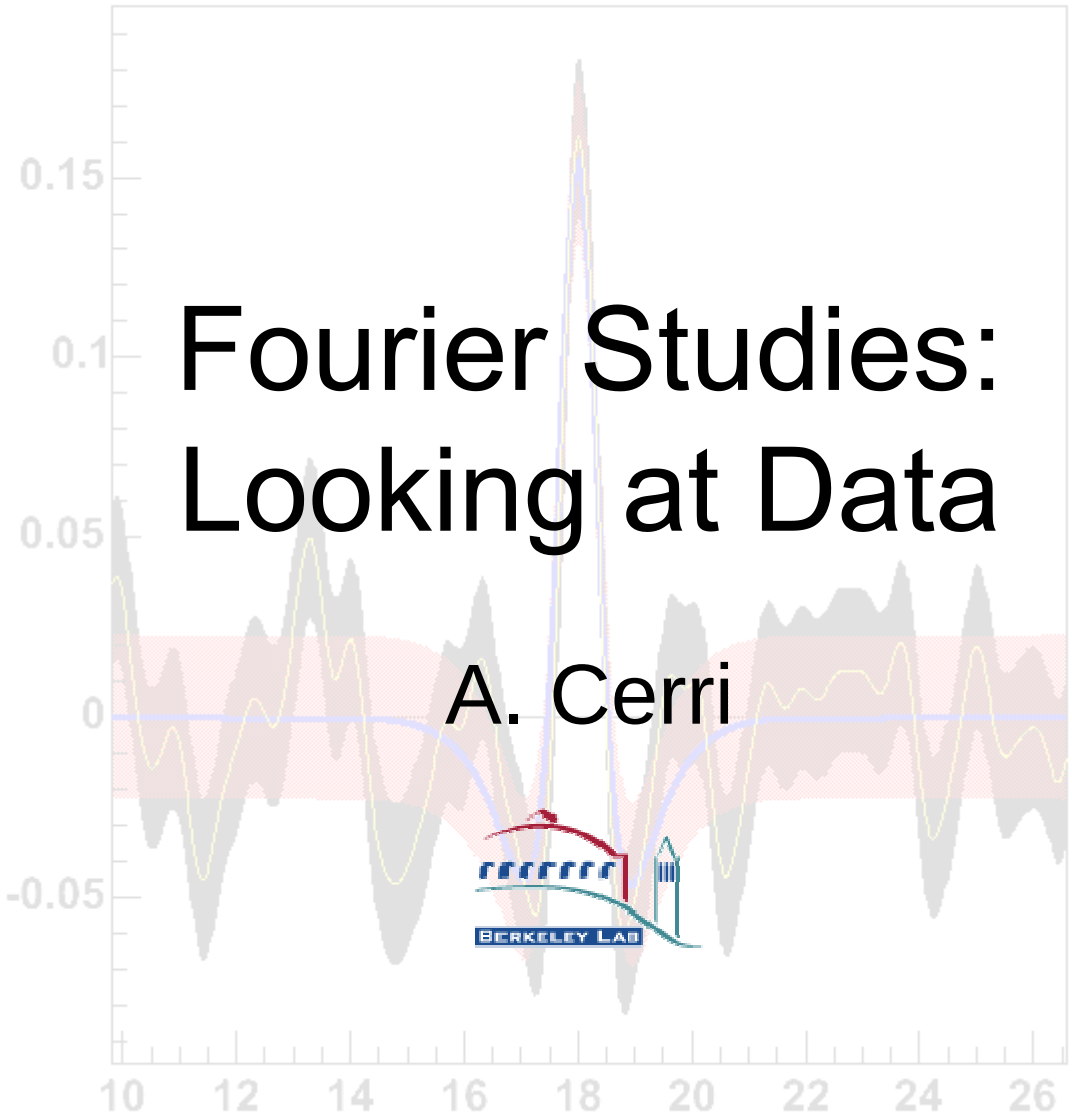


Fourier Studies: Looking at Data

A. Cerri

Outline

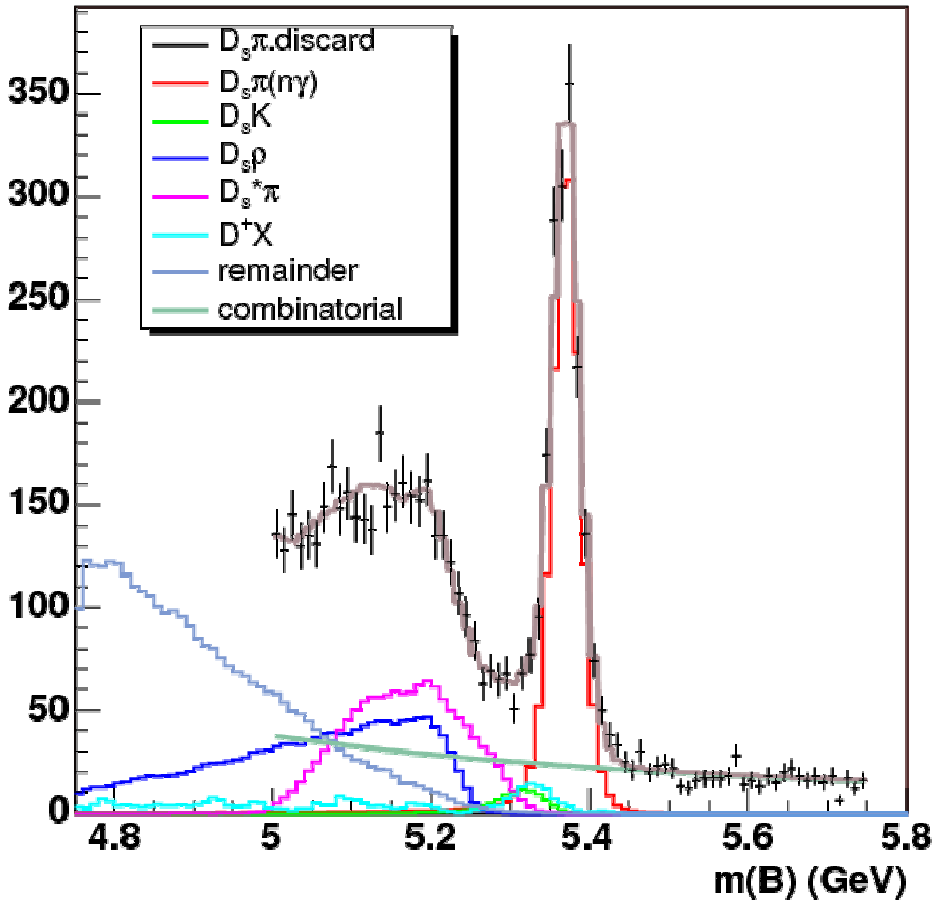
- Introduction
- Data Sample
- Toy Montecarlo
  - Expected Sensitivity
  - Expected Resolution
- Frequency Scans:
  - Fourier
  - Amplitude Significance
  - Amplitude Scan
  - Likelihood Profile
- Conclusions

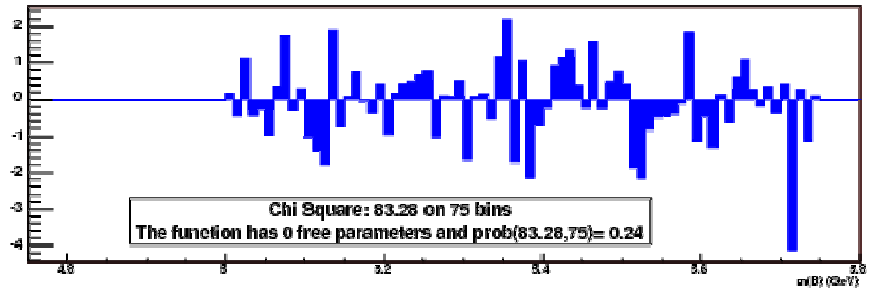
Introduction

- Principles of Fourier based method presented on 12/6/2005, 12/16/2005, 1/31/2006, 3/21/2006
- Methods documented in CDF7962 & CDF8054
- Full implementation described on 7/18/2006 at BLM
- Aims:
  - settle on a completely fourier-transform based procedure
  - Provide a tool for possible analyses, e.g.:
    - $J/\psi\phi$ direct CP terms
    - D_sK direct CP terms
  - Perform the complete exercise on the main mode ($\phi\pi$)
  - All you will see is restricted to $\phi\pi$. Focusing on this mode alone for the time being
- Not our Aim: bless a mixing result on the full sample

Data Sample

- Full 1fb^{-1}
- $D_s \rightarrow \phi\pi$, main Bs peak only
- ~1400 events in [5.33,5.41] consistent with baseline analysis
- S/B ~ 8:1
- Background modeled from [5.7,6.4]
- Efficiency curve measured on MC
- Taggers modeled after winter '05 (cut based) + OSKT



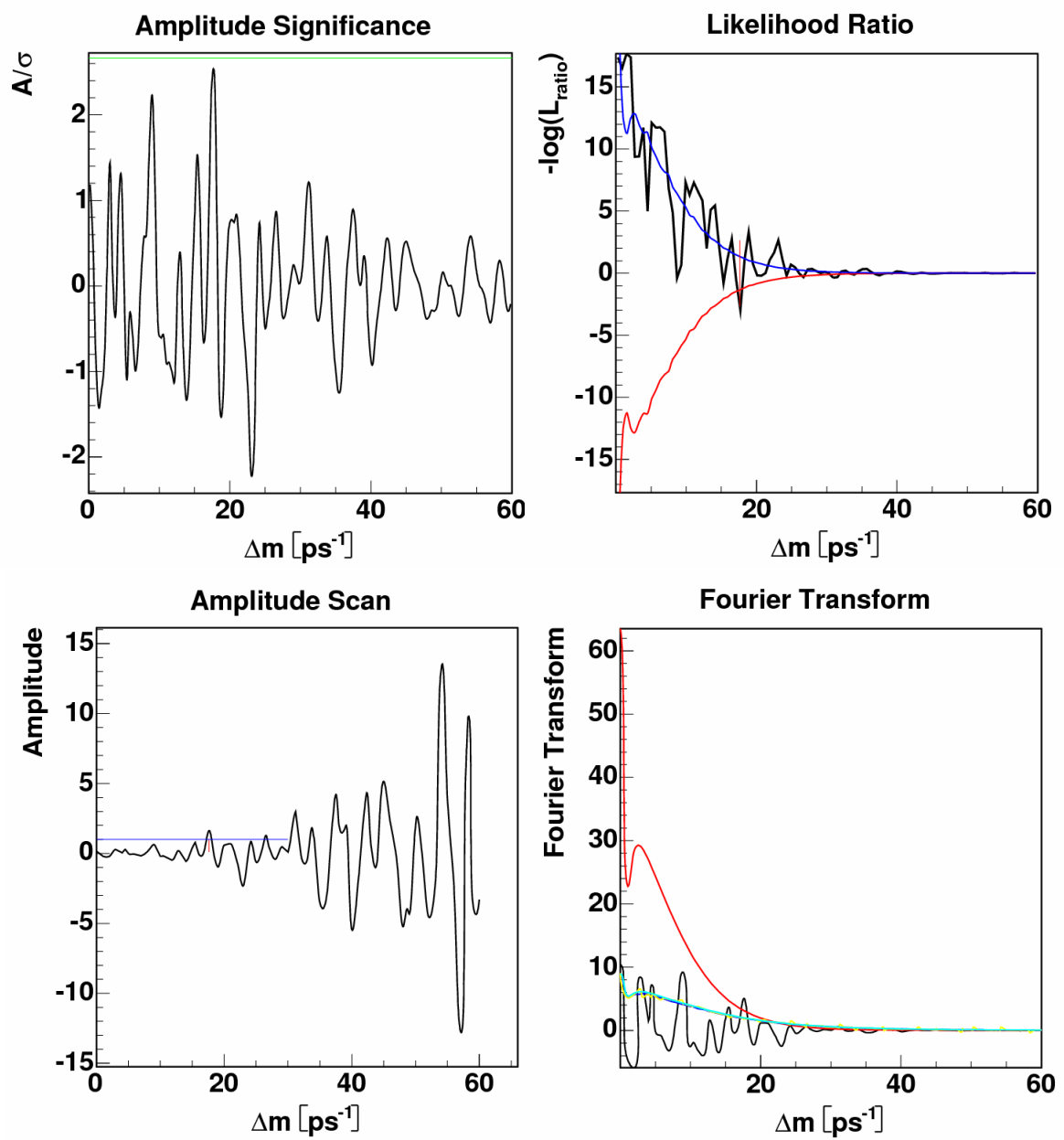


Toy Montecarlo

- Exercise the whole procedure on a realistic case (see BML 7/18)
- Toy simulation configured to emulate sample from previous page
- Access to MC truth:
  - Study of pulls (see BML 7/18)
  - Projected sensitivity
  - Construction of confidence bands to measure false alarm/detection probability
  - Projected Δm resolution

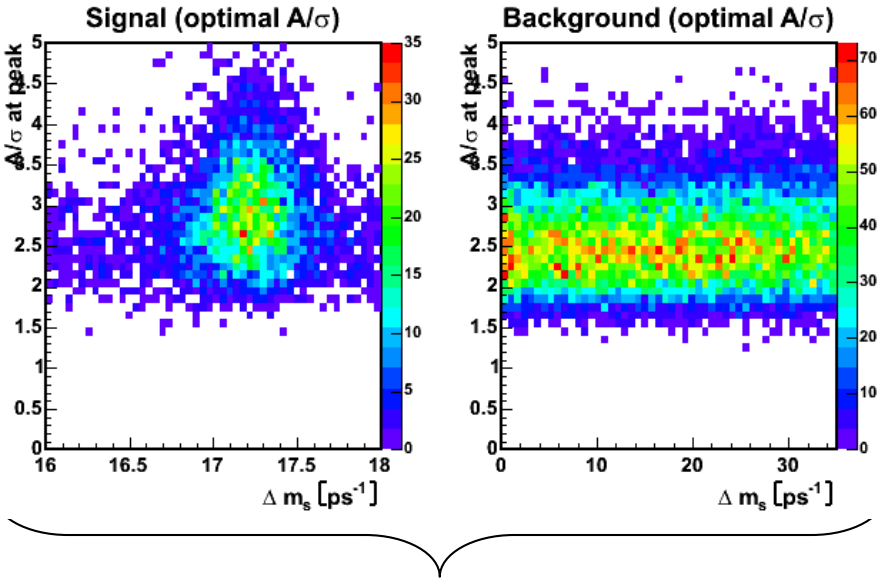
Toy Montecarlo: sensitivity

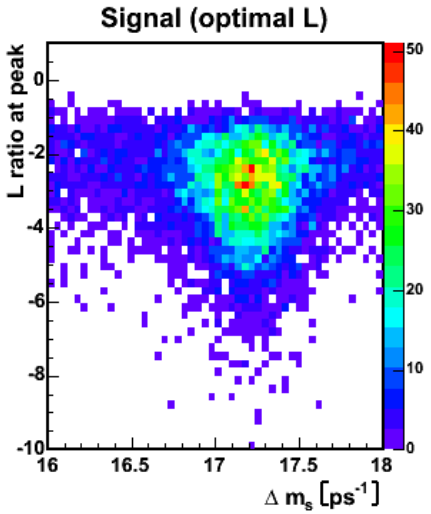
- Rem: Golden sample only
- Reduced sensitivity, but in line with what expected for the statistics
- All this obtained without t-dependend fit
- Iterating we can build confidence bands

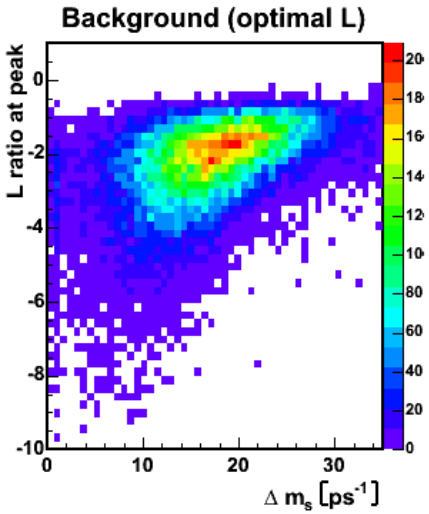


Distribution of Maxima

- Run toy montecarlo several times
  - "Signal"→default toy
  - "Background"→toy with scrambled taggers
- Apply peak-fitting machinery
- Derive distribution of maxima (position,height)







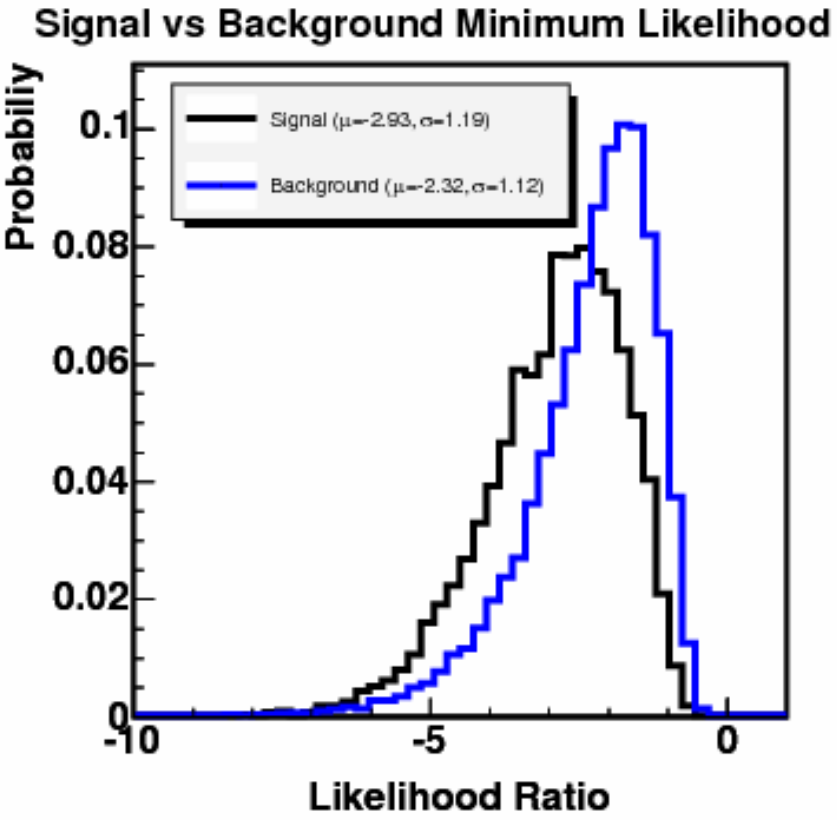
Max A/σ: limited separation and **uniform peak distribution for background**, but not model (&tagger parameter.) dependent

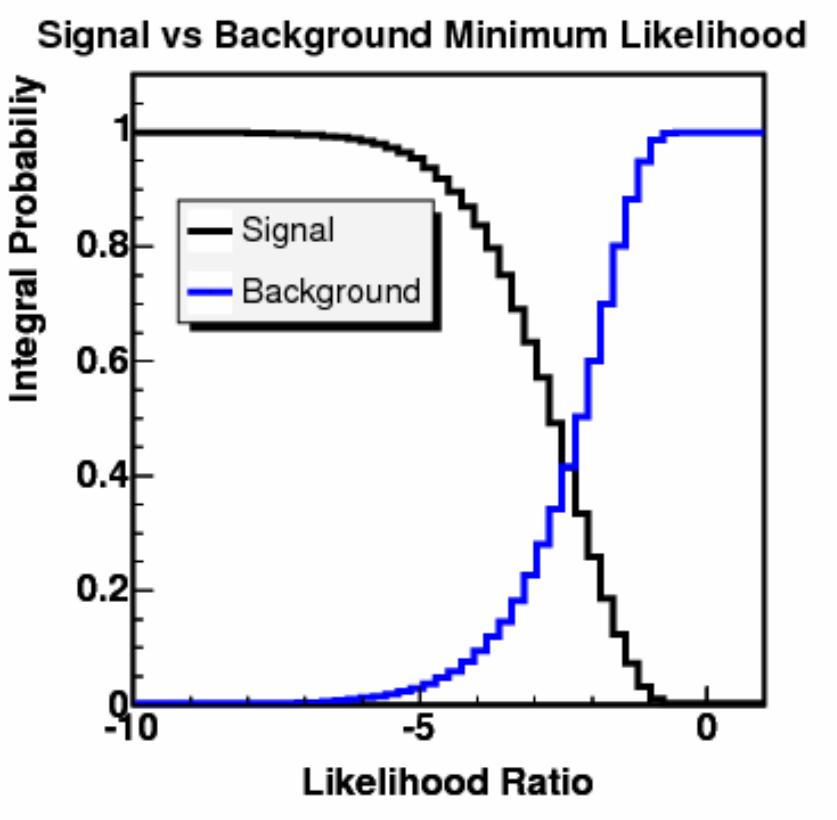
Min log L_{ratio}: improved separation and **localized peak distribution for background**

Toy Montecarlo: confidence bands

Signal or background depth of deepest minimum in toys

•Tail integral of distribution gives detection & false alarm probabilities

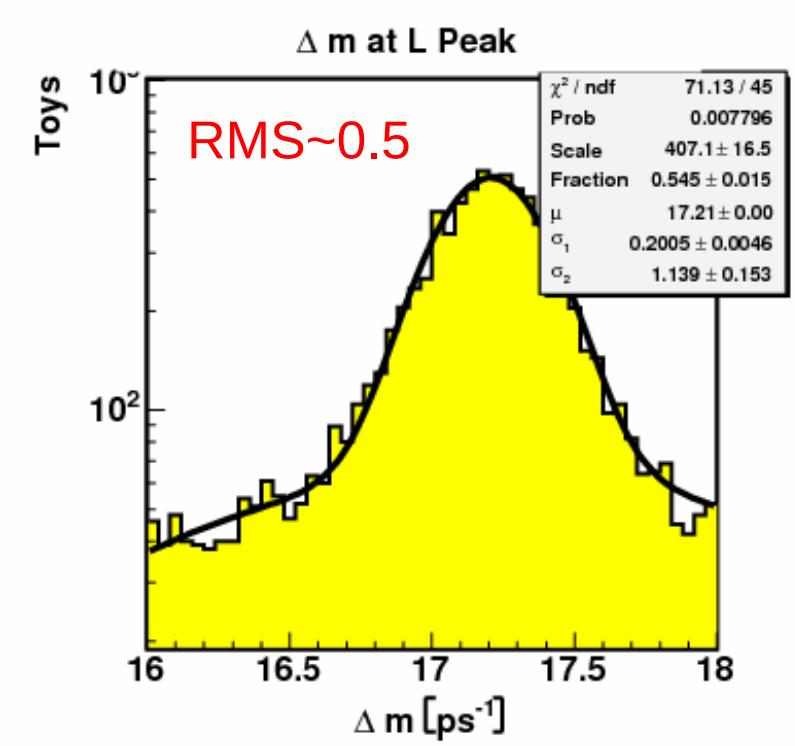


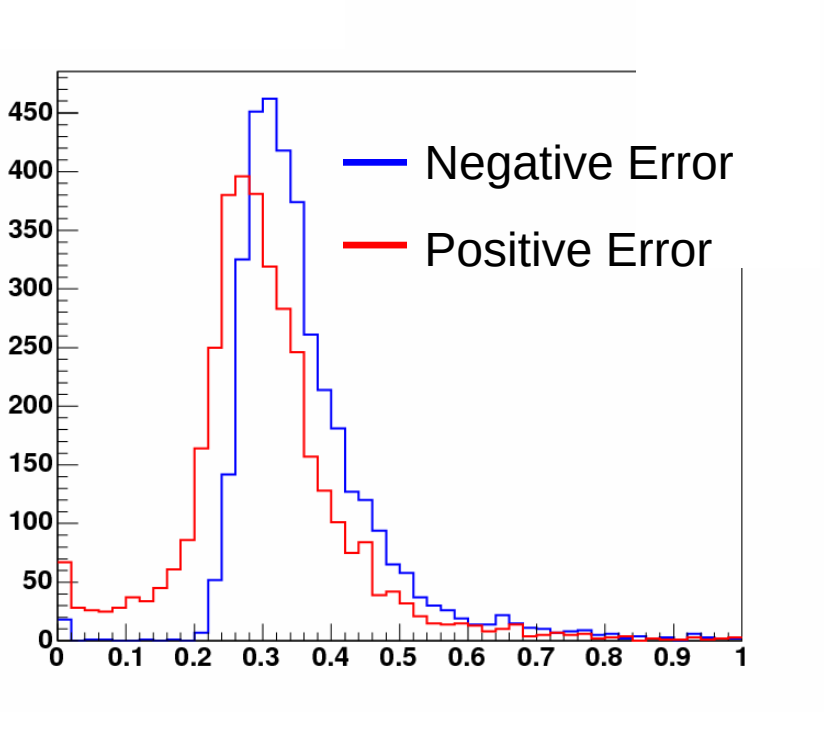


Toy Montecarlo: Δm resolution

Two approaches:

- Fit pulls distributions and measure width
- Fit two parabolic branches to L minimum in a toy by toy basis

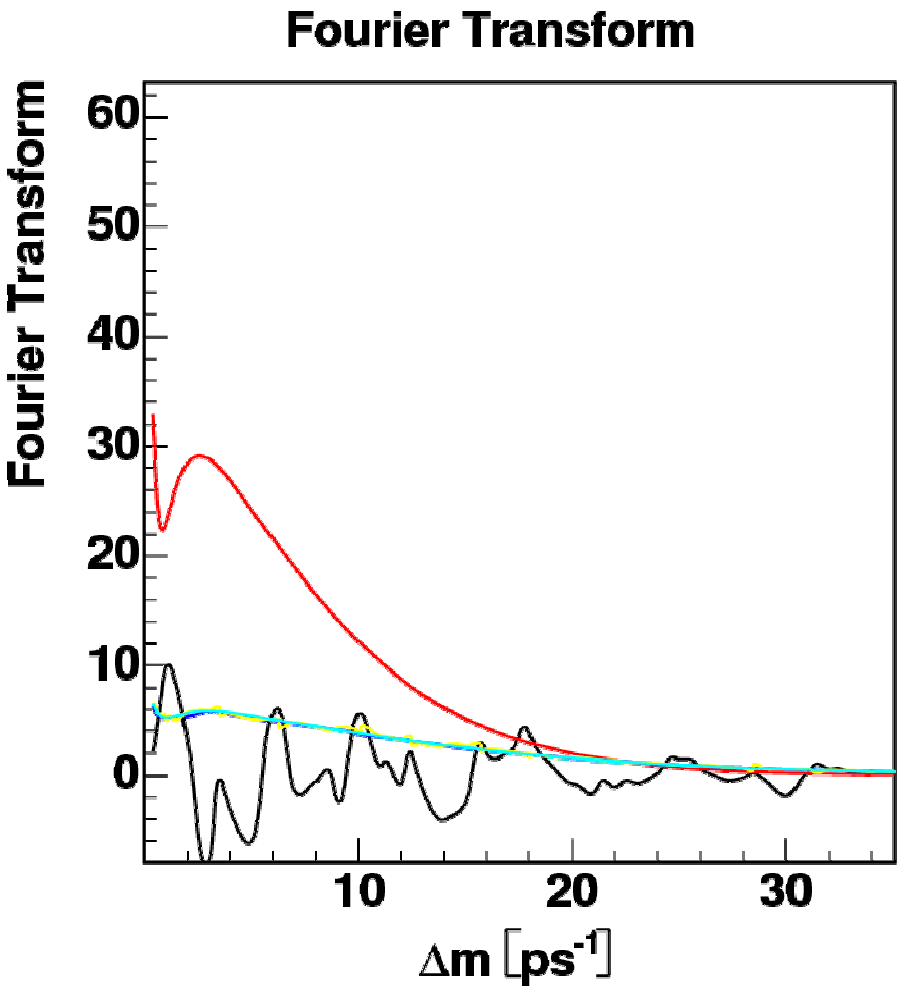


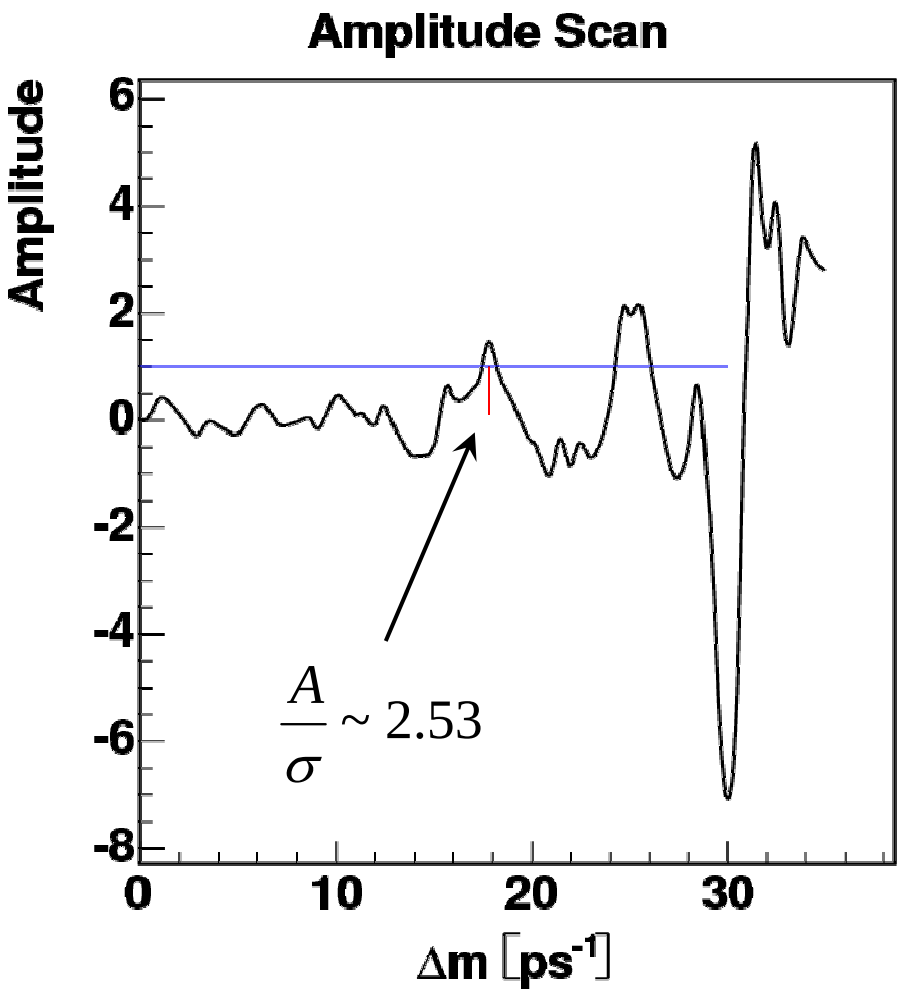


Data

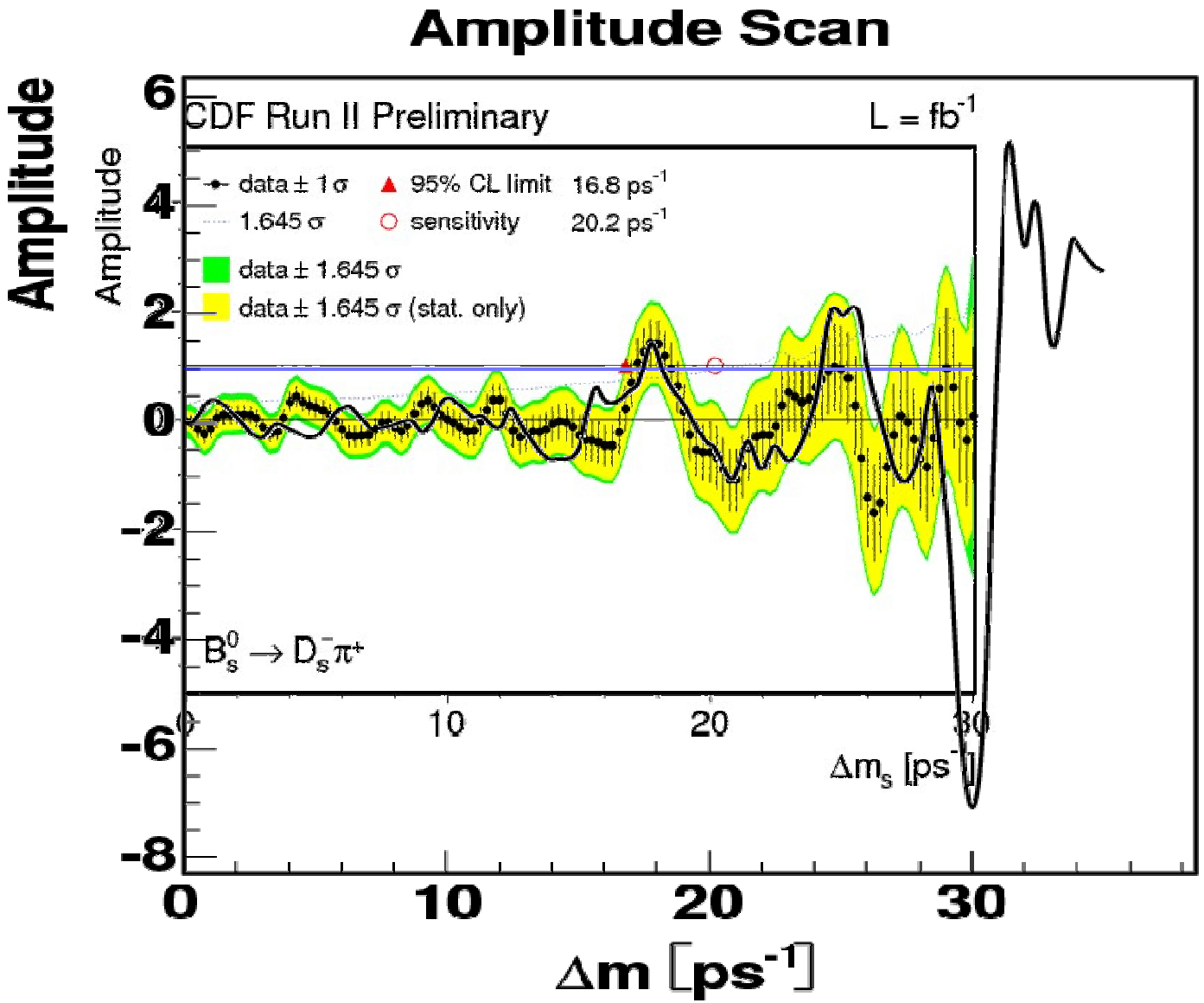
All the plots you are going to see are based on Fourier transform & toy montecarlo distributions, unless explicitely mentioned

Data: Fourier and Amplitude



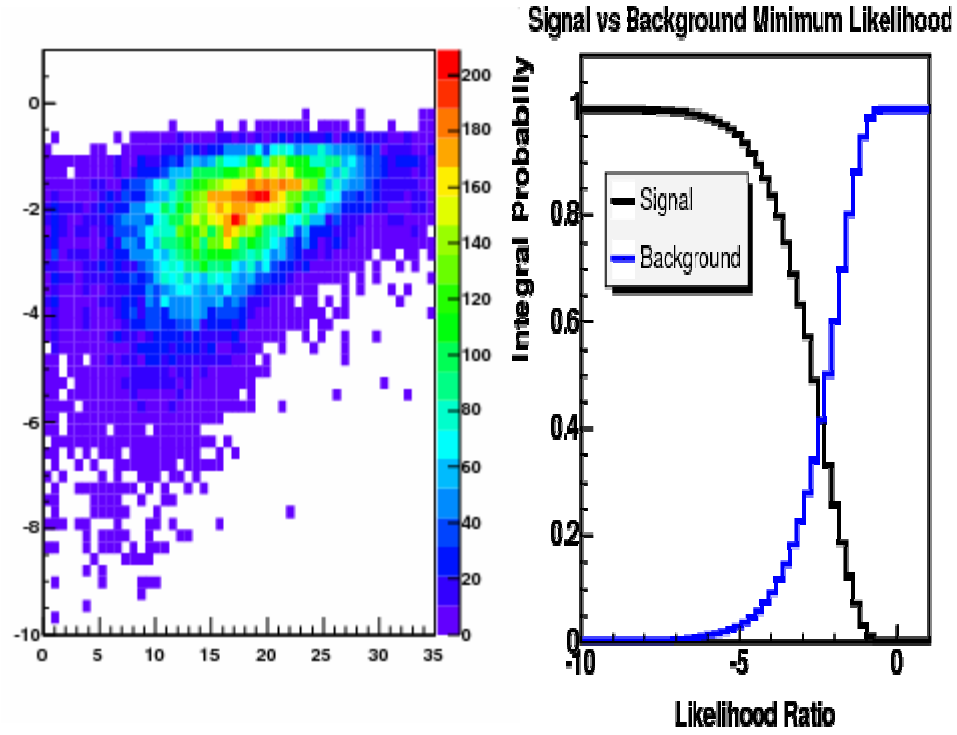


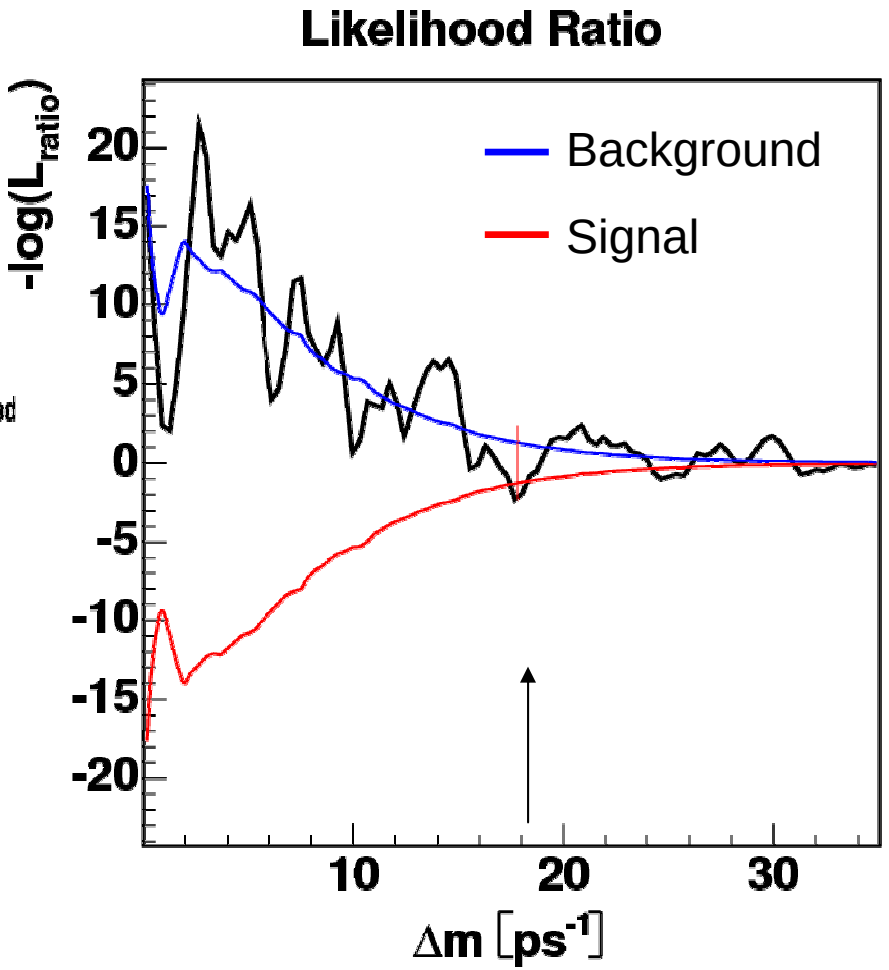
Compare with standard A-scan



Data: Where we look for a Peak

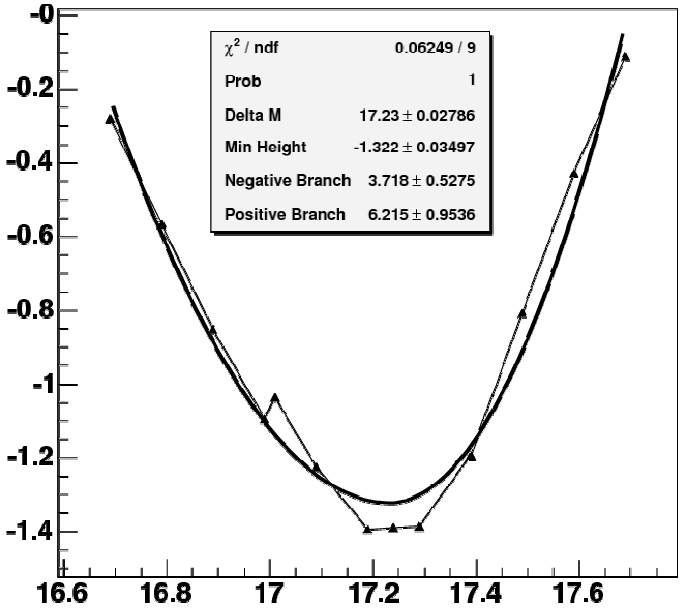
- Automated code looks for $-\log(L_{ratio})$ minimum
- Depth of minimum compared to toy MC distributions gives signal/background probabilities





Data Results

- Peak in L ratio is: -2.84 (A/σ=2.53)
  - Detection (signal) probability: 53%
  - False Alarm (background fake) probability: 25%
- Likelihood profile:



$$\Delta m_s = 17.23^{+0.41}_{-0.55}\, ps^{-1}$$

Conclusions

- Worked the exercise all the way through
- Method:
  - Assessed
  - Viable
  - Power equivalent to standard technique
- Completely independent set of tools/code from standard analysis, consistent with it!
- Tool is ready and mature for full blown study
- Next: document and bless result as proof-of-principle