EbE Vertexing for Mixing

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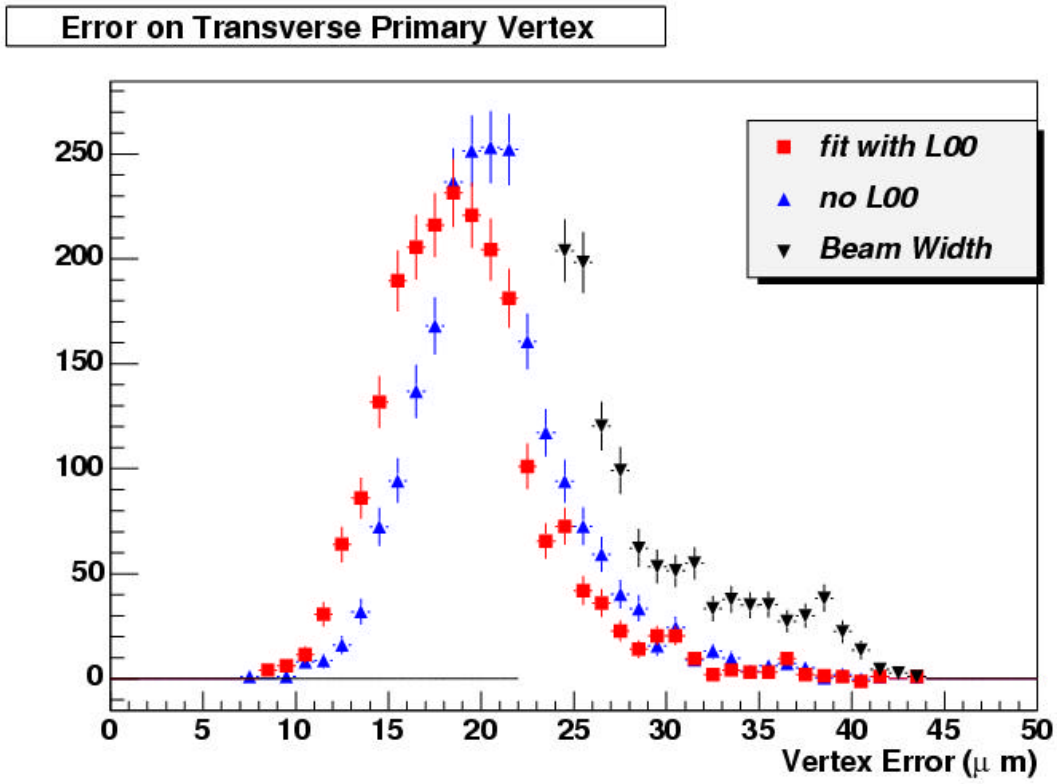
Outline

- Current status
  - What was used for the mixing results
  - What is the current understanding of Ebe
- Plans for improvements
  - How can we improve?
  - How much will this affect our reach:
    - Resolution
    - Better understanding (systematics)

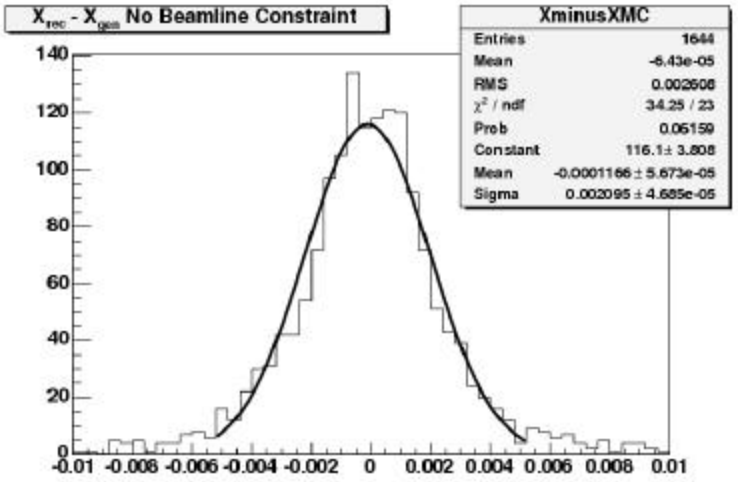
Current status

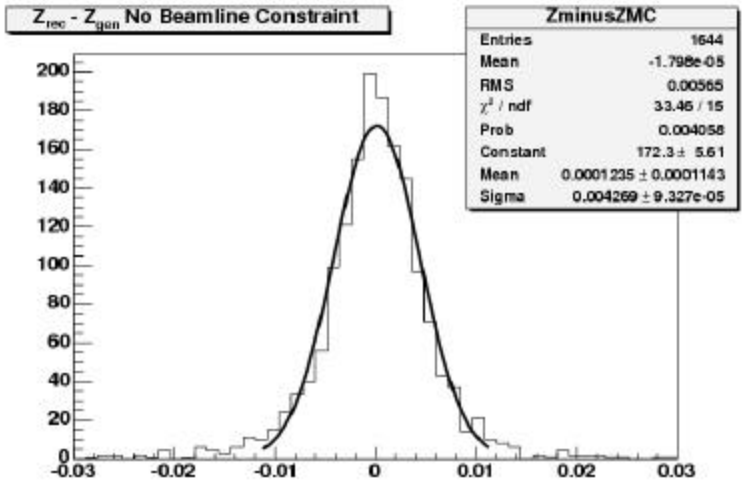
- Public analyses use a flat ~40um beamline!
  - Move to “hourglass”
  - Move to EbE



What do we know about EbE?

- Unbiased estimator of PVTX





- Reasonable (~5%) control of systematics

Mode	x scale	y scale	z scale
$B^{\pm} \to \psi K^{\pm}$	1.327 ± 0.035	1.399 ± 0.035	1.375 ± 0.029
$B^{\pm} \to D^0\pi^{\pm}$	1.408 ± 0.030	1.398 ± 0.031	1.367 ± 0.29
$B^0 \to D^{\pm}\pi^{\mp}$	1.426 ± 0.034	1.336 ± 0.029	1.288 ± 0.027

	Transverse	**Z**
Data (V_1-V_2)	1.33±0.035	1.37±0.035
MC (V_1-V_2)	1.192±0.034	1.26±0.035
MC (V-truth)	1.24±0.036	1.23±0.032
J/ψ Prompt Peak	1.236±0.024	NA
J/ψ d_0/s	1.176±0.019	NA

What do we not know about EbE?

Pull on Impact Parameter

Mode	Beamline $\sigma = 25\mu$	Beamline z dependent σ	Event-by-Event w/beam constraint	Event-by-Event w/o beam constraint
$B^{\pm} \to D^0\pi^{\pm}$	1.297 ± 0.025	1.178 ± 0.039	1.202 ± 0.021	1.050 ± 0.025
$B^0 \to D^{\pm}\pi^{\mp}$	1.256 ± 0.026	1.118 ± 0.027	1.163 ± 0.020	1.046 ± 0.027

- L_{xy} involves three ingredients:
  - EbE
  - Secondary vertex
  - Beamline (in beamline constrained fits)

…hence the plans for improvements!

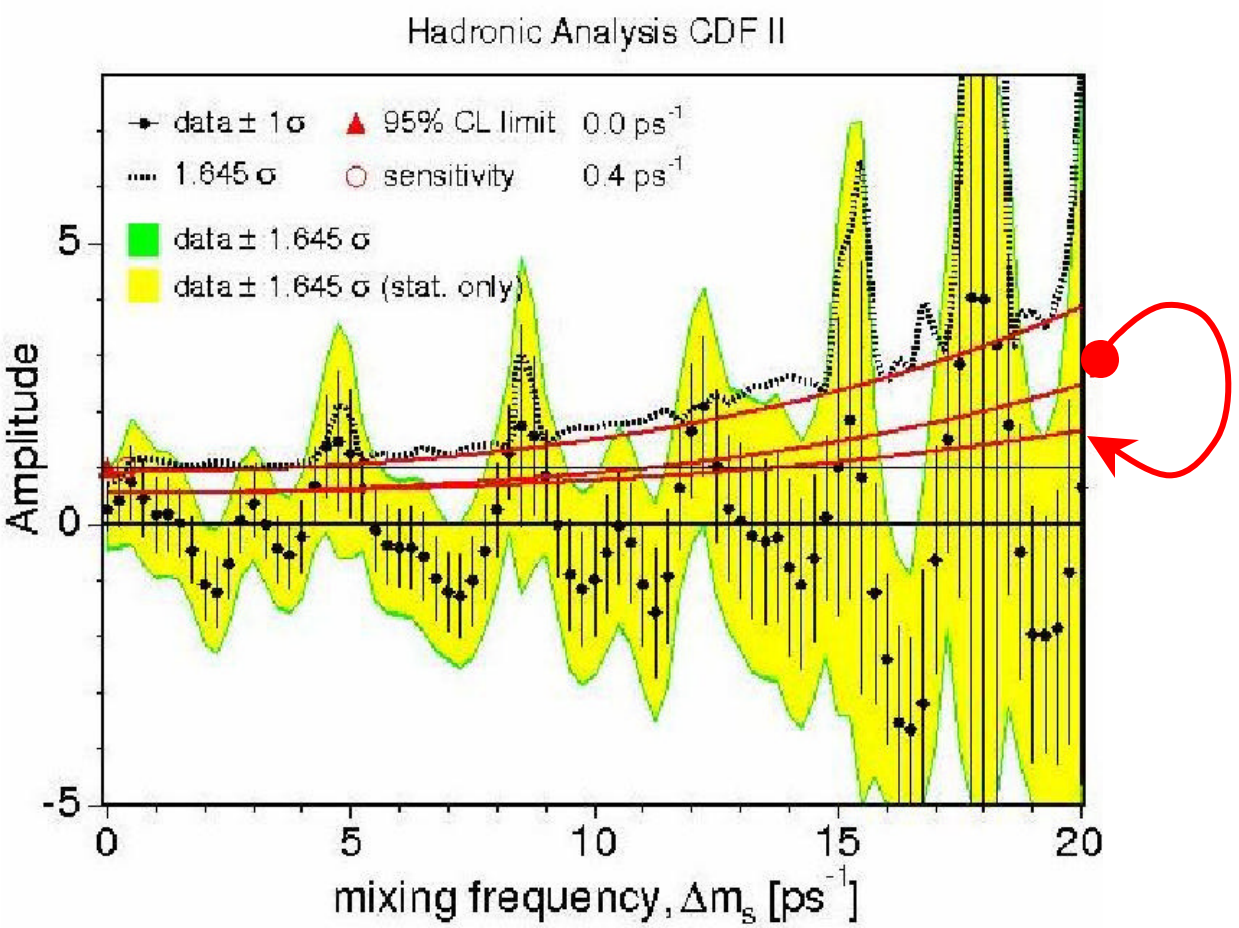
A Prioritized List:

1. Is the EbE code doing the right thing?
2. Understand beamline parameterization:
   I. Is it used correctly
   II. Is it measured correctly
3. Are secondary vertex pulls ok?
   I. Check with montecarlo truth
   II. If suspect still persists use n-prong vertices ($J/\psi K$, $K\pi\pi^{+/0}$, $K\pi\pi\pi^{+/0}$)
4. Do we understand the 1.38 scale factor?
5. (connected to 4.) investigate dependancies (Pt?, z?, multiplicity, η?)

What do we gain?

Euphemism

1. 15-20% In vertex resolution!
2. Better control of systematics (hard to evaluate)
3. Correct EbE resolution (it is not clear that it is correct now)



- Red arrow is the effect of 1. Only
- Point 2. Affects mostly the green area (tiny ?)
- Point 3. Has an effect qualitatively similar to 1., but hard to evaluate

Hadronic analysis systematics

source	selected Δm_s scan points				
	0.0	5.0	10.0	15.0	20.0
$B_s \to D_s K$ level	0.019	0.024	0.030	0.037	0.047
dilution scale factors	0.143	0.168	0.205	0.254	0.314
dilution templates	0.119	0.147	0.178	0.211	0.246
fraction of Λ_b	0.014	0.009	0.009	0.011	0.012
Punzi term for σ_{ct}	0.009	0.008	0.022	0.033	0.030
dilution of $B \to DX$	0.025	0.001	0.000	0.000	0.001
σ_{ct} scale factor	0.000	0.024	0.061	0.090	0.144
usage of L00 in bias curve	0.001	0.001	0.001	0.001	0.001
Bs lifetime uncertainty	0.001	0.001	0.001	0.001	0.001
reweighted p_t spectrum	0.001	0.001	0.001	0.001	0.001
non-Gaussian tails in ct resol.	0.001	0.027	0.052	0.078	0.104
neglect B^0 in fit	0.039	0.036	0.033	0.031	0.028
effect of $\Delta\Gamma/\Gamma = 0.2$	0.028	0.028	0.028	0.028	0.028
Total systematic	0.195	0.232	0.289	0.357	0.443
Statistical	0.393	1.129	1.010	2.652	5.281