$B \to K\nu\bar{\nu}$

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$B \to K\nu\bar{\nu}$

$B^+ \to K^+\nu\bar{\nu}$ MC study

Assumption

- $50\ \mathrm{ab}^{-1}$.
- full reconstruction is perfect.
- full reconstruction efficiency is 0.2%.
- the detector performance is the same as present Belle detector.

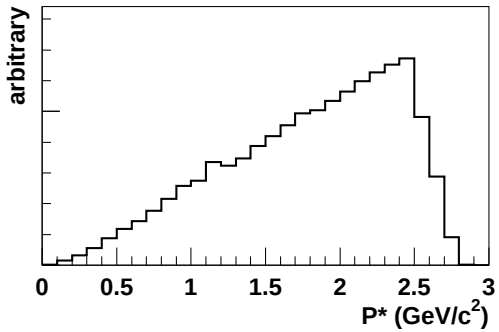
MC study

- Geant simulation.
- Only one charged track.
- Kaon identification to the track.
- Selection to E (ECL energy of unmatched clusters) and p^* (CM momenta of the only track)

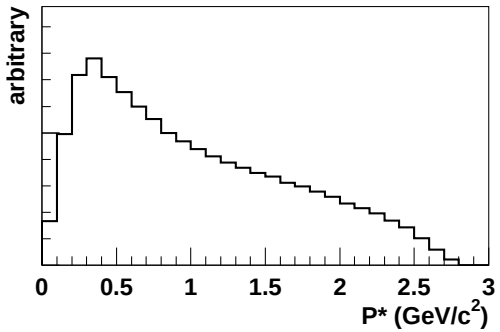
$B \to K\nu\bar{\nu}$

p^* distribution for signals and typical background.

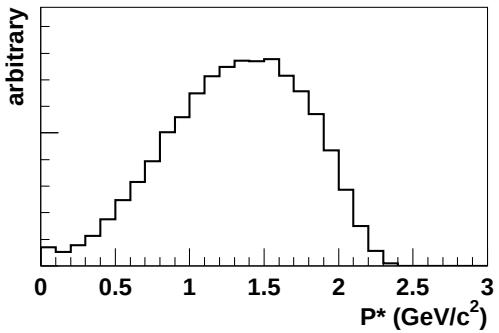
(a) $B^- \to K^-\nu\nu$



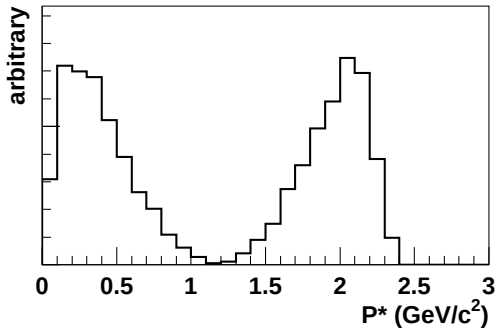
(b) $B^- \to \tau^-\nu$



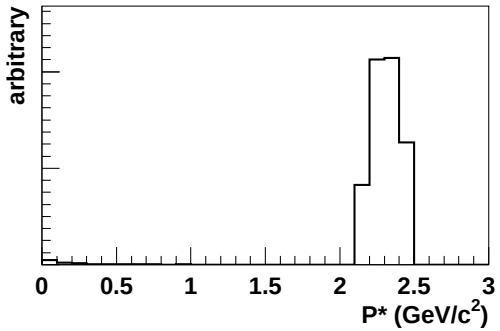
(c) $B^- \to D^0\ell^-\nu$



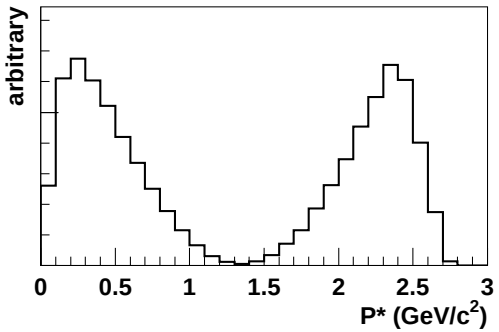
(d) $B^- \to D^0\rho^-$



(e) $B^- \to D^0\pi^-$



(f) $B^- \to \rho^+\pi^0$

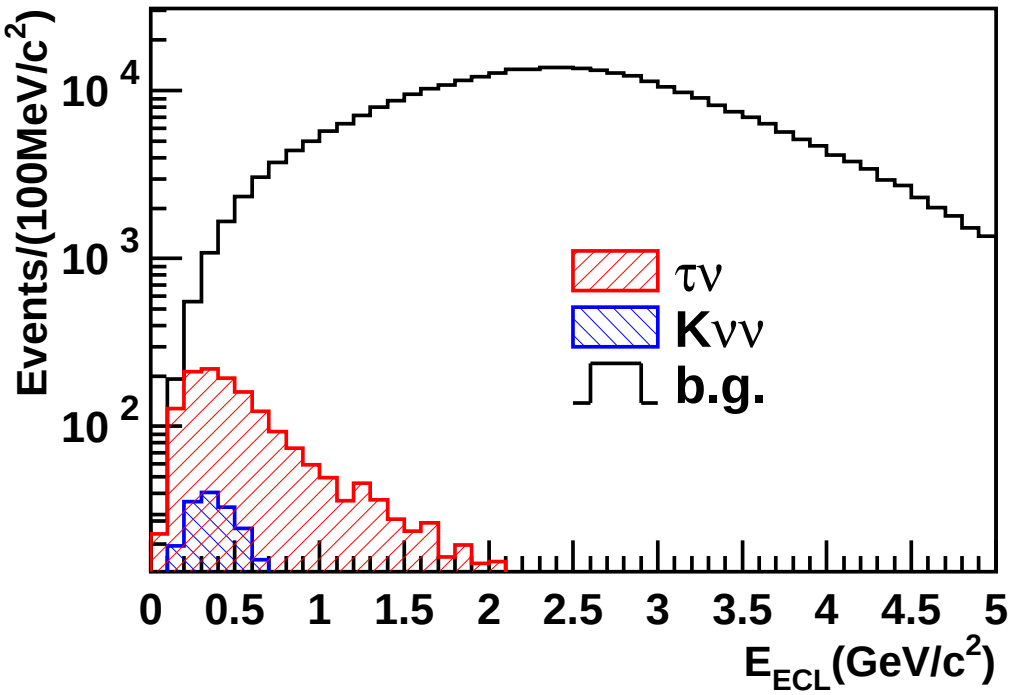


- Phase space is assumed for $B \to K\nu\bar{\nu}$.

$B \to K\nu\bar{\nu}$

If we apply similar selection criteria as present analysis....

- no PID
- $p^* > 0.7\ \mathrm{GeV}/c^2$

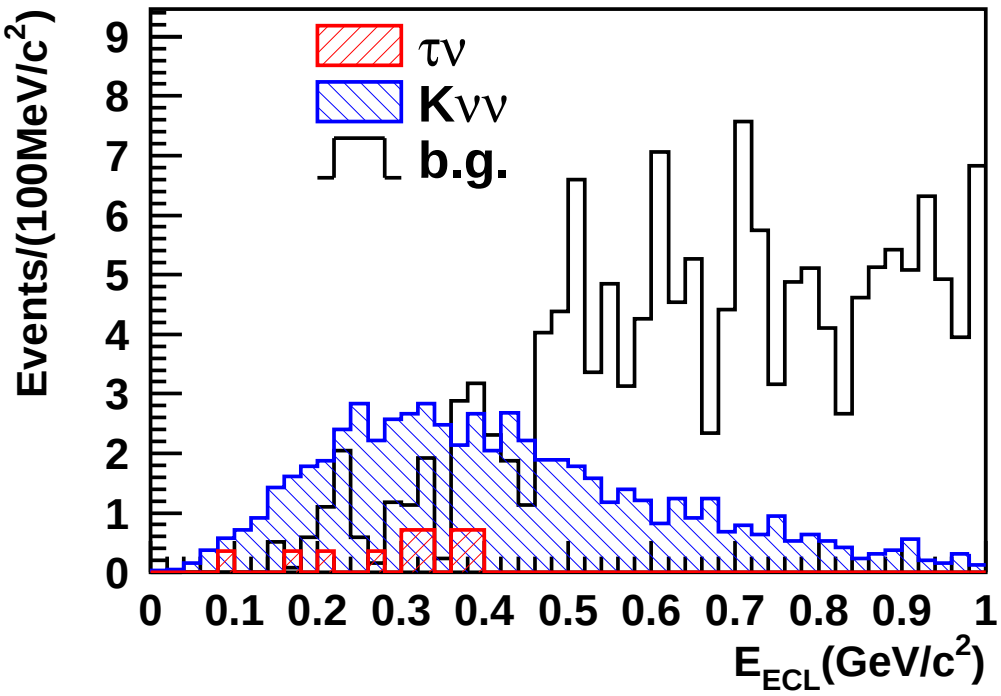


Obviously, we need tighter selection criteria.

$B \to K\nu\bar{\nu}$

Our optimized selection criteria:

- Tight KID
- $2.0\ \mathrm{GeV}/c^2 < p^* < 2.7\ \mathrm{GeV}$



$B \to K\nu\bar{\nu}$	43.0 ± 1.1
B decays $(b \to u)$	21.6 ± 3.3
rare B decays	7.8 ± 0.8
$B \to \tau\nu$	4.3 ± 1.2

significance 5.1σ

$B \to K\nu\bar{\nu}$

Background Breakdown

Mode	$E < 1.0$	$E < 1.0$ with KID	$E < 0.5$ with KID
$B^- \to D^{*0}\mu^-\bar{\nu}$	265.7 ± 11.7	8.2 ± 2.1	2.1 ± 1.0
$B^- \to D^0\pi^-$	199.0 ± 10.1	7.7 ± 2.0	3.1 ± 1.3
$B^- \to D^{*0}e^-\bar{\nu}$	181.1 ± 9.6	8.7 ± 2.1	2.1 ± 1.0
$B^- \to D^0\mu^-\bar{\nu}$	131.3 ± 8.2	25.1 ± 3.6	5.1 ± 1.6
$B^- \to D^{*0}\pi^-$	110.3 ± 7.5	3.6 ± 1.4	0.0 ± 0.0
$B^- \to D^0\rho^-$	95.9 ± 7.0	6.2 ± 1.8	1.0 ± 0.7
$B^- \to D^0e^-\bar{\nu}$	85.7 ± 6.6	19.5 ± 3.2	4.1 ± 1.5
$B^- \to D^{*0}\rho^-$	43.6 ± 4.7	3.6 ± 1.4	0.5 ± 0.5
$B^- \to D^0K^-$	13.3 ± 2.6	8.7 ± 2.1	2.1 ± 1.0
$B^- \to D^{*0}K^-$	5.6 ± 1.7	4.6 ± 1.5	0.5 ± 0.5
Other $b \to c$ decays	29.8 ± 3.9	3.1 ± 1.3	1.0 ± 0.7
$b \to c$ decays total	1161.4 ± 24.4	99.0 ± 7.1	21.5 ± 3.3

$B \to K\nu\bar{\nu}$

Mode	$E < 1.0$	$E < 1.0$ with KID	$E < 0.5$ with KID
$B^- \to K^{*-}\pi^-\pi^+$	28.0 ± 1.5	0.8 ± 0.2	0.2 ± 0.1
$B^- \to \pi^-\bar{K}^0$	22.8 ± 1.3	0.5 ± 0.2	0.0 ± 0.0
$B^- \to \rho^+\pi^0$	21.1 ± 1.3	0.4 ± 0.2	0.0 ± 0.0
$B^- \to K^- f_2'(1525)$	19.1 ± 1.2	12.5 ± 1.0	1.1 ± 0.3
$B^- \to K^-\pi^0$	18.5 ± 1.2	12.7 ± 1.0	3.3 ± 0.5
$B^- \to K^{*-}\rho^0$	13.6 ± 1.0	0.2 ± 0.1	0.1 ± 0.1
$B^- \to K^{*-} f_2(1270)$	10.9 ± 0.9	0.4 ± 0.2	0.0 ± 0.0
$B^- \to K^{*-} f_2'(1525)$	10.7 ± 0.9	8.2 ± 0.8	1.3 ± 0.3
$B^- \to \pi^-\pi^0$	9.3 ± 0.8	0.4 ± 0.2	0.2 ± 0.1
Other rare B decays	16.7 ± 1.1	3.2 ± 0.5	0.2 ± 0.1
Rare B decays total	215.6 ± 4.1	51.6 ± 2.0	7.8 ± 0.8
Total	1377.0 ± 24.7	150.6 ± 7.3	29.3 ± 3.4

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Future studies

- Full reconstruction.
  - Hadronic modes only / With semi-leptonic modes?
  - Background from full reconstruction.
  - ...
- Solid angle coverage / K_L reconstruction.
- $B^0 \to K_S\nu\bar{\nu}$, $B \to K^*\nu\bar{\nu}$
- ....