B_d oscillations with muon tags

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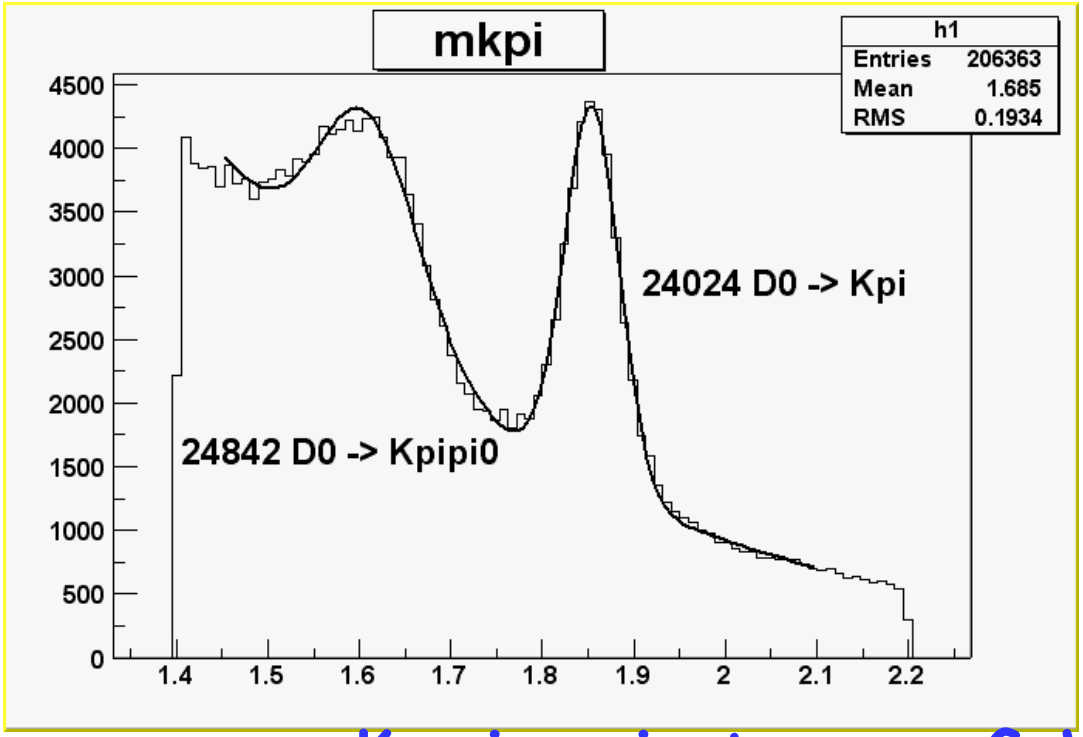
- Bd oscillations: goal is to establish a benchmark oscillation measurement as a rehearsal for Bs oscillations
- Signal
  - $B^+ \to D^0 \mu$
  - $B^0 \to D^* \mu$
    - $D^* \to D^0 \pi \to (K \pi) \pi$
    - $D^* \to D^0 \pi \to (K \pi \pi^0) \pi$
- Muon tagging
  - Muons
  - Tuning of tagging
    - Semileptonic B^+ sample
    - $B^+ \to J/psi\ K^+$ sample
- K - factors
- Asymmetries
- Plans

D^0 signal

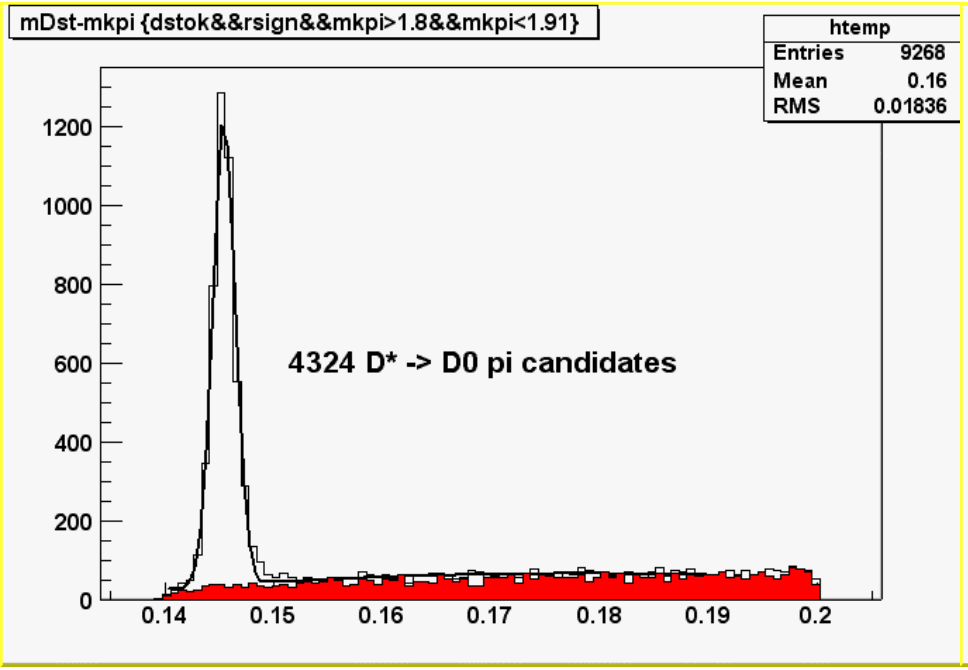
- AA analysis package V02.10.03
- 47 pb^{-1} p14 data
- Used B->μ D^0 (-> K π) particles as defined in AA package
- See also Sergey's talk two weeks ago for more details



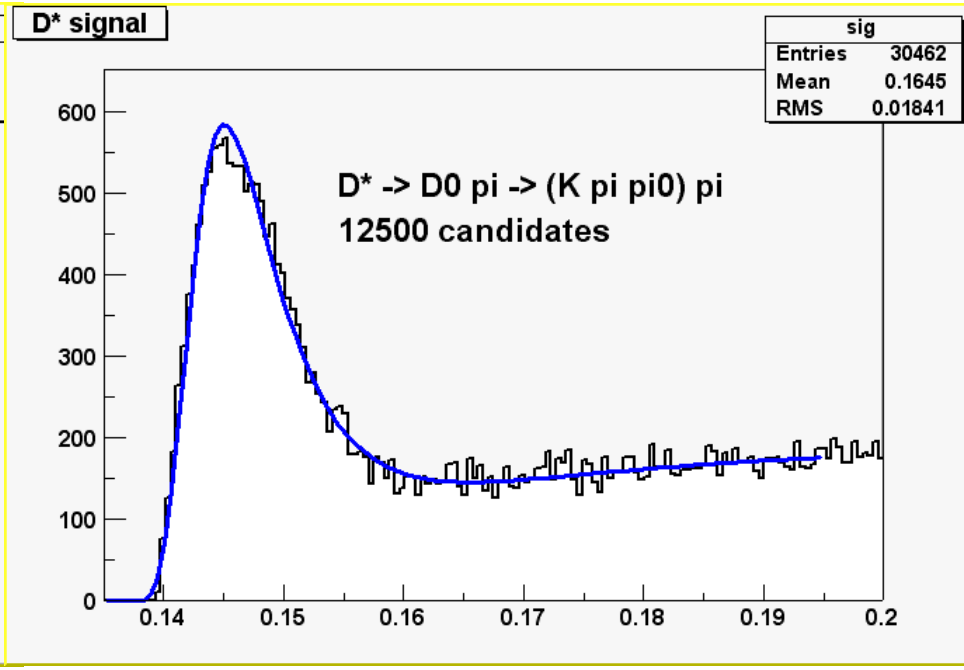
K π invariant mass, GeV

D* signal

- Slow pion selections
  - Any track with >1 SMT and > 1 CFT hits with correct charge correlation
  - Track gives best B vertex fit
    - Needs optimization



m(D*)-m(Kπ), GeV



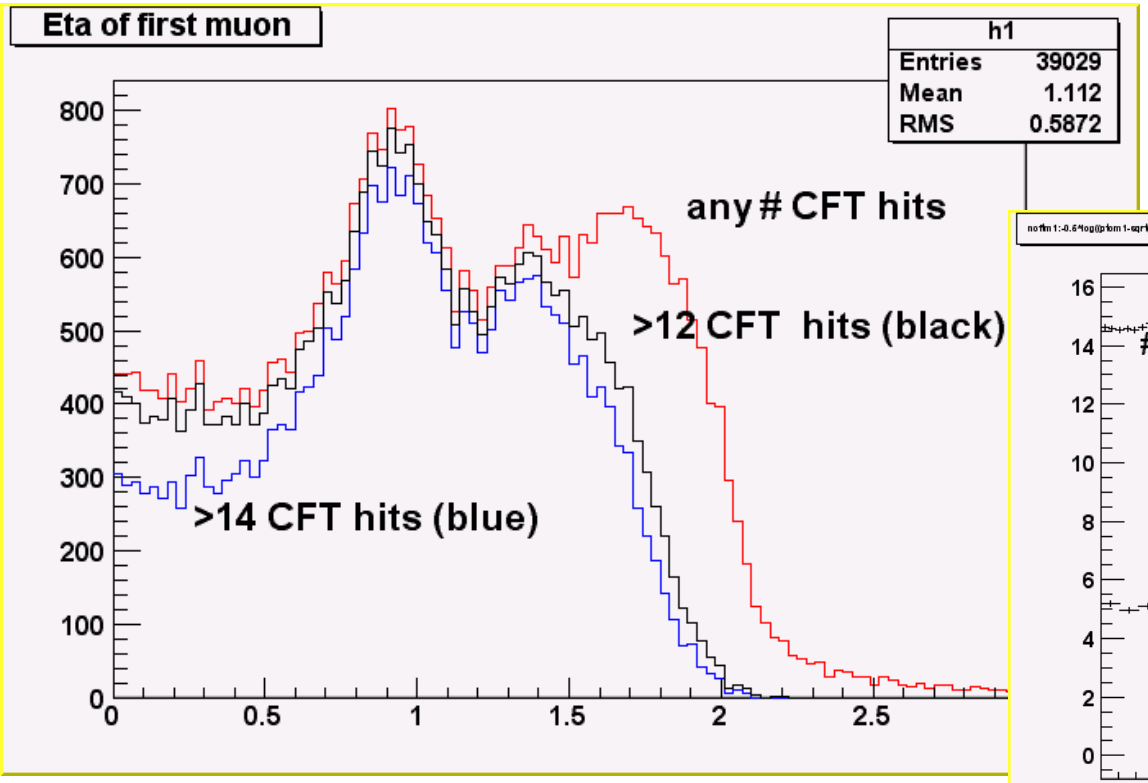
m(D*)-m(Kπ), GeV

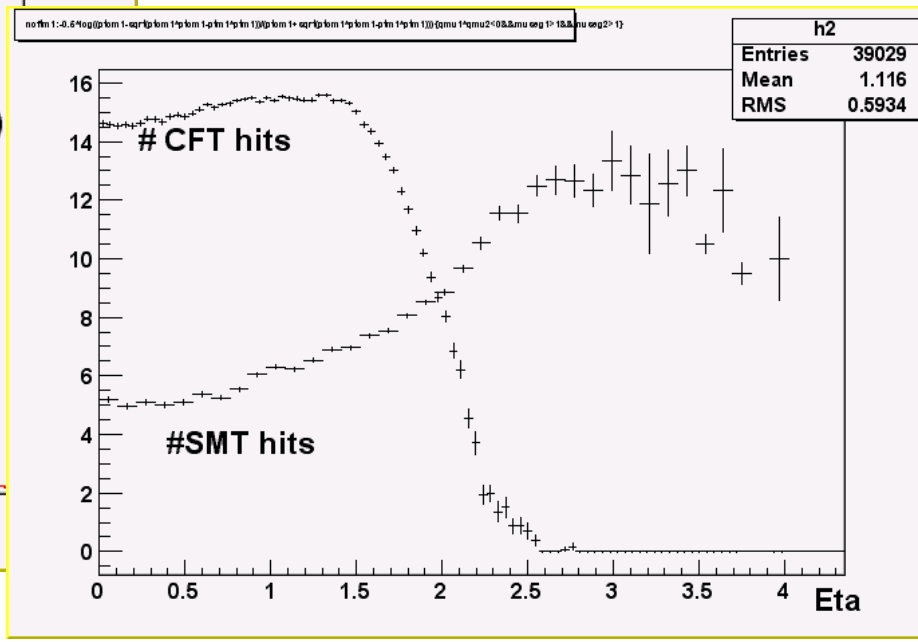
Tag muon selections

- Tag 1
  - Any muon candidate with max Pt
  - Later apply Pt cut, nseg cut, same jet veto, Jpsi veto etc.
- Tag 2
  - Any muon candidate with max Pt not from the same jet
  - Later apply Pt cut, nseg cut, Jpsi veto etc.
- For tag tune used semileptonic B+ sample
  - Events with D* removed

Muon eta coverage in J/psi sample

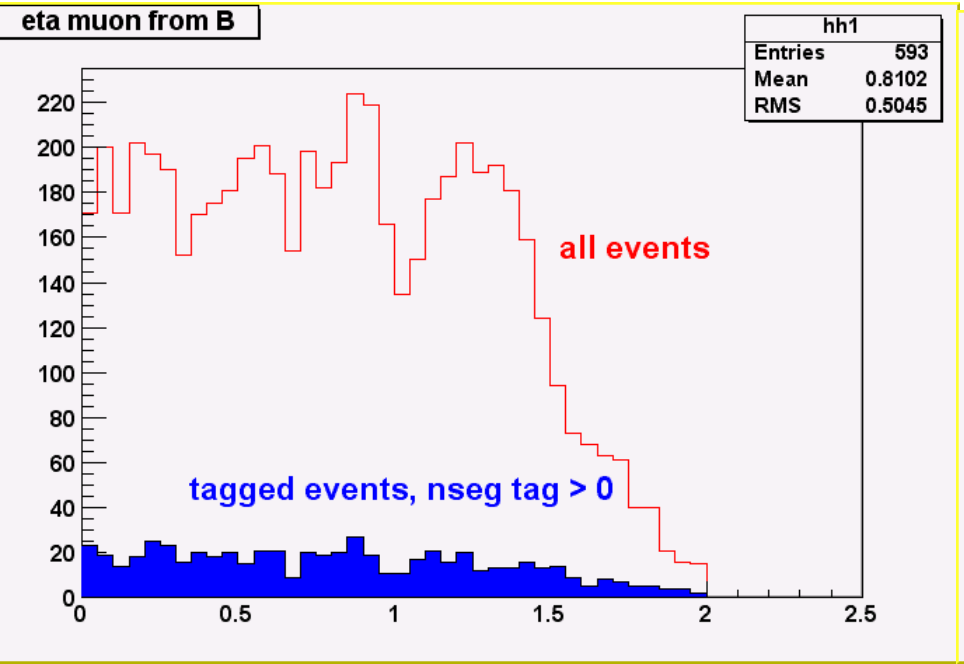
- Muon coverage extends to |eta|<2 for J/psi muons
  - Dimuon triggers do not require Tracker
- CFT acceptance cuts off ~ 20% of muons

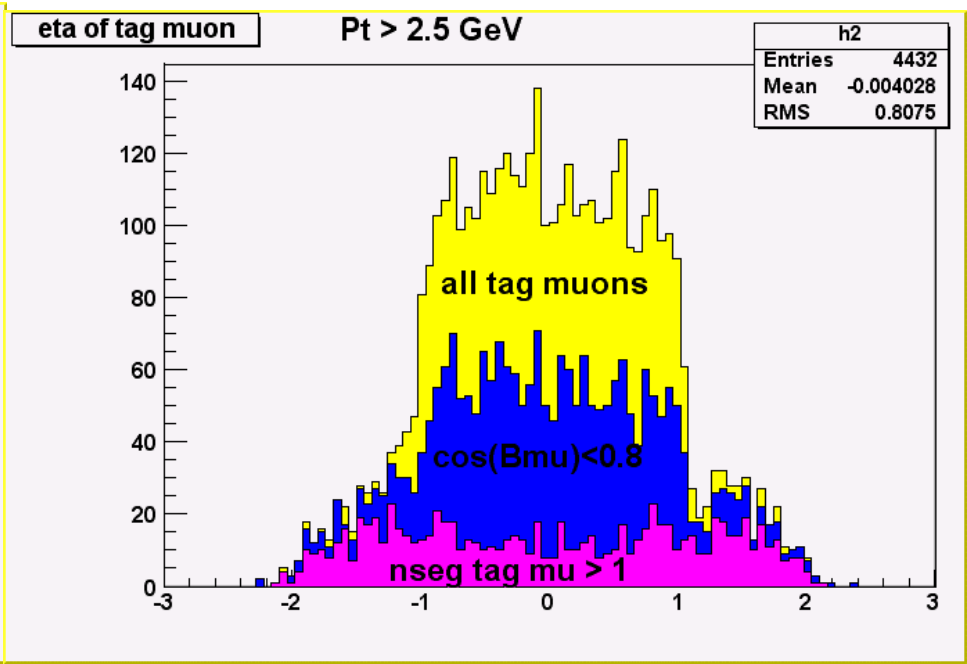




Muon eta coverage for tag muons

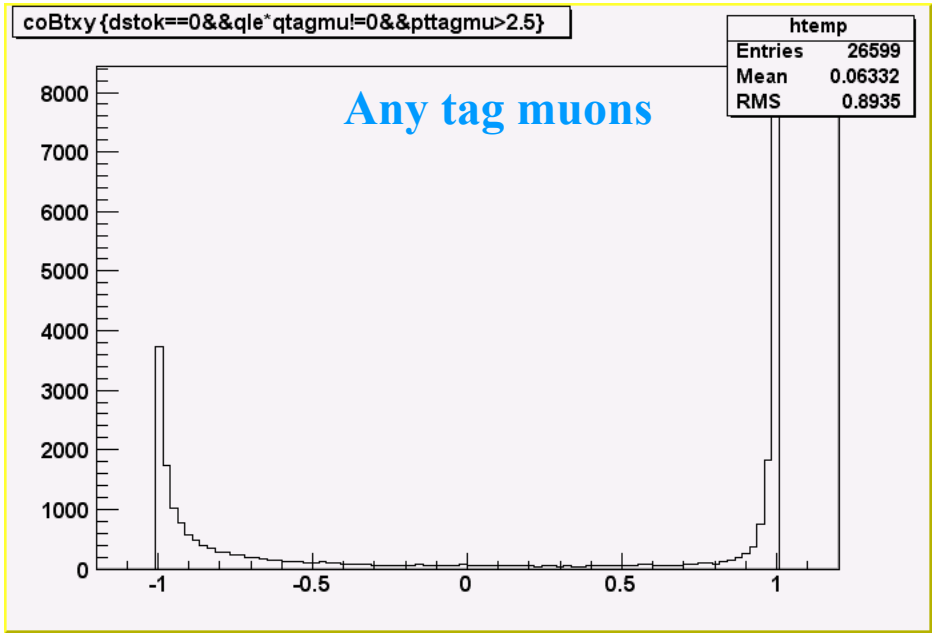
- Our signal comes mostly from single muon triggers => acceptance reduced by CTT and Tracking at L3
- Tagged events have better acceptance since dimuon triggers start to contribute more
  - |eta|>1.5 fraction increases from 13% to 16% for tagged events
- Tagged muons have full muon system acceptance |eta|<2
  - Nseg = 0 muons need more work, decided not to use for now

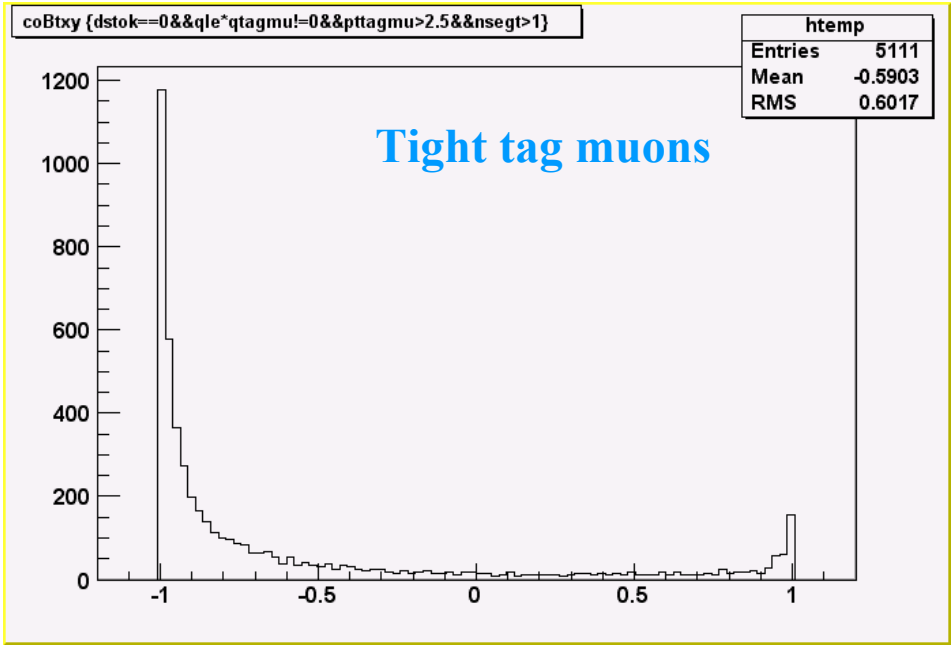




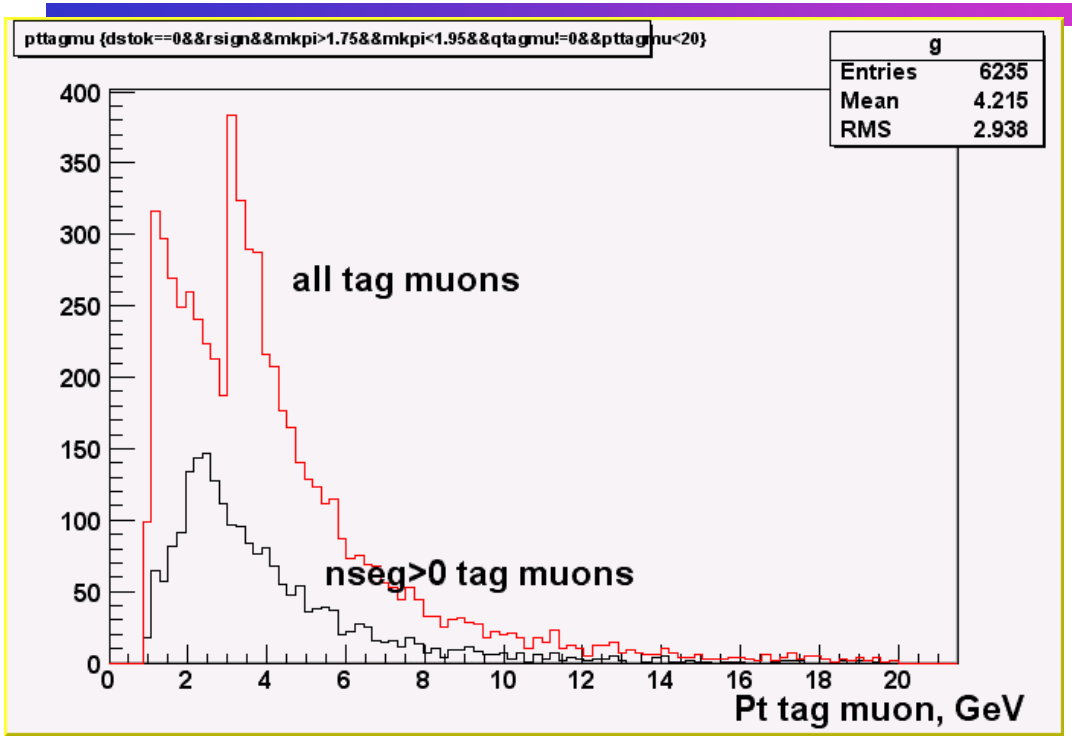
Tag muons: angle correlations

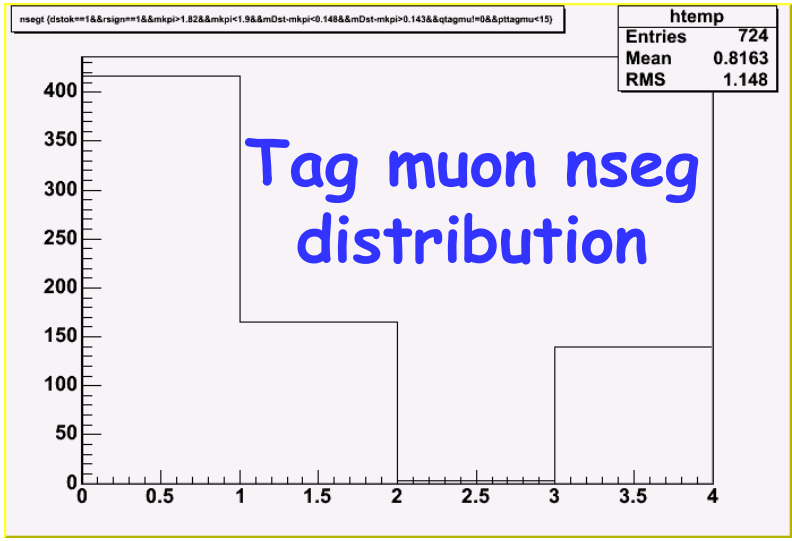
- Expect angle correlations for bb production
  - Back-to-back b-jets
  - Gluon splitting : close to each other b-jets
  - Interesting physics topic by itself
- cos (phi between B and tag muon)
  - nseg = 0 muons are coming mostly from the same jet





Tag muon momentum and nseg





- Nseg = 0 muons are abundant but not understood
  - MIPs punching through or decay muons ?
  - Still have reasonable dilution, see later – need more studies
- Nseg = 1 muons are useful
- Nseg = 2 muons are (almost) non-existent
- Nseg = 3 muons are useful and tight

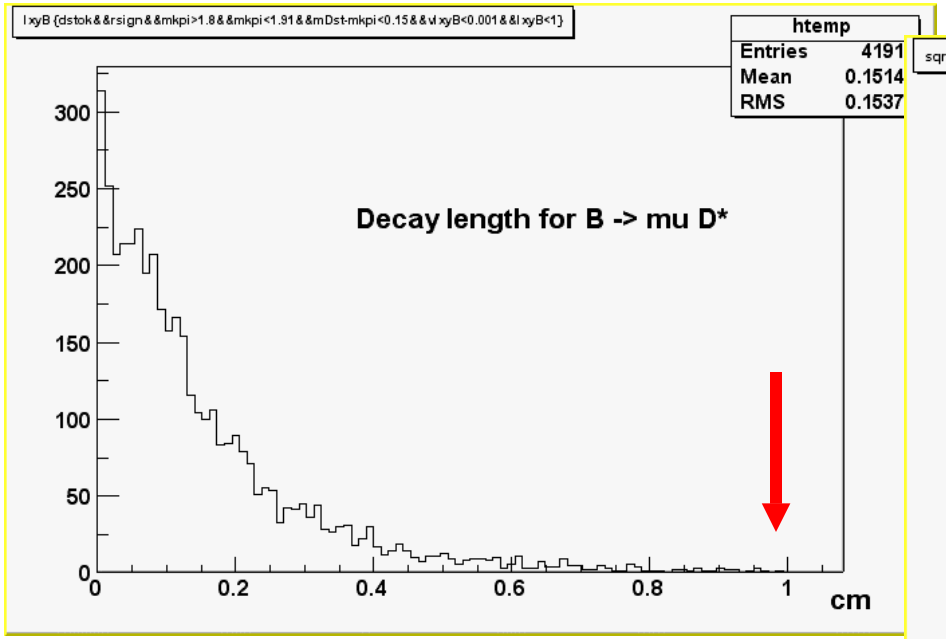
Comparison of different tags

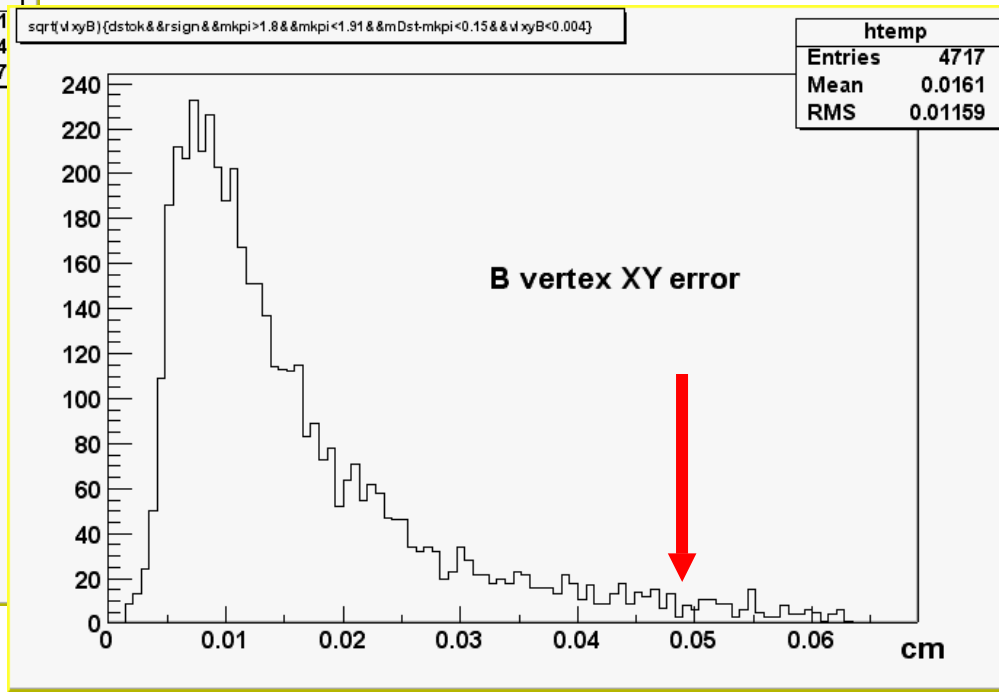
- Used B^+ enriched sample (K π channel only)
- Number of events extracted from D^0 mass peak fit
  - Tag 2 gave similar results
  - Effect of J/psi veto is small
- For some reason nseg = 0 muons have high dilution
  - Do not use for now but worth investigating

Tag 1 +	Nos	Nss	Eff,%	Dil,%	$e*D^2$ %
Pt>2.5	1640	884	16.6	29.9	1.48
Pt>2.5 nseg>0	726	410	7.5	27.8	0.57
Pt>3.0 nseg>0	583	282	5.7	34.7	0.68
Pt>4.0 nseg>0	388	217	4.0	28.1	0.31
Pt>2.5 nseg>1	468	240	4.6	32.2	0.48
Pt>3.0 nseg>0 $\cos(B\mu) < 0.8$	551	278	5.4	32.9	0.59

Fiducial selections

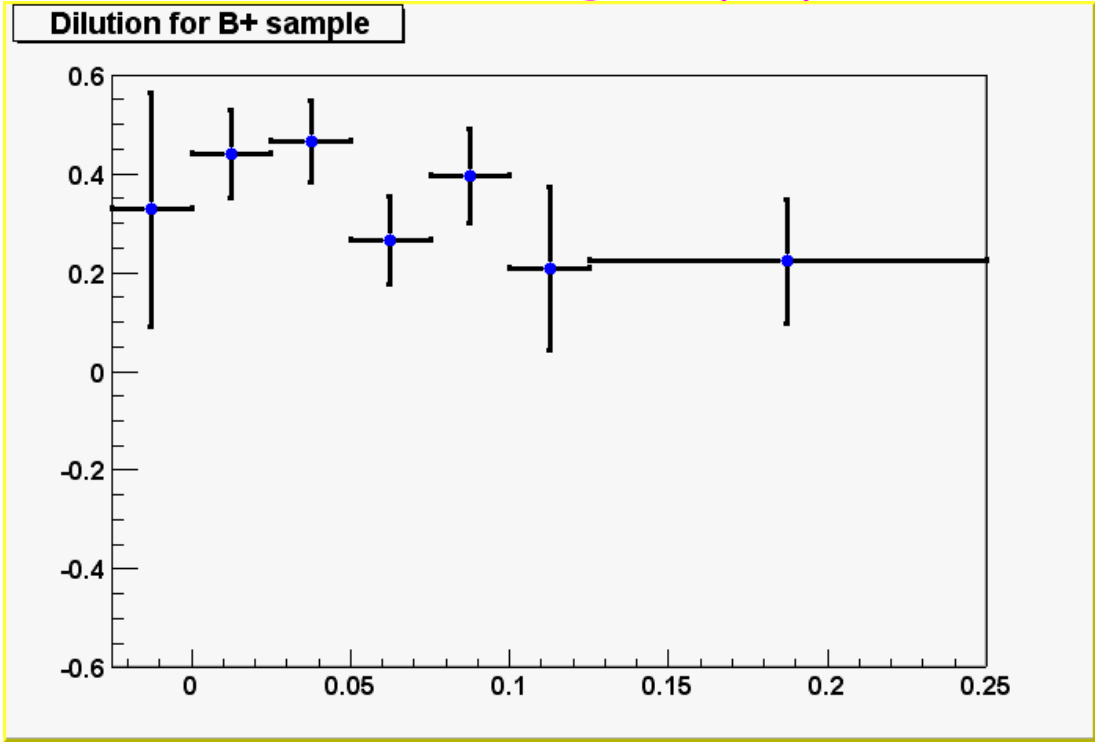
- it's a good idea to define fiducial parameter space where you trust your Tracker
  - Decay Length < 1cm
  - B vertex error < 500 um
  - May be can be extended after studies





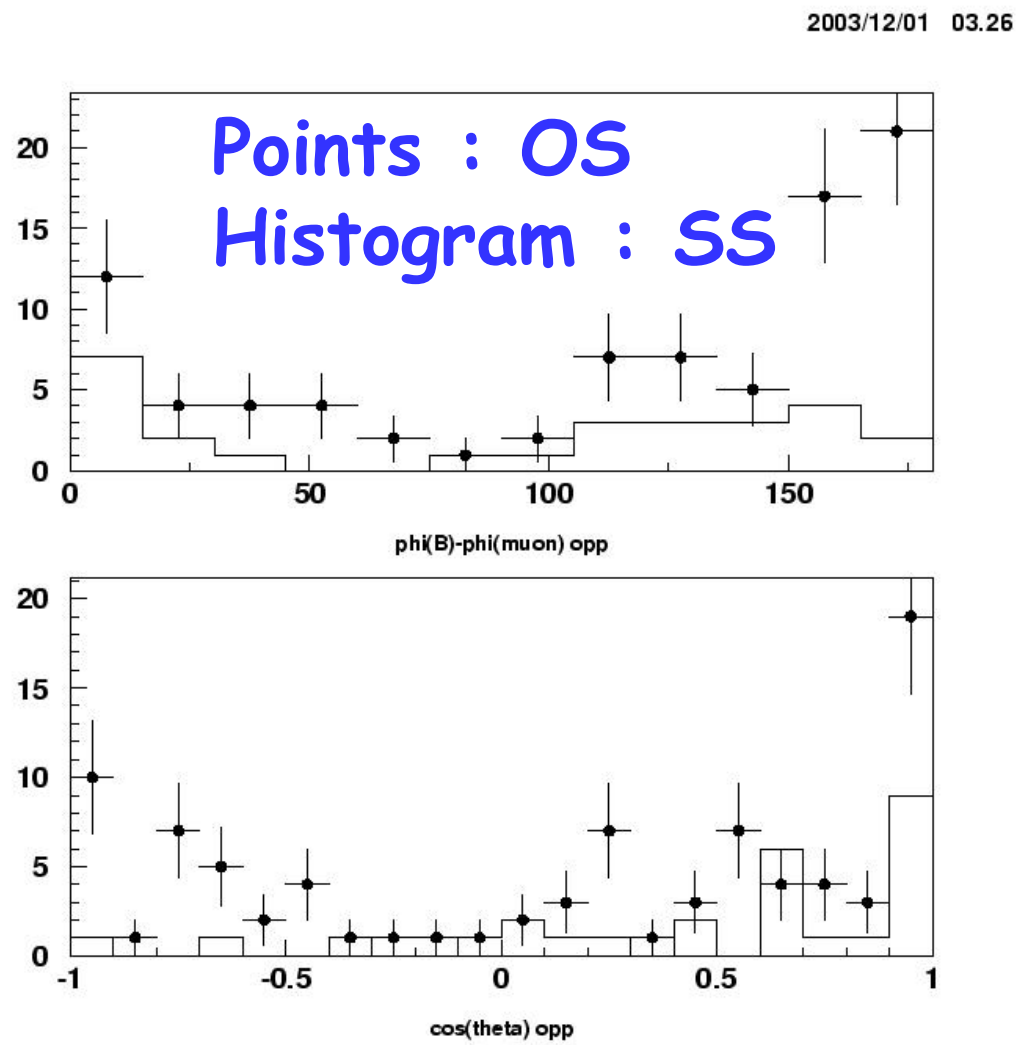
Dilution vs Proper Decay Length for B^+

- Proper XY Decay Length is defined as XY Decay Length * M_B / Pt
- B^+ does not oscillate – no dependence expected
  - However there is a contribution from B^0 in the sample that does oscillate. May see lower dilution for higher proper DL
- Plot OS-SS/OS+SS
- Tag muon
  - Pt > 2.5 GeV
  - Nseg > 0



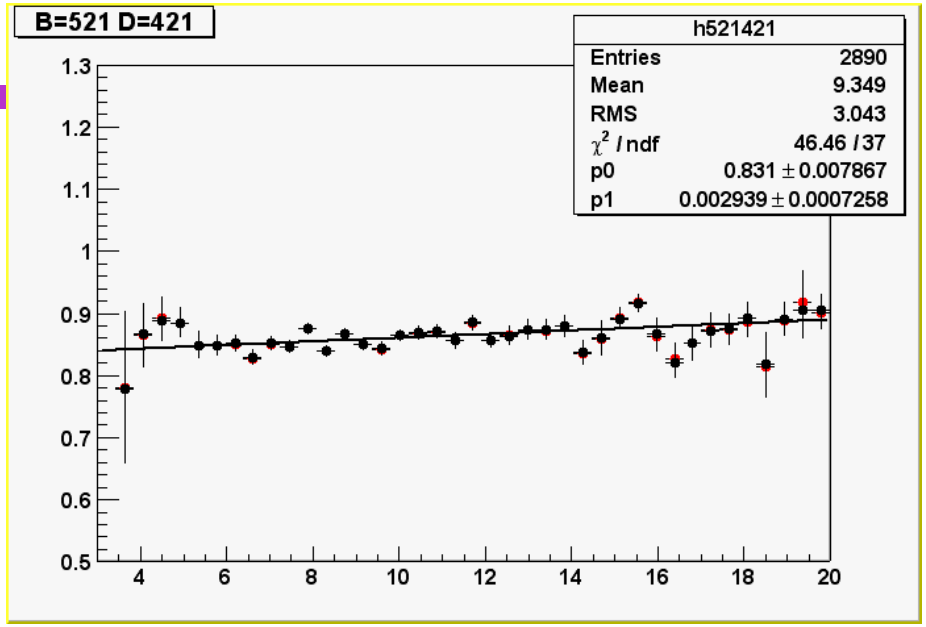
Tagging for B+->J/psi K+

- Important cross-check
  - Dilution is expected to be different wrt semileptonic channels
- Work in progress so far looked at angular correlations
- Used tight tag muons
- Preliminary dilution is high, 52%
  - 113 tagged events
  - ~2000 total events

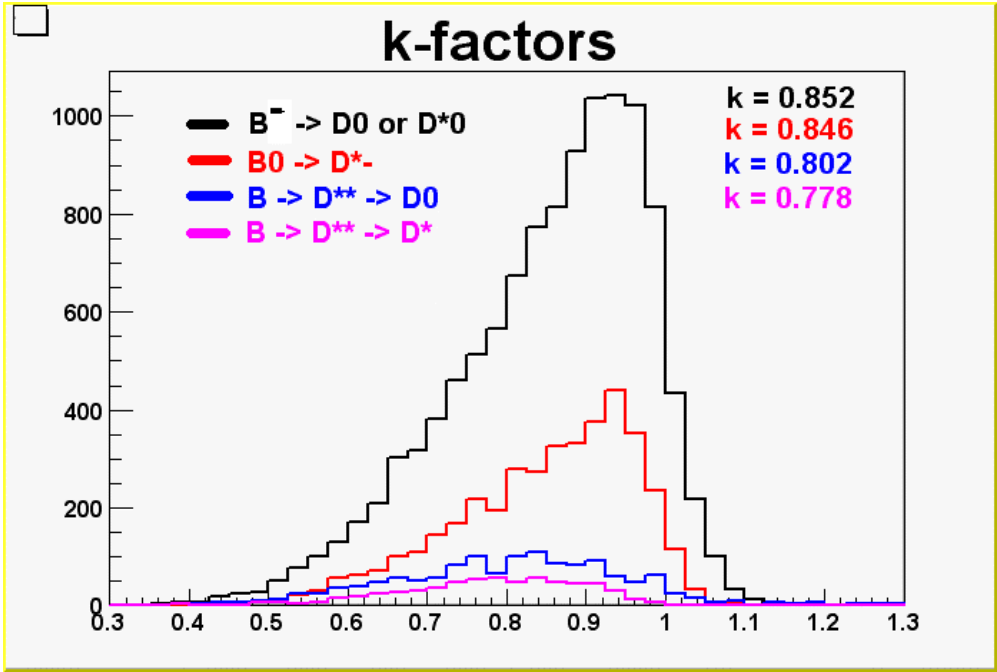


K-factors

- K-factor accounts for neutrino (and other neutrals like π^0)
- Smears proper decay length resolution
- Calculated from MC
- May have weak Pt dependence

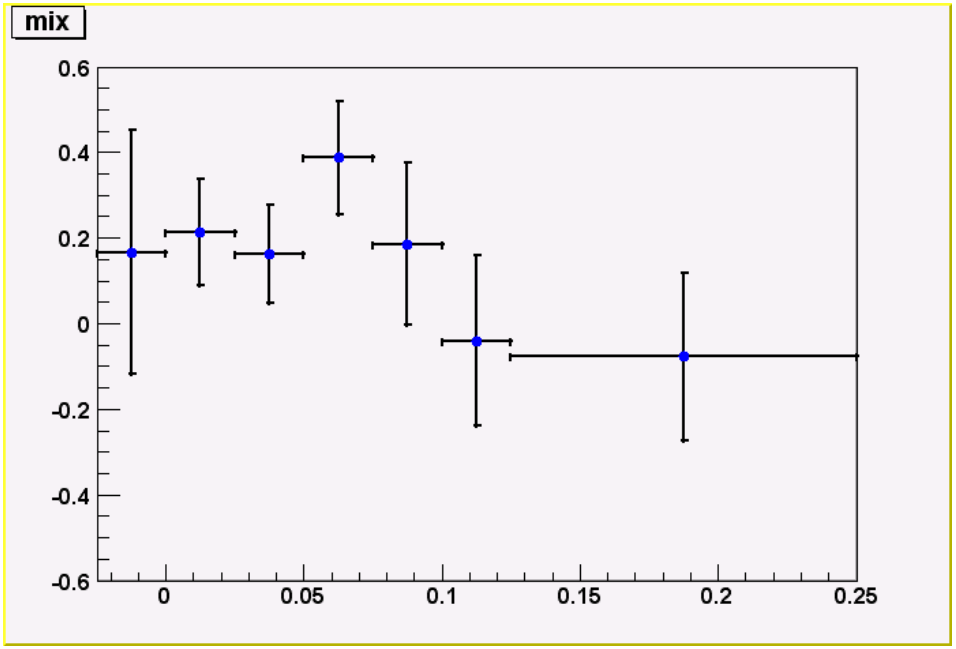


- Ratio of k-factors for K π and K π π^0 channels can be cross calibrated using data
  - Uses the fact that the lifetime is the same for both channels, see Sergey's talk on SST for semileptonic modes

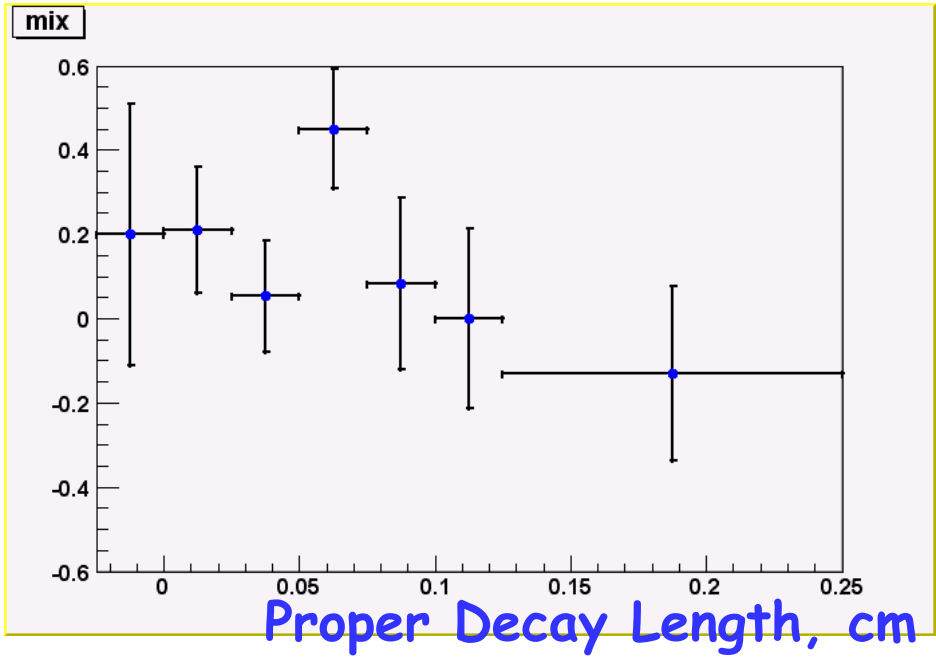


Asymmetry in K π channel OS-SS / OS+SS

- B^0 (= D*) sample shows oscillations in K π channel
  - No k-factor
- More work needed to understand mass peak fitting procedure
- More statistics will help



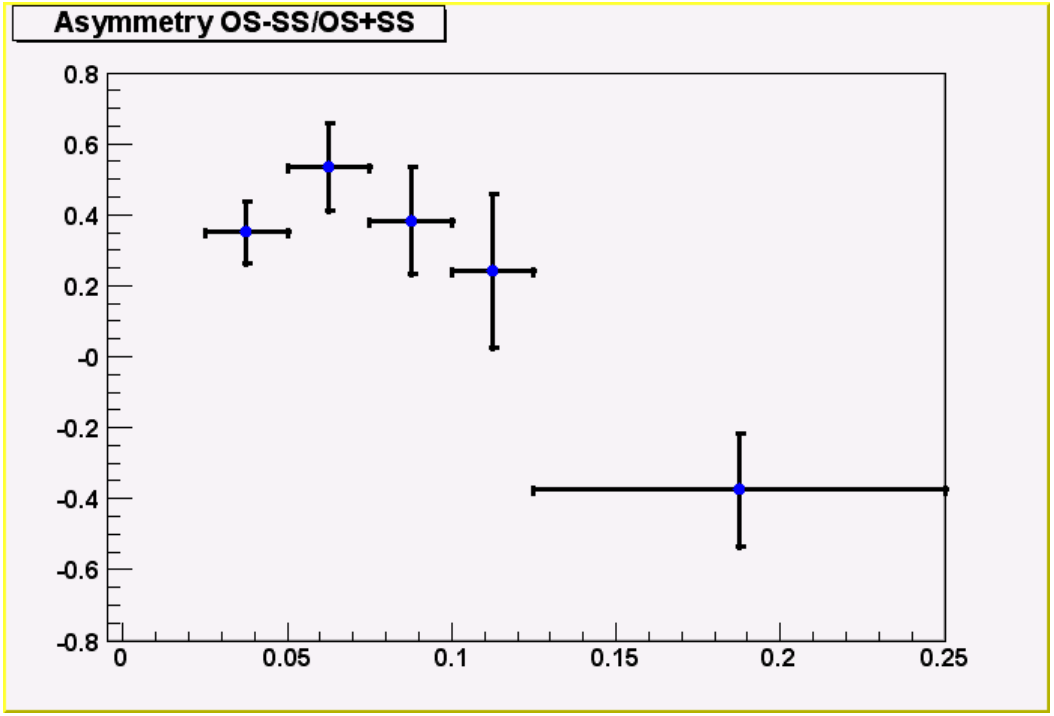
tag muon Pt > 2.5 GeV, nseg>0



tag muon Pt > 3 GeV, nseg>0

Asymmetry in K π π^0 channel

- B^0 (= D*) sample shows oscillations in K π π^0 channel
  - Use k-factor 0.85 to account for π^0
- More work needed to understand mass peak fitting procedure

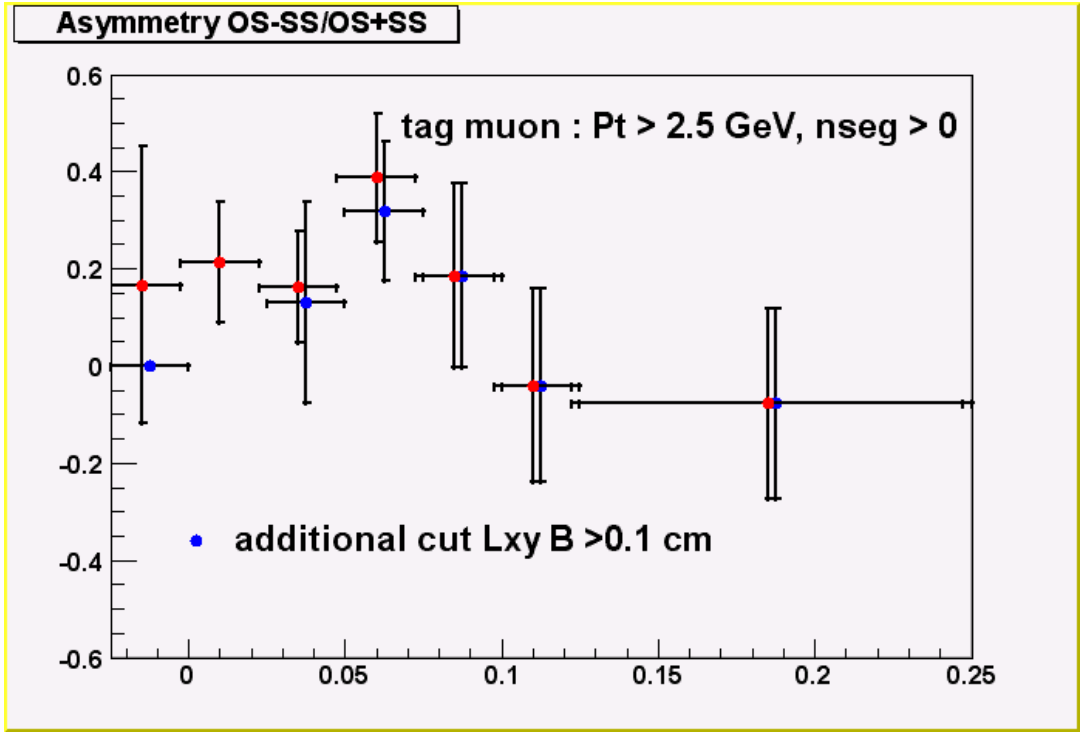


tag muon Pt > 2.5 GeV, nseg>0

Proper Decay Length, cm

Bias from lifetime cuts?

- Checked what happens to asymmetry if cut at 1 mm
- No interpretation yet



Plans

- Still long way to the final number
  - Optimize mass peak and background fits
  - Look at MC and sample composition
  - Oscillation fit & Δm measurement

  - For more information about analysis, see

    http://d0server1.fnal.gov/users/nomerot/Run2A/Bd_osc/B_d_oscillations.html
- Increase statistics
- Systematics

- Preliminary results possible for winter conferences (without final systematic errors)