconstruction to build an event by event tube constraint







Btube vs other constraint

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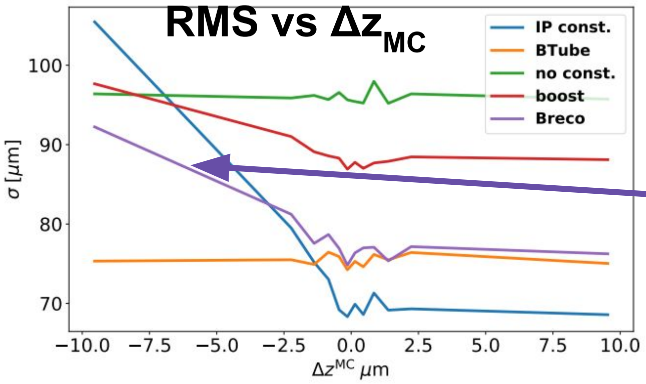
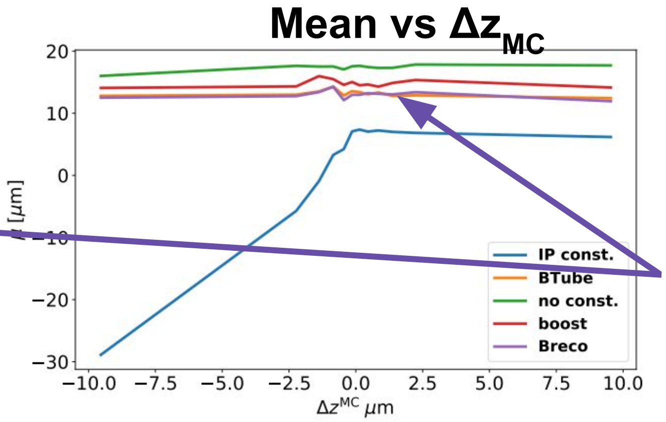
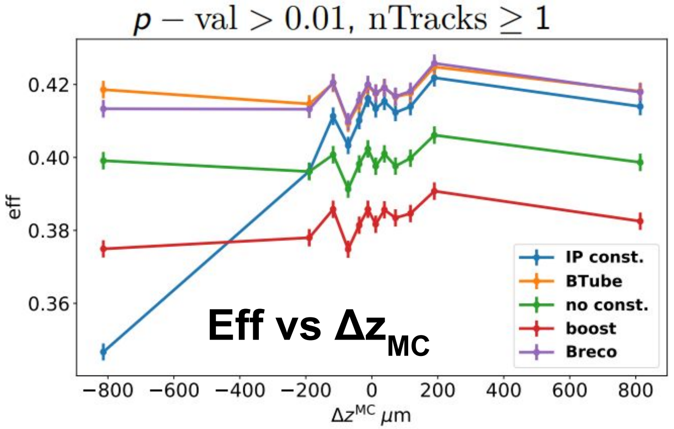
MPI





- RMS and mean vs Δz_{MC} for various constraint
- **Breco** is the actual standard de-facto



- **Btube features:**
- Best resolution and no Δz_{MC} dependency
- Btube has no (or little) bias vs Δz_{MC}
- Efficiency vs Δz_{MC} : as good as Breco

Possible only with full B_{SIG} reconstruction

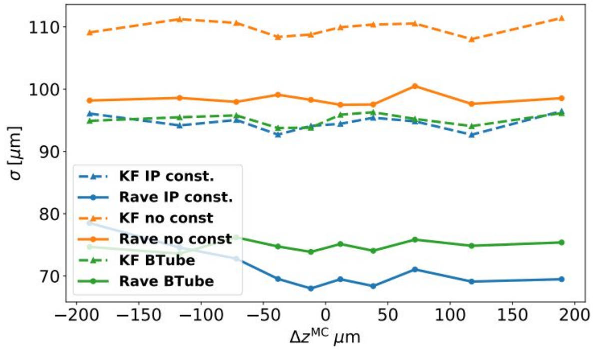
KFitter in TagV

Thibaud
MPI

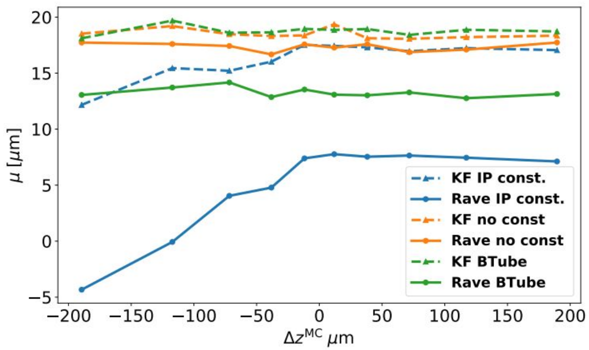
- BIIANA-125 (not yet in release)
- Rave vs KFitter on MC12 $B_0 \rightarrow D^{-}\pi^{+}$.

Tested for **IP constraint** - **No const** - **BTube**

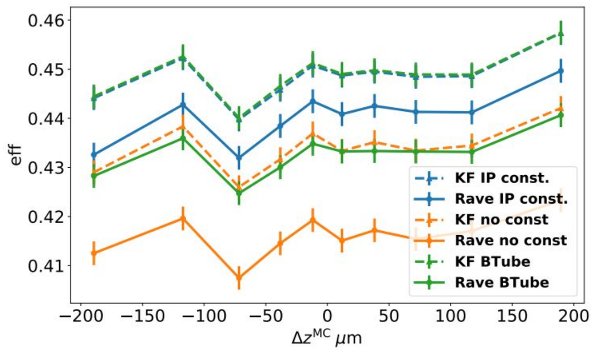
Resolution



Bias



Efficiency



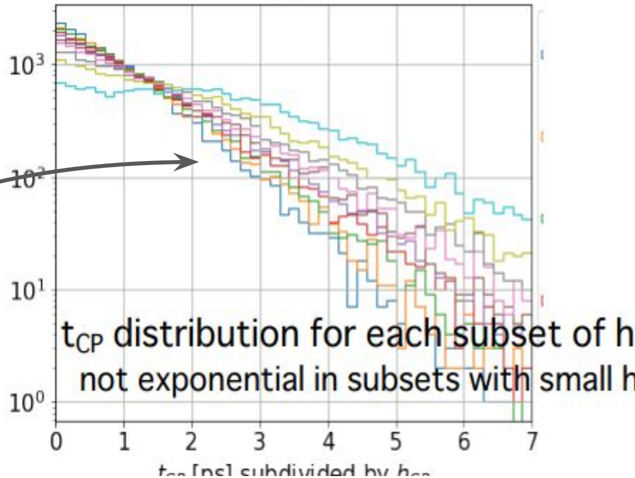
- KFitter less sensitive to non optimal IP constraint
- RAVE better resolution and less bias
- KFitter a bit more efficient $\boldsymbol{\varepsilon}$ +3.5%

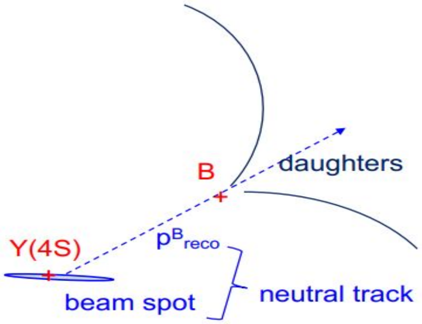
CP-side vertex: IP constraint w/ KFit

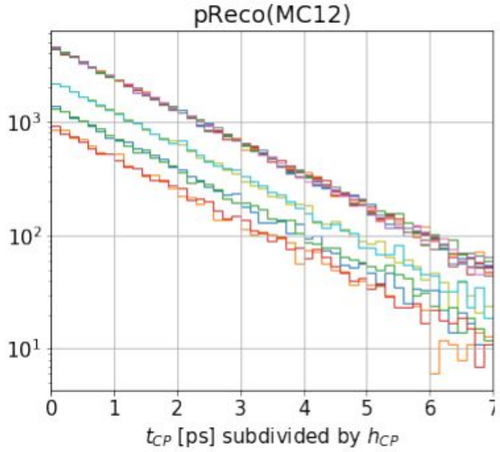
Tanigawa-san
Tokyo

- **CP-side: does the vtx resolution depends on vtx quality?**
  - **KFitter**
  - $h_{CP} = \chi^2/NDoF$
- Study t_{CP} vs h_{CP}: strong correlation
  - **τ depends on h_{CP}!**
- **Solution: event-by-event tube constraint**
  - Require fully reconstructed B^0
    - **P_{RECO} Tube**
  - **Similar to Btube, but for CP side**
- **Only available for fully reconstructed B's**

$$B^0 \rightarrow J/\psi K^0_S$$



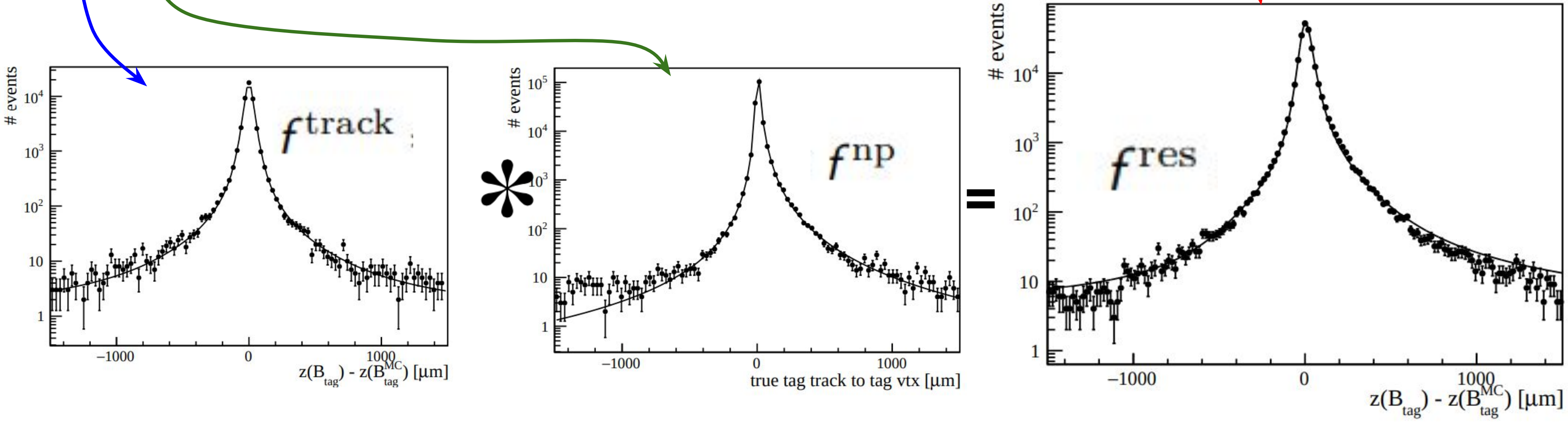




Δt resolution studies

Thibaud
MPI

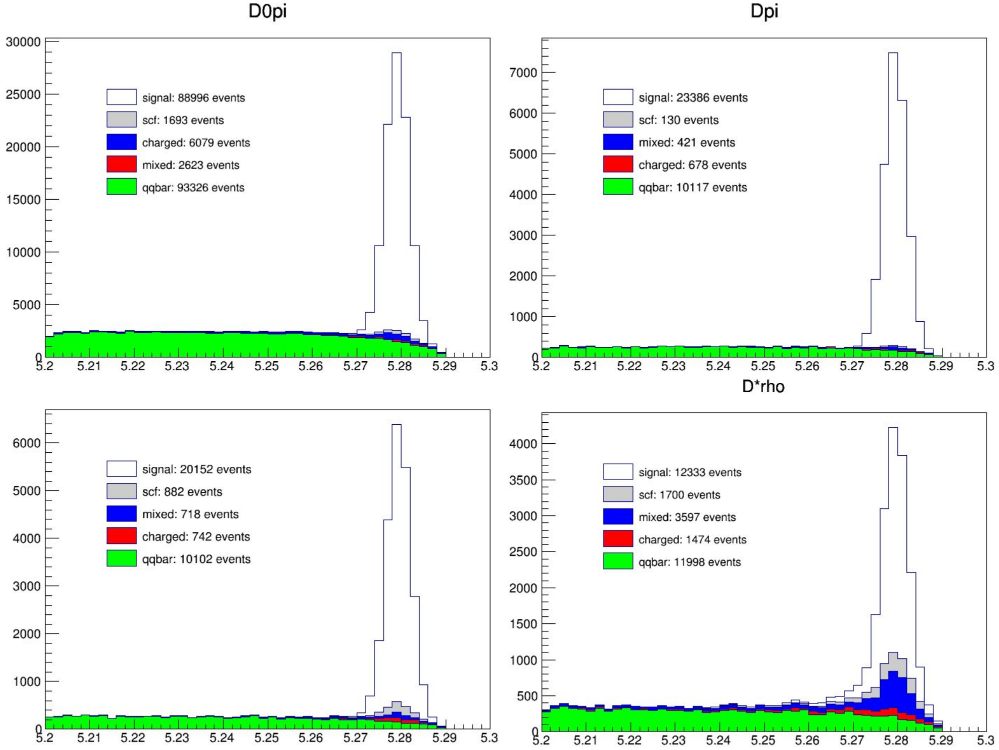
- **Total resolution**: convolution of $f^{\mathrm{res}} = f^{\mathrm{track}} * f^{\mathrm{np}}$
  - $\mathbf{f^{track}}$ (two gauss): resolution for primary tracks
    - average distance to Vtx_{MC}<0.01 μm
  - $\mathbf{f^{np}}$ (power law): average (weighted) distance of tracks from vtx (MC)
    - to account for non primary tracks.



Hadronic control sample $B \to D^{(*)}h$ MC

Onuki-san
Tokyo univ

MC12 400fb-1, D sub-decay summed



$B^0 \to D^- \pi^+$

$B^0 \to D^{*-} \pi^+$

$B^0 \to D^{*-} \rho^+$

$B^+ \to D^0 \pi^+$

$D^{*+} \to D^0 \pi^+$

$D^0 \to K^- \pi^+$ ...1

$\to K^- \pi^+ \pi^0$ ...2

$\to K^- \pi^- \pi^+ \pi^+$...3

$D^+ \to K^- \pi^+ \pi^+$

i.e) $D^0\pi$ -3, $D^*\rho$ -1, $D\pi$,

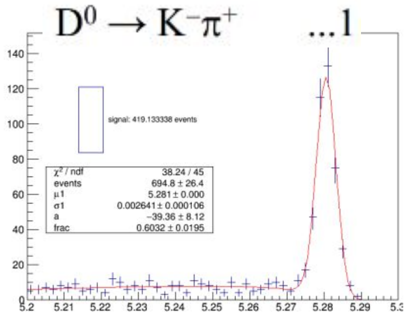
Studies for the Belle type resolution function.

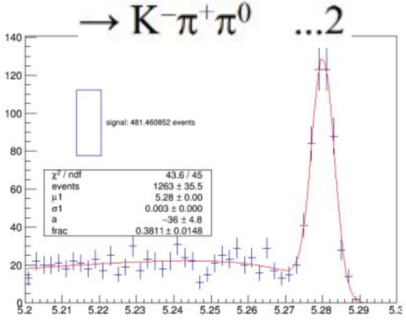
- Self cross feed(scf), mixed, charged BG separated
- shapes are from whole MC12b.
- Next:
  - Determine shapes in 7bins of wtag fraction
  - Fit for dE-M_{bc} in 7bin
  - Fit for dt in each BG

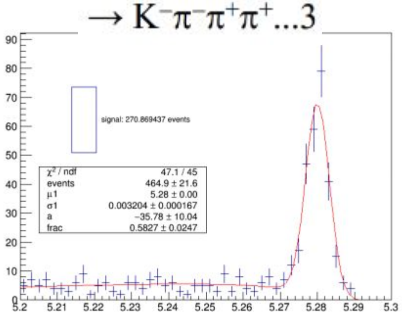
Hadronic sample

Onuki-san
Tokyo univ

Example M_{bc} for exp7+8 proc10







$B^0 \to D^-\pi^+$
$B^0 \to D^{*-}\pi^+$
$B^0 \to D^{*-}\rho^+$
$B^+ \to D^0\pi^+$

$D^{*+} \to D^0\pi^+$
$D^0 \to K^-\pi^+$ ...1
$\to K^-\pi^+\pi^0$ ...2
$\to K^-\pi^-\pi^+\pi^+$...3
$D^+ \to K^-\pi^+\pi^+$

i.e) $D^0\pi$ -3, $D^*\rho$ -1, $D\pi$,

Yield comparison
proc9/10 - MC12b

Overall ~good agreement, better with proc10

Scaled MC12b 5.6/fb corresponding to exp7&8 and data(proc9→proc10)				
B-decay ch	$B^+\to D^0\pi^+$	$B^0\to D^{*-}\pi^+$	$B^0\to D^{*-}\rho^+$	$B^0\to D^-\pi^+$
D-decay ch	Signal events (e7&8)	Signal events (e7&8)	Signal events (e7&8)	Signal events (e7&8)
1	445 (281→419±21)	119 (97→97±10)	62 (41→66±8)	380 (242→387±20)
2	560 (270→481±23)	146 (81→98±10)	74 (48→94±10)	
3	460 (160→271±17)	137 (43→66±8)	68 (25→42±7)	

MC-reweight fit method

Vladimir et al
MPI

BELLE2-CONF-PROC-2020-002
BELLE2-NOTE-PH-2019-023

- General idea:
    - Do not have a single resolution function Δt
    - Reweight MC sample to get pdf of each event
    - MC/Data discrepancy are cured by smearing MC quantities $\Delta t'_{rec} = \Delta t_{rec} + G(\boldsymbol{\alpha} \cdot \delta(\Delta t_{rec}))$
        - **α can be extracted from data by a global fit**
- One fit to extract:
    - CP parameters **S, A**
    - **τ**, **δ**m
    - Flavour tagger features w_i, (Δw_i)
    - as well as smearing factor
- Tested to extract **τ**(B^0), **τ**(B^+)
    - on multiple channels: B^0,B^+
- MC12b with L=400 fb^{-1}

	τ_{B^0} (ps) 1.525/1.527	α_{smear}		$\tau_{B^\pm}$ (ps) 1.637	α_{smear}
$B^0 \to J/\psi\ K^0_S$			$B^+ \to J/\psi\ K^+$		
$J/\psi \to \mu\mu$	1.533 ± 0.036	0 ± 1.08	$J/\psi \to \mu\mu$	1.613 ± 0.017	0 ± 0.59
$J/\psi \to ee$	1.465 ± 0.042	0 ± 0.86	$(J/\psi \to ee)$	(1.657 ± 0.021)	(0 ± 0.57)
$B^0 \to D^-\pi^+$					
$D^- \to K\pi\pi$	1.547 ± 0.014	0.25 ± 0.21			
$B^0 \to D^{*-}\pi^+$			$B^+ \to D^0\pi^+$		
$(D^0 \to K\pi)$	(1.520 ± 0.020)	(0 ± 0.26)	$D^0 \to K\pi$	1.654 ± 0.019	0.29 ± 0.25
$D^0 \to K3\pi$	1.543 ± 0.018	0 ± 0.26	$(D^0 \to K3\pi)$	(1.662 ± 0.015)	(0.33 ± 0.17)
$4\ B^0$ *channels*	1.545 ± 0.010	0 ± 0.32	$2\ B^\pm$ *channels*	1.637 ± 0.016	0.31 ± 0.21

Results for full fit on MC12 400 /fb

	6 channels $4B^0$ and $2B^{\pm}$	4 channels B^0 decays	generated in MC12	2 channels $D^{(*)-}\pi^+$	$D^-\pi^+$ $D^- \to K\pi\pi$	$(D^{*-}\pi^+)$ $D^0 \to K\pi$	$D^{*-}\pi^+$ $D^0 \to K3\pi$
$\tau_{B^0}(ps)$	1.529 ± 0.009	1.529 ± 0.009	$1.525/1.527$	1.531 ± 0.009	1.526 ± 0.011	(1.520 ± 0.019)	1.544 ± 0.017
$\tau_{B^{\pm}}(ps)$	1.645 ± 0.011		1.637				
$\delta m(ps^{-1})$	0.511 ± 0.006	0.511 ± 0.006	$0.502/0.506$	0.509 ± 0.006	0.505 ± 0.007	(0.517 ± 0.011)	0.517 ± 0.010
A	0.019 ± 0.034	0.019 ± 0.034	$0.$				
S	0.744 ± 0.048	0.745 ± 0.048	0.695				
W_1	0.471 ± 0.009	0.471 ± 0.009		0.473 ± 0.009	0.460 ± 0.011	(0.486 ± 0.021)	0.514 ± 0.019
W_2	0.430 ± 0.009	0.430 ± 0.009		0.429 ± 0.009	0.415 ± 0.010	(0.492 ± 0.020)	0.470 ± 0.017
W_3	0.336 ± 0.007	0.336 ± 0.007		0.337 ± 0.007	0.326 ± 0.009	(0.366 ± 0.016)	0.367 ± 0.015
W_4	0.191 ± 0.009	0.192 ± 0.009		0.192 ± 0.009	0.193 ± 0.010	(0.220 ± 0.020)	0.190 ± 0.016
W_5	0.177 ± 0.008	0.178 ± 0.008		0.177 ± 0.008	0.172 ± 0.009	(0.191 ± 0.018)	0.193 ± 0.016
W_6	0.118 ± 0.008	0.118 ± 0.008		0.118 ± 0.008	0.110 ± 0.009	(0.113 ± 0.018)	0.144 ± 0.016
W_7	0.026 ± 0.005	0.026 ± 0.005		0.026 ± 0.005	0.025 ± 0.005	(0.045 ± 0.011)	0.029 ± 0.010
α_{smear}	0 ± 0.36	0 ± 0.24		0 ± 0.23	0 ± 0.26	(0 ± 0.34)	0 ± 0.47

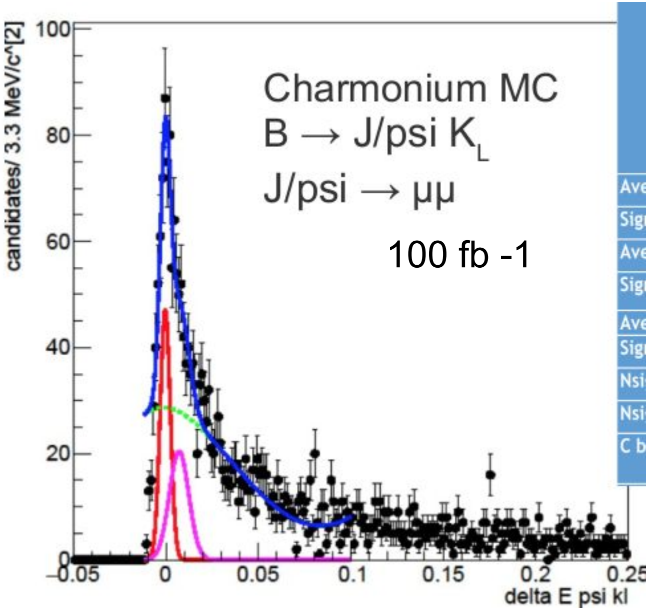
- Lifetime for single and combined channels (B^0 and B^+)
- As well as CP parameters: A, S
- Test with MC, so expected α~0
- Tag eff extracted in the same fit

B → J/psi K_L

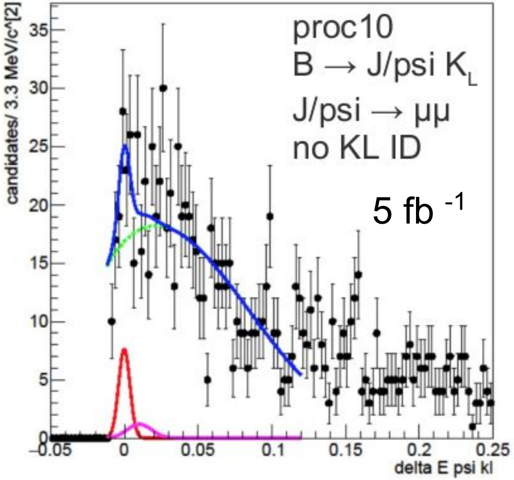
Benjamin et al
LNF

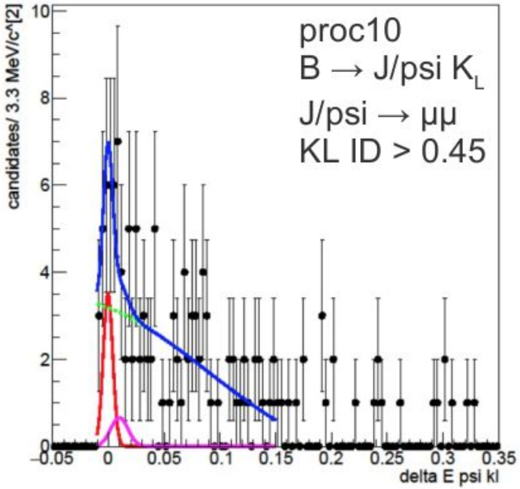
- K_L working on data and MC since rel-4 (proc10 - MC13)
- ΔE distributions: signal two gauss + background (green)

Impact of cut on KL ID >0.45



- Using previously extracted shapes we fit proc10 data



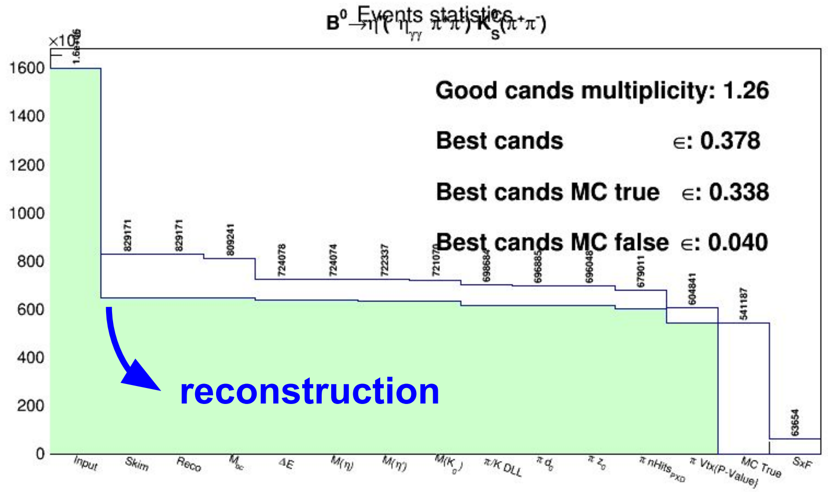


Efficiency $B^0\to\eta'(\to\eta(\to\gamma\gamma)\,\pi^+\pi^-)K^0_S(\to\pi^+\pi^-)$

SL
Padova

- Signal efficiency and SxF varied a lot depending:
  - MC campaign (simulated beam background)
  - Basf2 release (issue and improvement on reconstruction, mostly tracking and vertexing)

MC Campaign/Release	Efficiency	SxF
MC7/Rel-09 (B2TIP)	23 %	3.8 %
MC9/Rel-02	22 %	6.7 %
MC10/Rel-02	11 %	3.5 %
MC12b/Rel-03	19 %	4.5 %
MC12b/Rel-04	**37 %**	**9.3 %**
“ Best Cand -SxF BDT	**34 %**	**4.0 %**



Optimized for Efficiency, not (yet) for SxF suppression.
Just using old (B2TIP) cuts, including SxF BDT (see backup)

In 9/fb expected ~(13+4+24) events
($\eta_{\gamma\gamma}\,2\pi$+$\eta_{3\pi}\,2\pi$+$\rho\gamma$) Belle (6+0+11) events

More in B^+ channel (K^+ vs K_s)

How can you contribute? Tasks

- CP side vertex fit bias studies (...)
  - Is TreeFitter introducing some correlation with Δt and so bias?
- CP fitter (Yusa-san, SL, Vladimir, …)
  - Using rooTatami (Belle), RooRarFit (BaBar), direct rooFit implementation
  - Would be nice to have a common, blessed, and validated tool
- Δt resolution (Vladimir, Thibaud, …)
  - As a common tools for different TDCPV analysis
- K_L final states (Benjamin, ...)
- Semileptonic control samples (Thomas, ...)
- Common ntuple for control channel studies (Jakub, ...)
- Systematics (...)
- Many final states looking for analysis!
  - B^0->pi pi, rho rho, a1 (Chiara, …)
  - b->ccs (Thomas, …)
  - b->qqs (SL, ...)
- **Many studies done for B2TIP, it's time to redo them on data**

Write your name on the dots!

Join TDCPV WG

we have flavours cakes

Plan for Moriond

- Studies on Data prior to TDCPV analysis
  - B^0 lifetime with hadronic modes (Reem) [Reem's talk]
  - B^0 mixing with fully hadronic decays (Sviat) [Fernando's talk]
    - Goal is validation of analysis tools

For ICHEP

- Steps toward first publication quality measurement of TD $B^0 \rightarrow J/\psi K^0_S$ measurement (many people)
  - $B \rightarrow J/\psi K$ signal extraction (Yusa-san)
  - Flavour Tagger performances on Data (Fernando, Colm)
  - **Δt resolution function**
  - CP-fit validation
  - Toys studies on MC
  - Review and unblinding

Backup

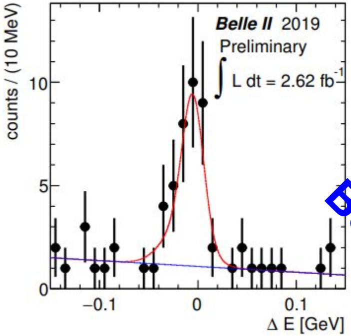
AS REQUESTED, I FIT MY PRESENTATION ON ONE POWERPOINT SLIDE.
I HAD TO USE ALL OF THE WHITE SPACE, BUT I THINK IT WAS WORTH IT TO FIT EVERYTHING ON ONE PAGE.
IT'S ACTUALLY ONLY ONE BULLET POINT, BUT IT'S A LONG ONE.
www.dilbert.com

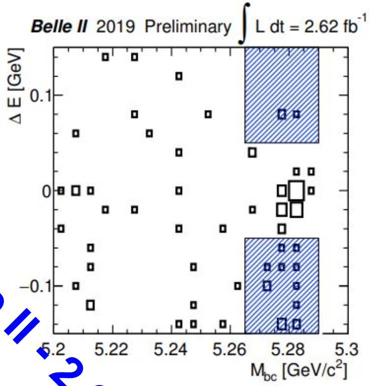
sin(2φ_1) measurement from $B^0 \to J/\psi K^0_S$

- Signal reconstruction is ready since this summer

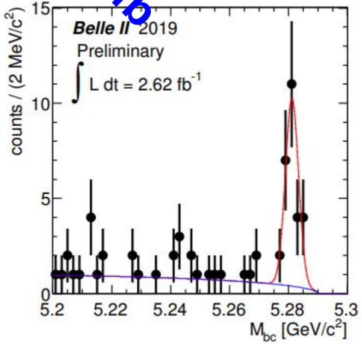
Mode	Belle II, 2019 data		Belle II, MC expectation		Belle, 2001 data [2]	
	2.62 fb^{-1}	1 fb^{-1}	2.62 fb^{-1}	1 fb^{-1}	10.5 fb^{-1}	1 fb^{-1}
$B^0 \to J/\psi K^0_S$	26.9 ± 5.2	10.3 ± 2.0	27.5	10.5	123	11.7

Extrapolated to 10/fb ~ **O(100)** events





Belle II : 2.6 /fb



VOLUME 86, NUMBER 12 PHYSICAL REVIEW LETTERS 19 MARCH 2001

Measurement of the *CP* Violation Parameter sin2ϕ_1 in B^0_d Meson Decays

A. Abashian,[44] K. Abe,[8] K. Abe,[36] I. Adachi,[8] Byoung Sup Ahn,[14] H. Aihara,[37] M. Akatsu,[19] G. Alimonti,[7] K. Aoki,[8]

We present a measurement of the standard model *CP* violation parameter sin2ϕ_1 (also known as sin2β) based on a 10.5 fb^{-1} data sample collected at the $\Upsilon(4S)$ resonance with the Belle detector at the KEKB asymmetric e^+e^- collider. One neutral *B* meson is reconstructed in the $J/\psi K_S$, $\psi(2S)K_S$, $\chi_{c1}K_S$, $\eta_c K_S$, $J/\psi K_L$, or $J/\psi\pi^0$ *CP*-eigenstate decay channel and the flavor of the accompanying *B* meson is identified from its charged particle decay products. From the asymmetry in the distribution of the time interval between the two *B*-meson decay points, we determine sin2$\phi_1 = 0.58^{+0.32}_{-0.34}(\text{stat})^{+0.09}_{-0.10}(\text{syst})$.

$B \to J/\psi\ K^0_S/K^+$ signal extraction

Yusa-san
Niigata Univ

Selection criteria

BELLE2-NOTE-PH-2019-042

Basically same as proc9 data analysis.

Event shape variables R2 < 0.3

J/ψ:
- $|d0| < 0.5$ cm, $|z0| < 2.0$ cm
- electron: electronID > 0.1 at least 1 daughter
- muon: muonID > 0.1 at least 1 daughter
- $2.8\ \mathrm{GeV}/c^2 < M_{\ell\ell} < 3.2\ \mathrm{GeV}/c^2$

$K^\pm$:
- kaonID > 0.1

K^0_S:
mergedKshorts → stdKshort from stdV0s
(many warning message after changing to release-4)
$0.45\ \mathrm{GeV}/c^2 < M_{\pi\pi} < 0.55\ \mathrm{GeV}/c^2$

Signal region is defined to be $M_{bc} > 5.27\ \mathrm{GeV}/c^2$, $|\Delta E| < 40$ MeV.

$B^0 \to J/\psi(\to e^+e^-)K^0_S$

efficiency = 23.7%
(26.1%) (proc9)

$B^0 \to J/\psi(\to \mu^+\mu^-)K^0_S$

efficiency = 44.0%
(32.2%) (proc9)

$B^+ \to J/\psi(\to \mu^+\mu^-)K^+$

efficiency = 47.6%
(45.6%) (proc9)

Stefano Lacaprara, INFN Padova

of events in each selection step

After reconstruction and J/ψ and Ks mass, $M_{bc}/\Delta E$

new release

1M $B^0 \to J/\psi(\to e^+e^-)K^0_S$ 453357, 234018

1M $B^0 \to J/\psi(\to \mu^+\mu^-)K^0_S$ 511699, 441203

5M $B^+ \to J/\psi(\to \mu^+\mu^-)K^+$ 2727751, 2368902

old release

1M $B^0 \to J/\psi(\to e^+e^-)K^0_S$ 336432, 263129

1M $B^0 \to J/\psi(\to \mu^+\mu^-)K^0_S$ 380836, 326933

5M $B^+ \to J/\psi(\to \mu^+\mu^-)K^+$ 2659844, 2315086

Ratio of new/old before $M_{bc}/\Delta E$ selection

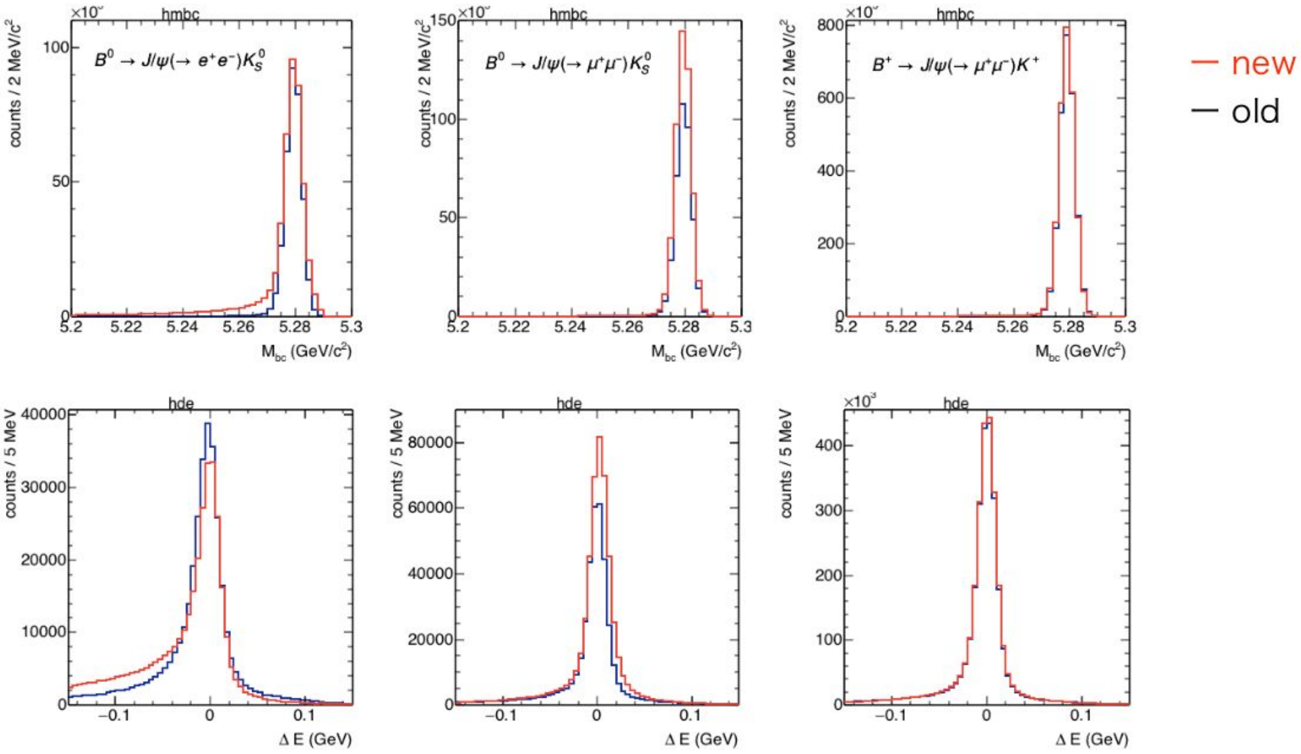
$B^0 \to J/\psi(\to e^+e^-)K^0_S$ 1.35

$B^0 \to J/\psi(\to \mu^+\mu^-)K^0_S$ 1.34

→ Gains are consistent in electron and muon modes.

Difference comes from kinematics selections.

$M_{bc}/\Delta E$ comparison

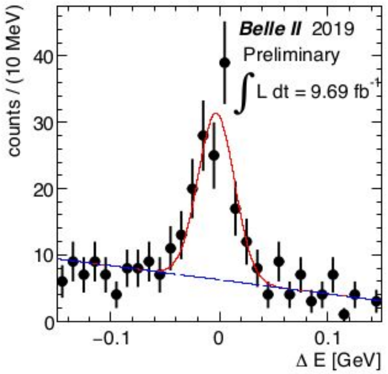


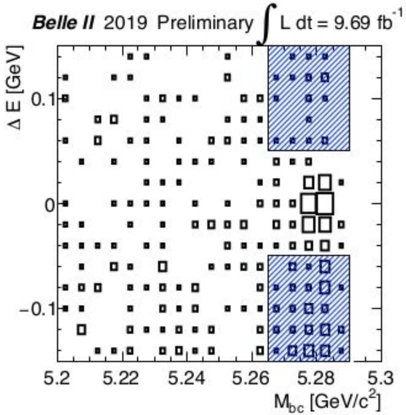
Tail component in electron mode is larger in new release.

Brems correction does not work correctly?

Use correctBrems instead of correctFSR?

Update with unofficial processing data





$B^0 \to J/\psi K^0_S$

proc10+unofficial exp. 10

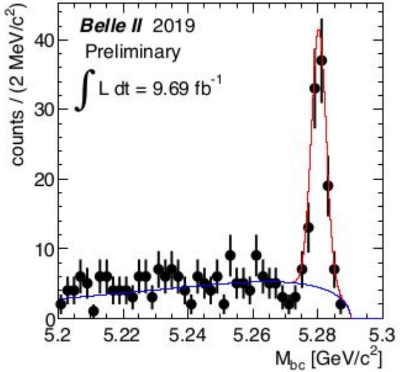
$104.2\pm10.9 \to 10.8$ events/fb^{-1}

exp. 10 only

$25.7\pm5.3 \to 6.3$ events/fb^{-1}

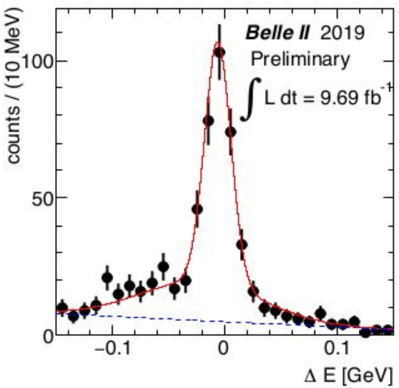
proc 10 only

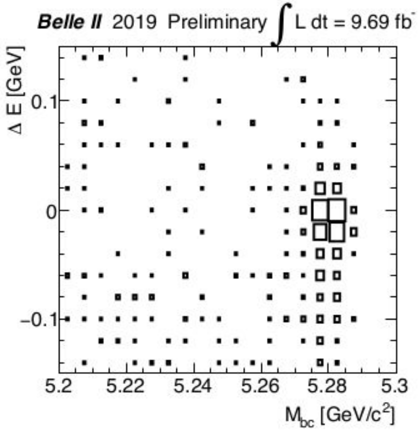
$78.9\pm9.4 \to 14.1$ events/fb^{-1}



12.3 events/fb^{-1} is expected from MC

Update with unofficial processing data





$B^+ \to J/\psi K^+$

proc10+unofficial exp. 10

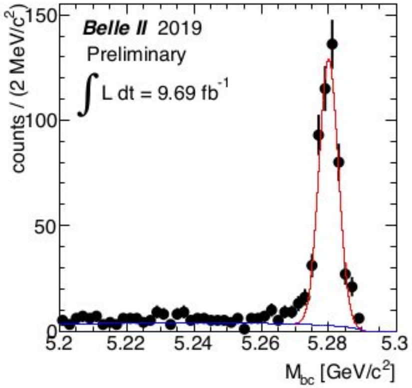
356.2±17.6 → 36.8 events/fb^{-1}

exp. 10 only

90.4±8.5 → 22.2 events/fb^{-1}

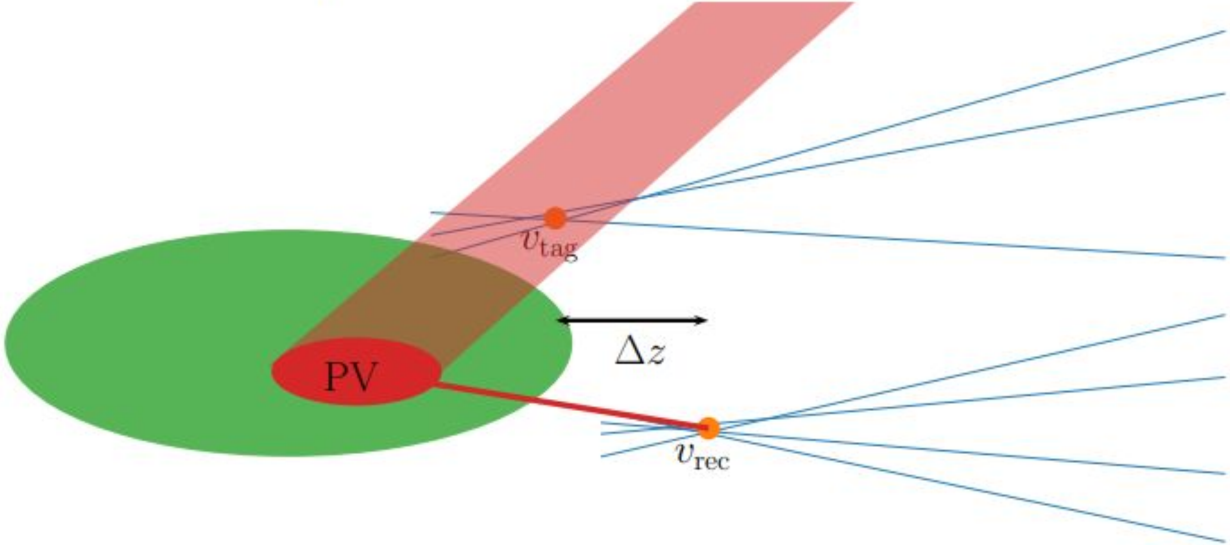
proc 10 only

265.2±15.0 → 47.3 events/fb^{-1}



46.6 events/fb^{-1} is expected from MC

Tag vtx fit with BTube option



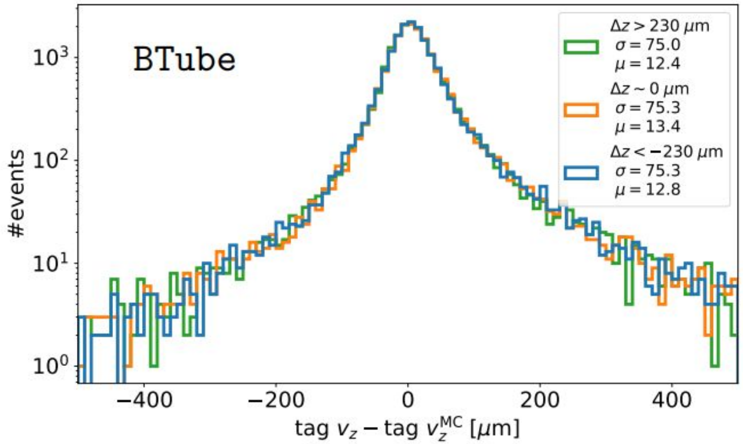
With the new BTube option:

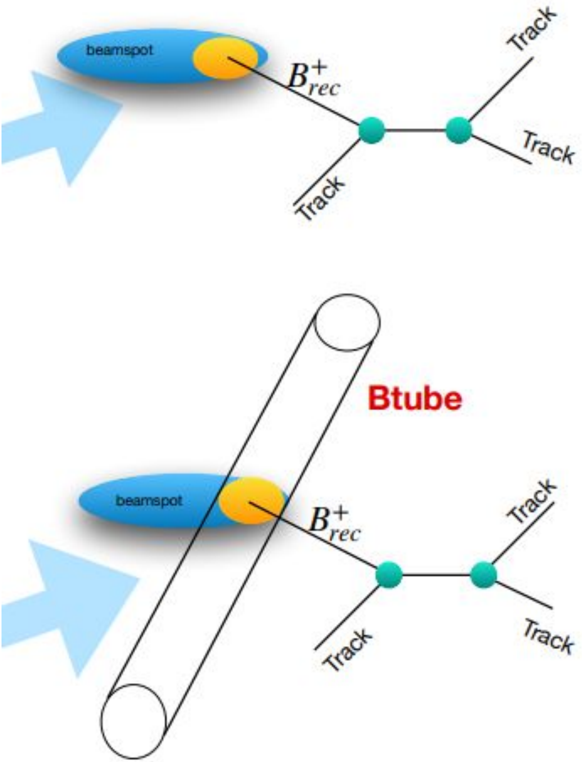
- The PV is found by projecting the reconstructed B back to the IP;
- The PV is then elongated to 20 cm in the tag B flight direction using momentum conservation;
- This constraint makes physical sense.

Tag Vertex Fit

Sourav (Tel Aviv),
Thibaud (MPI)

- **Btube** constraint: now available on **light-icarus**
  - Set explicitly **trackFindingType="standard_PXD"**
- Propagate $B_{\mathbf{sig}}$ to beamspot
  - Get the vertex of both B
  - Compute flight direction of B_{TAG}
  - Use the tube as a constraint on tag side
  - [BIIANA-120]





$\tau(B^0)$ hadronic

Reem (IPHC Strasbourg)
BELLE2-NOTE-PH-2019-017

- No flavour tagging needed,
- Using simple Δt resolution function
  - 3 gaussian
  - Not using event per event resolution
- 6 fully reconstructed hadronic final states.
  - **In common with BToCharm WG**

- **B^0 channels** :
  - $B^0 \to D^- \rho^+$, $D^- \to K^+ \pi^- \pi^-$
  - $B^0 \to D^- \pi^+$, $D^{*-} \to D^0 \pi^-$
  - $B^0 \to D^{*-} \pi^+$,
  - $B^0 \to D^{*-} \rho^+$
  - $B^0 \to D^{*-} a1^+$

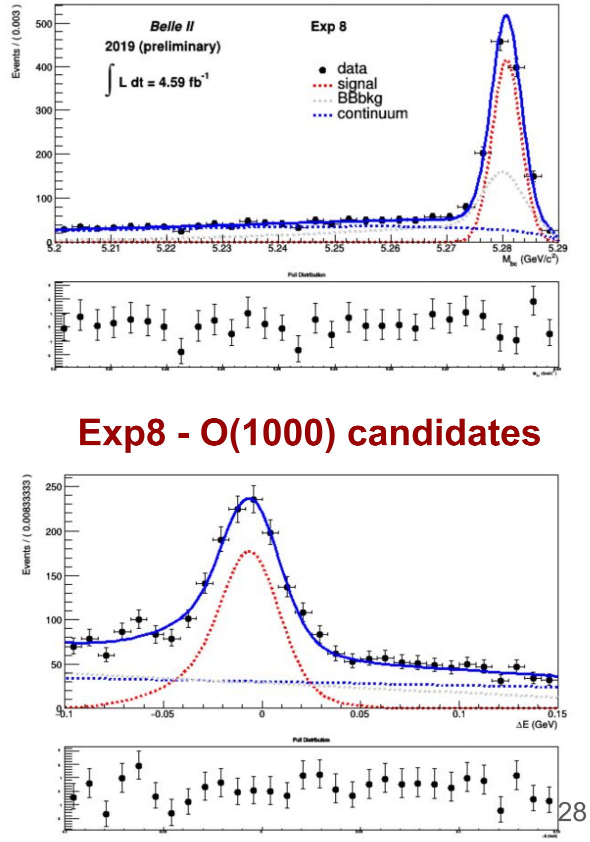
D^0 channels

$D^0 \to K^- \pi^+$
$D^0 \to K^- \pi^+ \pi^0$
$D^0 \to K^- \pi^+ \pi^+ \pi^-$

$a1^+ \to \pi^+ \pi^+ \pi^-$
$\rho^+ \to \pi^+ \pi^0$

Decay	Selection efficiency %
$B^0 \to D^- \pi^+$	20
$B^0 \to D^- \rho^+$	10
$B^0 \to D^{*-} \pi^+$	22
$B^0 \to D^{*-} \rho^+$	8
$B^0 \to D^{*-} a_1$	6.6

$B^0 \to D^- a_1^+$ excluded due to high background



Exp8 - O(1000) candidates

Lifetime extraction

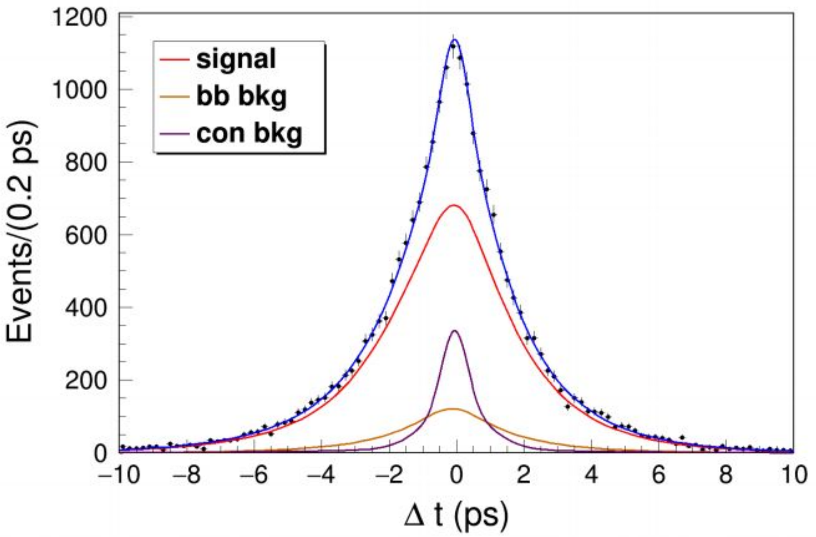
BELLE2-NOTE-PH-2019-017

- UML fit on Δt with full pdf
  - Signal/BB/continuum
  - Fixing some parameters from MC
- Test on MC 80/fb
  - **Data stil blind**

$$\mathrm{P}_{\mathrm{all}}(\Delta t) = f_s \boxed{\mathrm{P}_{\mathrm{sig}}(\Delta t)} + f_{b\bar{b}}\, \mathrm{P}_{b\bar{b}}(\Delta t) + (1 - f_s - f_{\bar{b}})\, \mathrm{P}_{\mathrm{cont}}(\Delta t).$$

$$\boxed{\mathrm{P}_{sig}(\Delta t)} = \int_{-\infty}^{+\infty} \boxed{\mathcal{P}_{th}(\Delta t')}\, \mathcal{R}_{sig}(\Delta t - \Delta t')\mathrm{d}\Delta t'.$$

$$\boxed{\mathcal{P}_{th}(\Delta t)} = \frac{1}{2\tau_B} \exp\left(-\frac{|\Delta t|}{\tau_B}\right).$$



f_{s1}	0.4 ± 0.05
μ_{s1}	-0.0091 ± 0.09
σ_{s1}	0.451
f_{s2}	0.45 ± 0.054
μ_{s2}	-0.34 ± 0.11
σ_{s2}	1.23
f_{s3}	$1 - f_{s1} - f_{s2}$
μ_{s3}	-0.8 ± 0.21
σ_{s3}	4.09
τ_{B^0}	1.52 ± 0.019

Working on systematics

Target: Moriond

B^0 lifetime measurement

- Measurement of B meson lifetimes with hadronic decay final states
  - **Phase III data,**
  - IPHC Strasbourg, Reem Rasheed et al
    - BELLE2-NOTE-PH-2019-017
    - Status: in review by conveeners, soon to go to RC
- No flavour tagging needed, simple Dt resolution function
  - 6 fully reconstructed hadronic final states. **In common with BToCharm WG**

- **B^0 channels** :
  - $B^0 \to D^- \rho^+$, $D^- \to K^+ \pi^- \pi^-$
  - $B^0 \to D^- \pi^+$, $D^{*-} \to D^0 \pi^-$
  - $B^0 \to D^{*-} \pi^+$,
  - $B^0 \to D^{*-} \rho^+$
  - $B^0 \to D^{*-} a1^+$

D^0 channels

$D^0 \to K^- \pi^+$
$D^0 \to K^- \pi^+ \pi^0$
$D^0 \to K^- \pi^+ \pi^+ \pi^-$

$a1^+ \to \pi^+ \pi^+ \pi^-$
$\rho^+ \to \pi^+ \pi^0$

Decay	Selection efficiency %	σ_{effe}(statistical) %
$B^0 \to D^-\pi^+$	20	0.04
$B^0 \to D^-\rho^+$	10	0.03
$B^0 \to D^{*-}\pi^+$	22	0.043
$B^0 \to D^{*-}\rho^+$	8	0.025
$B^0 \to D^{*-}a_1$	6.6	0.019

$B^0 \to D^- a_1^+$ excluded due to hig background

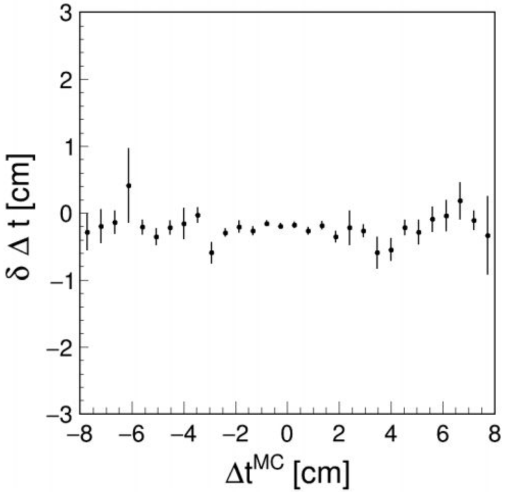
Δt model and fit (MC only)

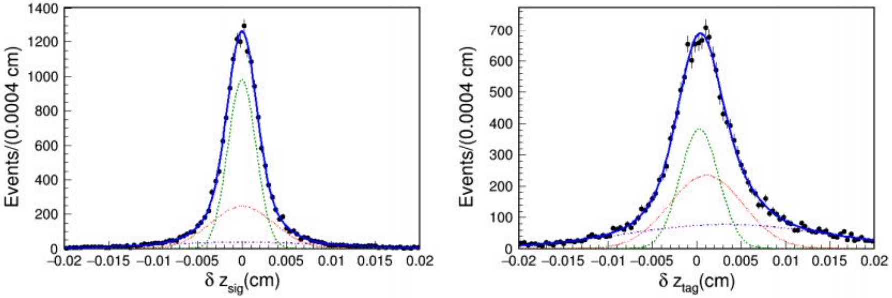
- Convolution of physics
- And resolution function

$$\mathcal{P}_{th}(\Delta t) = \frac{1}{2\tau_B} \exp\left(-\frac{|\Delta t|}{\tau_B}\right).$$

$$\mathrm{P}_{sig}(\Delta t) = \int_{-\infty}^{+\infty} \mathcal{P}_{th}(\Delta t')\, \mathcal{R}_{sig}(\Delta t - \Delta t')\mathrm{d}\Delta t'.$$

- Not using the event-based uncertainty
  - No dependency of Δz residual on Δt_{MC}
- Simplified model:
  - triple gaussian separately for signal and tag side
  - For signal, continuum, BB





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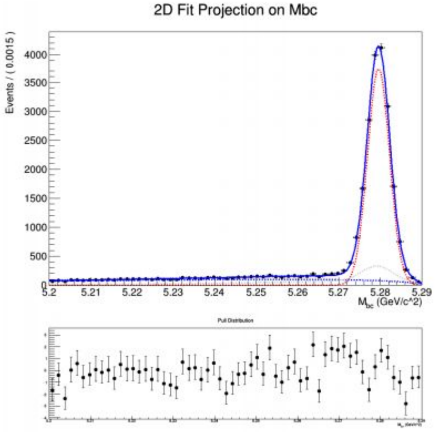
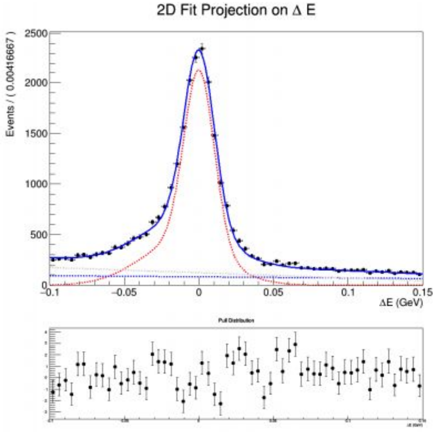
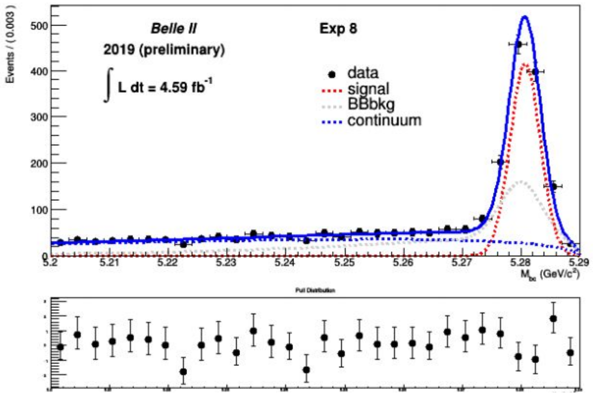
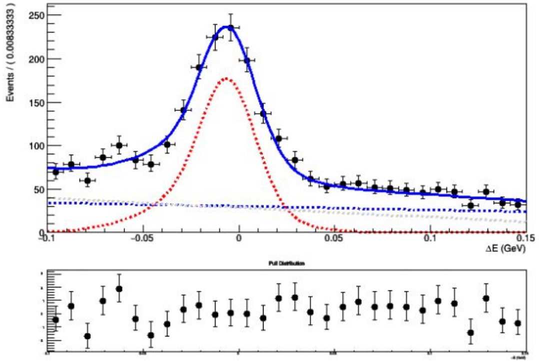
Signal in MC and Data

- 2D fit on Mbc and DE with signal, BB, and continuum contribution









- In data (exp8 only), O(1000) candidates
- Clean signal
  - f_{sig}~53% in signal region (0.4 for MC)

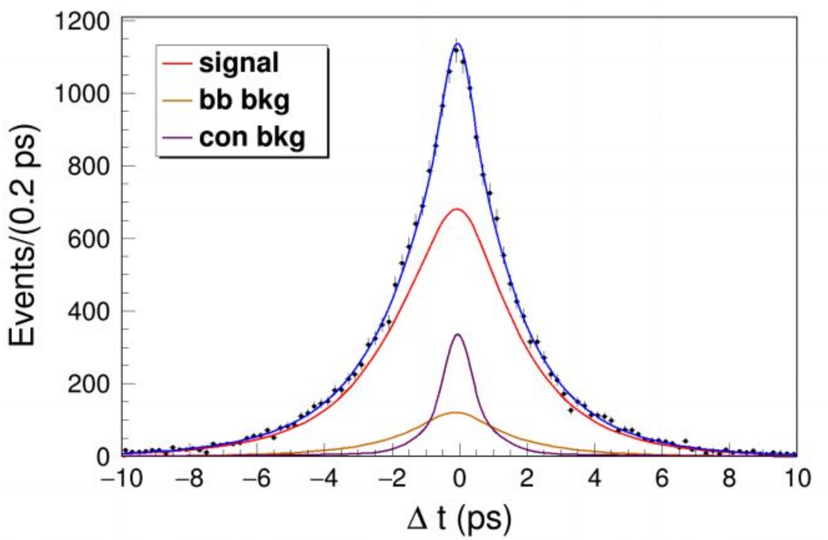
Lifetime extraction

- UML fit on Δt with full pdf
  - Fixing some parameters from MC
- Test on MC 80/fb
  - **Data stil blind**

$$\mathrm{P_{all}}(\Delta t) = f_s\,\mathrm{P_{sig}}(\Delta t) + f_{b\bar{b}}\,\mathrm{P}_{b\bar{b}}(\Delta t) + (1 - f_s - f_{\bar{b}})\,\mathrm{P_{cont}}(\Delta t).$$

$$\mathrm{P}_{sig}(\Delta t) = \int_{-\infty}^{+\infty} \mathcal{P}_{th}(\Delta t')\,\mathcal{R}_{sig}(\Delta t - \Delta t')\mathrm{d}\Delta t'.$$

$$\mathcal{R}_{sig}(\Delta t) = f_{s1}\,\mathcal{N}(\Delta t;\ \mu_{s1}, \sigma_{s1}) + f_{s2}\,\mathcal{N}(\Delta t;\ \mu_{s2}, \sigma_{s2}) + (1 - f_{s1} - f_{s2})\,\mathcal{N}(\Delta t;\ \mu_{s3}, \sigma_{s3})(4)$$



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μ_{s1}	-0.0091 ± 0.09
σ_{s1}	0.451
f_{s2}	0.45 ± 0.054
μ_{s2}	-0.34 ± 0.11
σ_{s2}	1.23
f_{s3}	$1 - f_{s1} - f_{s2}$
μ_{s3}	-0.8 ± 0.21
σ_{s3}	4.09
τ_{B^0}	1.52 ± 0.019

Working on systematics

Target: Moriond

Flavor tagger validation

Fernando (TS)
Colm (IPMU)

- Use fully-hadronic **self-tagged B^0 decay**
- **Use Time Integrated PDF**
  - signal flavour **α** flavour and tag-side **β**

$$\mathcal{P}^{\mathrm{Obs}}_{\alpha\beta} = \frac{\varepsilon}{2}[1 - \alpha\beta(\alpha \cdot \Delta w + (1-2w)\cdot(1-2\chi_d))]$$

  - **ε** Tagging efficiency
  - w wrong tag probability
  - Δw (B vs Bbar w)
  - **α** flavour of signal side B (self tagged)
  - **β** flavour of tag side B (flavour tagger)
  - χ_d B meson mixing
  - **From fit get: ε_i, w_i, Δw_i**
    - for i=1,7 bins (r=|1-2w|)

Control Samples (same as $\tau(B^0)$)

1	$B^+ \to \bar{D}^0 \pi^+$
2	$B^+ \to \bar{D}^0 \rho^+$
3	$B^+ \to \bar{D}^{*0} \pi^+$
4	$B^+ \to \bar{D}^{*0} \rho^+$
5	$B^+ \to \bar{D}^{*0} a_1^+$

1	$D^+ \to K^- \pi^+ \pi^+$
2	$D^+ \to K^0_S \pi^+$
3	$D^+ \to K^0_S \pi^+ \pi^0$
4	$D^+ \to K^- \pi^+ \pi^+ \pi^0$

Plus neutral modes

Flavor tagger validation

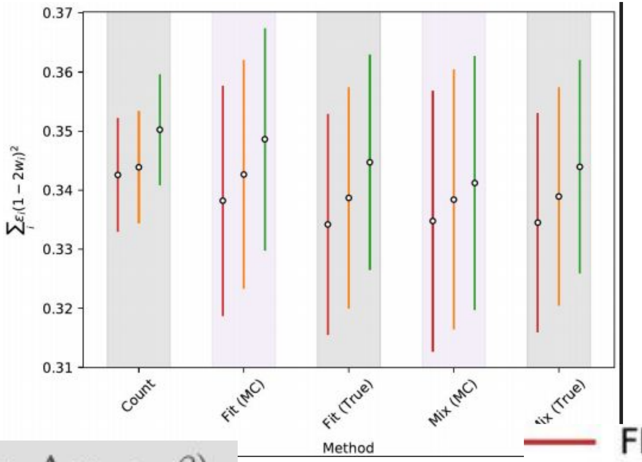
Fernando (TS)
Colm (IPMU)

- Use fully-hadronic **self-tagged B^0 decay**
- **Use Time Integrated PDF**
  - signal flavour α flavour and tag-side β, χ_d B meson mixing

$$\mathcal{P}^{\mathrm{Obs}}_{\alpha\beta} = \frac{\varepsilon}{2}[1 - \alpha\beta(\alpha\cdot\Delta w + (1-2w)\cdot(1-2\chi_d))]$$

- **From fit get: $\varepsilon_i, w_i, \Delta w_i$**
  - for i=1,7 bins (r=|1-2w|)
- Closure test on MC ok
- Working toward a full fit

$$\mathcal{P}_{\mathrm{Sig}} = \mathcal{P}(\Delta E)\times\mathcal{P}(M_{bc}|\Delta E)\times\mathcal{P}(\varepsilon, w, \Delta w, \alpha, \beta)$$



FBDT_qrCombined
FANN_qrCombined
DNN_qrCombined

Control Samples (same as $\tau(B^0)$)

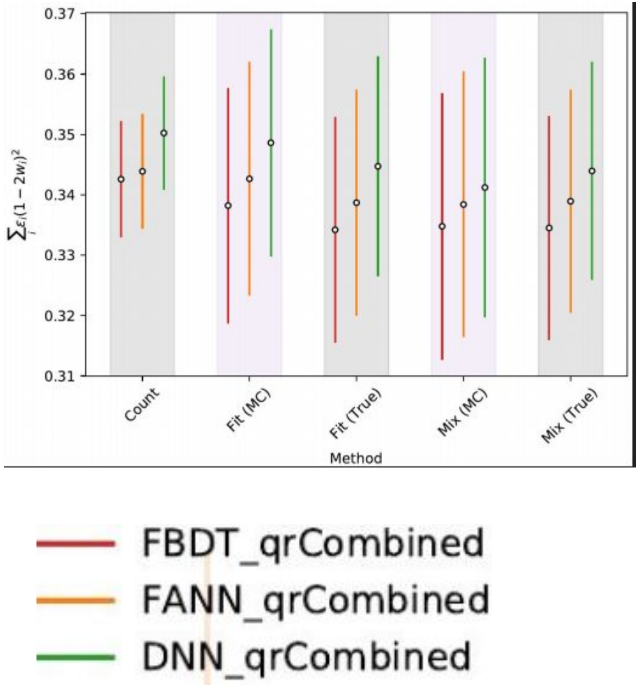
1	$B^+ \to \bar{D}^0\pi^+$
2	$B^+ \to \bar{D}^0\rho^+$
3	$B^+ \to \bar{D}^{*0}\pi^+$
4	$B^+ \to \bar{D}^{*0}\rho^+$
5	$B^+ \to \bar{D}^{*0}a_1^+$

1	$D^+ \to K^-\pi^+\pi^+$
2	$D^+ \to K^0_S\pi^+$
3	$D^+ \to K^0_S\pi^+\pi^0$
4	$D^+ \to K^-\pi^+\pi^+\pi^0$

Plus neutral modes

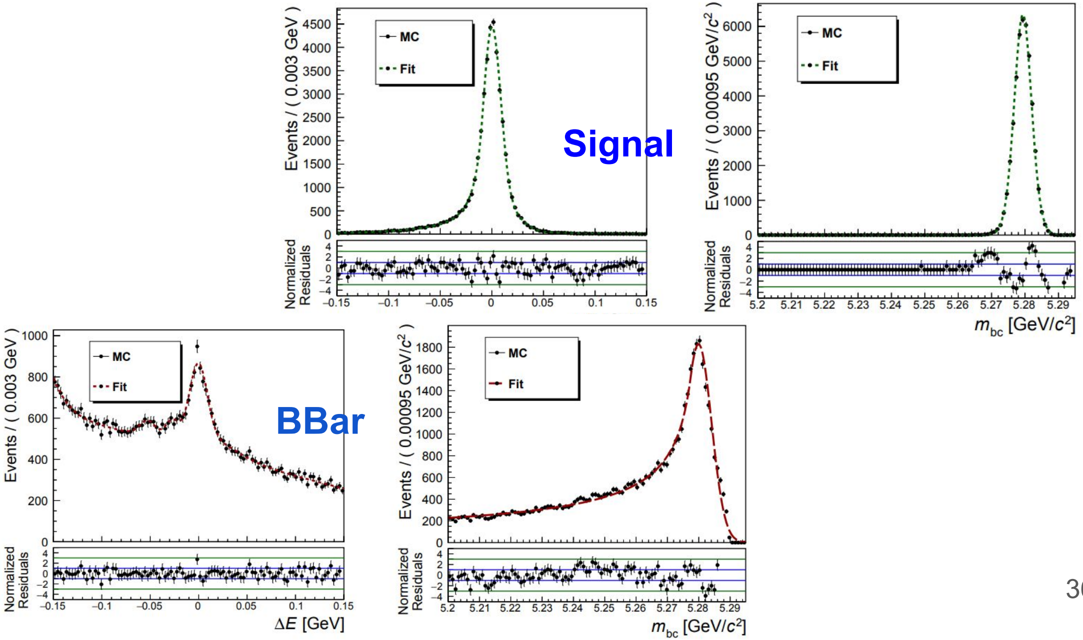
Results on MC: total effective eff

On MC: testing fit machinery
Also $\varepsilon_i, w_i, \Delta w_i$ measured
Good match with MC truth

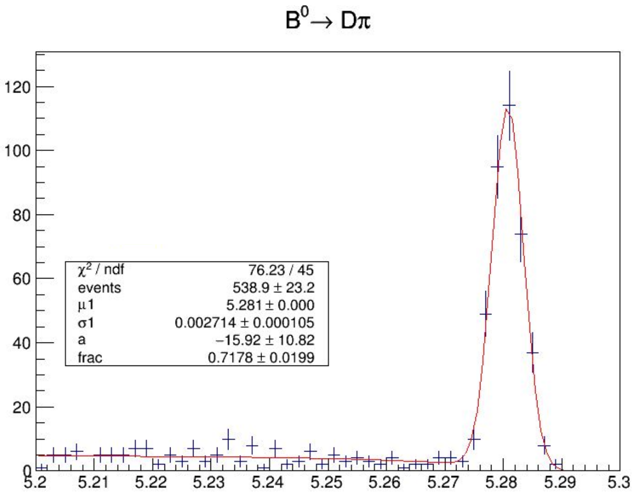


Write 2D fit for with components for signal, continuum and BBar

$$\mathcal{P}_{\mathrm{Sig}} = \mathcal{P}(\Delta E) \times \mathcal{P}(M_{bc} | \Delta E) \times \mathcal{P}(\varepsilon, w, \Delta w, \alpha, \beta)$$



Hadronic control sample $B \to D^{(*)}h$ yields in proc10



Scaled MC12b 5.6/fb corresponding to exp7&8 and data(proc9→proc10)				
B-decay ch	$B^+ \to D^0\pi^+$	$B^0 \to D^{*-}\pi^+$	$B^0 \to D^{*-}\rho^+$	$B^0 \to D^-\pi^+$
D-decay ch	Signal events (e7&8)	Signal events (e7&8)	Signal events (e7&8)	Signal events (e7&8)
1	445 (281→419±21)	119 (97→97±10)	62 (41→66±8)	380 (242→387±20)
2	560 (270→481±23)	146 (81→98±10)	74 (48→94±10)	
3	460 (160→271±17)	137 (43→66±8)	68 (25→42±7)	

Prompt yield check by fit using single gaussian + argus function.
The peaking BG is not taken into account.
The obtained yields in proc10 become closer to the MC expectation than that of proc9.

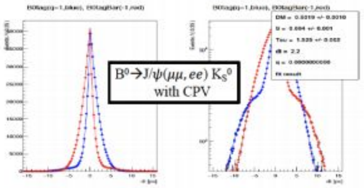
The MPI TD analysis in full

Data

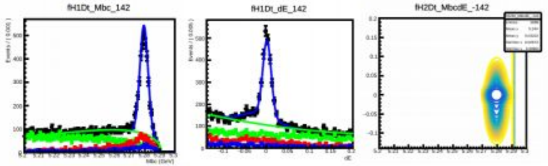
assistive MC

ALPOS
- reading input files
- final selections
- managing of tasks
- **combined TD fit**

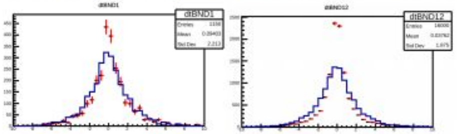
1. fitDtGen.C+ntuple.Upsilon4S.Gen.py
   - check input generator parameters



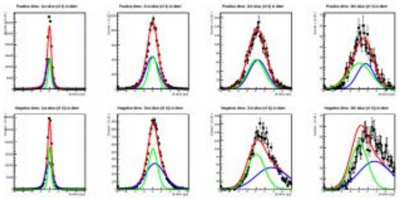
2. qqBkgFrac.C - fit qq bkg fractions in data



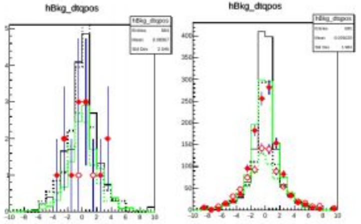
3. dt distr. for qq bkg using side band data



4. fitRecFunc.C - dt resolution functions for MC



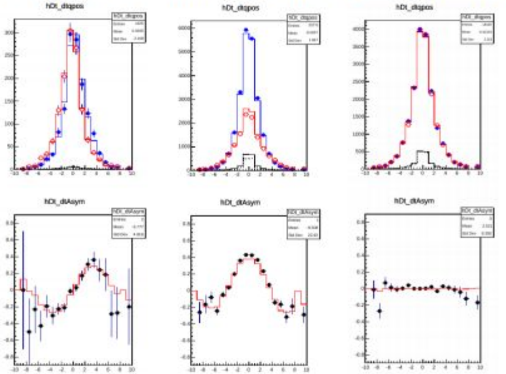
5. Peaking bkg in Mbc (dt distr. from MC)



6. Physics results of TD fit

	Complete TD analysis of 7 channels in MC12 – 01	*generated*
τ_{B^0} (ps)	1.524 ± 0.007	1.525/1.527
$\tau_{B^\pm}$ (ps)	1.646 ± 0.009	1.637
δm (ps^{-1})	0.506 ± 0.0001	0.502/0.506
S	0.771 ± 0.049	0.695
W_1	0.473 ± 0.008	
W_2	0.446 ± 0.007	
W_3	0.347 ± 0.006	
W_4	0.207 ± 0.007	
W_5	0.190 ± 0.006	
W_6	0.131 ± 0.006	
W_7	0.039 ± 0.004	
α_{smear}	0 ± 0.023	

7. dtplots.C - final dt distributions and yields



Lifetime extraction: MC12 400/fb

	τ_{B^0} (ps) 1.525/1.527	α_{smear}		$\tau_{B^\pm}$ (ps) 1.637	α_{smear}
$B^0 \to J/\psi\ K^0_S$ $J/\psi \to \mu\mu$ $J/\psi \to ee$	 1.533 ± 0.036 1.465 ± 0.042	 0 ± 1.08 0 ± 0.86	$B^+ \to J/\psi\ K^+$ $J/\psi \to \mu\mu$ $(J/\psi \to ee)$	 1.613 ± 0.017 (1.657 ± 0.021)	 0 ± 0.59 (0 ± 0.57)
$B^0 \to D^-\pi^+$ $D^- \to K\pi\pi$	 1.547 ± 0.014	 0.25 ± 0.21			
$B^0 \to D^{*-}\pi^+$ $(D^0 \to K\pi)$ $D^0 \to K3\pi$	 (1.520 ± 0.020) 1.543 ± 0.018	 (0 ± 0.26) 0 ± 0.26	$B^+ \to D^0\pi^+$ $D^0 \to K\pi$ $(D^0 \to K3\pi)$	 1.654 ± 0.019 (1.662 ± 0.015)	 0.29 ± 0.25 (0.33 ± 0.17)
$4\ B^0\ channels$	1.545 ± 0.010	0 ± 0.32	$2\ B^\pm\ channels$	1.637 ± 0.016	0.31 ± 0.21

- In general good agreement for all channels
  - Channel in ( ) not used for global fit

FT wrong tag: counting method

Onuki-san
Tokyo univ

- Using hadronic control samples

Counting method: Belle note#320

$$R^{B^0}_{measured} = \frac{R_{w=0} + w_{B^0}(1 - R_{w=0})}{1 - w_{B^0}(1 - R_{w=0})}$$

$$w_{B^0} = \frac{R^{B^0}_{measured} - R_{w=0}}{(1 - R_{w=0})(R^{B^0}_{measured} + 1)}$$

where

$$R^{B^0}_{measured} = N^{B^0}_{sf} / N^{B^0}_{of}$$

$$R^{\bar{B}^0}_{measured} = N^{\bar{B}^0}_{sf} / N^{\bar{B}^0}_{of}$$

$$R_{w=0} = \frac{\chi_d}{1 - \chi_d}$$

$$\chi_d = 0.182 \pm 0.015 \text{ (PDG average)}$$

$B^0 \to D^- \pi^+$
$B^0 \to D^{*-} \pi^+$
$B^0 \to D^{*-} \rho^+$
$B^+ \to \bar{D}^0 \pi^+$

$D^{*+} \to D^0 \pi^+$
$D^0 \to K^- \pi^+$ ...1
$\to K^- \pi^+ \pi^0$ ...2
$\to K^- \pi^- \pi^+ \pi^+$...3
$D^+ \to K^- \pi^+ \pi^+$

i.e) $D^0\pi$ -3, $D^*\rho$ -1, $D\pi$,

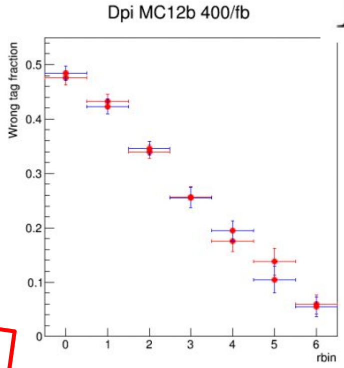
Measure from data

$$w_{ave} = (w_{B^0} + w_{\bar{B}^0})/2$$

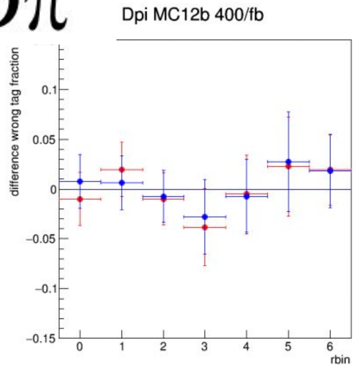
$$\Delta w = w_{B^0} - w_{\bar{B}^0}$$

More on Fernando's talk later

Dπ



w^i_{ave}



Δw^i

FBDT_ qrCombined

FANN_ qrCombined

Final states considered (Belle)

- **η'** $\to \eta\pi^+\pi^-$: BR=42.6%
  - **η** $\to \gamma\gamma$: BR=38.41%
  - **η** $\to \pi^+\pi^-\pi^0$:BR=22.94%
- **η'** $\to \rho(\to \pi^+\pi^-)\gamma$: BR=28.9%
  - Including non resonant $\pi^+\pi^-\gamma$
- $K^0_S \to \pi^+\pi^-$: BR=69.2 %

In Belle, most of signal comes from

- **η'** $\to \rho(\to \pi^+\pi^-)\gamma$

η $\to \pi^+\pi^-\pi^0$ was not used in this analysis, only **η** $\to \gamma\gamma$

Mode	N_S	Σ	$\epsilon(\%)$	$\epsilon B_s(\%)$	$BF(10^{-6})$
$\eta'_{\eta\pi\pi}K^+$	$28.9^{+6.5}_{-5.7}$	9.4	21.7	3.78	69^{+15}_{-14}
$\eta'_{\rho\gamma}K^+$	$42.5^{+9.1}_{-8.3}$	7.5	14.2	4.18	92^{+20}_{-18}
$\eta'_{\eta\pi\pi}\pi^+$	$0.0^{+1.2}_{-0.0}$	0.0	23.7	4.11	–
$\eta'_{\rho\gamma}\pi^+$	$0.0^{+5.6}_{-0.0}$	0.0	15.4	4.55	–
$\eta'_{\eta\pi\pi}K^0$	$6.4^{+3.4}_{-2.7}$	3.5	20.8	1.25	46^{+25}_{-20}
$\eta'_{\rho\gamma}K^0$	$10.1^{+4.4}_{-3.6}$	4.0	11.5	1.16	79^{+34}_{-28}

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B→η' K status

SL Padova
BELLE2-NOTE-PH-2018-038

- **Belle saw signal with 10.5 /fb,** both for B^+ and B^0
- **η'** rediscovered at Belle II (see also my PhysPerf talk)

4 October 2001

PHYSICS LETTERS B

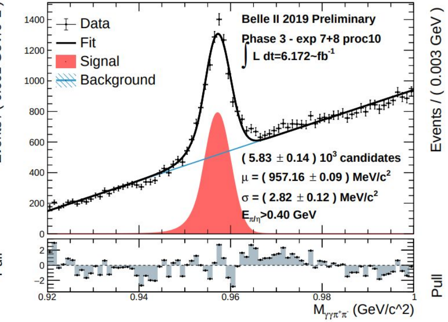
ELSEVIER

Physics Letters B 517 (2001) 309–318
www.elsevier.com/locate/npe

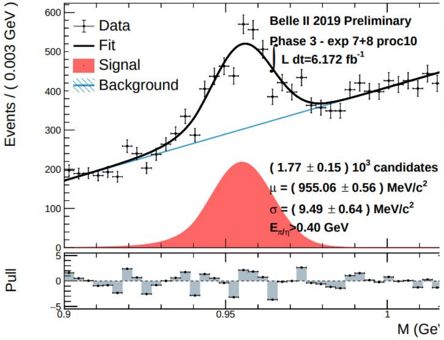
Measurement of the branching fraction for $B \to \eta' K$ and search for $B \to \eta' \pi^+$

Belle Collaboration

$\eta' \to \eta(\to \gamma\gamma)\, \pi^+\pi^-$
proc10 exp 7+8

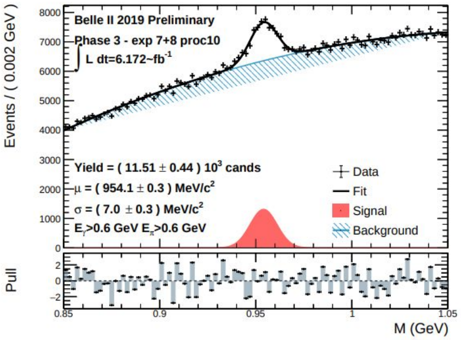


$\eta' \to \eta(\to \pi^+\pi^-\pi^0)\, \pi^+\pi^-$
proc10 exp 7+8



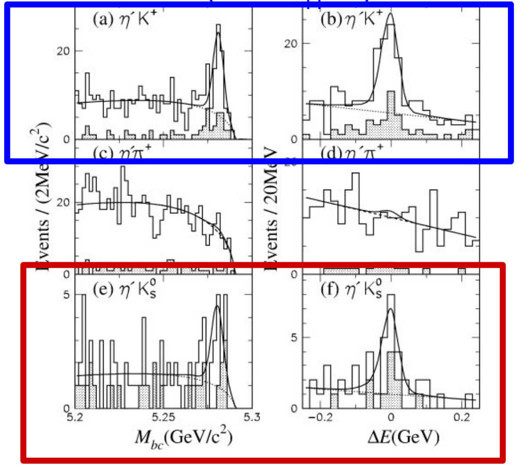
ε(3π/2γ) = 0.52 ± 0.05
Not used in Belle

$\eta' \to \rho(\to \pi^+\pi^-)\, \gamma$
proc10 exp 7+8



$\varepsilon(\rho\gamma/\eta_{\gamma\gamma} 2\pi) = 1.1 \pm 0.06$

B^+: BR=$(79^{+12}_{-11} \pm 8) \times 10^{-6}$



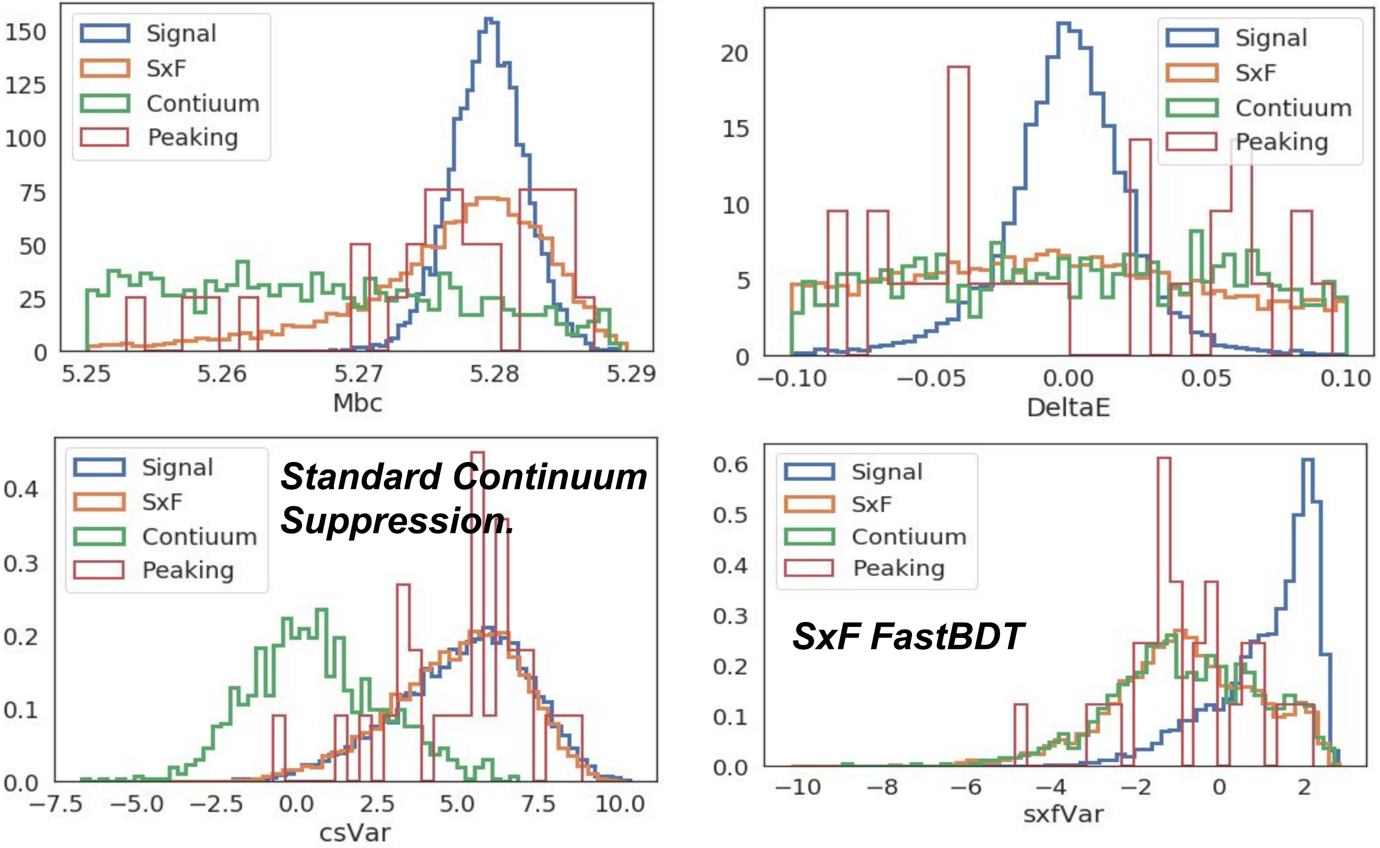
Belle 10.5 /fb

B^0 : BR=$(55^{+19}_{-16} \pm 9) \times 10^{-6}$

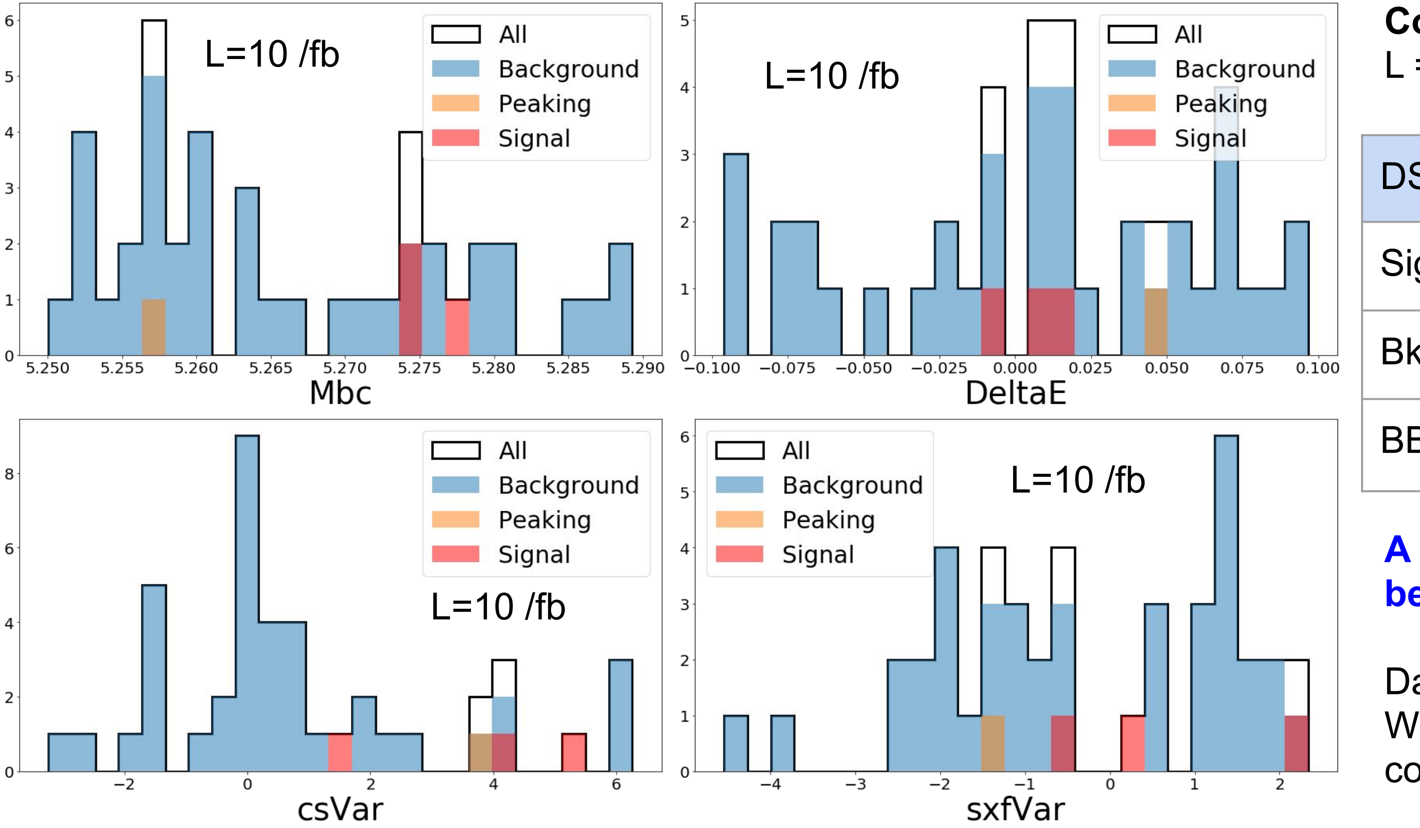
- Very good agreement with MC: peak position, width, and yield
- σ(B/B2)= **2.7 vs 2.8 MeV ($\gamma\gamma\pi^+\pi^-$) and 8.8 vs 7.0 MeV ($\rho\gamma$)**

Shaded $\eta' \to \eta\pi\pi$, white all (including $\eta' \to \rho\gamma$)

Pdf: Signal - SxF - Bkg - BB



Test on Run Dependent MC12d



Continuum (+τ) + BBar
L = 10 /fb

DS	Exp'd	Seen
Signal	~10	3
Bkg	~100	40
BB	~3	1

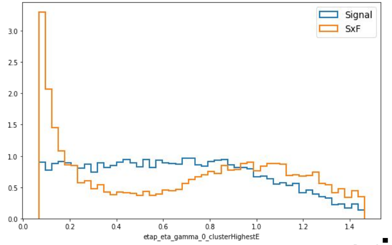
A quick test, much to be understood yet.

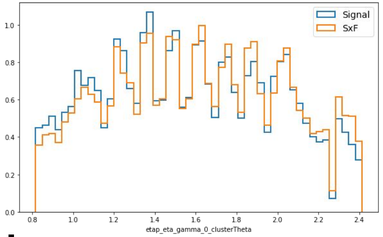
Data still blind
Will look at SB and continuum

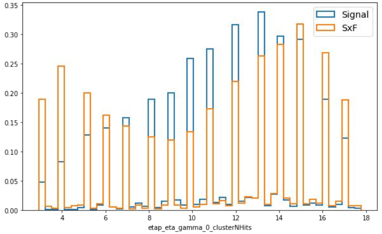
SxF Mitigation: fastBDT

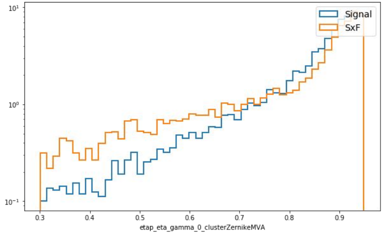
Almost 100% of SxF from $\eta(\to\gamma\gamma)$.

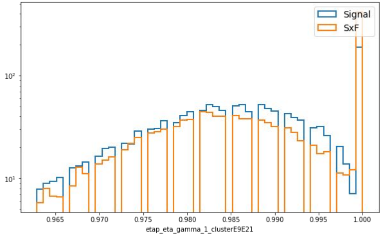
γ variables

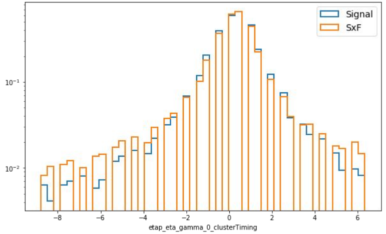




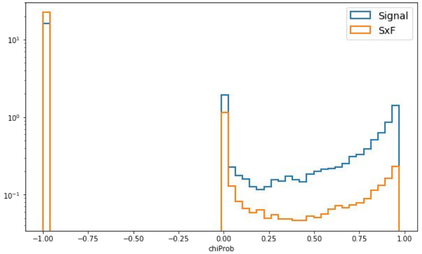


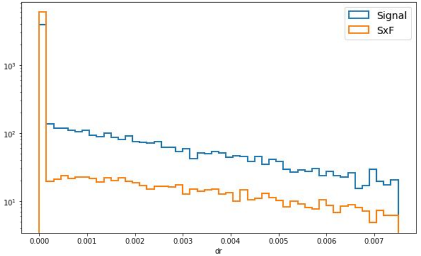


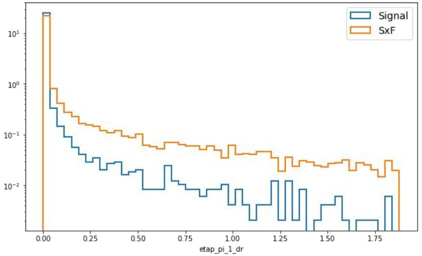




η' vertex variables







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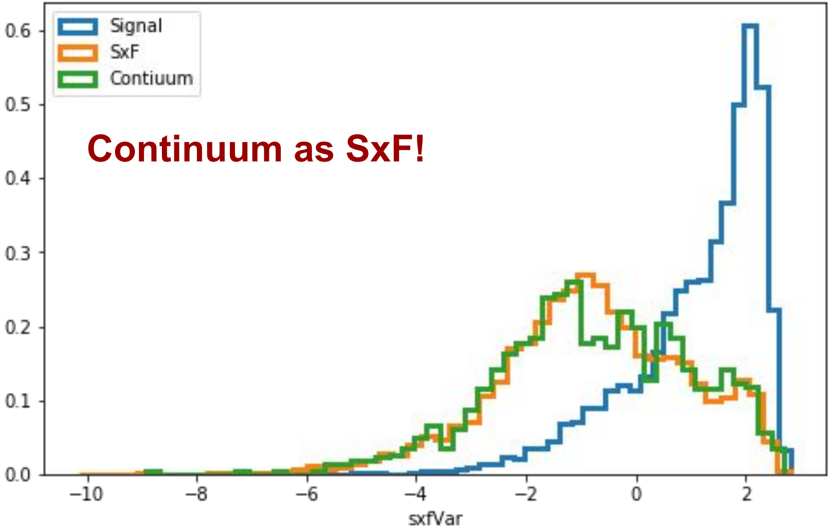
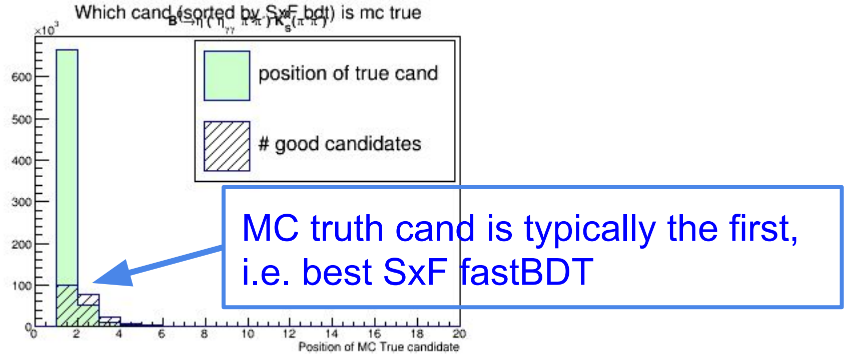
SxF FastBDT output

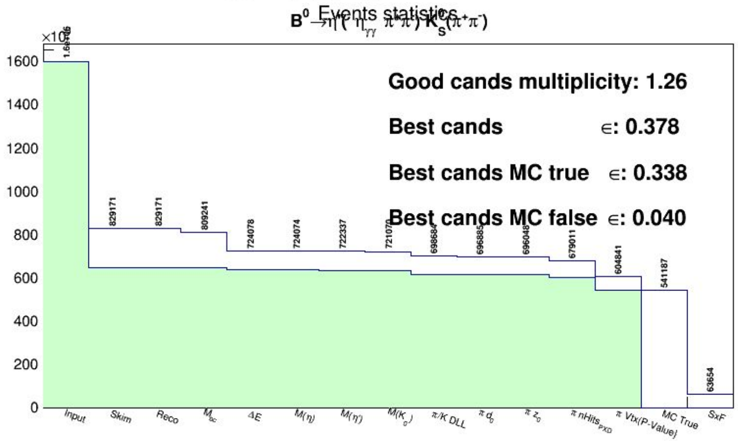


Selection	Efficiency	SxF
All candidates	37.0 %	9.3%
Best cand (SxF FBDT)	**33.8 %**	**4.0 %**

Need toys to understand which is better

Sorting Candidates by SxF FastBDT





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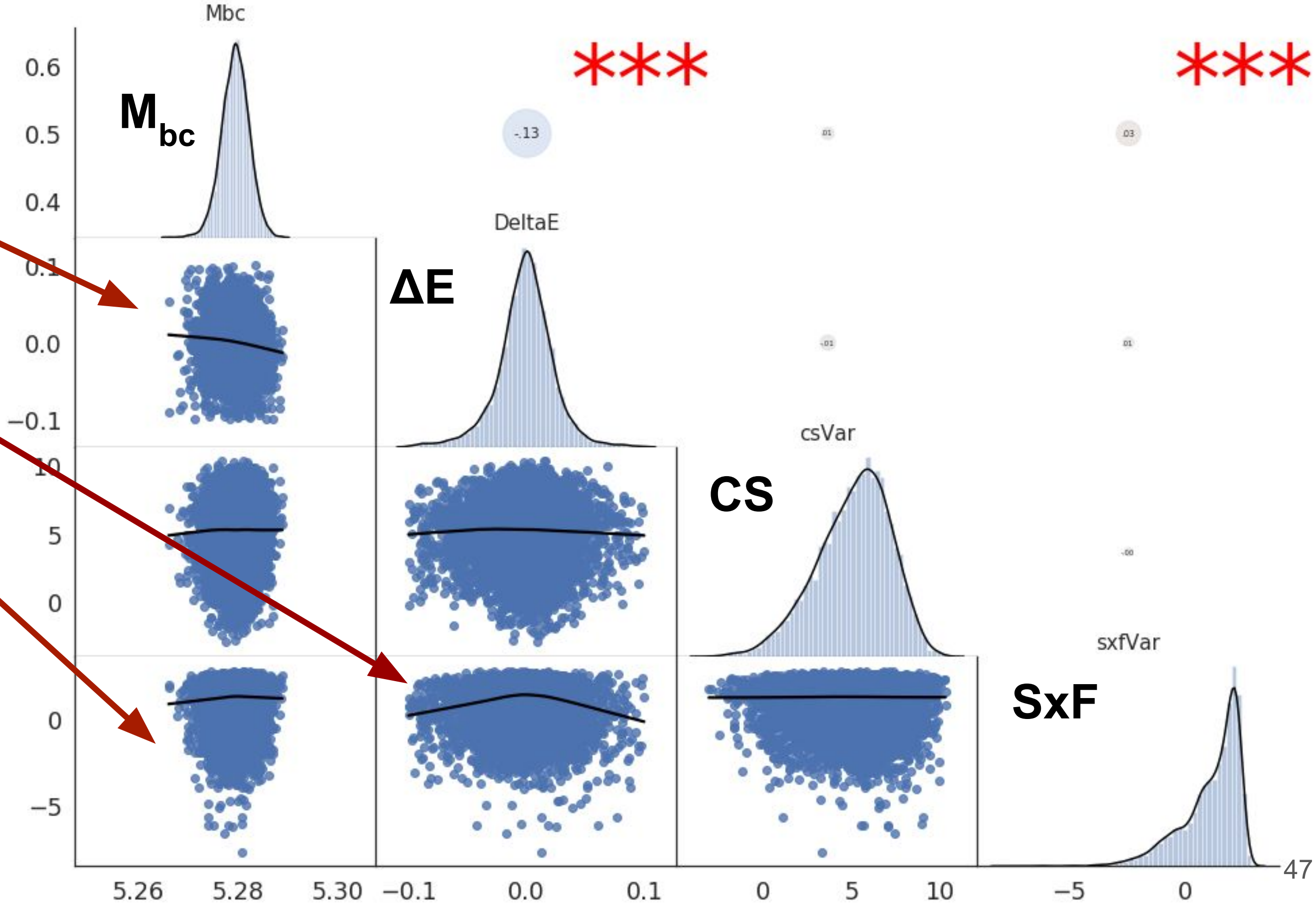
Correlation (for signal)

Correlation M_{bc} **vs** ΔE **0.13**: know issue

Cont suppression ok

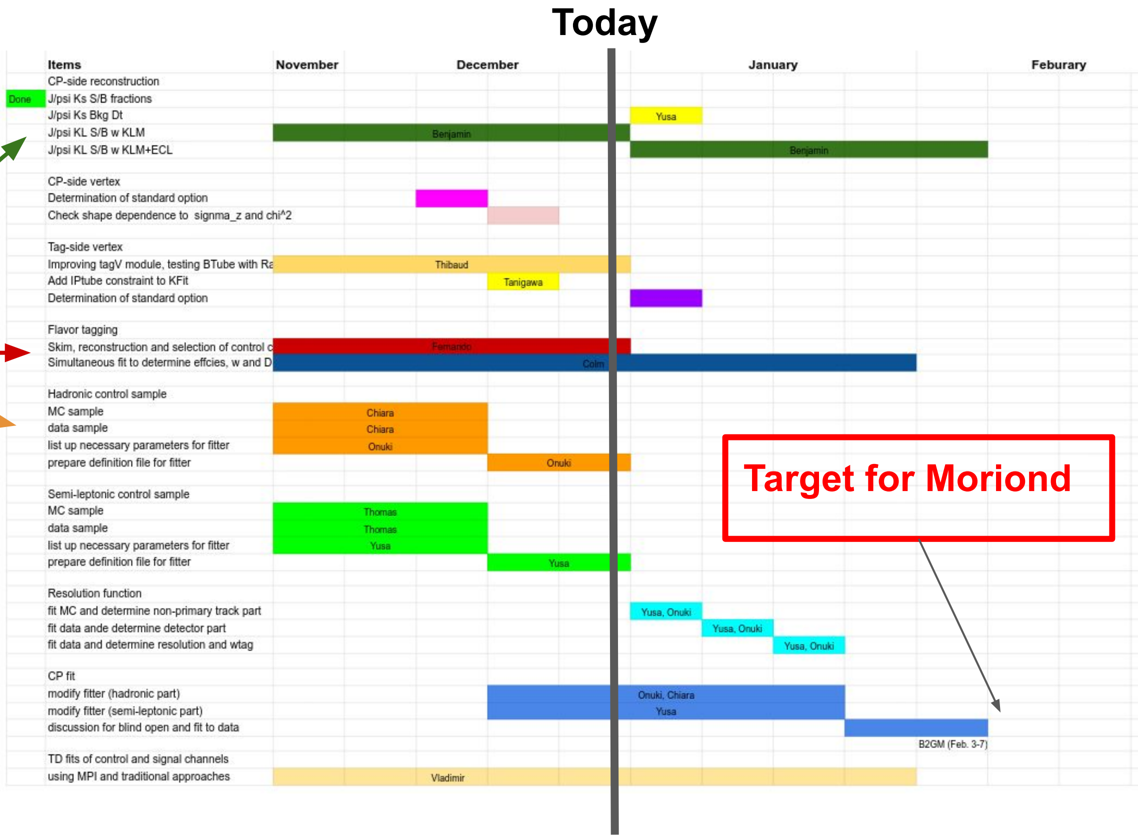
ΔE **vs SxF** symmetric correlation

M_{bc} **vs SxF** small **0.09**



Preparation and test of analysis tools

- Δt measurement, control samples, wrong tag fraction, Δt resolution
- A plan with work sharing is in place, involving many people and groups
- Italian contribution:
  - **Fernando**
    - FlavourTagger
  - **Benjamin**:
    - B^0 -> J/psi K_L
    - Hard for winter conf maybe?
  - **Chiara** (now J)
    - Had control sample



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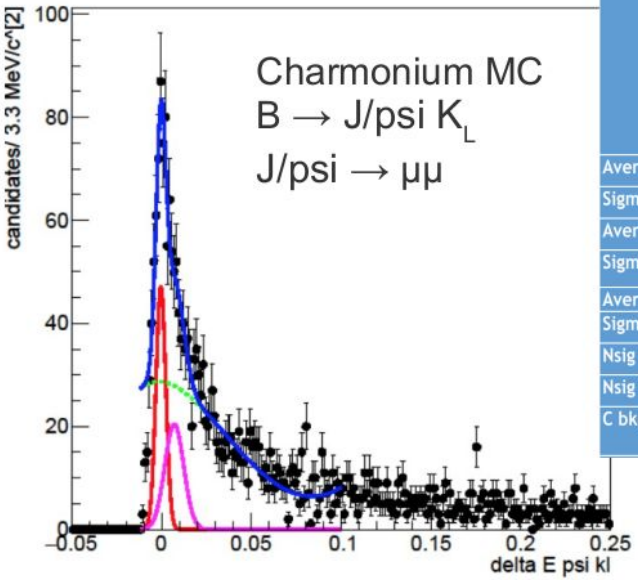
$B \to J/psi\ K_L$

- Since release-04 K_L (i.e. proc10) ID is working on both data and MC
- We reconstruct $B \to J/psi\ K_L$ decays using about 5 fb^{-1} of data
- We derive ΔE distributions from 100 fb^{-1} equivalent of $B \to c\bar{c}\ X$ MC

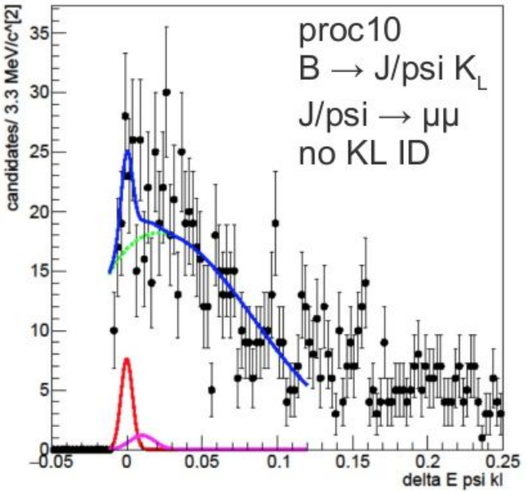


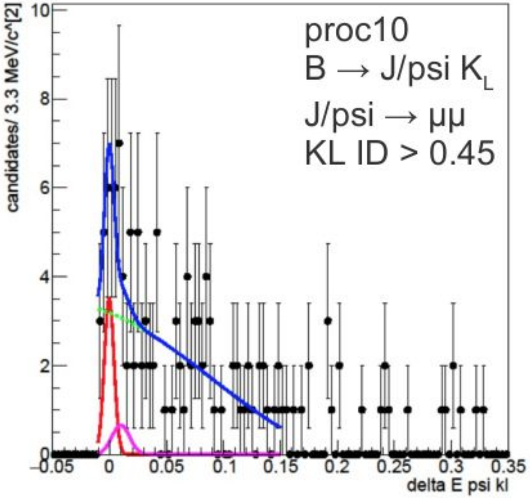
	Charm μμ New MC no cut on klid	Charm ee new MC No cut on klid	Charm right decay chain μμ	Charm right decay chain ee	Charm cut on Ψ mass and klong -id μμ	Charm cut on Ψ mass and klong -id ee
Aver 1	0.3±0.6	0.±.4	-			-
Sigma 1	2.63±.47	4.0±.4				
Aver 2	7±2.4	9.0±2.8				
Sigma 2	5.24±1.4	47±9.7				
Aver						
Sigma 3						
Nsig 1	445±64	419±50	267±45	309±23	317±41	267±25
Nsig 2	340±64	360±61	133±45	40±17	251±46	123.±25
C bkg	10566±430	10800±421	291±72	999±858	2799±246	9209±846

1

B → J/psi K_L (2)

- Using previously extracted shapes we fit proc10 data





For this analysis, estimated efficiency K-long identification (for K_L ID > 0.45) is:

0.70 +/- 0.05 +/- 0.1

	Charm μμ New MC no cut on klid	Charm ee new MC No cut on klid	Data μμ No cut on klid	Data ee No cut on klid	Data μμ cut on Klid	Data ee cut on Kl
Aver 1	0.3±0.6	0.±.4	-			-
Sigma 1	2.63±.47	4.0±.4				
Aver 2	7±2.4	9.0±2.8				
Sigma 2	5.24±1.4	47±9.7				
Aver						
Sigma 3						
Nsig 1	445±64	419±50	19.5±7	29±15	18.6±4.7	11.3±5
Nsig 2	340±64	360±61	12±4	17±8	11±4	7.±3
C bkg	10566±430	10800±421	234±107	999±160.	105±19	187±21