Measuring $\Delta\Gamma_s$ via Mixing

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Workshop on B Physics at Run II
and Beyond

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- Context: An Idea from the First Workshop
- Using Mixing
- Some Plots
- Duhoh! (Homer Simpson noises)

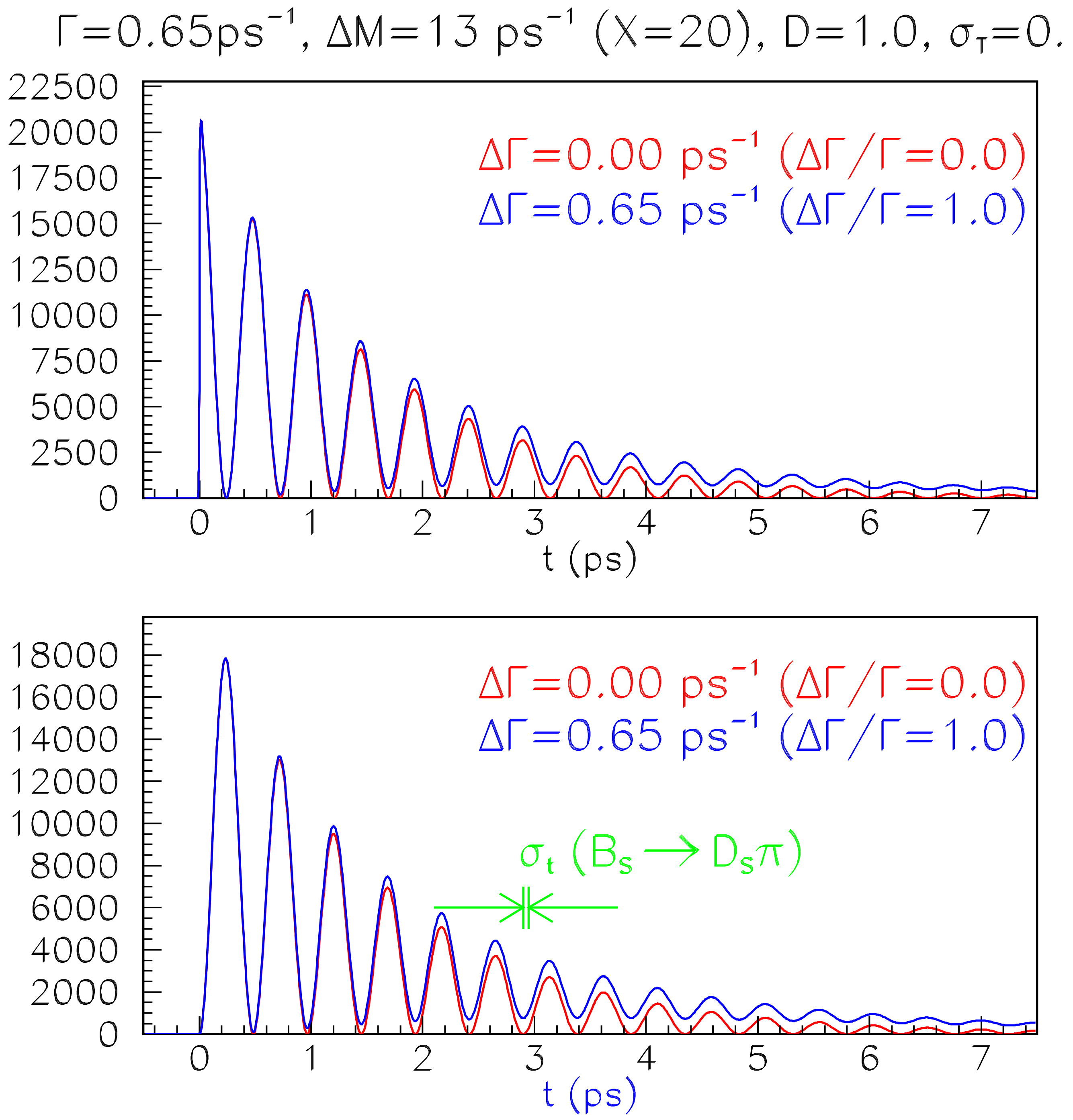
`http://home.fnal.gov/~kutschke/BTeV/talks/000225_wg3.ps`

Context: An Idea from the First Workshop

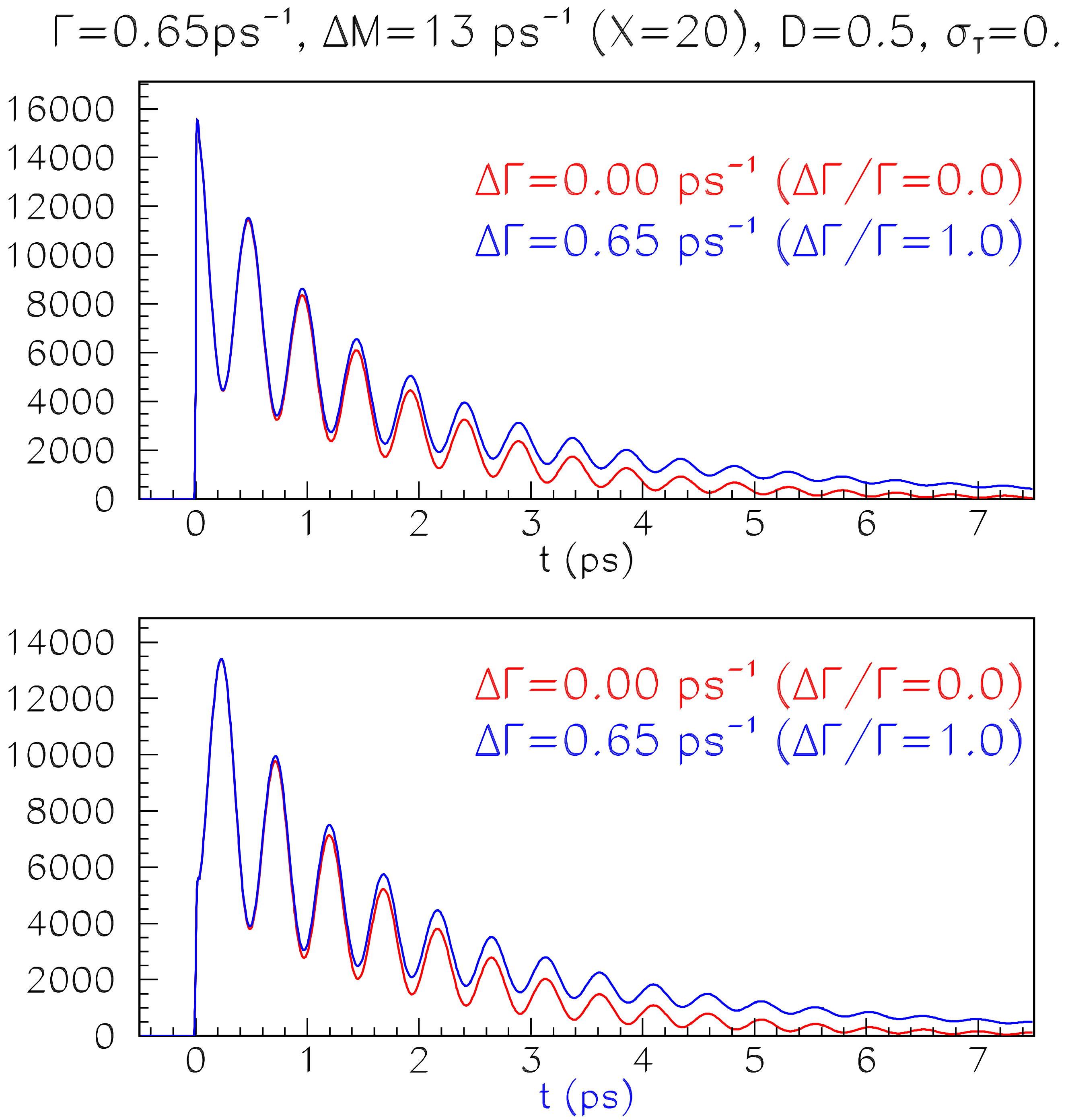
- Compare a CP^+ mode to a CP^- mode.
  - No handy candidate pure CP^- modes.
- Compare a CP^+ mode to a 50-50 mixture.
  - Covered by other talks.
- Fit a 50-50 mixture to two lifetimes.
  - Observables $\propto (\Delta\Gamma/\Gamma)^2$.
- $\Delta\Gamma$ contribution to mixing

$$\frac{d\Gamma}{dt} = \Gamma e^{-\Gamma\, t}\left(\cosh(\frac{\Delta\Gamma}{2}\, t) \pm D\cos(\Delta m\, t)\right)$$

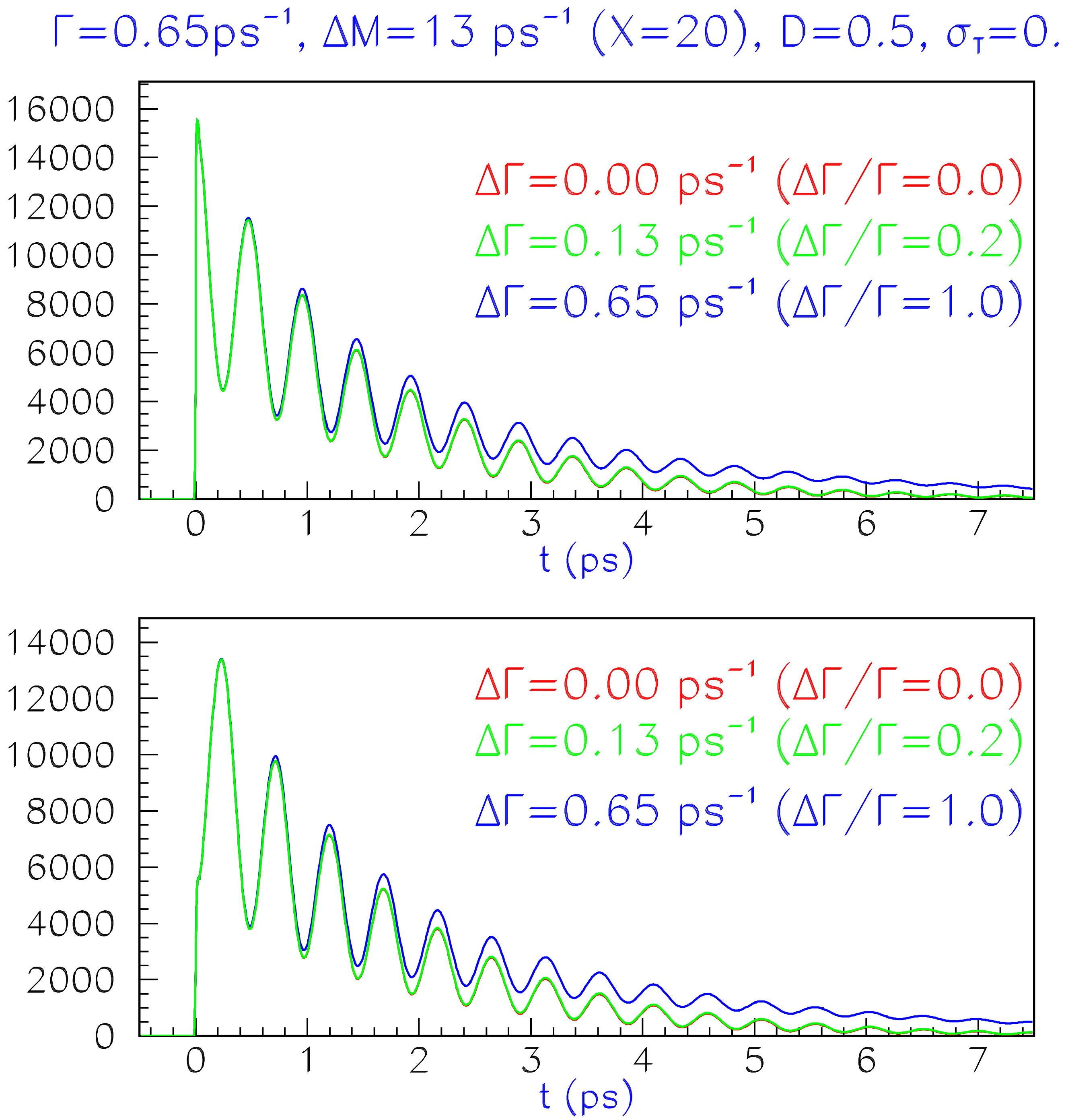
$$\Gamma = \frac{\Gamma_H + \Gamma_L}{2} \qquad\qquad \Delta\Gamma = \pm(\Gamma_H - \Gamma_L)$$



Γ=0.65ps⁻¹, ΔM=13 ps⁻¹ (X=20), D=1.0, σT=0.
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
ΔΓ=0.00 ps⁻¹ (ΔΓ/Γ=0.0)
ΔΓ=0.65 ps⁻¹ (ΔΓ/Γ=1.0)
0 1 2 3 4 5 6 7
t (ps)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
ΔΓ=0.00 ps⁻¹ (ΔΓ/Γ=0.0)
ΔΓ=0.65 ps⁻¹ (ΔΓ/Γ=1.0)
σt (Bs → Dsπ)
0 1 2 3 4 5 6 7
t (ps)



$\Gamma=0.65\mathrm{ps}^{-1}$, $\Delta M=13\ \mathrm{ps}^{-1}$ $(X=20)$, $D=0.5$, $\sigma_T=0.$
$\Delta\Gamma=0.00\ \mathrm{ps}^{-1}$ $(\Delta\Gamma/\Gamma=0.0)$
$\Delta\Gamma=0.65\ \mathrm{ps}^{-1}$ $(\Delta\Gamma/\Gamma=1.0)$
t (ps)
$\Delta\Gamma=0.00\ \mathrm{ps}^{-1}$ $(\Delta\Gamma/\Gamma=0.0)$
$\Delta\Gamma=0.65\ \mathrm{ps}^{-1}$ $(\Delta\Gamma/\Gamma=1.0)$
t (ps)


Γ=0.65ps⁻¹, ΔM=13 ps⁻¹ (X=20), D=0.5, σT=0.
16000
14000
12000
10000
8000
6000
4000
2000
0
ΔΓ=0.00 ps⁻¹ (ΔΓ/Γ=0.0)
ΔΓ=0.13 ps⁻¹ (ΔΓ/Γ=0.2)
ΔΓ=0.65 ps⁻¹ (ΔΓ/Γ=1.0)
0 1 2 3 4 5 6 7
t (ps)
14000
12000
10000
8000
6000
4000
2000
0
ΔΓ=0.00 ps⁻¹ (ΔΓ/Γ=0.0)
ΔΓ=0.13 ps⁻¹ (ΔΓ/Γ=0.2)
ΔΓ=0.65 ps⁻¹ (ΔΓ/Γ=1.0)
0 1 2 3 4 5 6 7
t (ps)

Why is this?

$$\frac{d\Gamma}{dt} = \Gamma e^{-\Gamma\, t}\left(\cosh(\frac{\Delta\Gamma}{2}\, t) \pm D\cos(\Delta m\, t)\right)$$

- Observables $\propto (\Delta\Gamma/\Gamma)^2$!
- Sums and differences isolate all information.
- There is no interference term.
- Compare to a $50-50$ mixture of B_H and B_L:

$$\begin{aligned}\frac{d\Gamma}{dt} &= 0.5\left(\Gamma_L e^{-\Gamma_L\, t} + \Gamma_H e^{-\Gamma_H\, t}\right)\\ &= \Gamma e^{-\Gamma\, t}\left(\cosh(\frac{\Delta\Gamma}{2}t) - \frac{\Delta\Gamma}{2\Gamma}\sinh(\frac{\Delta\Gamma}{2}t)\right)\end{aligned}$$

Conclusions

- Meausuring $\Delta\Gamma$ via mixing has no essentially the same information content as fitting an untagged, 50-50 mixture to the sum of two gaussians.
- There is no interference term between $\Delta\Gamma$ and Δm.
- No sense in paying the tagging price.
  $\Rightarrow$ Reject this method

Work Plan

- Write one paragraph to be included in the report.