

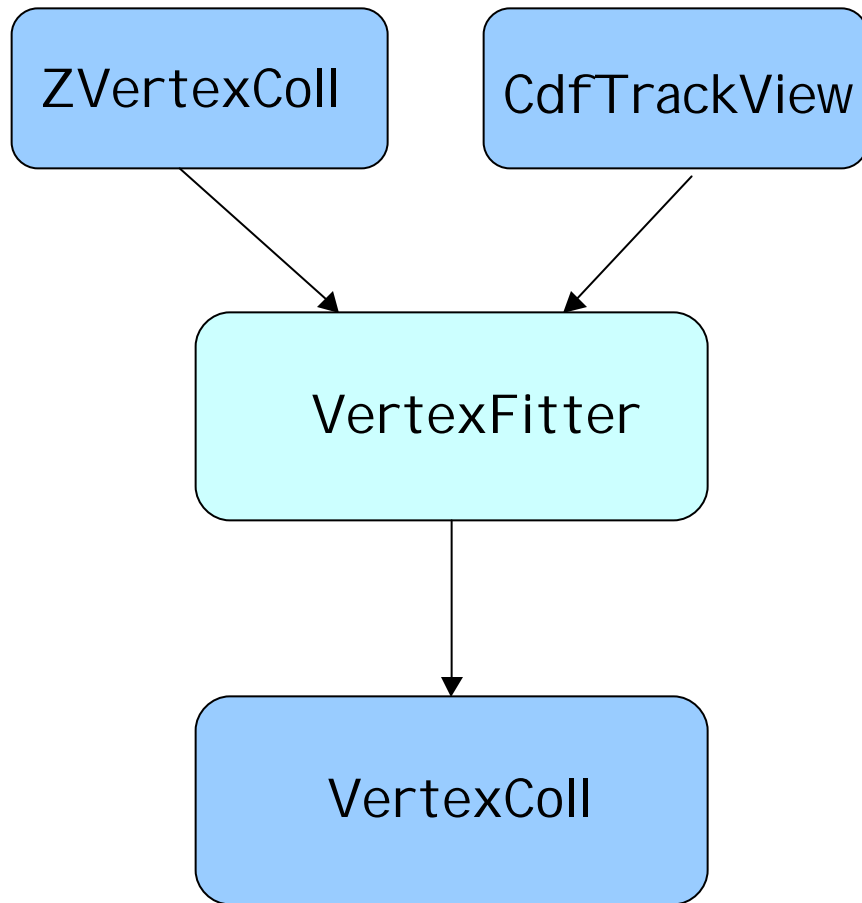
# Primary Vertex finding

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# Introduction

- EBE vertexing yields better resolution WRT beamline based primary vertex
  - How much better?
  - Bias?
- Start from the tools of the high Pt group
  - Reuse as much code as possible
  - Tune to our environment!

# The high Pt incarnation



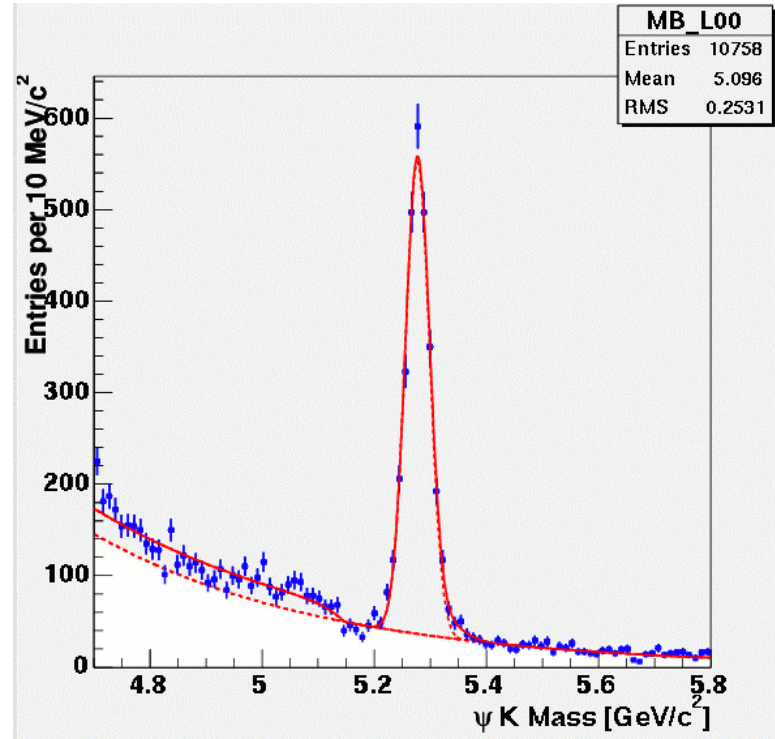
1. Take  $z_0$  and beamline
2. Include all tracks from view which are  $\pm 3\sigma$  in  $d_0$  and  $z_0$
3. Run CTVMFT constraining to a single vertex
4. If tracks with  $\chi^2 > 10$ 
  - Prune them
  - Goto 3
  - Write out Vertex

- Migrated to 5.3
- L00-aware
- Concentrate on wrapping and studying performance testing!

Basic tracking cuts like COT hits, Pt etc are harder than desired for low Pt purposes. This is just the default of PrimeVtx module. These parameters can be changed easily.

# Sample and Selection

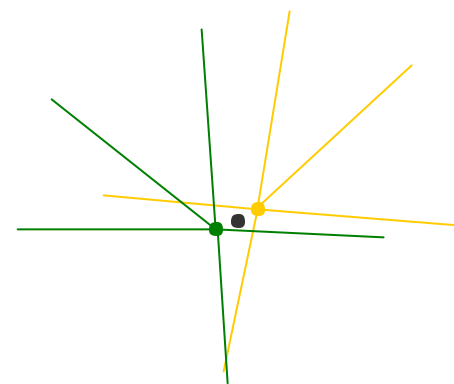
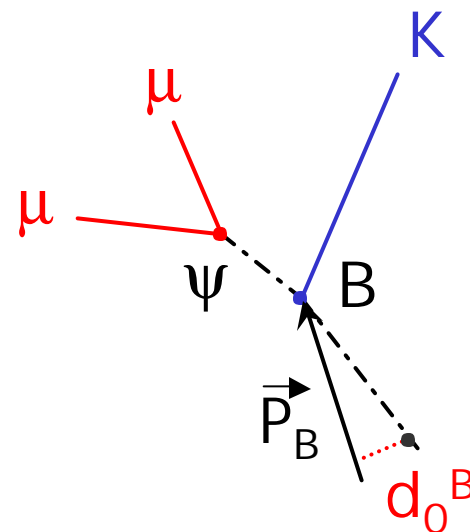
- Fully reconstructed  $B \rightarrow \psi K$
- Xpmm0d (5.3.1 production)
- CharmMods machinery
- $L_{xy} > 500 \mu\text{m}$
- Background subtraction based on upper sideband only
- ~2400 events!



This defines the sample, but what variables can we use to measure what we want?

# Resolutions

- Ultimate goal is Lxy resolution on Bs
- Break it down:
  - PVertex vs BVertex resolution
  - Beamline vs EBVertex based
  - EBVertex track sources:
    - Standalone Si
    - L00 hits
      - » Pt, Si hits etc. requirements
- What do you look at?
  - Lxy on background???
  - (like on lifetimes)
  - B meson  $d_0$
  - PV against PV

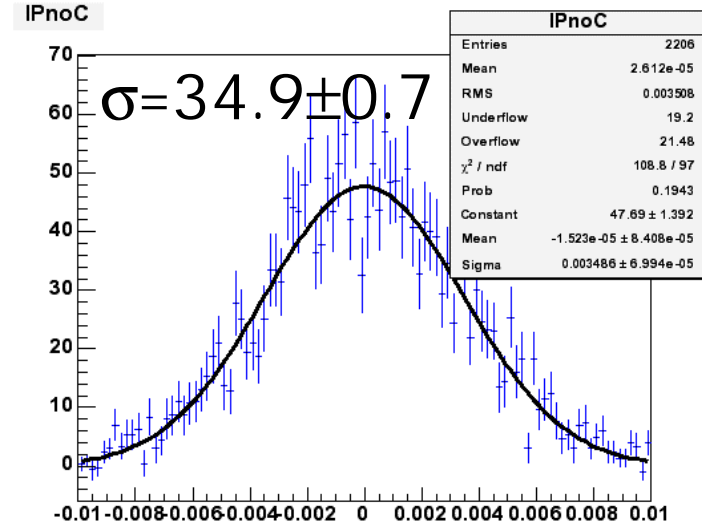
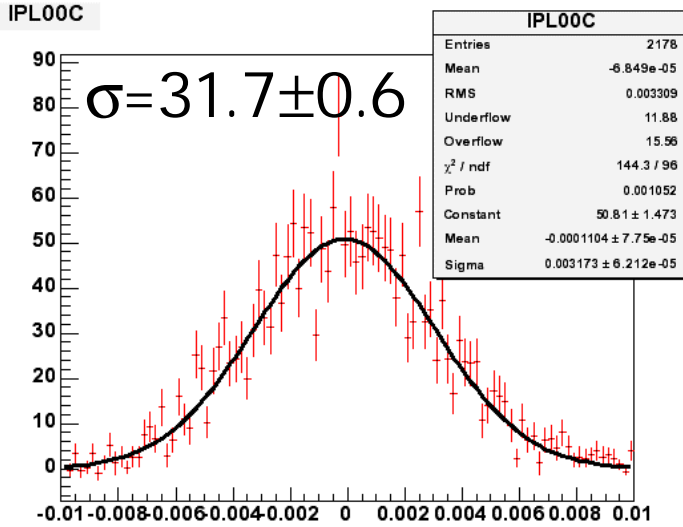


# B Impact Parameter

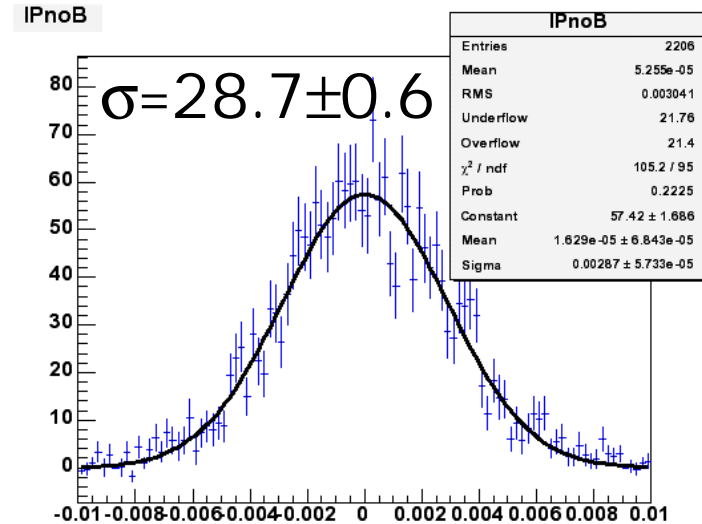
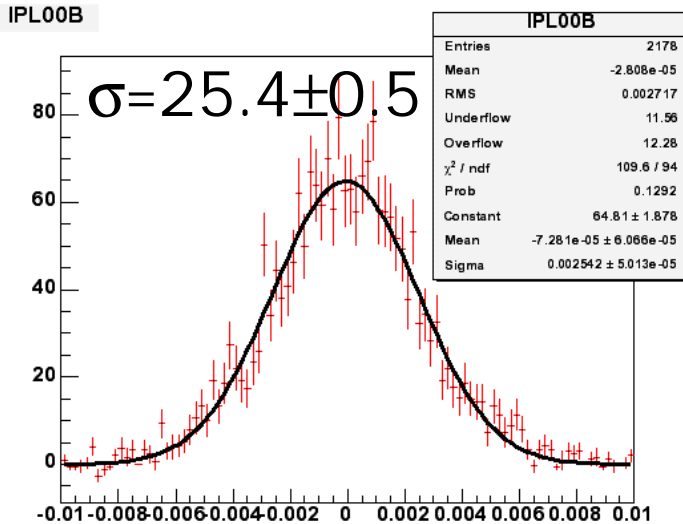
With L00

Without L00

Beamline Based



EBEVtx Based



# What do we learn?

L00	EBEVtx	$\sigma$
N	N	$34.9 \pm 0.7$
N	Y	$28.7 \pm 0.6$
Y	N	$31.7 \pm 0.6$
Y	Y	$25.4 \pm 0.5$

~10%

~13%

~22%

~25%

- ~30% improvement in resolution from “standard” to L00+EBEVtx (10-13% from L00 & 20-25% from EB EVtx)
- This should map 1:1 on  $L_{xy}$  resolution (?)

With L00

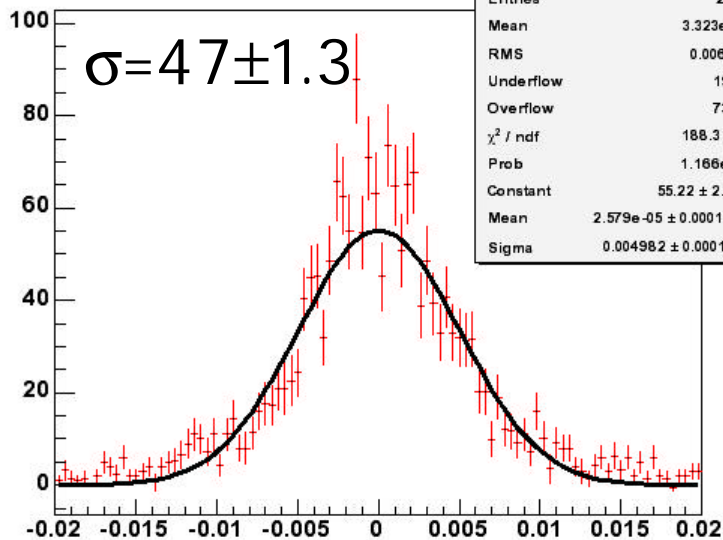
$(\frac{1}{2})$

$\Delta Z$

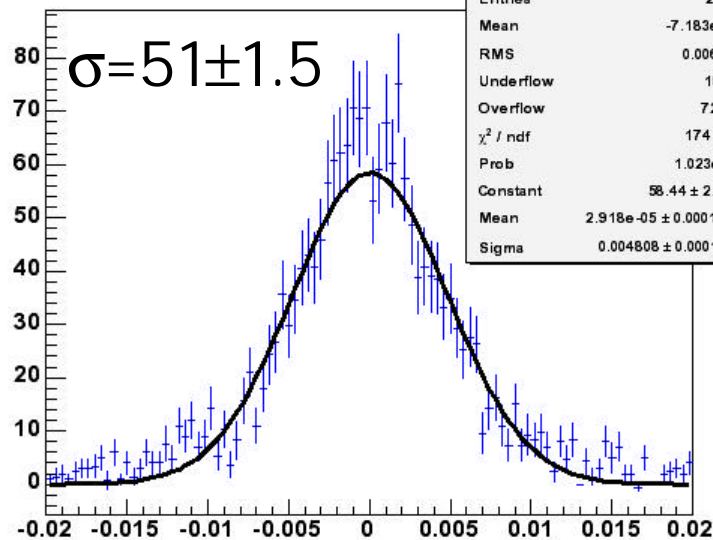
Without L00

Beamline Constrained

Z1minusZ2\_std

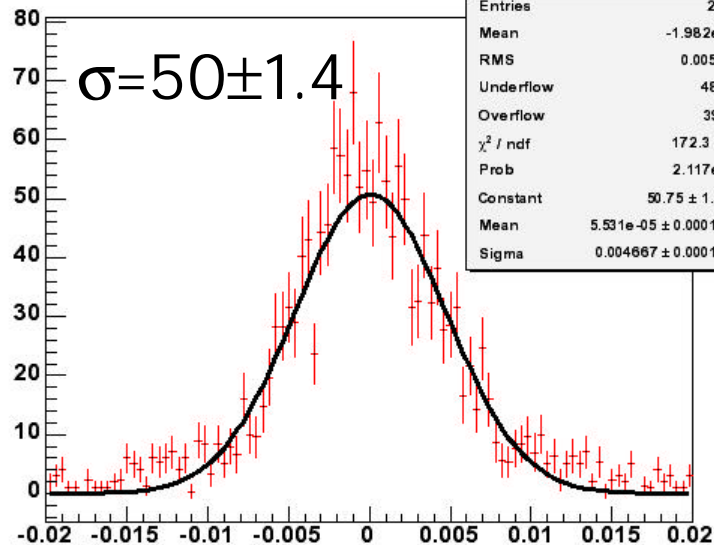


Z1minusZ2\_NOL00

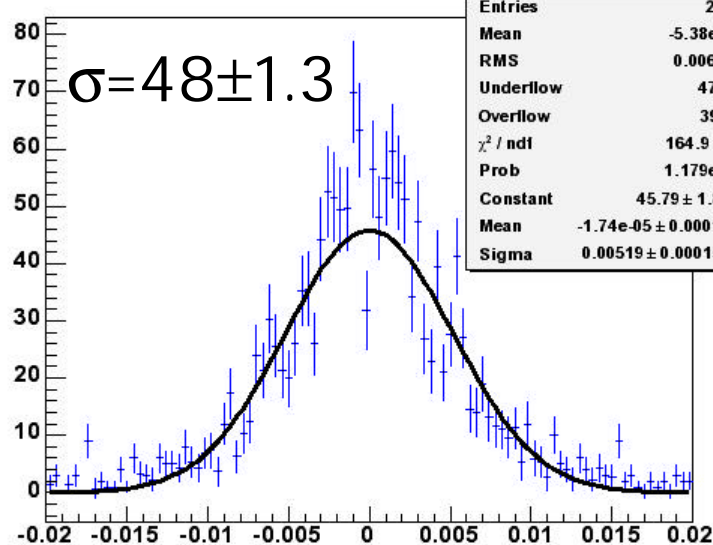


EBEVtx Based

Z1minusZ2\_nbcstd



Z1minusZ2\_nbcNOL00





# What do we learn?

L00	BeamCon.	$\sigma$
N	N	$51 \pm 1.5$
N	Y	$48 \pm 1.3$
Y	N	$47 \pm 1.3$
Y	Y	$50 \pm 1.4$

- ~50 $\mu\text{m}$  resolution on Z !!!
- L00 and BC have no sig. effect (pew)

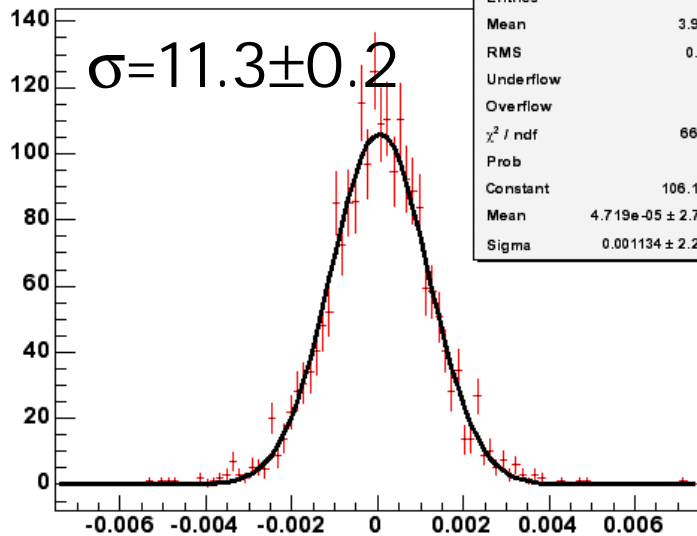
$(\frac{1}{2}) \Delta x?$

With L00

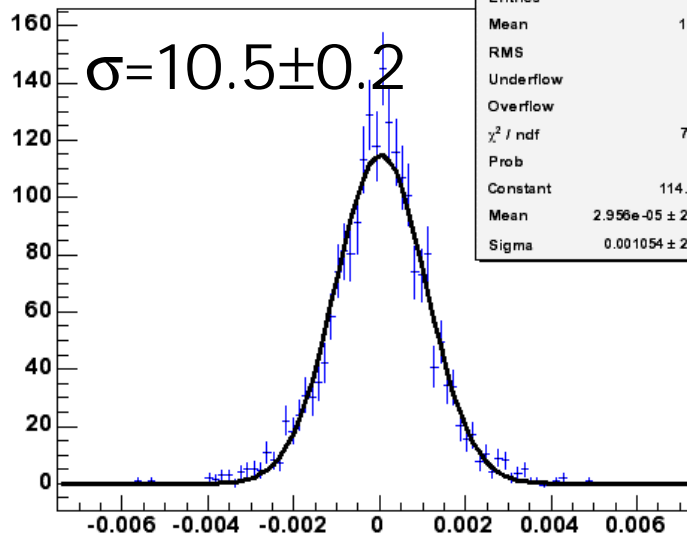
Without L00

Beamline Constrained

X1minusX2\_std

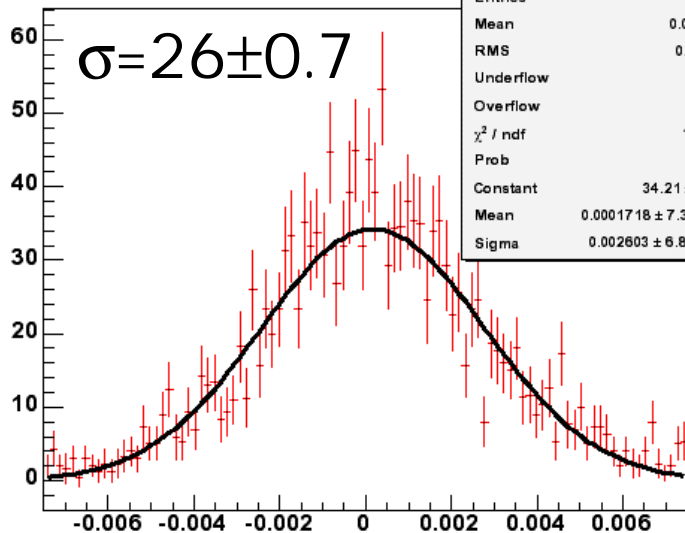


X1minusX2\_NOL00

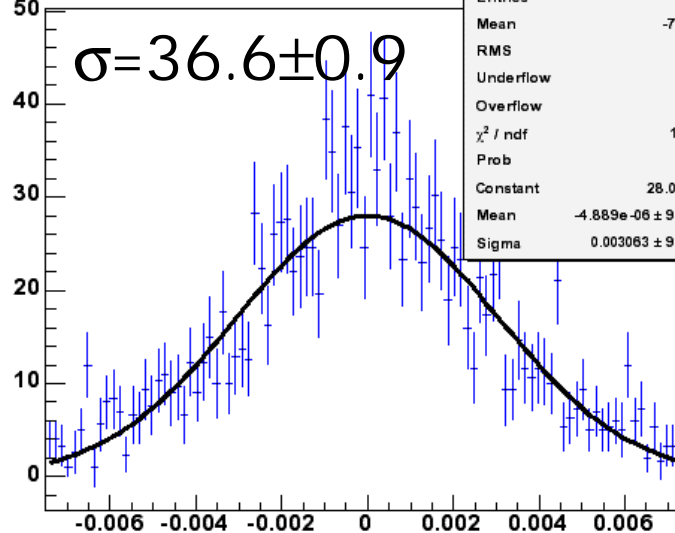


EBEVtx Based

X1minusX2\_nbcstd



X1minusX2\_nbcNOL00

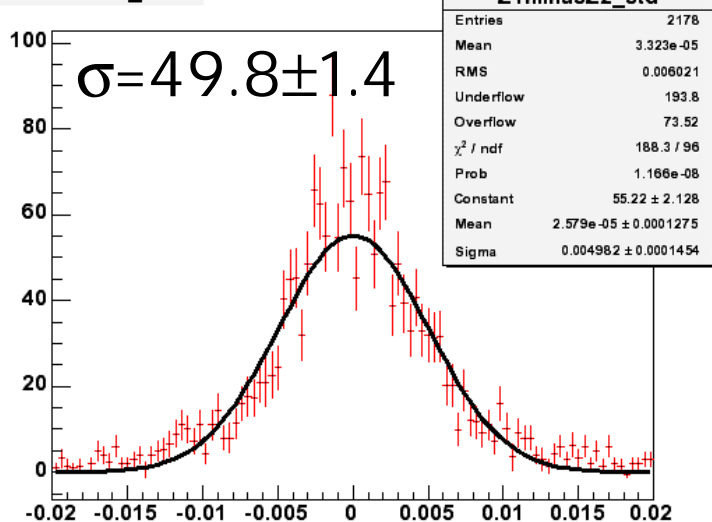


# Standalone Silicon?

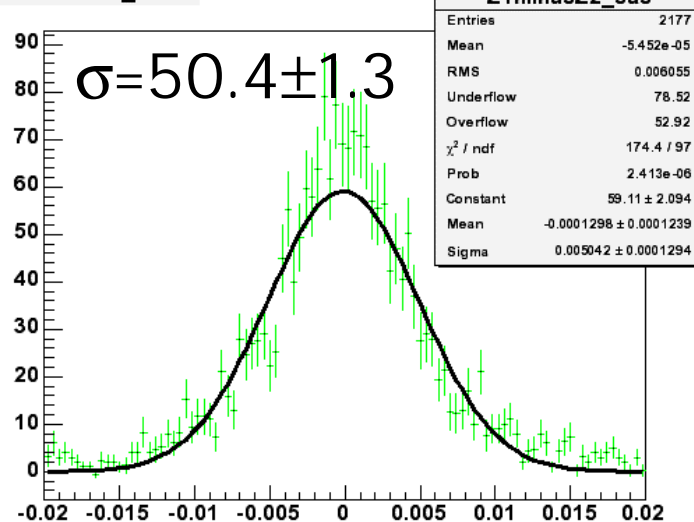
"Standard"

+Standalone

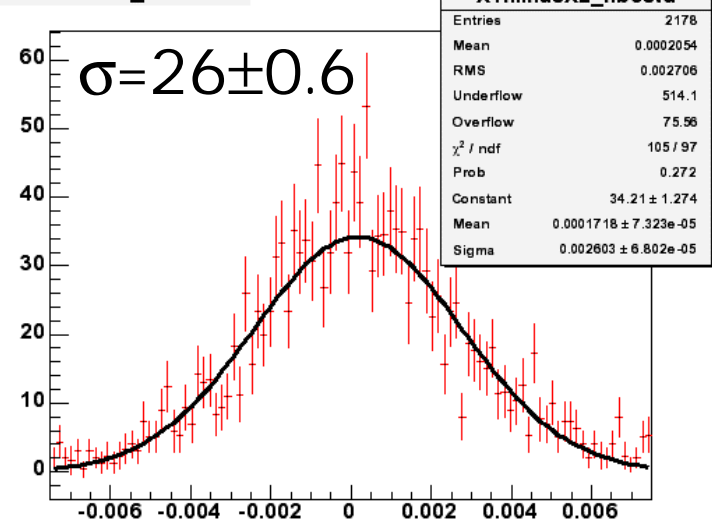
Z1minusZ2\_std



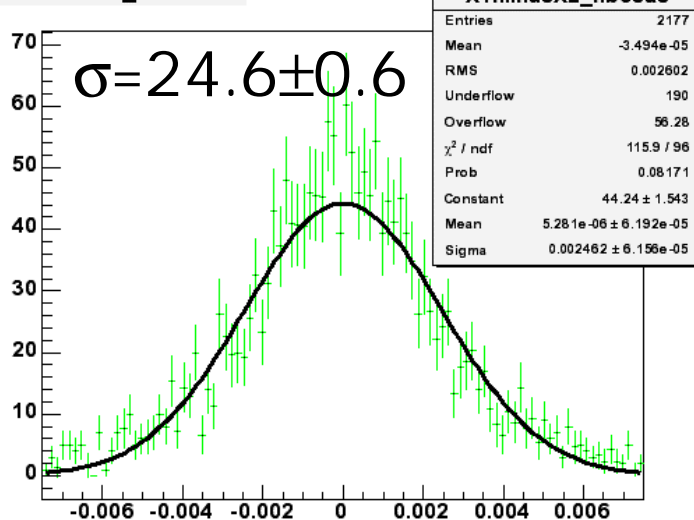
Z1minusZ2\_sas



X1minusX2\_nbcstd



X1minusX2\_nbcsas

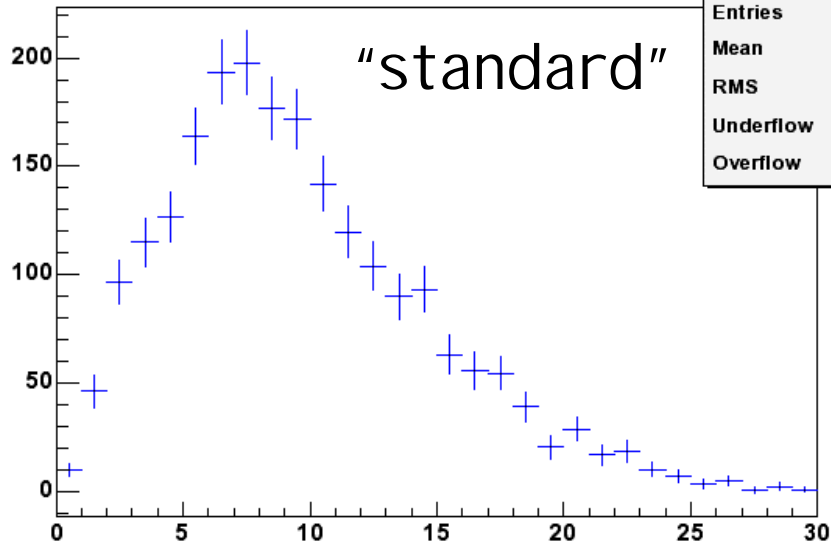


$(\frac{1}{2}) \Delta Z$

$(\frac{1}{2}) \Delta X$

# Are we really adding tracks?

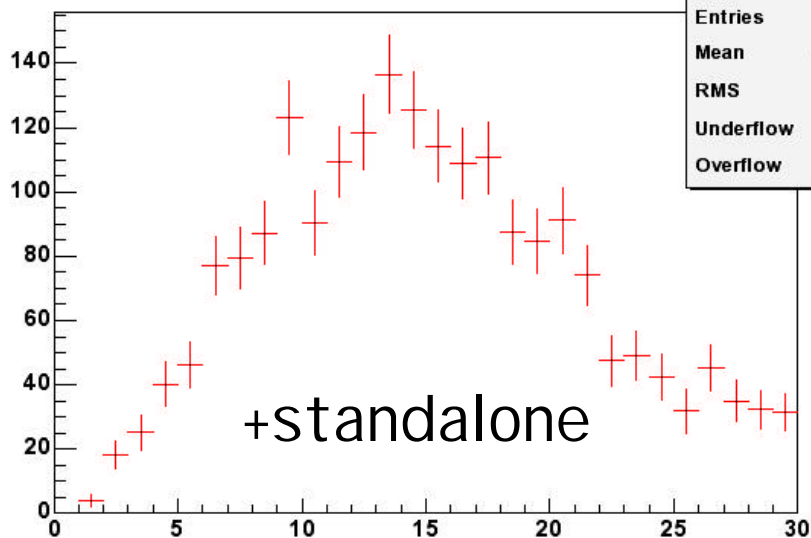
Tracks Used in PrimeVtx



## Adding standalone Si:

- On average see +5 tracks/event
- Same resolutions!
- Tracks are probably forward/low Pt
- Not really useful for our purpose!

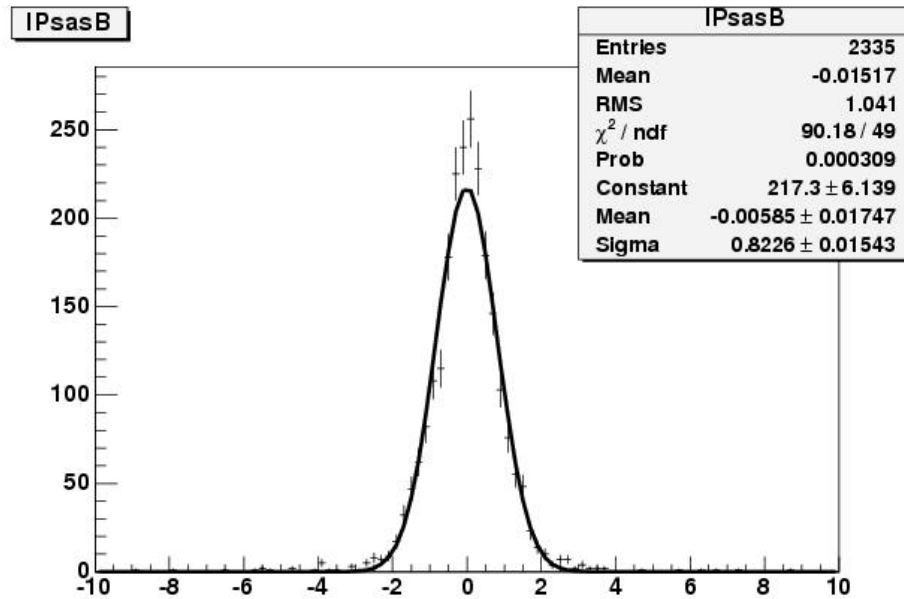
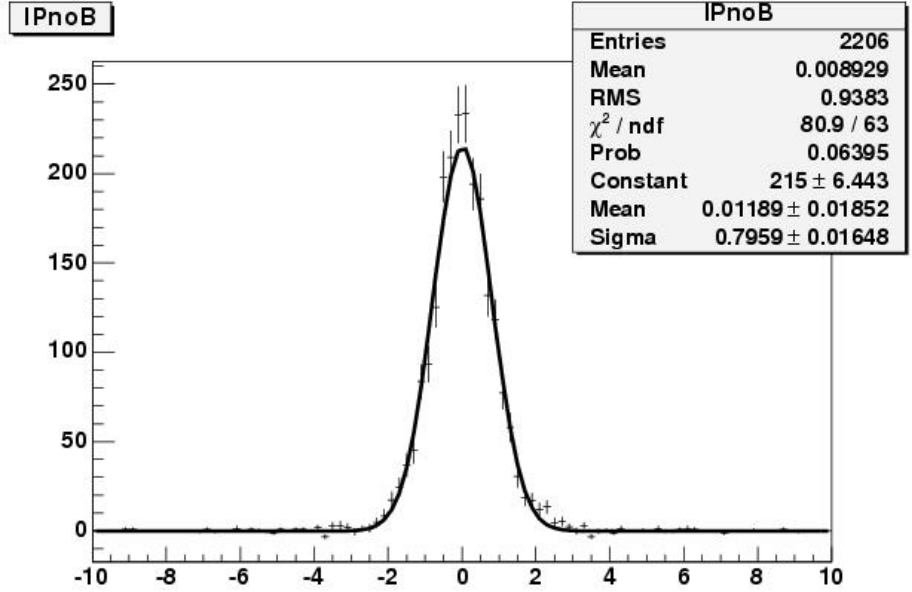
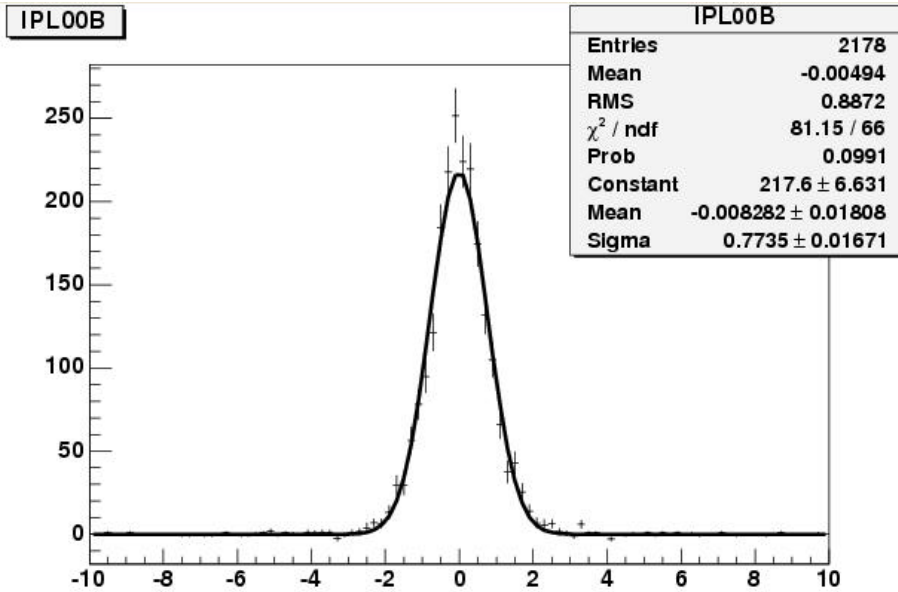
Tracks Used in PrimeVtx



# Use the B “track” as a seed?

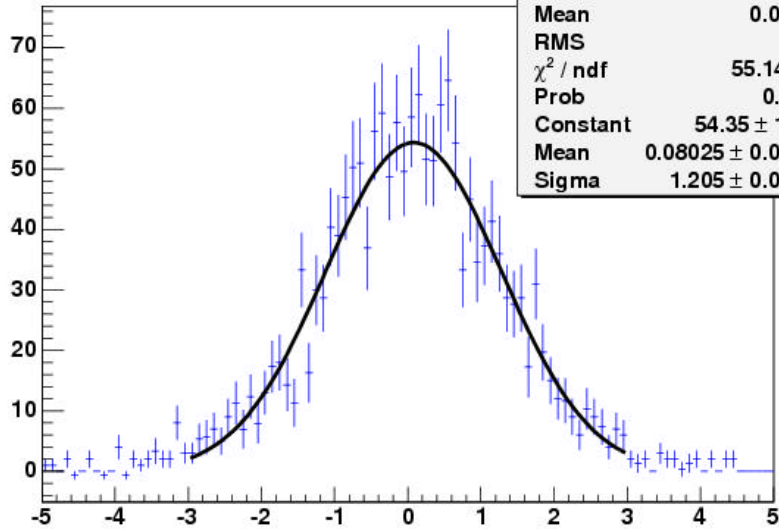
- Requires some coding
- Is in principle equivalent to constraining the B to point to the PV
- We prefer this second approach, since it will make dealing with EBEVtx identical for partially and fully reco'd B analyses
- Study in progress to see how the Lxy resolution improves

# Pulls I



# Pulls I I

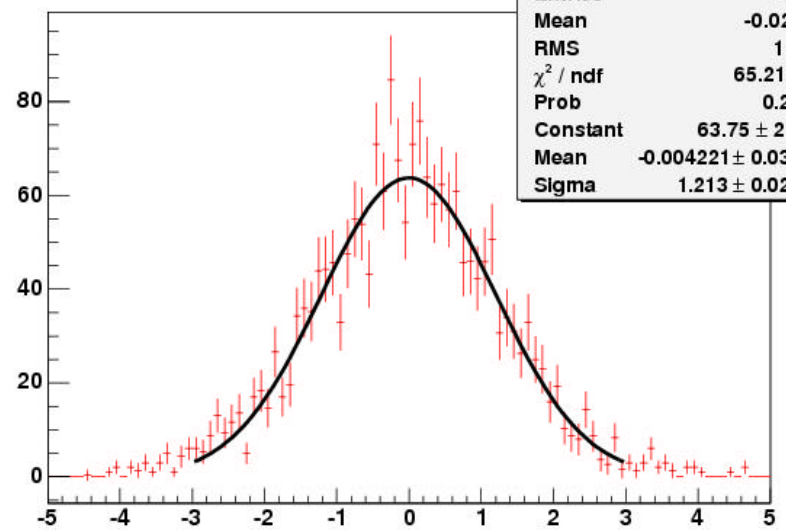
XPull\_noBeamC



X1minusX2\_std

Entries	2178
Mean	0.04794
RMS	1.32
$\chi^2 / \text{ndf}$	55.14 / 57
Prob	0.5453
Constant	$54.35 \pm 1.884$
Mean	$0.08025 \pm 0.03333$
Sigma	$1.205 \pm 0.02992$

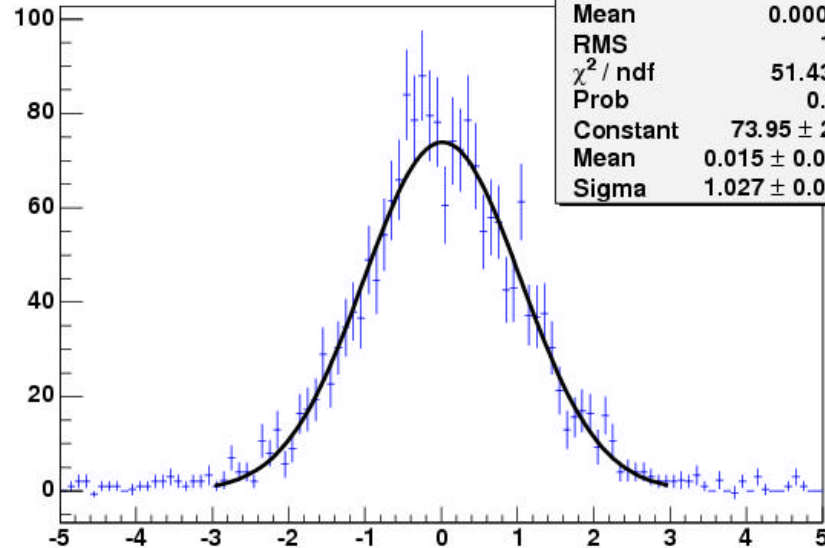
XPull\_noBeamC



X1minusX2\_sas

Entries	2177
Mean	-0.02753
RMS	1.307
$\chi^2 / \text{ndf}$	65.21 / 57
Prob	0.2128
Constant	$63.75 \pm 2.005$
Mean	$-0.004221 \pm 0.03095$
Sigma	$1.213 \pm 0.02708$

ZPull



Z1minusZ2\_std

Entries	2178
Mean	0.0002501
RMS	1.185
$\chi^2 / \text{ndf}$	51.43 / 57
Prob	0.6832
Constant	$73.95 \pm 2.284$
Mean	$0.015 \pm 0.02535$
Sigma	$1.027 \pm 0.02034$

# To Do's

- Still fighting for pulls, once we are confident on errors it will make sense to look at  $\sigma_{Lxy}$
- MC with 5.3.3 on its way (already shown results on 5.3.1)
- Input to pvtx has been loosened but NOT tuned (could gain some more, not much probably)
- CDF note in preparation



# What's available

- DCalcPrimVertexModule is part of CharmMods in the repository
- Uses the standard B group recipe (TrackSelector...) to define input class of tracks
- Automatically takes care of candidate's daughters exclusion
- Example of usage soon in repository
- CDF note will document it

# Conclusions

- PrimeVtx is effective:
  - Vertex resolution improves by ~30%
  - L00 contributes with ~1/3 of that
  - Z resolution looks not bad either: ~50 $\mu$ m
- Code is in the repository available to everybody to play with
- We hope to finalize our studies very soon!
- Start having fun!