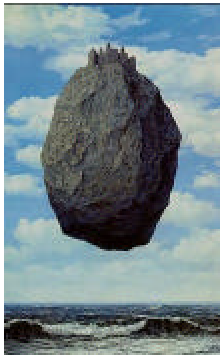


Mixing: a tasty stone soup

Alessandro Cerri

LBNL

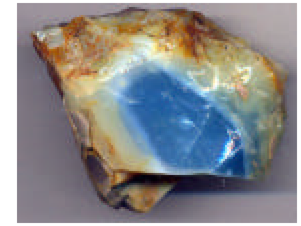
THIS TALK IS BASED ON NON BLESSED CDF RESULTS AND IS INTENDED FOR CONSUMPTION INTERNAL TO THE EXPERIMENT ONLY

Introduction

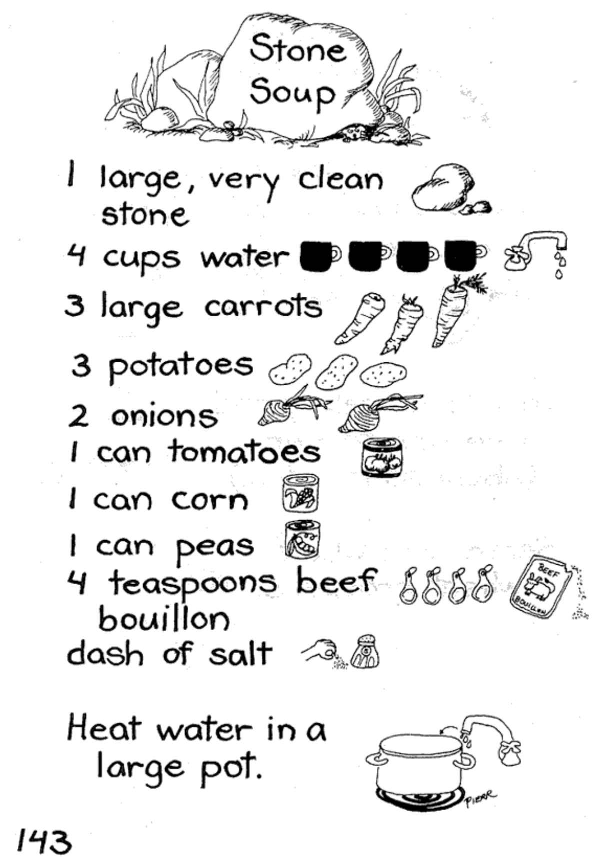
- Topics in progress:
  - Invite people to take part into the “real action”
  - Broadening our understanding of “Δm_s tools”
- Several interesting topics
- Lots of room for improvements
- Selection is arbitrary, but not far from thorough (ouch!)

Topics

(there is more to a stone soup than just the stone)



- Primary Vertex reconstruction
- Properties of tracks around B mesons
- PID:
  - dE/dx
    - COT
    - Si
  - TOF
  - Joint



Primary Vertex

Primary Vertex Reconstruction

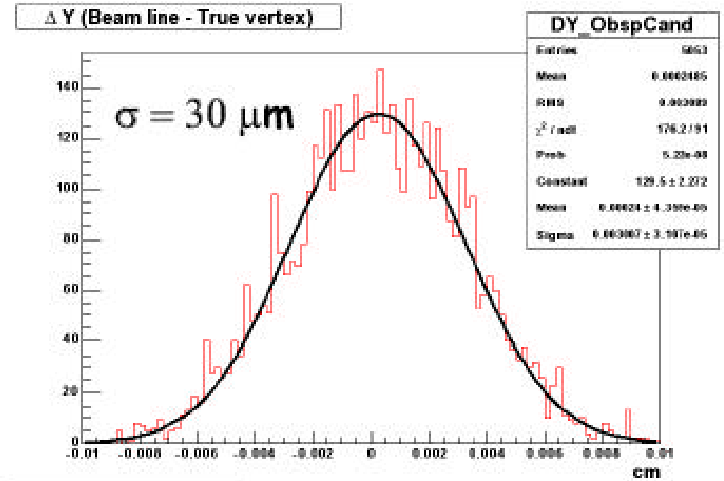
- Lifetime resolution is a fundamental ingredient for a sensitive Δm_s analysis
- Traditionally the B group avoids bias rather than pushing resolution: beamline at candidate's z_0
- We cannot accept this trade-off for x_s
- We want to use the Si reconstruction and the event information at its best

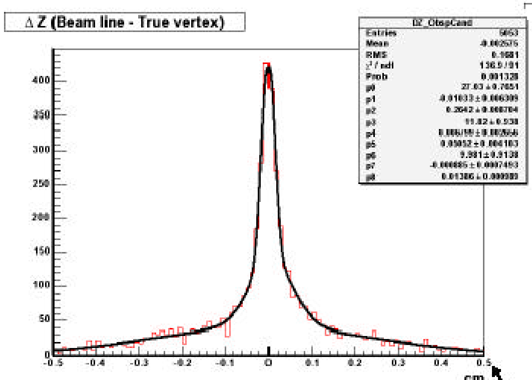
Event by event vertex!

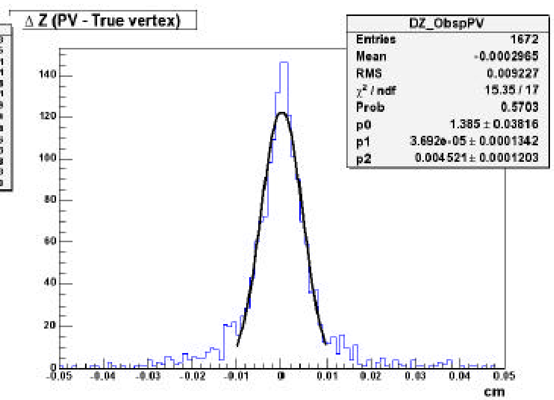
Event by Event Vertex

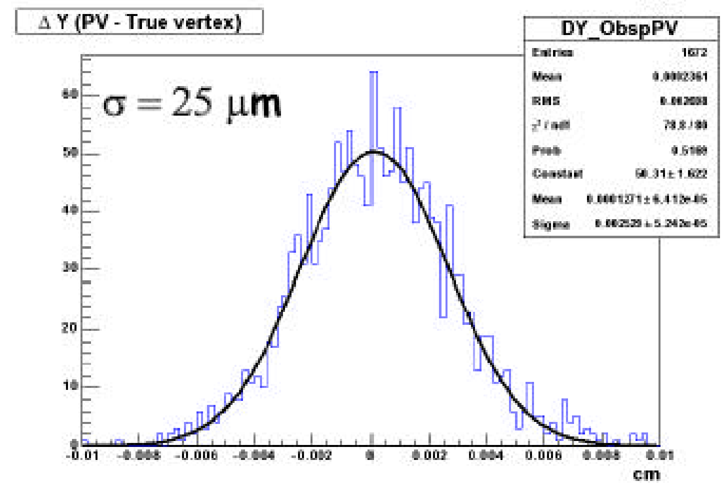
Padova, Roma, LBNL

- Montecarlo based studies available now
  - Modest improvement in (x,y)
  - Noticeable effect in z!
- Data based (J/ψ) in the pipeline









3 Gaussians:
55% σ = 2.6 mm
24% σ = 505 μm
21% σ = 139 μm

Different scale

σ = 45 μm

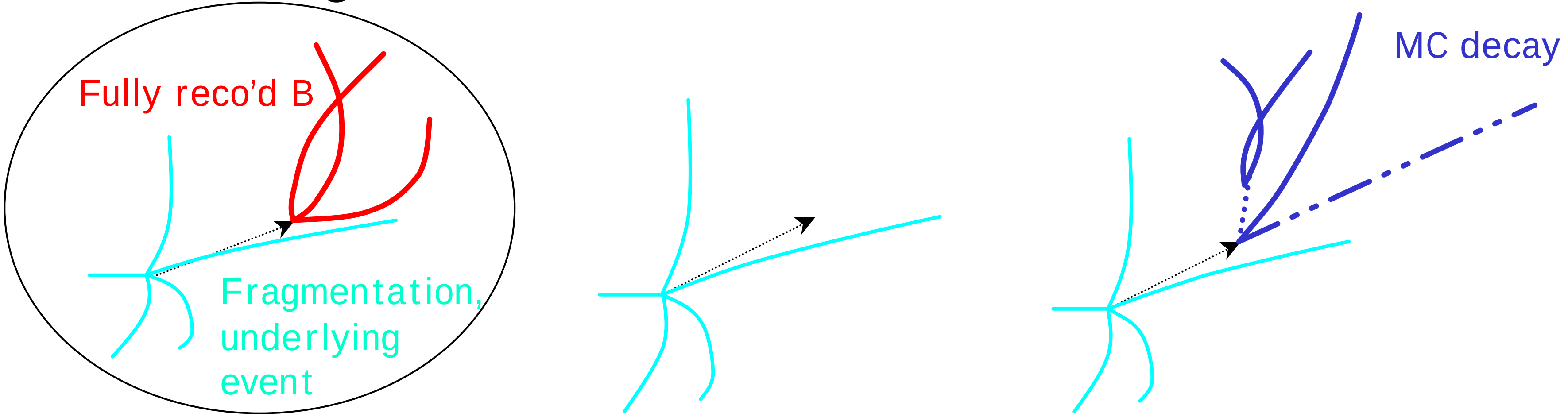
What is sitting around a reconstructed B?

(SST)

Tracks around B mesons

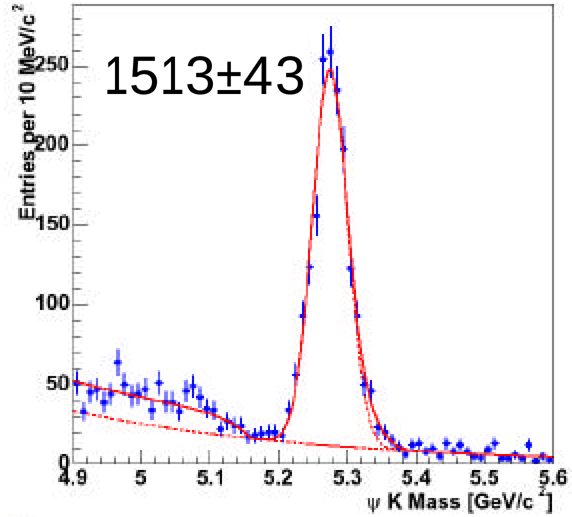
LBNL

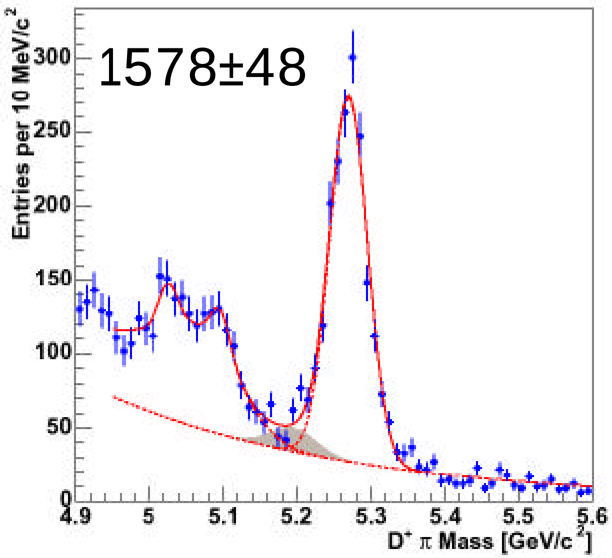
- Fragmentation tracks are the salt of SS(K)T
- Current SST based on Run I “facts”
- We have to push the performance as much as we can
  - Refine understanding of fragmentation
  - Transfer knowledge to MC
  - Optimize SS(K)T performance
- This is part of the studies carried on for an “embedding montecarlo”:

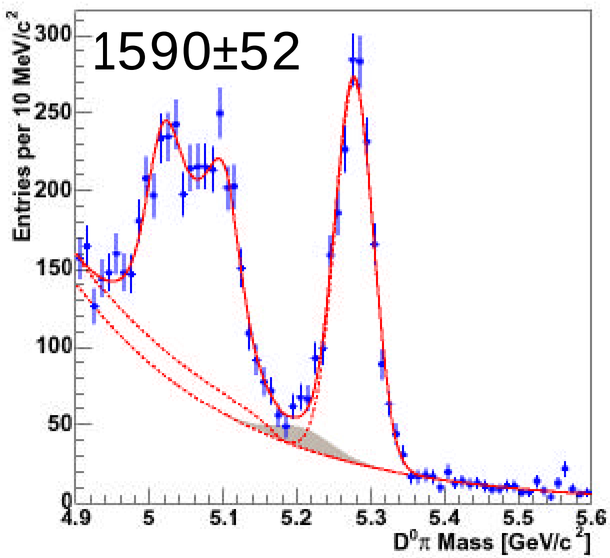


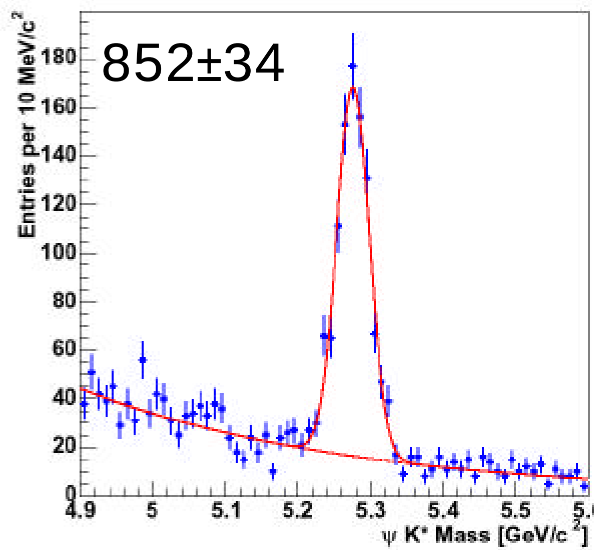
Properties of Tracks about B Mesons

- Samples:
  - Leptonic: ψK_s, ψK^*
  - Hadronic: $D^0\pi$, $D^+\pi$
- Sideband subtraction performed everywhere

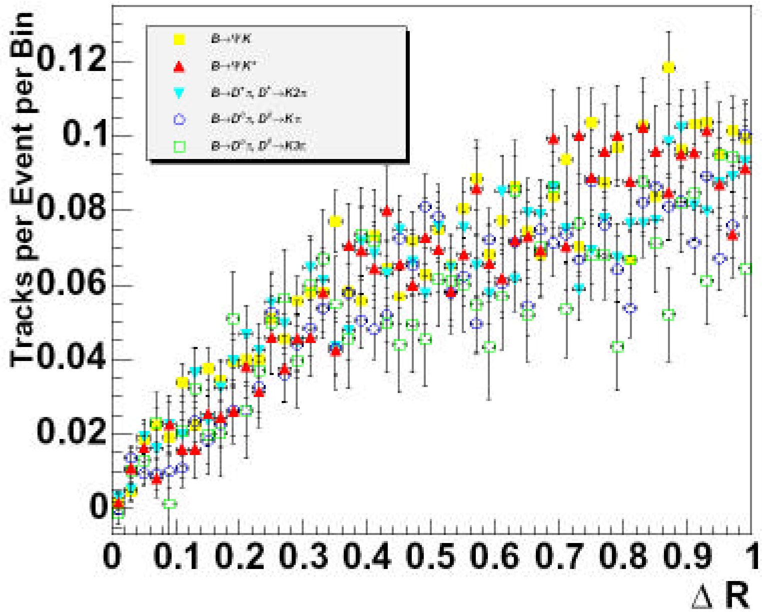


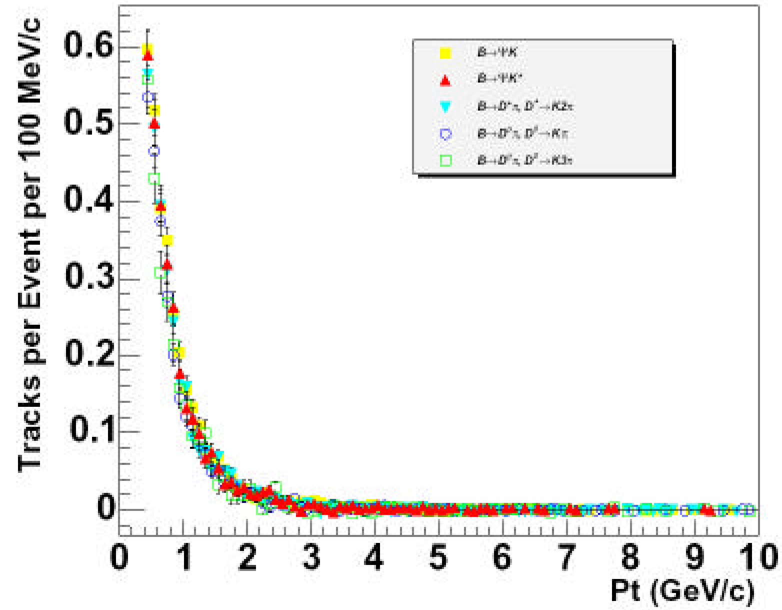


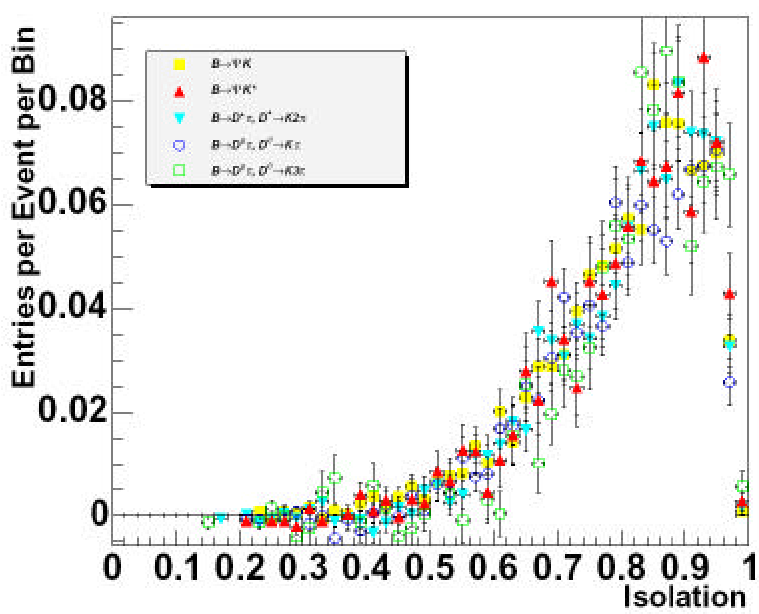




Tracks around ΔR≤1







Tagging properties

	$B^+ \to \psi K^+$	$B^+ \to D^0\pi^+$ $D^0 \to K\pi$	$B^+ \to D^0\pi^+$ $D^0 \to K3\pi$	$B^0 \to \psi K^*$	$B^0 \to D^+\pi^-$ $D^+ \to K\pi\pi$
N_{ch}	3.24 ± 0.06	2.78 ± 0.05	2.76 ± 0.05	3.09 ± 0.06	2.90 ± 0.05
N_{ch}^{OS}	1.77 ± 0.04	1.53 ± 0.03	1.56 ± 0.04	1.53 ± 0.04	1.49 ± 0.03
N_{ch}^{SS}	1.47 ± 0.04	1.25 ± 0.03	1.20 ± 0.04	1.56 ± 0.04	1.41 ± 0.03
p_t	0.93 ± 0.01	0.87 ± 0.007	0.85 ± 0.005	0.92 ± 0.01	0.90 ± 0.007
Iso	0.81 ± 0.003	0.81 ± 0.002	0.85 ± 0.002	0.81 ± 0.003	0.82 ± 0.003
ΔR	0.62 ± 0.004	0.62 ± 0.003	0.60 ± 0.004	0.62 ± 0.004	0.60 ± 0.003

Table 1: The average value of various tracking quantities for the 5 samples described in the text. In all cases, tracks are required to have at more than 2 axial silicon hits. Only tracks with $\Delta R < 1.0$ with respect to the B meson are included. Uncertainties quoted here are statistical only.

	$B^+ \to \psi K^+$	$B^+ \to D^0\pi^+$ $D^0 \to K\pi$	$B^+ \to D^0\pi^+$ $D^0 \to K3\pi$	$B^0 \to \psi K^*$	$B^0 \to D^+\pi^-$ $D^+ \to K\pi\pi$
N_{ch}	3.35 ± 0.07	3.12 ± 0.05	3.07 ± 0.08	3.17 ± 0.07	3.21 ± 0.05
N_{ch}^{OS}	1.82 ± 0.04	1.72 ± 0.04	1.73 ± 0.05	1.56 ± 0.04	1.67 ± 0.04
N_{ch}^{SS}	1.53 ± 0.04	1.39 ± 0.04	1.34 ± 0.05	1.60 ± 0.04	1.53 ± 0.04
pt	0.95 ± 0.01	0.87 ± 0.008	0.84 ± 0.003	0.90 ± 0.004	0.86 ± 0.007
Iso	0.80 ± 0.004	0.81 ± 0.003	0.84 ± 0.003	0.81 ± 0.004	0.82 ± 0.003
ΔR	0.62 ± 0.004	0.63 ± 0.004	0.60 ± 0.005	0.62 ± 0.005	0.62 ± 0.004

Table 2: The average value of various tracking quantities for the 5 samples described in the text. These results differ from Table 1 in that the pseudorapidity range of the B candidate is now limited to $|\eta_B^{detector}| < 0.6$

To-do

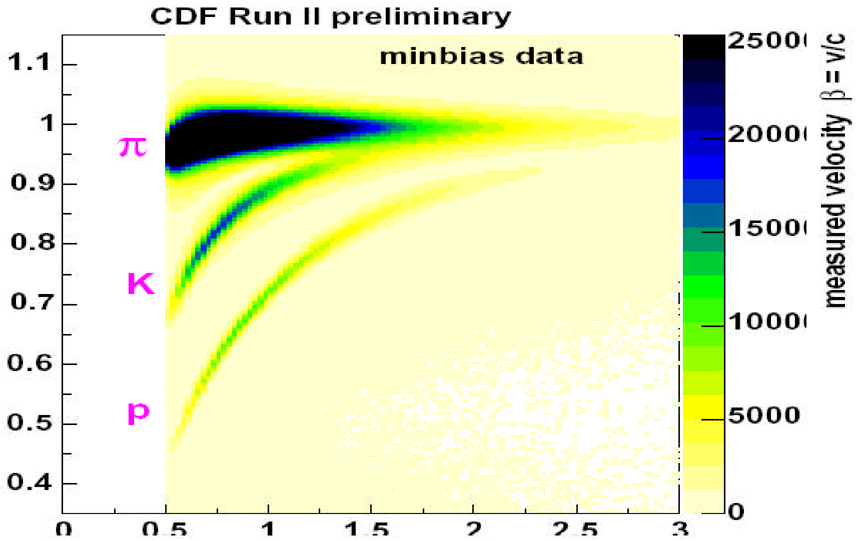
- Compare with MC
- Repeat with B_s
- Propagate the information/tools to flavour tagging!

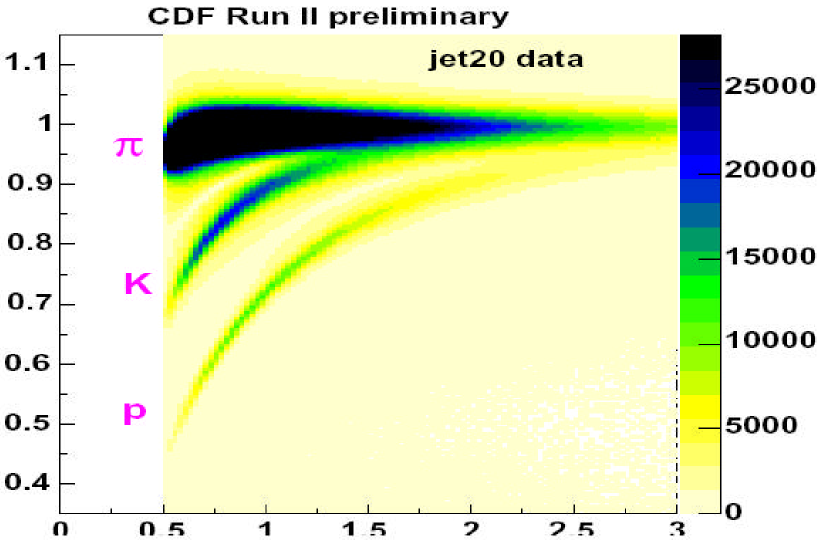
Particle ID

PID: TOF

Rome, Pisa, Fermilab…

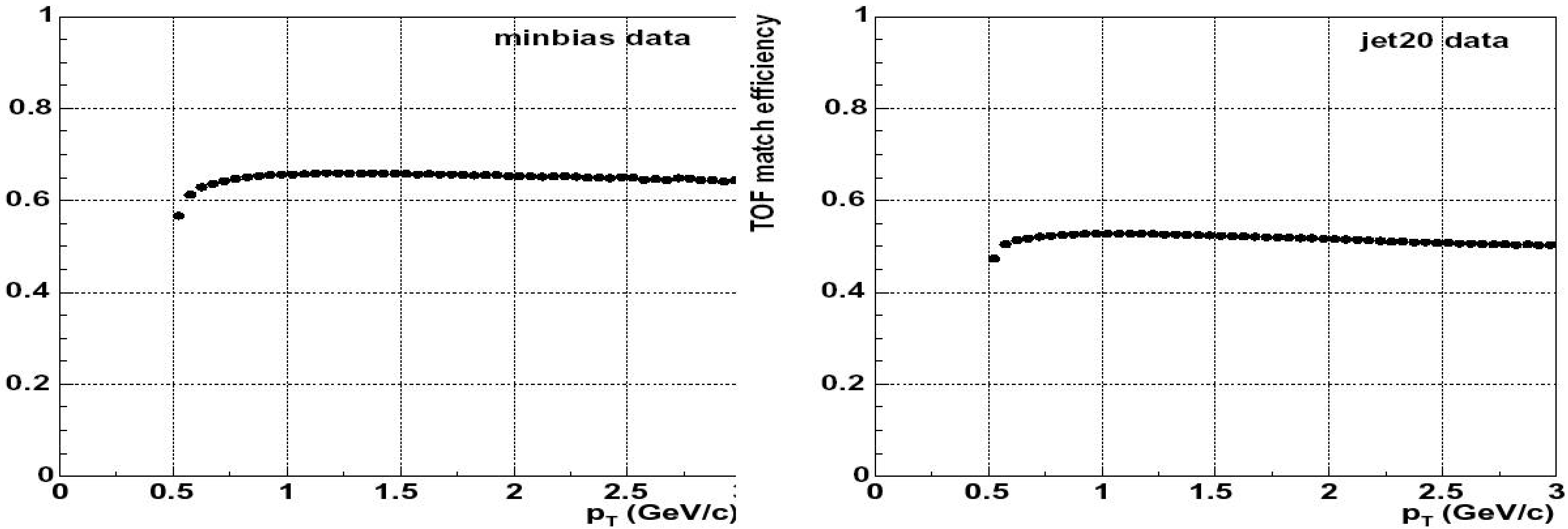
- Critical for Kaon-id
- I.E. critical for Δm_s
- Efficiency/separation are the main issues!





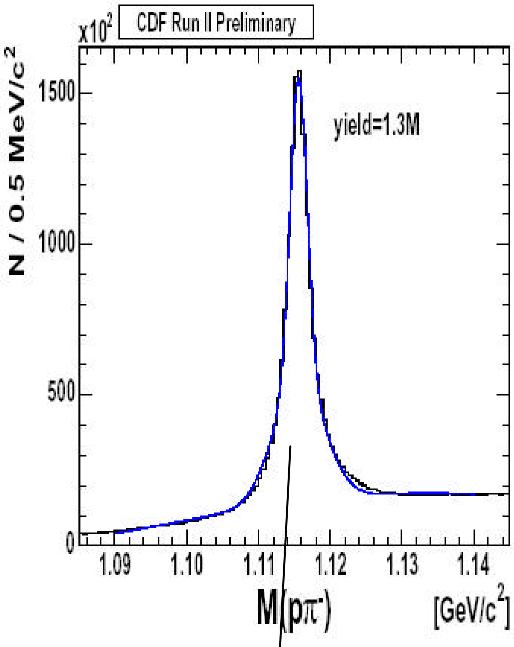
TOF Efficiency

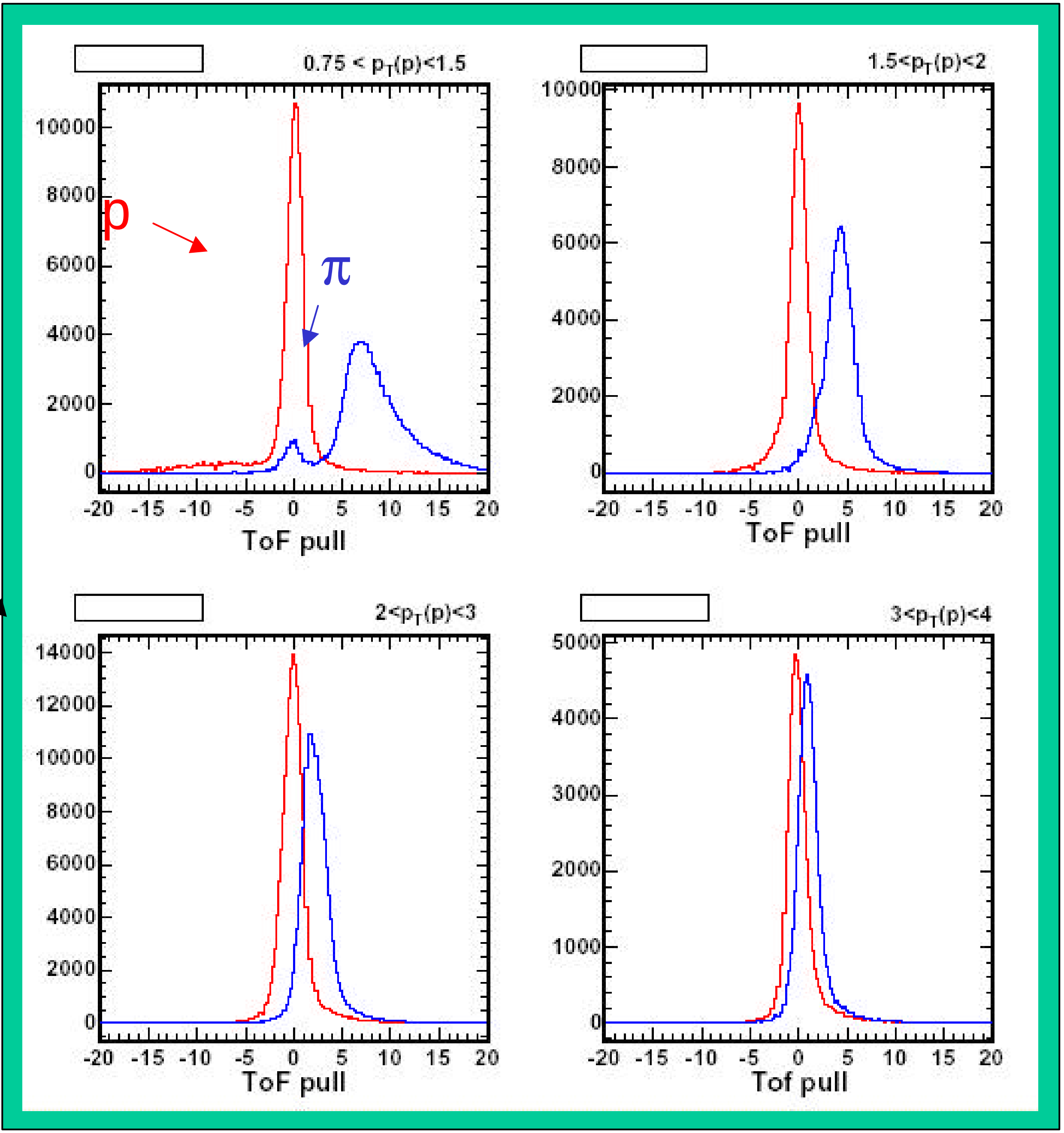
latest news from FNAL



- Efficiency improved WRT previous releases
- Intrinsic correlation with occupancy (unavoidable)
- Figure ~50-60%
- Can we live with it?

TOF separation





- Take p, π(, K?) from known source (Λ decay)
- Study separation in Pt bins

dE/dx

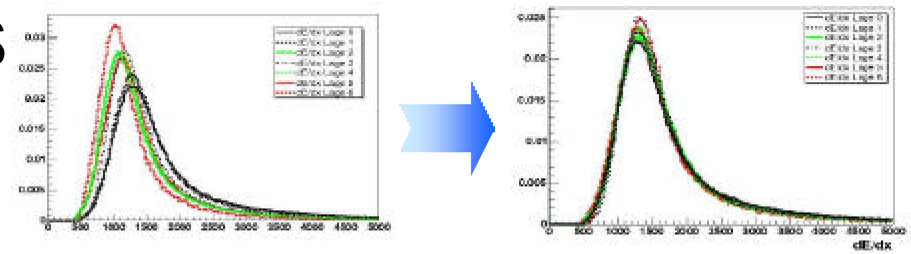
Penn, Pisa, Karlsruhe…

- “Standard” dE/dx (COT-based)
  - Big progress has been made in the recent analyses (see Diego’s talk)
  - Separation close to what we had in Run I
  - Still lacking a systematic, top-down approach to the problem starting from low level (hit/wire/run) calibrations
- “Silicon” dE/dx is the real appealing news: we have an excellent radiator (~10% of rad. Length), let’s use it!

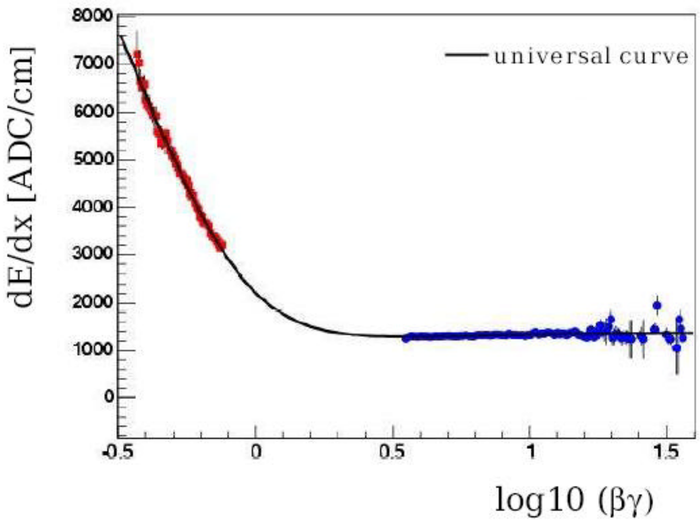
Si based dE/dx

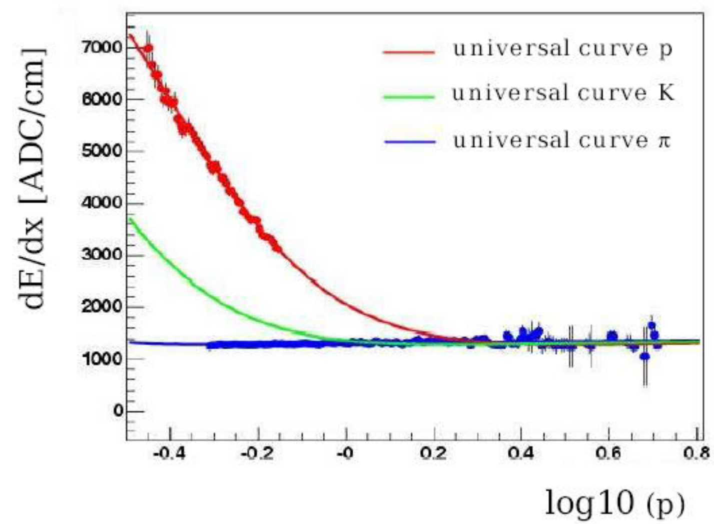
Karlsruhe

- ✓Layer level calibrations



- ✓Extraction of UC





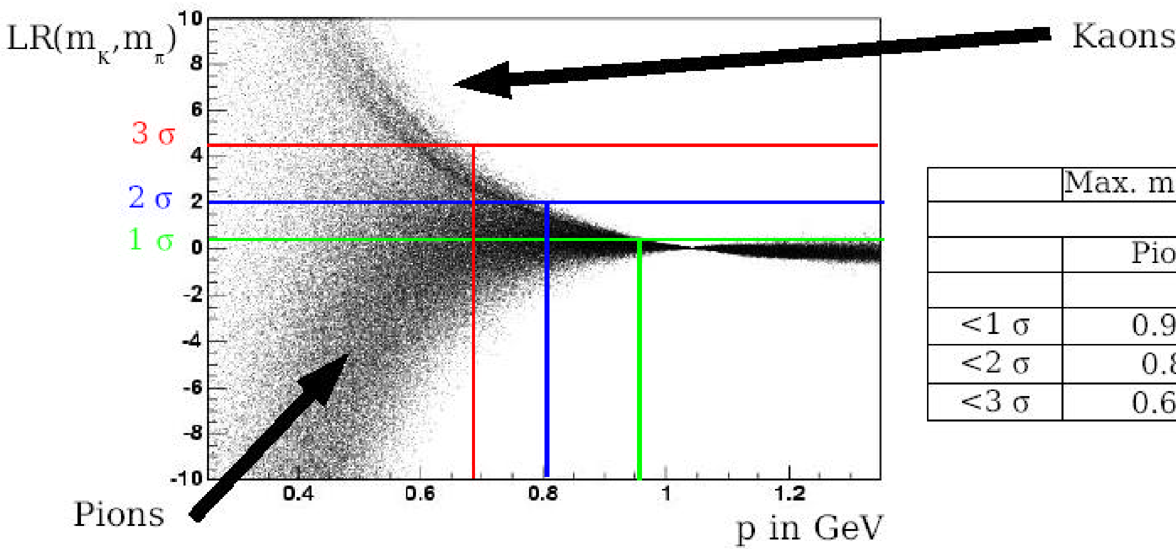
blue : pions from $D^{*\pm} \rightarrow D^0 \pi^\pm$

red : secondary protons , low momentum and |d0|>0.5 cm

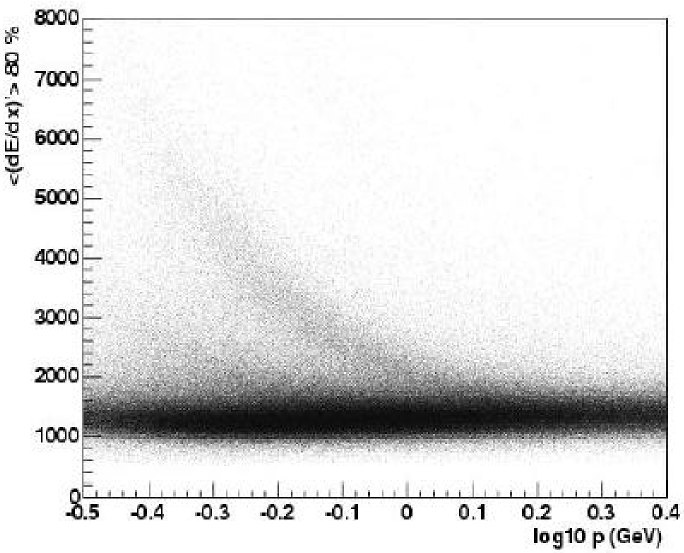
Likelihood ratio based separation

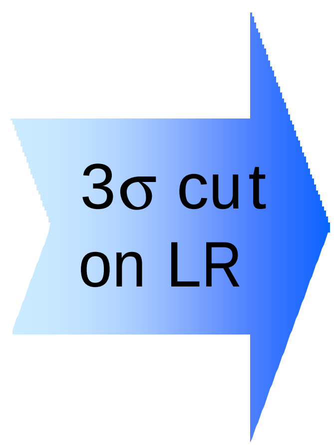
Karlsruhe

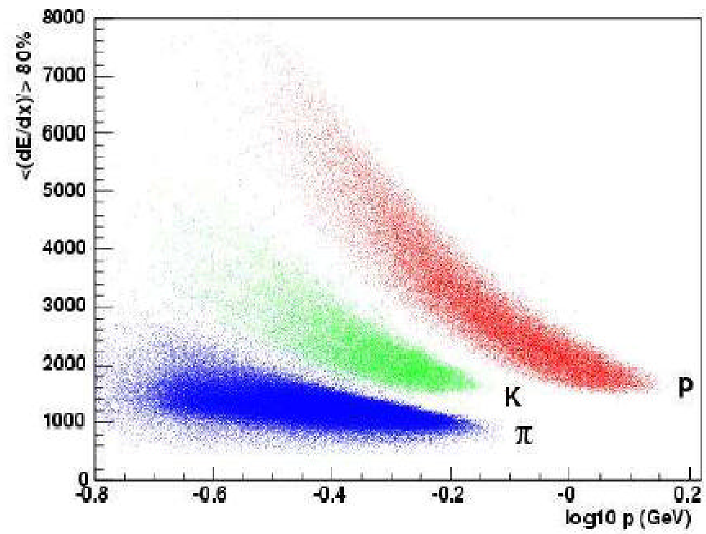
e.g. tracks with $|\eta|<1$ and #SiHits>8 :



	Max. momentum for PID in GeV		
	Pion	Kaon	Proton
$<1\ \sigma$	0.95	0.95	1.9
$<2\ \sigma$	0.8	0.8	1.6
$<3\ \sigma$	0.65	0.65	1.4

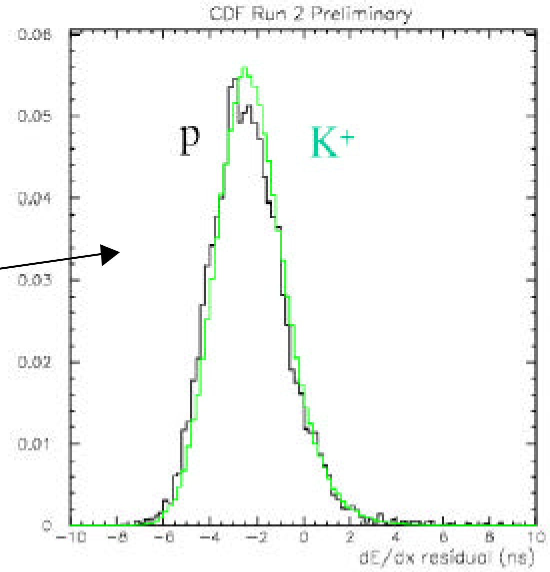




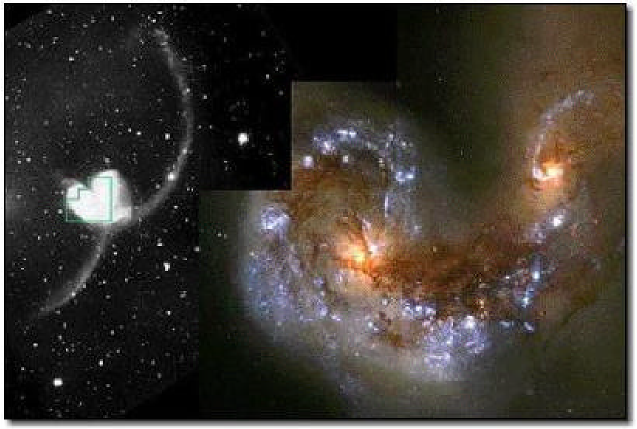


To-do

- TOF:
  - Efficiency? (single-ended hits)
  - Separation? (t0)
- dE/dx
  - Low level understanding of dE/dx(COT) corrections
  - Perfect dE/dx(Si)
- Improve studies on data:
  - good K samples (see Pierluigi)
  - Spectrum/geometrical distribution
  - Understand non-trigger objects!



Merging PID algorithms



- Excellent idea, but...
- Stage 0:
  - Exploit each individual algorithm to its full extent!
- Stage 1:
  - TOF+dE/dx (COT)
  - TOF+dE/dx (COT+Si)
- Stage 2:
  - All together
- Merging can emphasize either efficiency or separation

Conclusions

- Path to Δm_s full of low level issues to be addressed
- These are just the first steps:
  - A lot of room for improvements
  - There is a lot of technology to develop