First Look at Babar data to tune dE/dx and track hit efficiency in FastSim

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goal

- Replace the Babar PID tables with PID selectors built with basic ingredients simulated in FastSim: dE/dx (DCH+SVT), DIRC, TOF, etc.
  - It requires a precise enough description of the basic ingredients

- The current SuperB drift chamber baseline configuration is similar to Babar for what the measurement of dE/dx is concerned
  - Use Babar data to study the performance of dE/dx (DCH) and tune a realistic simulation

current status

- $\langle dE/dx \rangle_{hit}$ of the single hit is evaluated using the Bethe Bloch formula
- $\sigma(\langle dE/dx \rangle_{hit}) = \alpha \left(\frac{dE}{dx} \right)^{\beta} dx^{\gamma}$

α, β, γ tuned based on BAD1500 and some generic assumptions:

α = so that the K-π separation consistent with two plots in BAD1500

$\beta = 1$

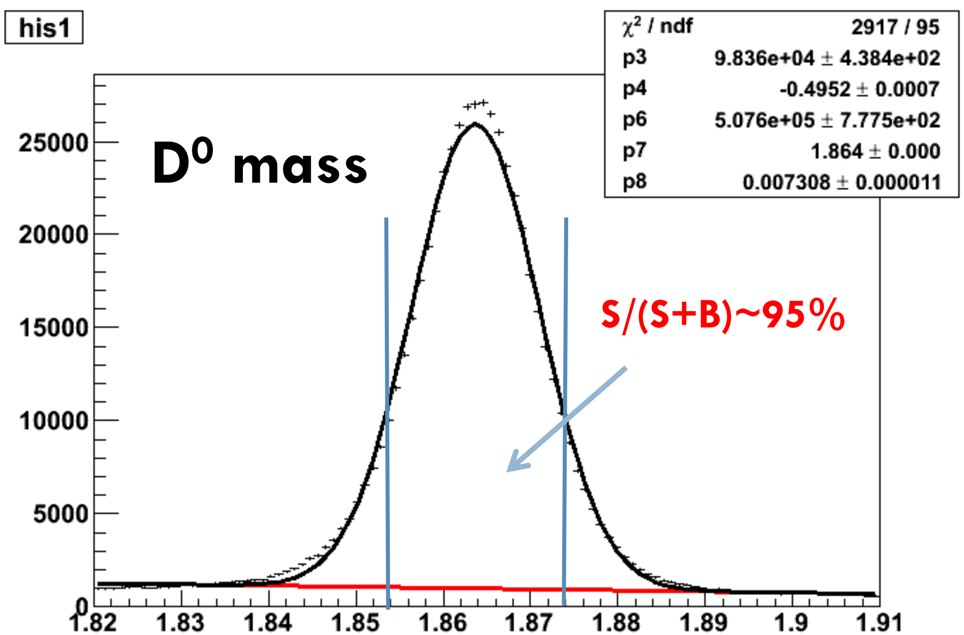
$\gamma = -0.5$

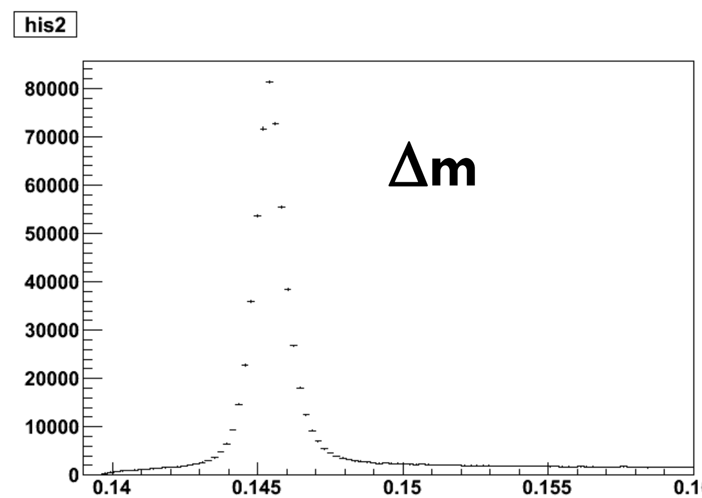
- $\langle dE/dx \rangle_{track}$ of the track is measured as a 'random' truncated average of $\langle dE/dx \rangle_{hit}$ of the track's hits
- dE/dx pulls are OK (μ=0, σ=1 by construction).
  See Leonid's talk at FastSim meeting 29 Apr 2010)

Selection of pure pions and kaons samples in Babar data

- Selection of $D^{*+} \rightarrow D^0\pi^+$, $D^0 \rightarrow K^-\pi^+$ (+ c.c.)

$|mD^0 - \langle mD^0 \rangle| < 1.5\ \sigma$
$144.45 < \Delta m < 146.45$ MeV

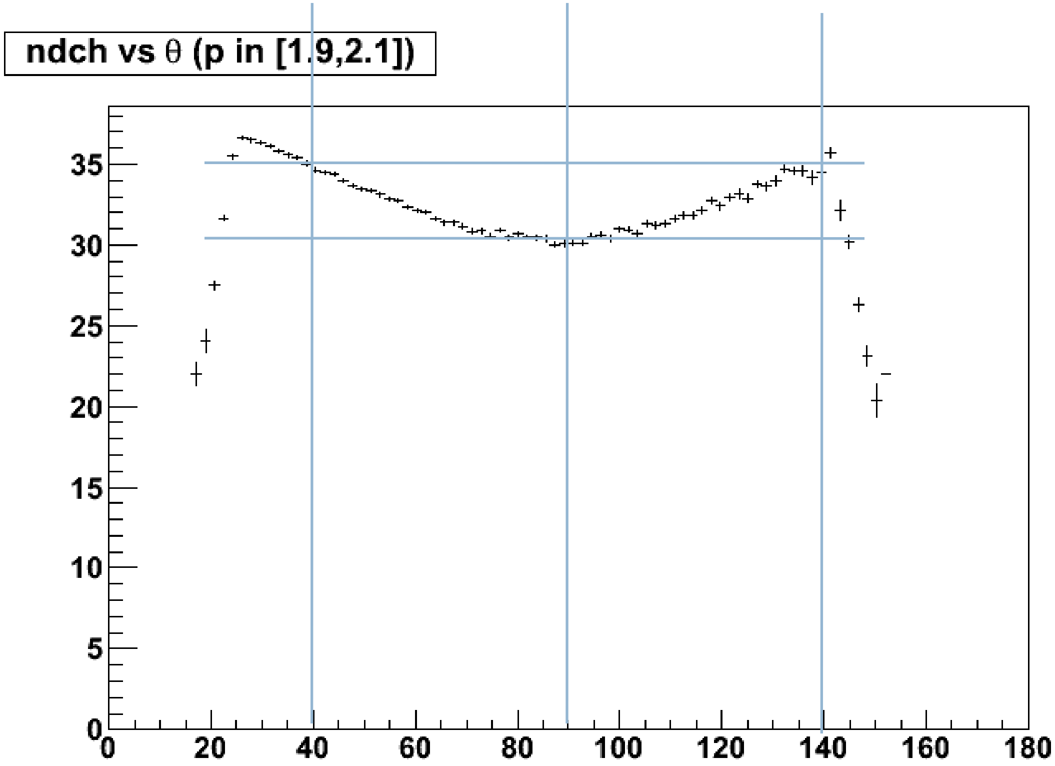


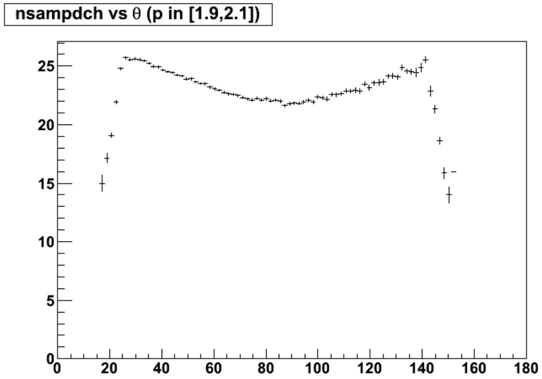


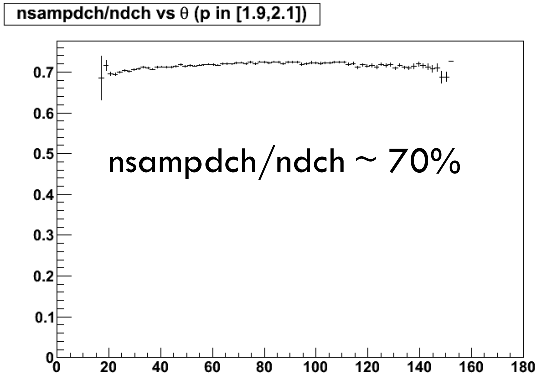
DCH hits as a function of θ

the #hits drops by ~15% from θ=40° to θ=90°

(in FastSim the hit efficiency does not depend on θ at present)

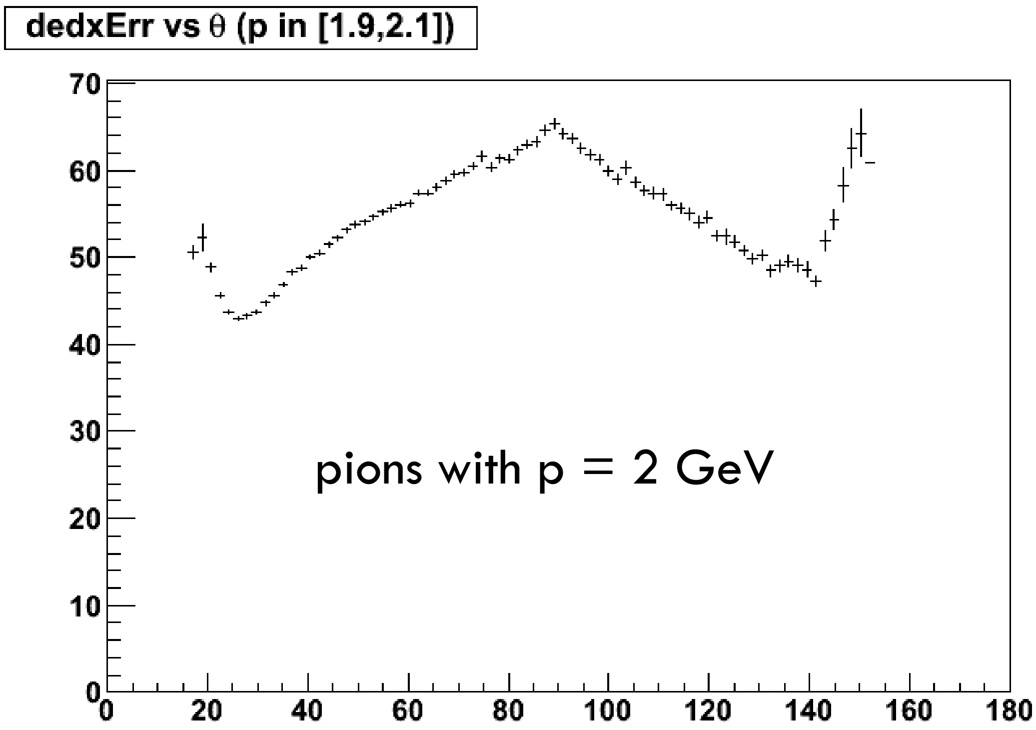






σ(dE/dx) vs θ (pions)

I want to fit this distribution to measure γ :



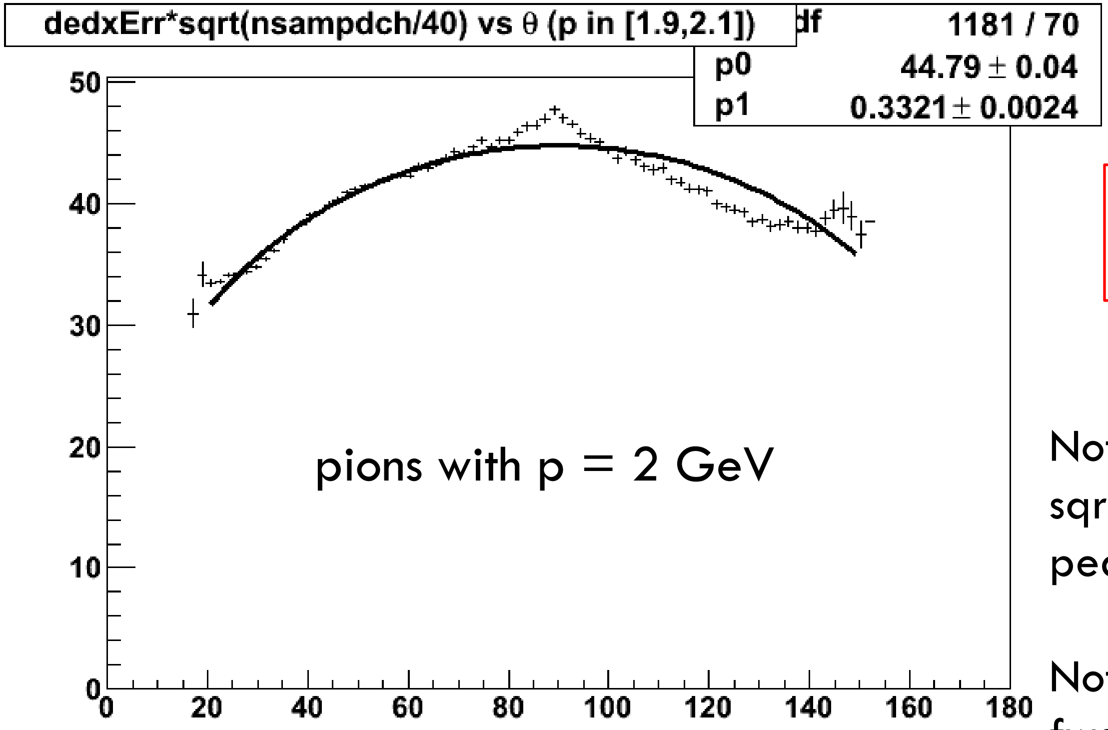
$$\sigma\left(\frac{dE}{dx}\right) = \alpha\left(\frac{dE}{dx}\right)^{\beta} dx^{\gamma}$$

dx~h/sin(θ)
h=cell height

But before fitting, I rescale the distribution by sqrt(N_hit), **assuming that the error scales as 1/sqrt(N_hit)**

The result in the next slide

σ(dE/dx) vs θ (pions)



$\longleftrightarrow$ p1 = - γ

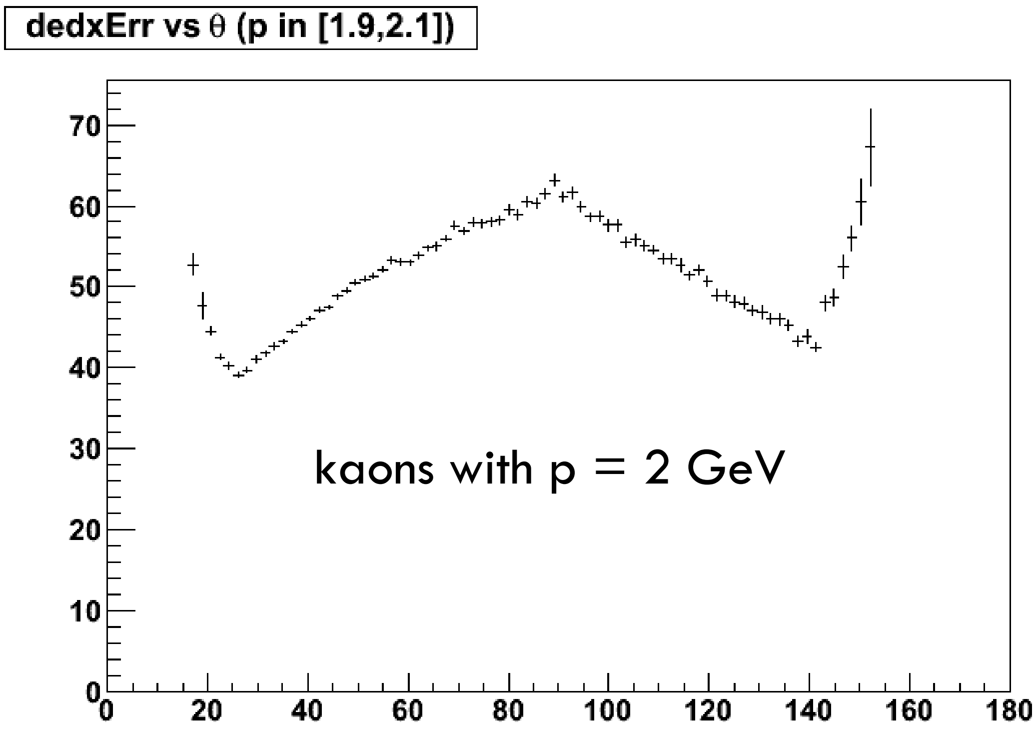
➔ γ = -0.33
(it is -0.5 in FastSim at present)

Note 1: the normalization by sqrt(N_hit) has *almost* removed the peaks in the fwd/bwd regions

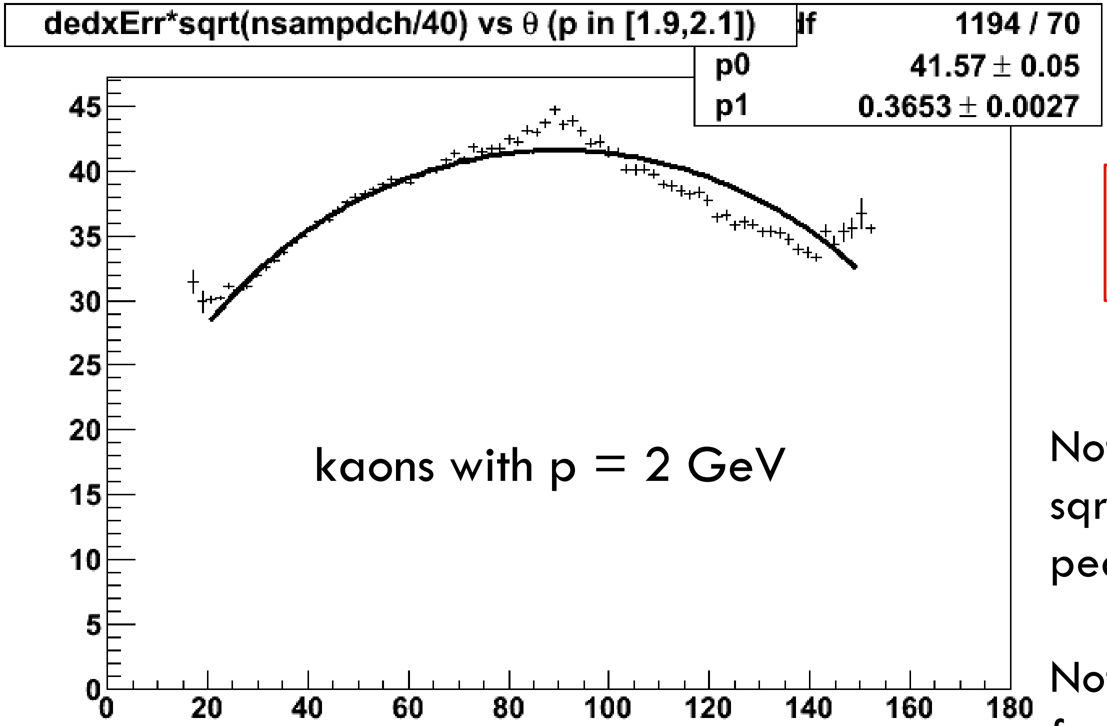
Note 2: the distribution is significantly fwd-bwd asymmetric

σ(dE/dx) vs θ (kaons)

The same for kaons…



σ(dE/dx) vs θ (kaons)



$\leftrightarrow$ p1 = - γ

➔ γ = -0.37
(it is -0.5 in FastSim at present)

Note 1: the normalization by sqrt(N_hit) has *almost* removed the peaks in the fwd/bwd regions

Note 2: the distribution is significantly fwd-bwd asymmetric

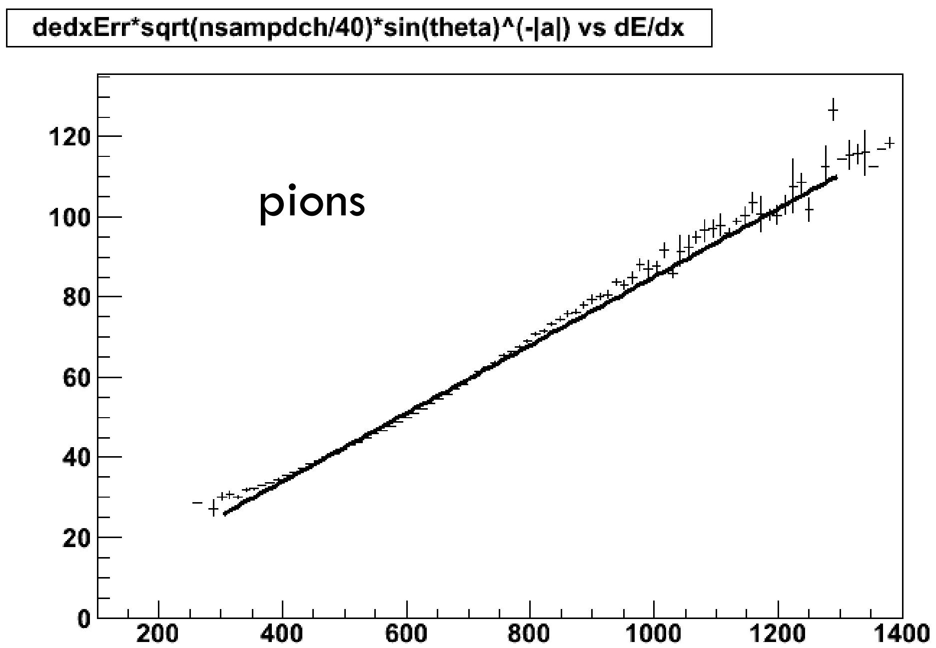
good agreement between pions and kaons

σ(dE/dx) vs dE/dx (pions)

Now I want to "measure" α and β:

$$\sigma\left(\frac{dE}{dx}\right) = \alpha\left(\frac{dE}{dx}\right)^{\beta} dx^{\gamma}$$

I take σ(dE/dx) vs dE/dx after having normalized σ(dE/dx) by sqrt(N_hit)/dx$^{\gamma}$



Not a real fit: I consider y(x)=par0*x and find the value of par0 that 'fits' reasonably well. If such value exists, then it means that α=par0 and β=1 is a reasonable assumption

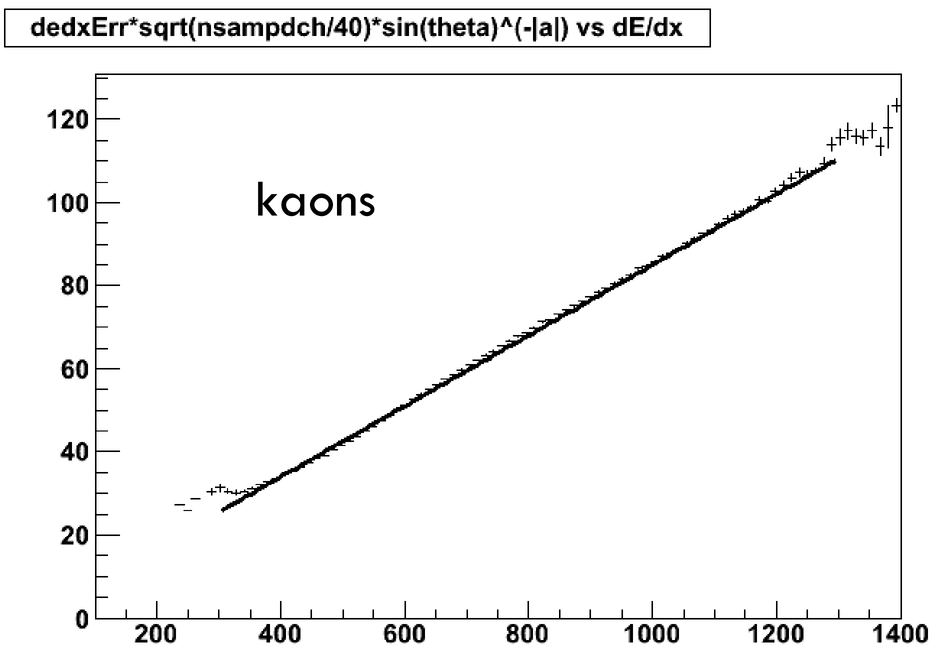
In the plot on the left:
α=0.085
β=1

σ(dE/dx) vs dE/dx (kaons)

same for kaons

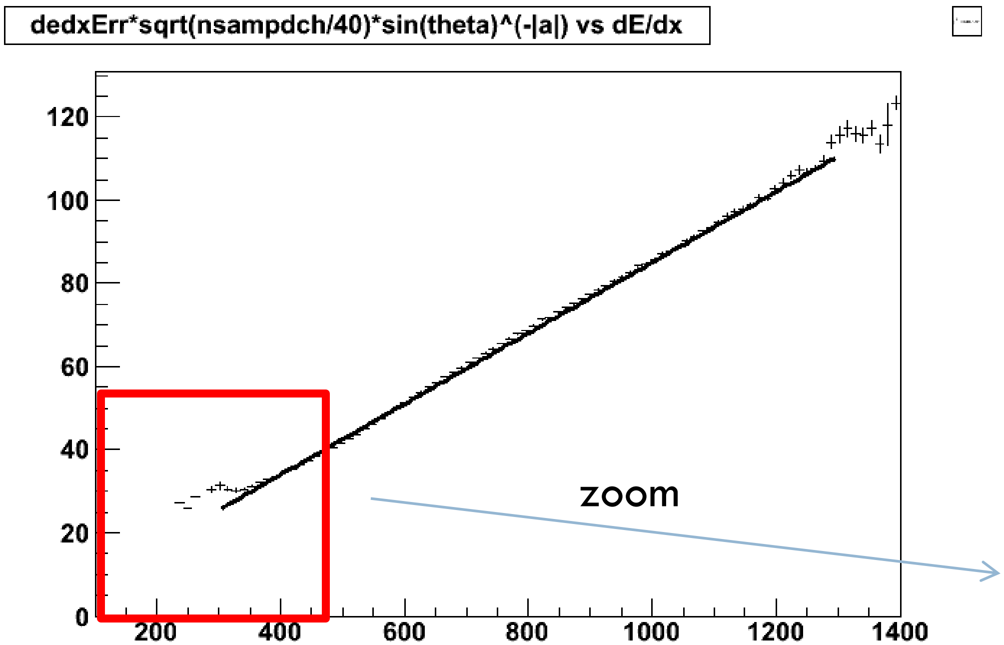
In the plot below:
α=0.085
β=1

$$\sigma\left(\frac{dE}{dx}\right) = \alpha\left(\frac{dE}{dx}\right)^{\beta} dx^{\gamma}$$

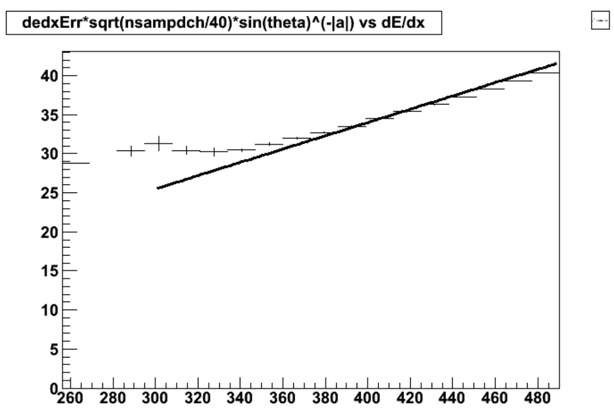


good agreement between pions and kaons

σ(dE/dx) vs dE/dx (kaons)

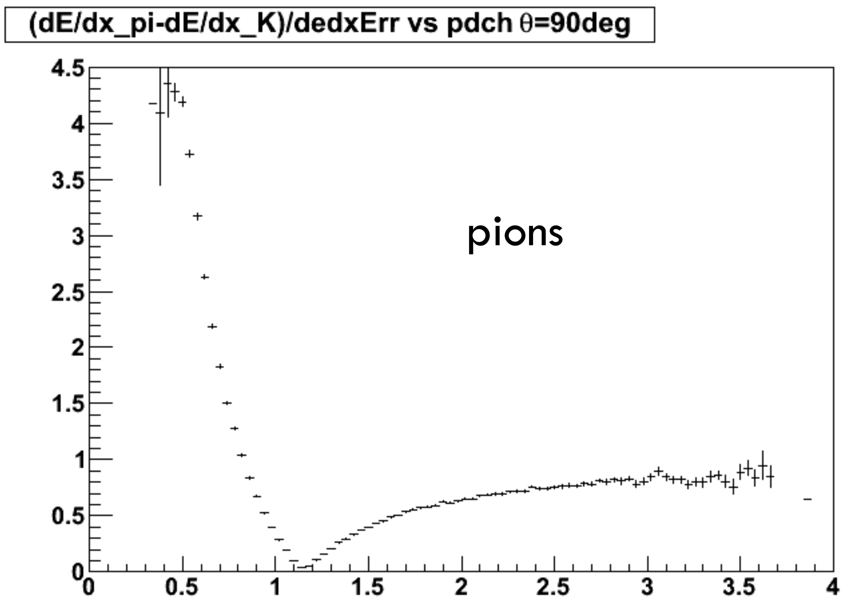


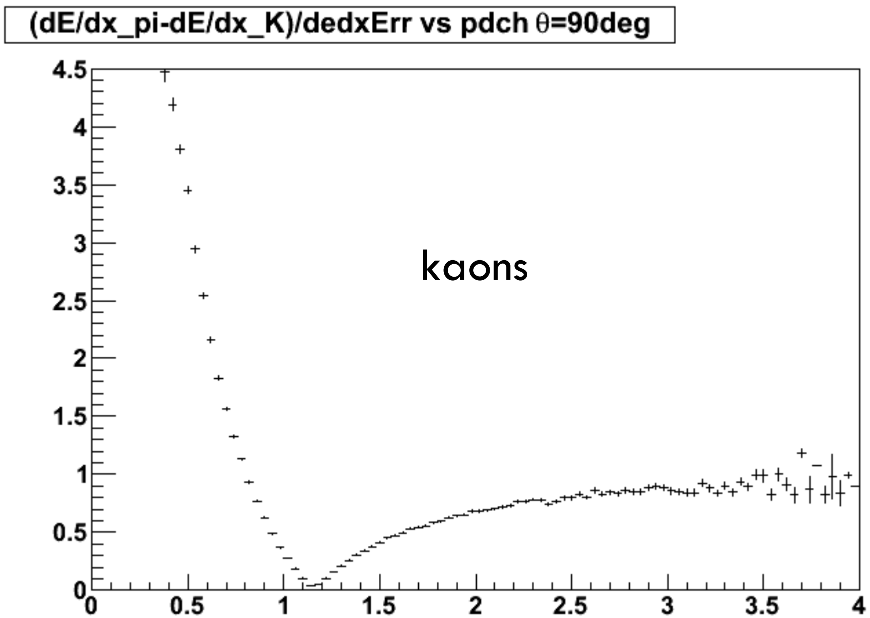
Some effects must be investigated in more detail



Kaon-pion separation with dE/dx

$\theta = 90°$

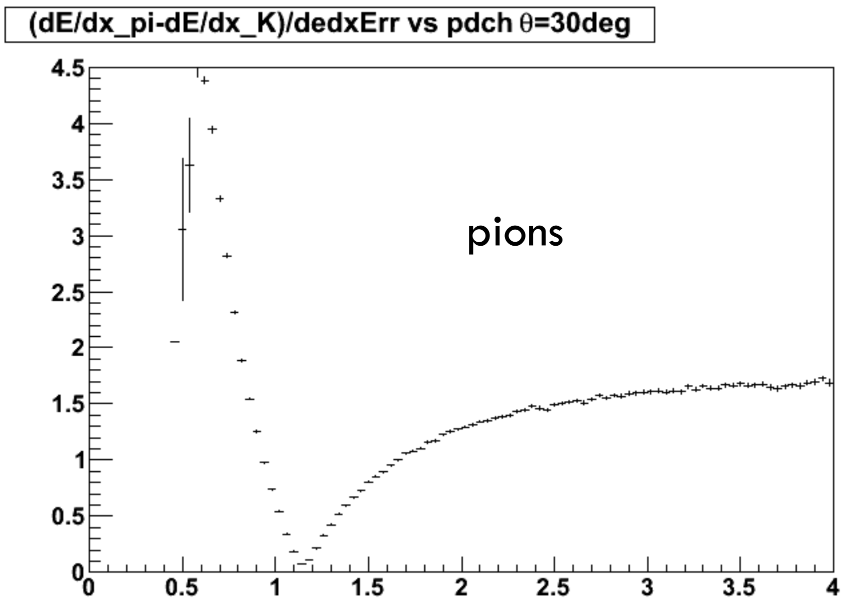


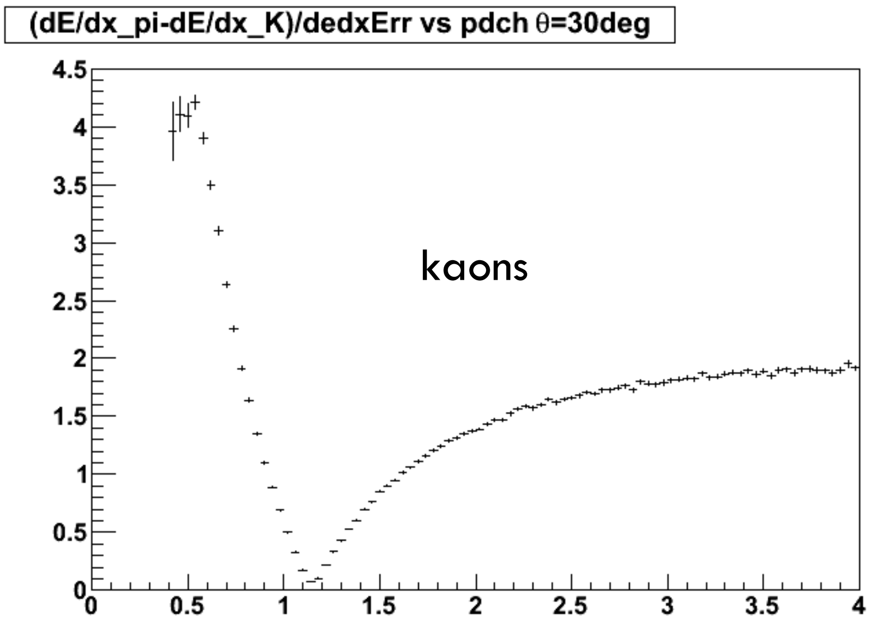


separation = [dE/dx_(exp pion)-dE/dx_(exp kaon)]/σ(dE/dx)

Kaon-pion separation with dE/dx

$\theta = 30°$

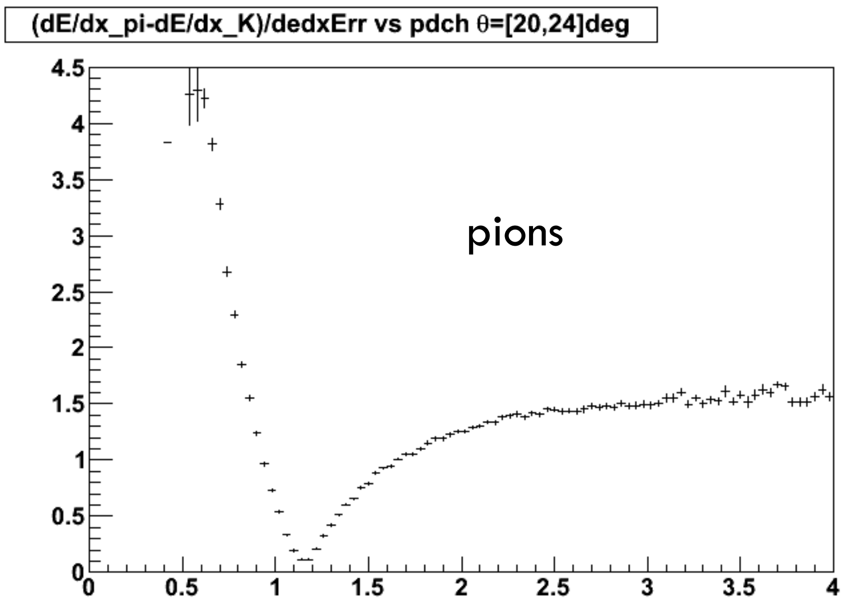


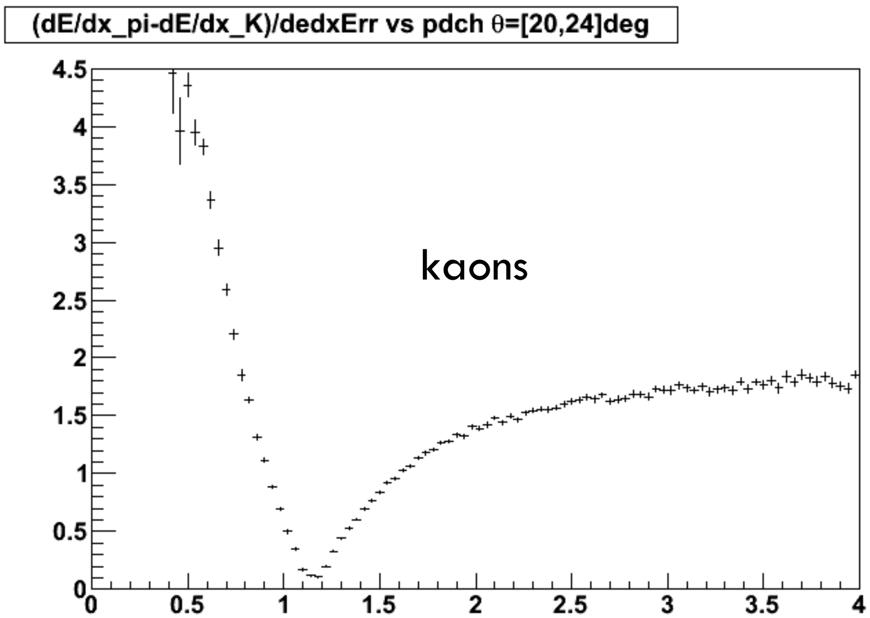


separation = [dE/dx_(exp pion)-dE/dx_(exp kaon)]/σ(dE/dx)

Kaon-pion separation with dE/dx

θ in [20°,24°]





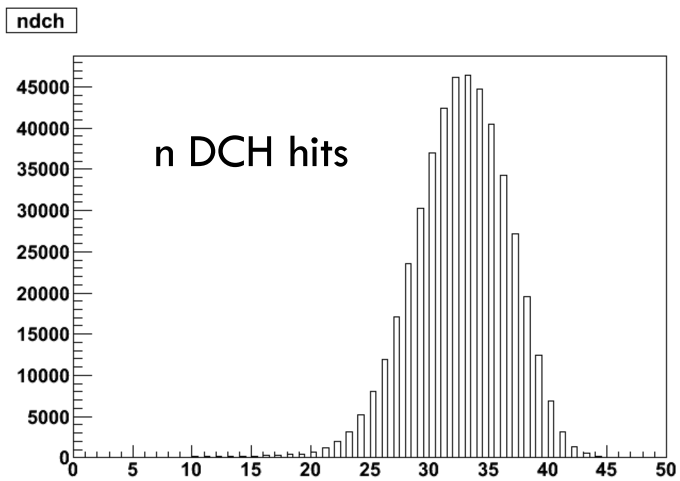
separation = [dE/dx_(exp pion)-dE/dx_(exp kaon)]/σ(dE/dx)

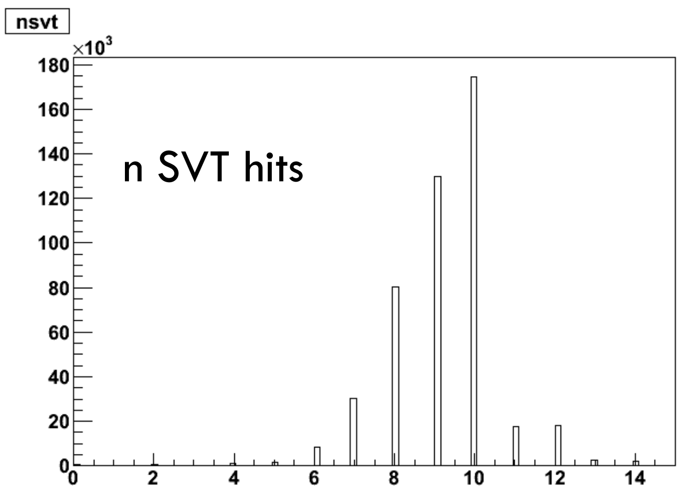
Summary

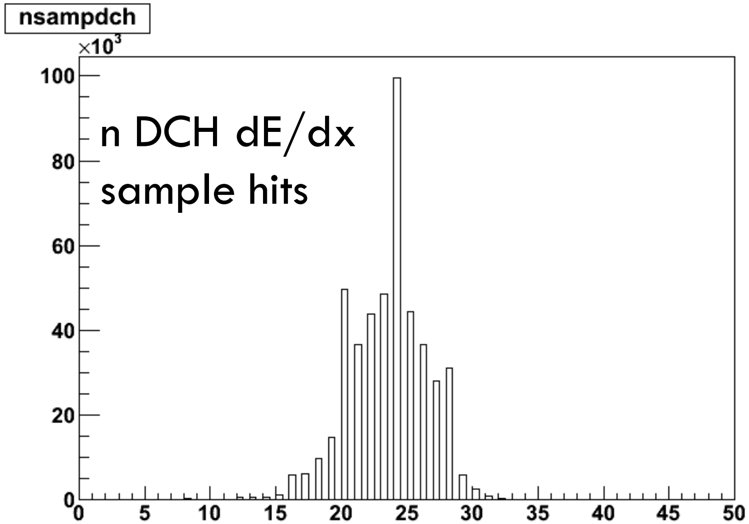
- First look at babar data seems promising to improve the FastSim dE/dx (DCH)
- Need to understand better some aspects observed on data
- Next step is to change FastSim accordingly and perform a Babar-data vs FastSim comparison
- Babar data may also be useful to tune dE/dx (SVT)

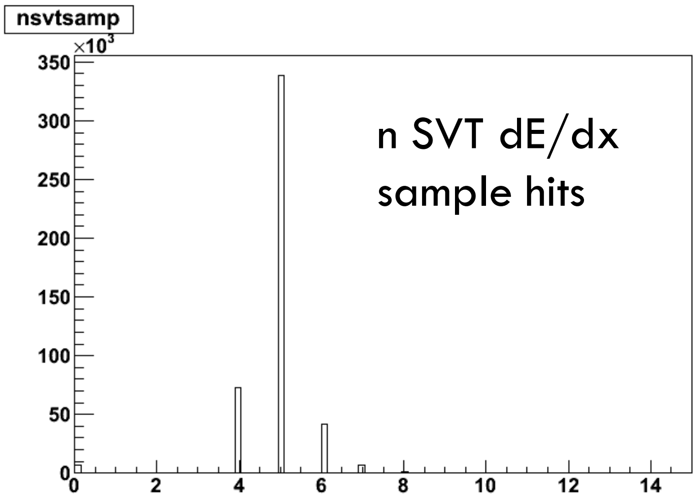
BACKUP

DCH and SVT hits - pions -









p vs theta (pions)