



Status of Vertexing/Tracking

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Max-Planck-Institut für Physik (Werner-Heisenberg-Institut) Recent tracking/vertex studies related to PXD performance

- Tracking/vertex reconstruction with different background
- Belle I MC in basf2

20th international DEPFET workshop May 14th 2016 - Kloster Seeon, Germany

Background studies

G. Casarosa

Study of the effect of the PXD data reduction Considered Backgrounds:

- No background
- Standard background + QED background in a small time window (-1000 ns to +800 ns)
- Standard background + QED background in a large time window (-10 μ s to 10 μ s)

Tracking Efficiency

➡ includes everything: geometrical acceptance, pattern recognition, fit

tests done	no background	background + QED in the small time window	background + QED in the large time window	te
PXDDataReduction <i>not included</i> in the simulation	85%	70%	×	PXDD nc in th
PXDDataReduction included in the simulation	84%	79%	74%	PXDE incl

➡ factors out geometrical acceptance; includes pattern recognition, fit

tests done	no background	background + QED in the small time window	background + QED in the large time window
PXDDataReduction <i>not included</i> in the simulation	94%	76%	×
PXDDataReduction included in the simulation	94%	88%	83%

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Efficiency vs p_{τ}

efficiency VS pt, normalized to MCParticles

----0.9 0.9 0.8 0.8 0.7 0.7 0.6 0.6 0.5 0.5 0.4 0.4 no ROI, no bkg no ROI, no bkg 0.3 0.3 no ROI, bkg 1 no ROI, bkg 1 0.2 0.2 ROI, bkg 1 ROI, bkg 1 0.1 0.1 + 3.5 p, (GeV/c) 8 0.9 1 p_, (GeV/c) 0 0.5 1.5 2.5 2 0.8 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7

➡ includes everything: geometrical acceptance, pattern recognition, fit

➡ bkg I = background + QED in the small time-window

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efficiency VS pt, normalized to MCParticles

Track quality: residuals



VXFTF efficiency



Tracks with at least one PXD hit

➡ includes everything: geometrical acceptance, pattern recognition, fit

tests done	no background	background + QED in the small time window (bkg1)	background + QED in the large time window (bkg2)
PXDDataReduction <i>not included</i> in the simulation	59%	25%	×
PXDDataReduction included in the simulation	54%	37%	30%

Integrated efficiency

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PXD data reduction and background

0.9 0.8 0.7 0.6 6 0.5 0.4 ROI, no bkg ROI, no bkg 0.3 ROI, bkg 1 ROI, bkg 1 0.2 ROI, bkg 2 ROI, bkg 2 0.1 3.5 p. (GeV/c) 8 0.9 1 p_. (GeV/c) 0.5 1.5 2.5 0 2 0.10 0.3 0.50.6 0.70.8

efficiency VS pt, normalized to MCParticles

ciency VS pt, normalized to MCParticles

➡ includes everything: geometrical acceptance, pattern recognition, fit

➡ bkg I = background + QED in the small time-window

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Efficiency vs VXD layer

PR efficiency VS VXD Layer, normalized to MCTrackCand



- ➡ factors out geometrical acceptance
- ➡ bkg I = background + QED in the small time-window

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Track quality: residuals



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Track quality: pulls



Time dependent measurements



Background studies V. Chekelian/L. Li Gioi

JPsiKS_Analysis: only tracks with PXD hits are considered

21.04.2016 1.) build-2016-04-20 2.) add_simulation(..., usePXDDataReduction=True)

	nev_GEN	SigV:nev eff resol	TagV:nev eff	resol
noBkg	490000	134427 27.4% 22.5	132307 27.0%	56.1
Bkg1	495000	75620 15.3% 22.8	74130 15.0%	59.1
Bkg2-QED	465000	47460 10.2% 23.3	35559 7.6%	68.3
Bkg3-QED-PXE	490000	35559 7.3% 27.8	33870 6.9%	77.4

for comparison results presented at 06.04.2016 using build-2016-04-01

	nev_GEN	SigV:nev eff	resol	TagV:nev	/ eff	resol
noBkg	490000	150557 30.7%	22.1	148363	30.3%	55.1
Bkg1	500000	82280 16.5%	22.8	80297	16.1%	61.2
Bkg2-QED	485000	26621 5.5%	24.1	25393	5.2%	77.1
Bkg3-QED-PXD	495000	0		0		

Small time window: -1000 ns to +800 ns Large time window: -10 μ s to 10 μ s

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Vertex resolution: reco side



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Vertex resolution: tag side



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Without PXD data reduction and hits

PsiKS_Analysis-noPXDsel,

Vertex Fit: including tracks without PXD hits Vtx Resolution study: including tracks without PXD hits

	nev_GEN	SigV:ne	v eff	shift	resol	TagV:ne	v eff	shift	resol
noBkg	490000	170946	34.9%	-0.1	27.0	169709	34.6%	2.5	58.2
Bkg1	500000	128861	25.85	0.4	36.7	132765	26.5%	-4.7	69.6
Bkg2-QED	485000	80067	16.5%	-19.7	244.5	118198	24.4%	-73.9	143.6
Bkg3-QED-PX	D 495000	81758	16.5%	27.9	800.0	119847	24.2%	-115.1	174.8

Vertex resolution: reco side



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Vertex resolution: tag side



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Converted Belle I MC

Very first look at the Belle I MC analysed using the BASF2 framework



Requesting at least one SVD hit per track

Bias = 0.17 μm

• Resolution = $43 \,\mu m$

Algorithm to be optimized for Belle I Weighting not optimal Very first estimation

- Bias ~ 18 μm
- Resolution ~ 87 μm

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Summary

- A lot of work ongoing in the tracking/vertexing
 - Today: selection of the part most related to PXD
 - Next talk on the impact of the PXD on the π^0 vertex reconstruction
- Tracking performs very well in case of no background
 - Very first look at the QED background
 - Optimization/fine tuning is needed (and planned) in order to increase efficiency
- The Belle II Pixel Vertex Detector (PXD) is crucial for the Belle II physics program
 - Tracks with PXD hits have a largely better impact parameter and vertex resolution
- Belle I converted MC shows the importance of the PXD in vertex resolution

Backup slides

ROI and TagV

