

# Issues from the Inclusive Hadronic Spectra AWG

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**Simulation/Generators Workshop, 12 July, 2004**

- **Detector Simulation Wish List**
- **Generators Wish List**
- **Our Potential Input to Generators**

**We measure inclusive spectra, total rates, BRs**

**...and would like to do masses, more BRs**

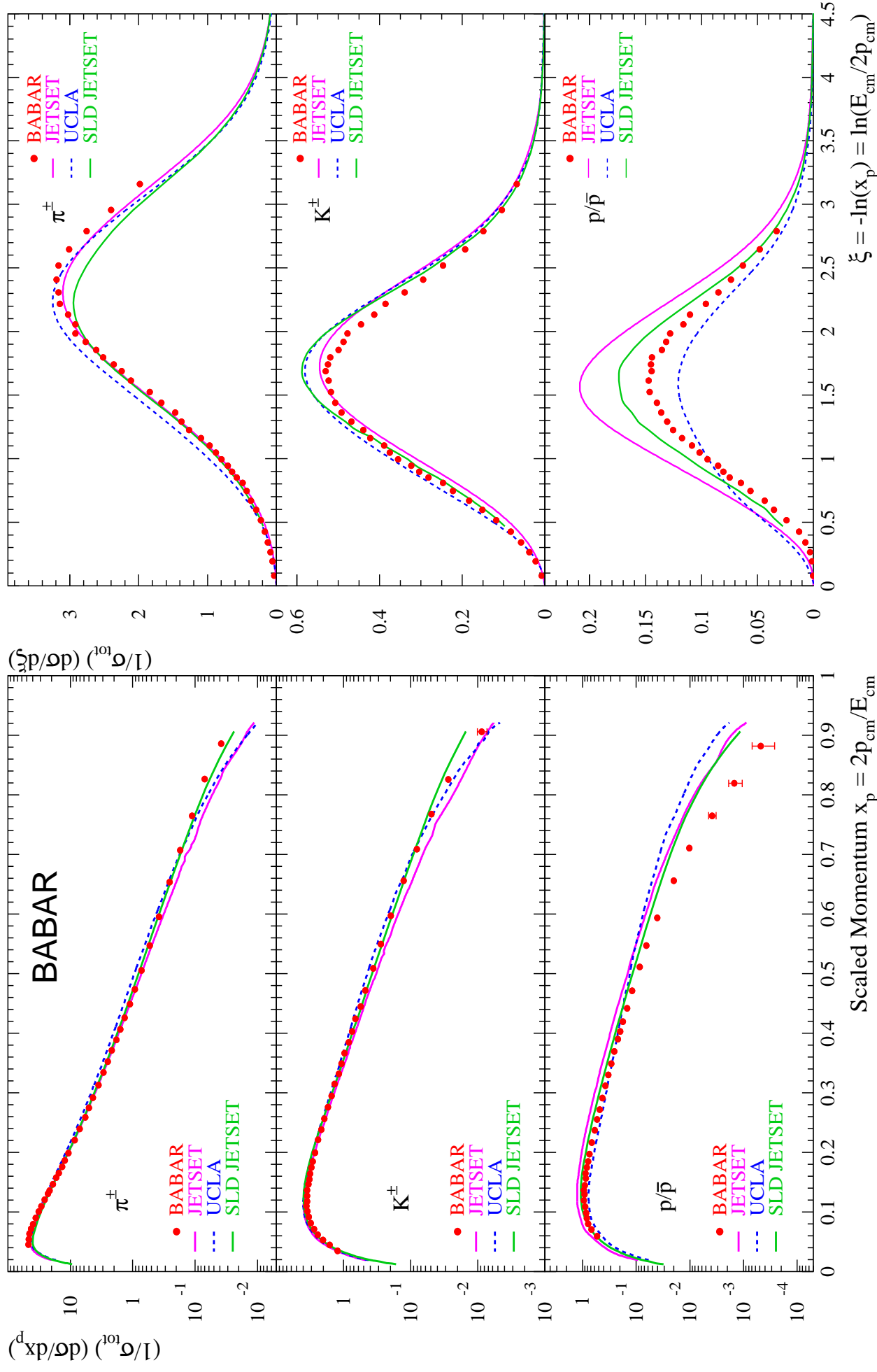
# Detector Simulation Wish List

- Better understanding of tracking
  - efficiency in general
    - vs. particle type
    - vs.  $p$ ,  $\cos\theta$
    - vs. origin point ( $K_S$ ,  $\Lambda^0$  decay products)
  - for decays in flight, scattered particles
- Better understanding of interactions in detector material
  - resonances in simulation Christ, Dunwoodie
  - mass shifts, material densities Coleman, Dunwoodie
- Better understanding of PID
  - shifts, tails, cutoffs, packing in  $dE/dx$  Hartfiel, Coleman
  - backgrounds in DIRC Hartfiel
  - DIRC hits near threshold
  - DIRC shifts at high  $p$ ,  $\theta_C$
- Similar list for EMC, IFR ... someday
- More systematic validation

# Generators Wish List

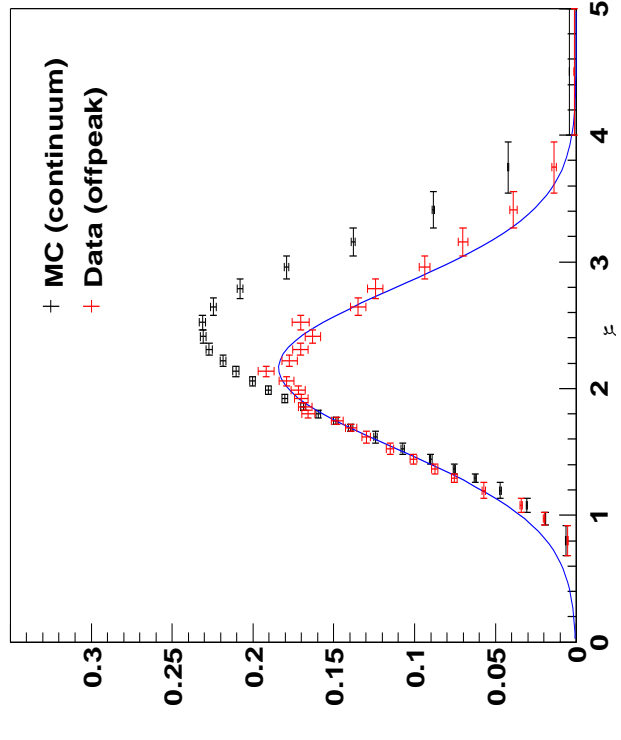
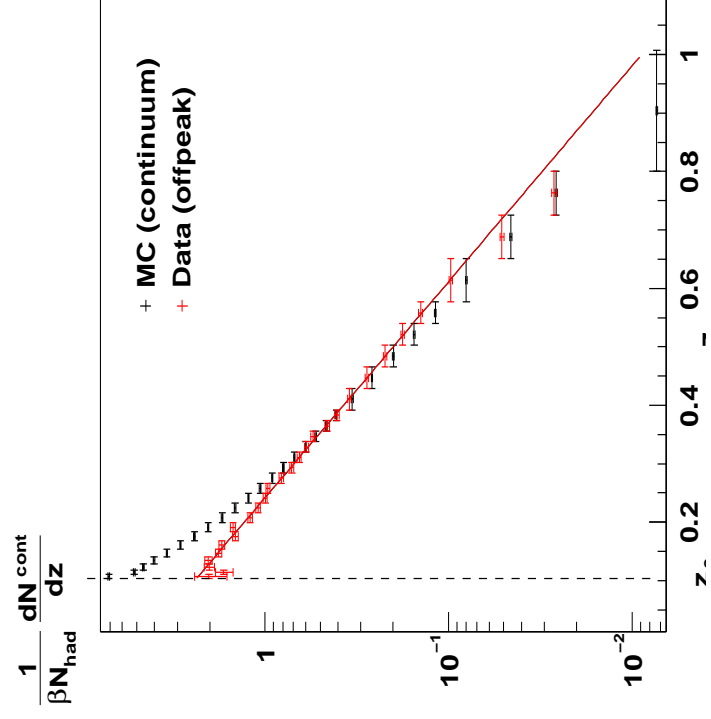
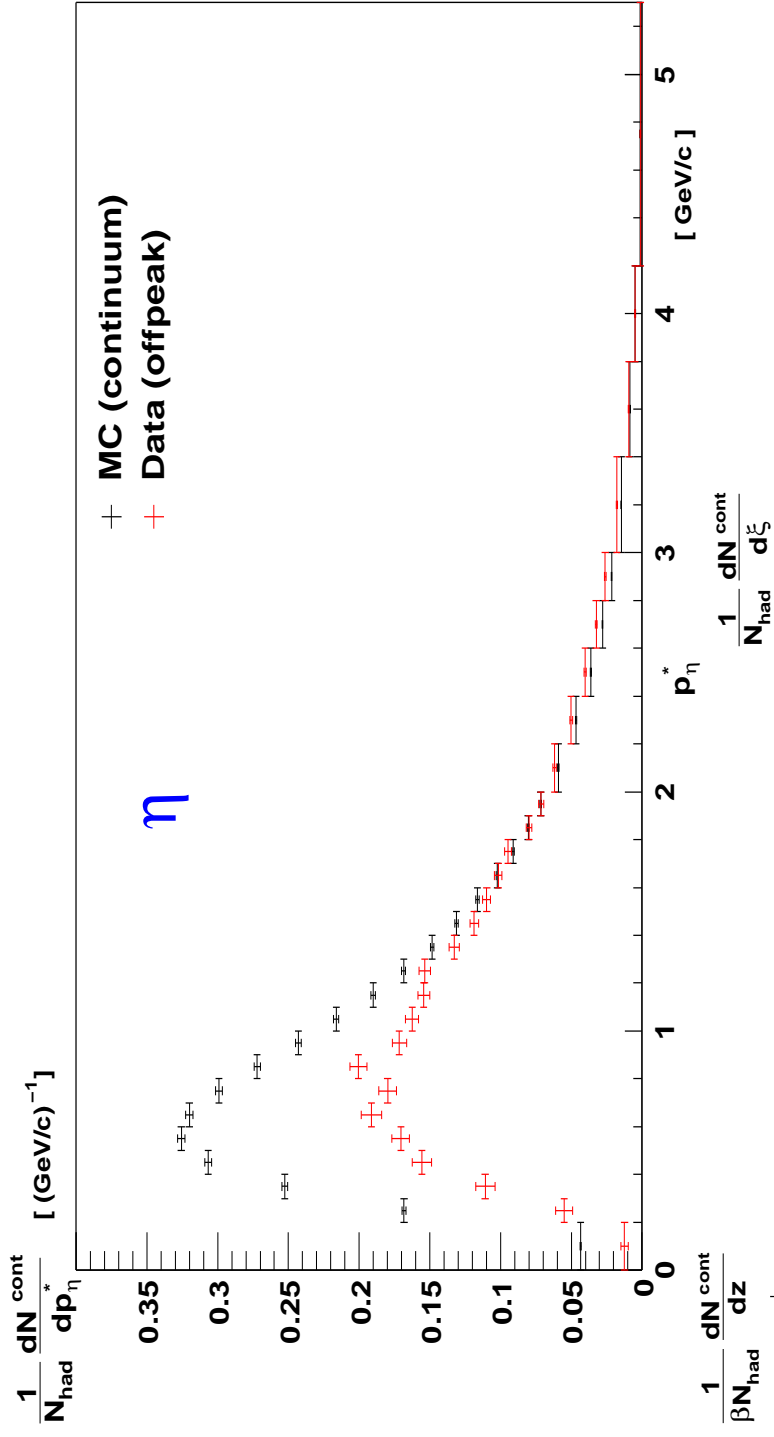
- Continuum simulation (JETSET) is “good enough” for us
  - nice to have **UCLA** also ... negligible diffs in e.g. evt. sel.
  - should implement **HERWIG** ... will give unrealistically large differences i.e. very conservative (limits) on systematics
  - who wants a **generator level** sim. w/easily changed params?
- Background events
  - $e^+e^- \rightarrow \tau^+\tau^-, \mu^+\mu^-$  sims are fine
  - (radiative) **Bhabhas** are our biggest problem
    - need sim near **and past** acceptance edge
    - how to provide a limited size set that covers full  $\theta$  range?
  - $\gamma\gamma$  simulation could use quite a bit of work
- “Interesting” particles in continuum events
  - JETSET has no pentaquarks, excited baryons,  $D^{***}$ , etc.
  - can “modify” another particle, special sim. request
  - good enough for now, but someday....

# Our potential inputs to continuum generators

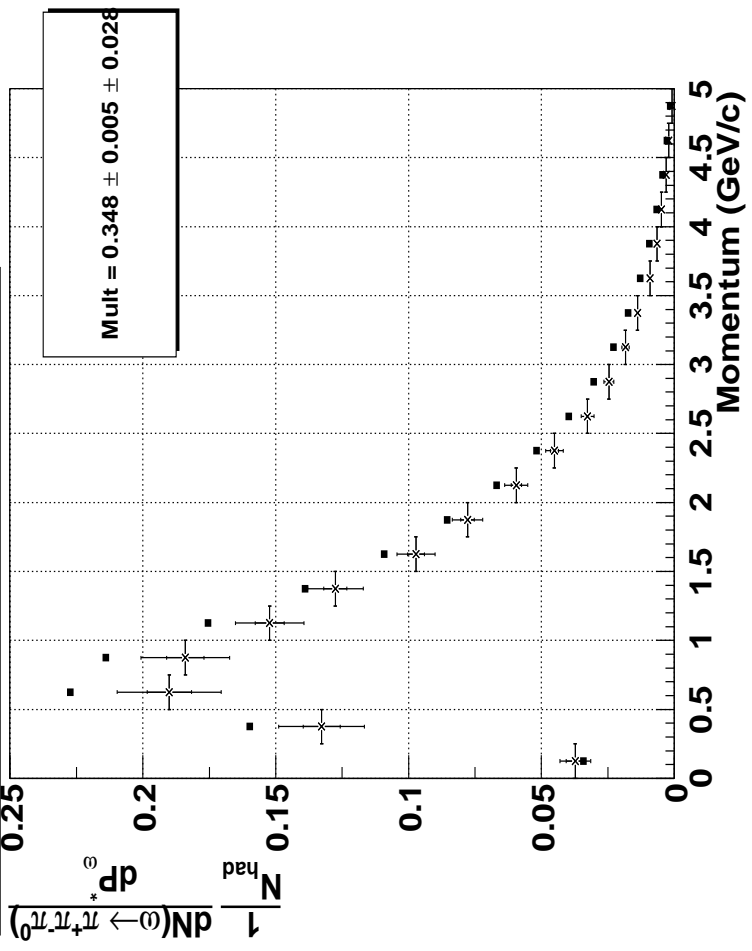


● Problems in inclusive spectra

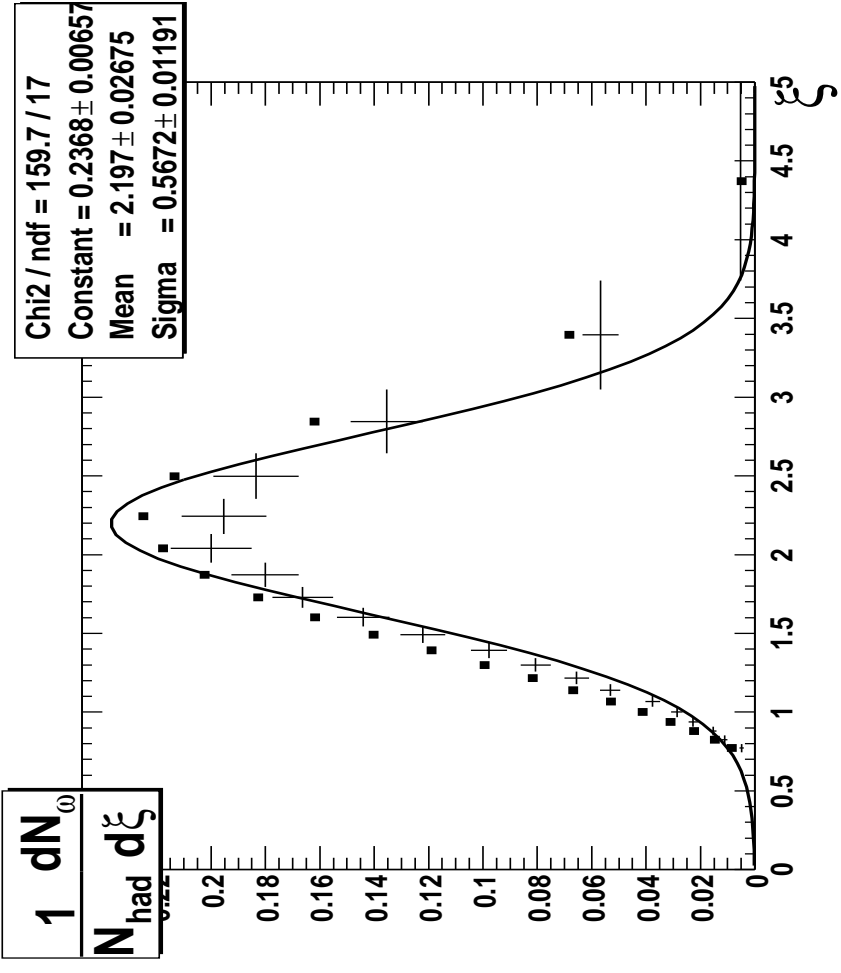
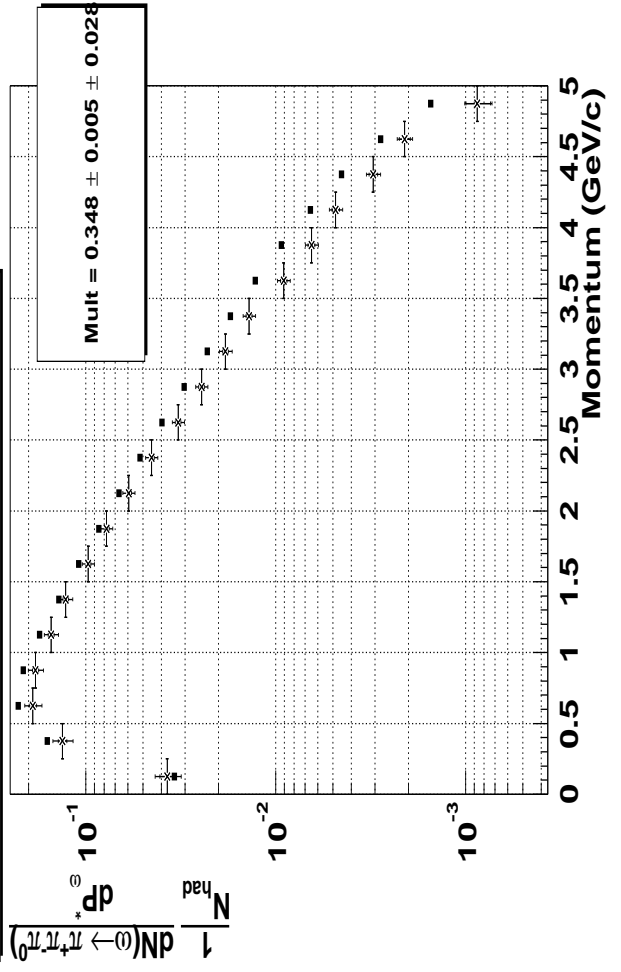
● Be sure to check all variables!



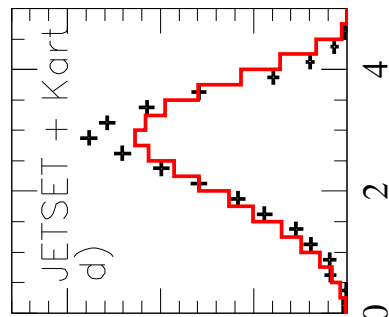
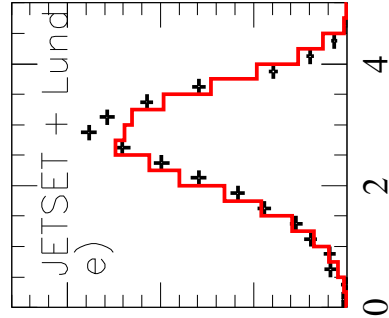
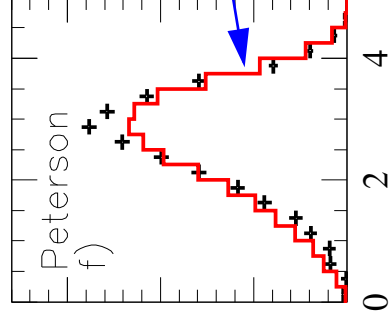
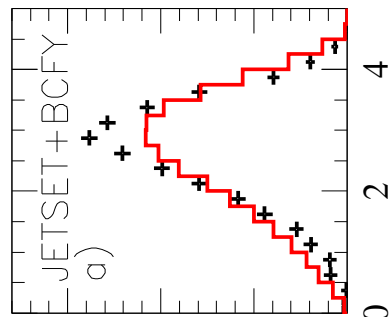
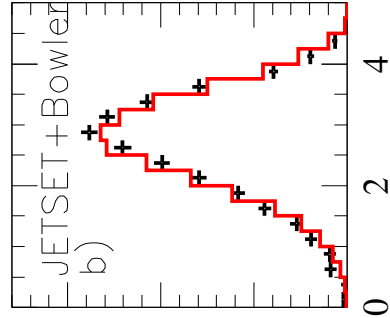
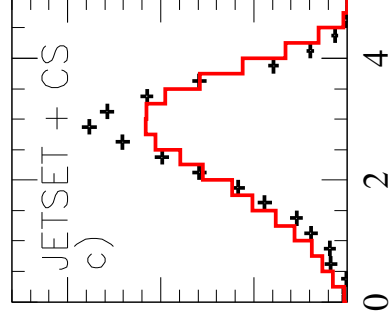
**P\* spectrum for  $\omega$  Off Peak data**



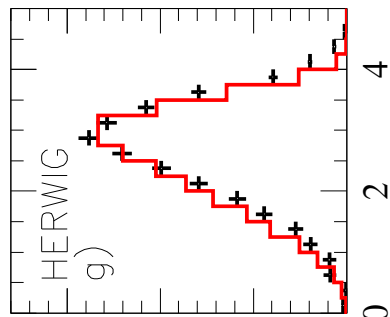
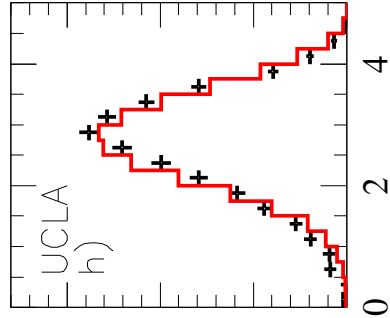
**P\* spectrum for  $\omega$  Off Peak data**



# $\Lambda_c p^*$ spectrum vs. several models



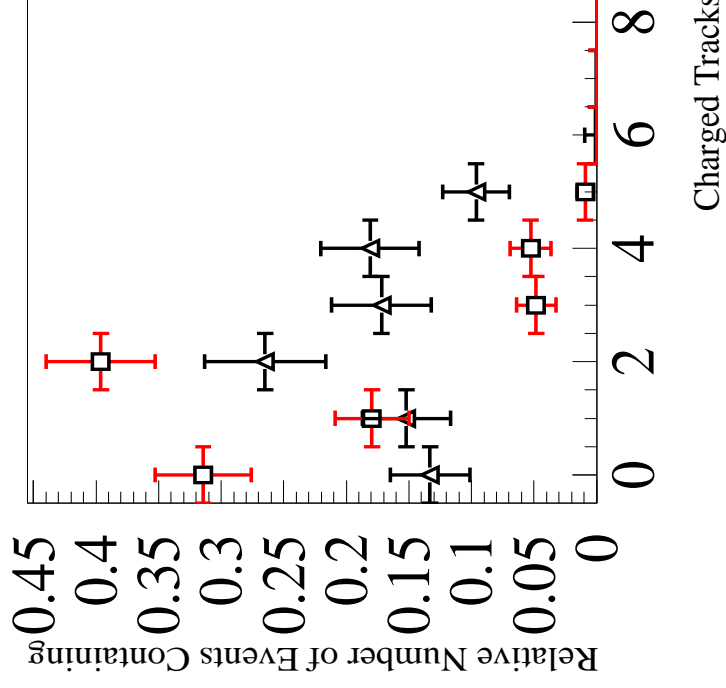
$p^*$  (GeV/c)  $\rightarrow$



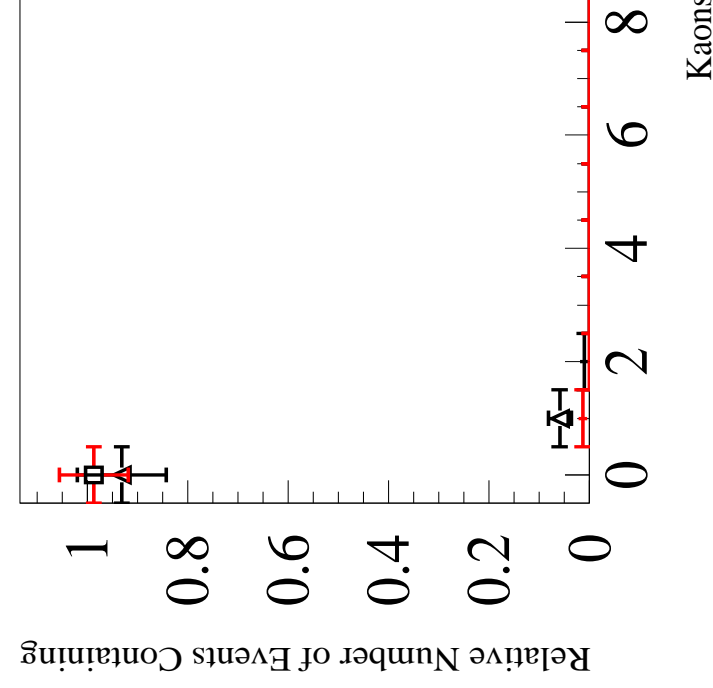
Our c.m. energy is **low enough** that we might expect/hope the models to **break down** in interesting ways

We have seen one such problem directly in the class of events containing **two charmed baryons**

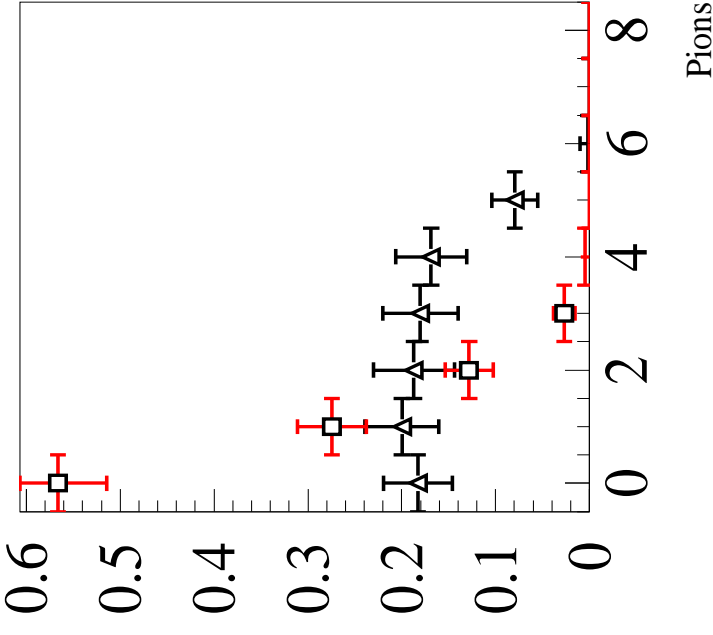
Models have extra protons (and neutrons), but few additional particles; data behave quite differently



Protons



Kaons



Pions

## Lessons

- JETSET is **NOT** a control sample
  - rate of photons (that convert)
  - p0 (that merge)
    - r, w, f, ...
  - charged multiplicity distribution
  - average mult.,  $E_{\text{charged}}$ ,  $E_{\text{neutral}}$ , energy flow ~2-5%
- OK to use for **developing** analysis, but...
- Use **continuum-subtracted** data to test  $B\bar{B}$  sim.
- Use **continuum data** to evaluate backgrounds
- Look for **data** from ARGUS, CLEO, BELLE, BaBar(!), ...
- Use **reliable** simulations, e.g.  $\tau^+\tau^-(\gamma)$ ,  $\mu^+\mu^-(\gamma)$ ,  $e^+e^-(\gamma)$ , fully constrained ISR, ...

# Statements of philosophy

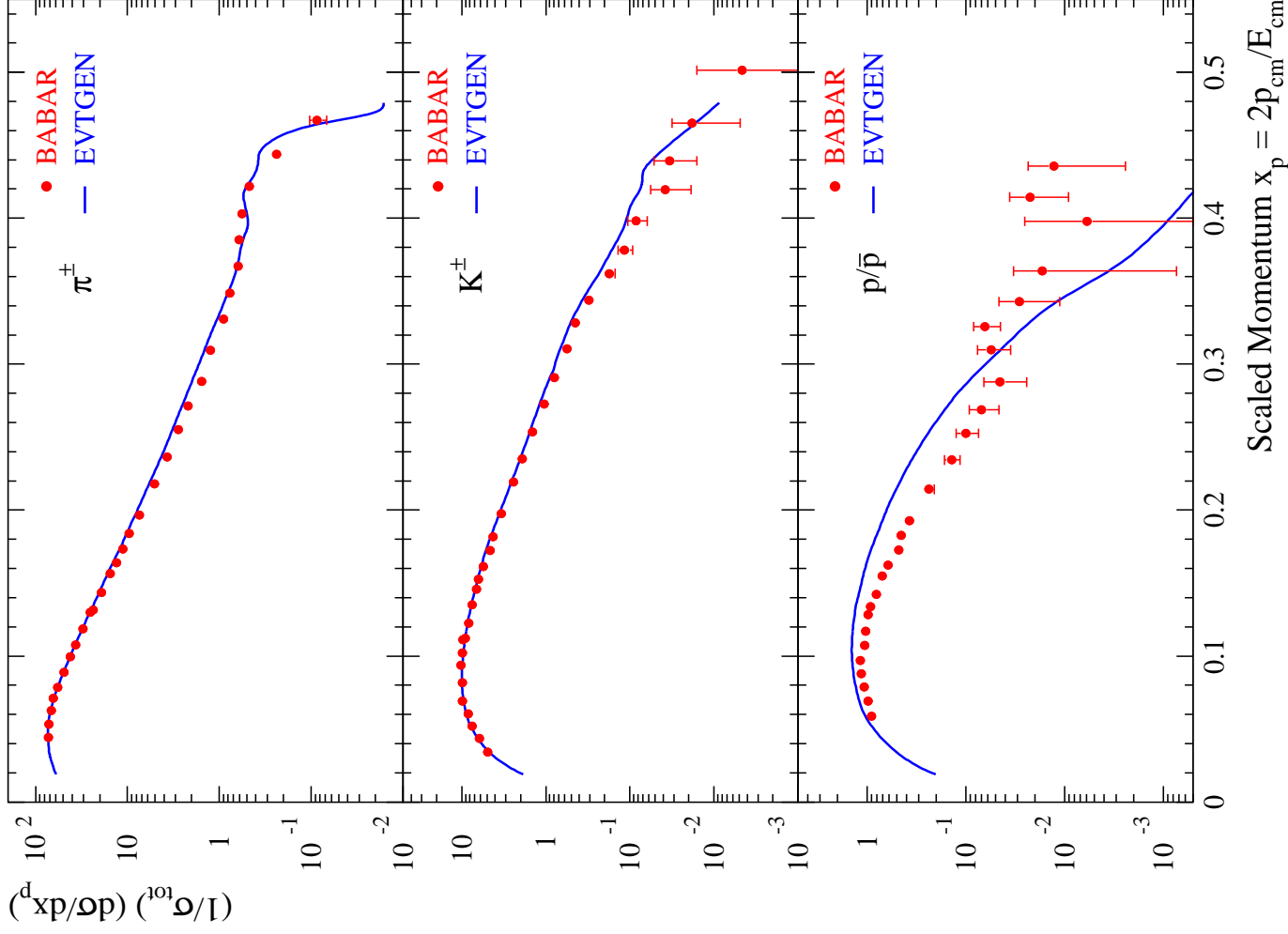
## Continuum

- JETSET is good enough for our AWG purposes
- We should worry about it only if it limits some other physics
- We should **not** be in the business of tuning models
  - too much work
  - too many concurrent issues
- We **could** try simple tweaks to evaluate/limit systematics
  - noting the concurrent issues
  - ...and if it works, put it in...
- Better to annoy the authors!
  - attend S.Abachi talk 27 July

## Y4S, $B\bar{B}$ Decays

- Again, EVTGEN is good enough for our purposes
- But undoubtedly not for all other physics
- We **are** responsible for tuning our model
  - bit by bit
  - not ignoring the big picture
- Will try to note **specific** steps below

# Charged $\pi, K, p$



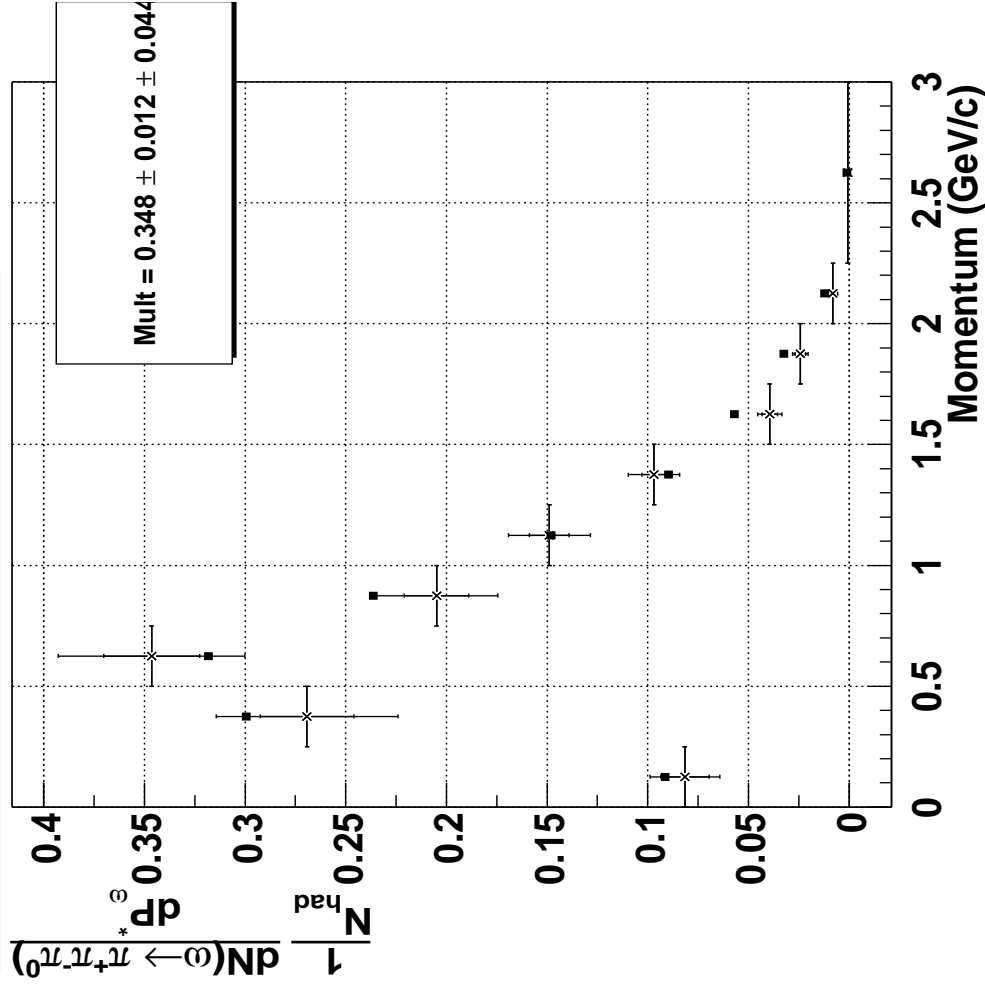
→ pions look **good** overall, but could use work at the high end -- 2,3-body decays

→ kaons **also good** at low end, could use work at high end,

→ protons are **miserable**; but see below

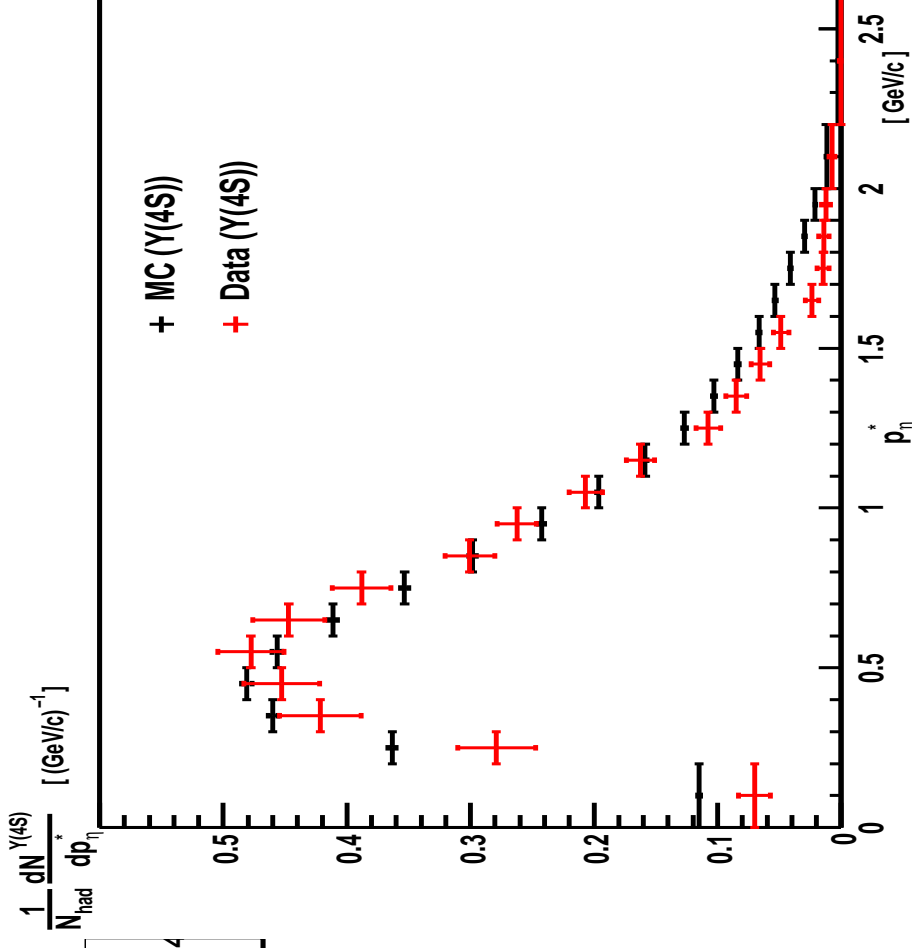
•  $\omega$

**P\* spectrum for  $\omega$  Y(4S) data**



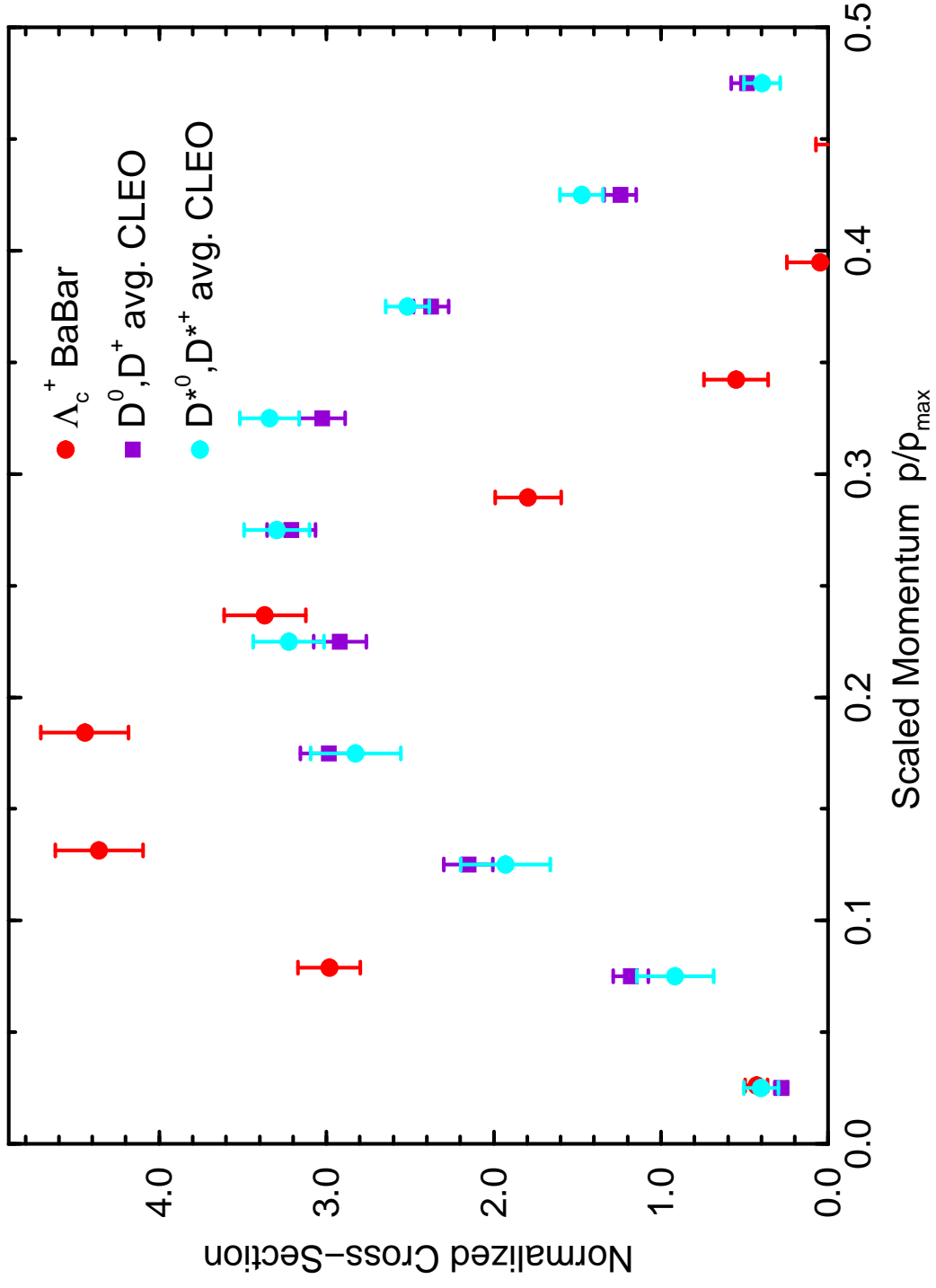
- within (large) errors at low p
- MC **excess** at high end; work on few-body decays

•  $\eta$



- spectrum **shifted** at low p;  
reduce MC  $D \rightarrow \eta$  or  $W \rightarrow \eta$ ?
- far **too many** high-p h in MC;  
2-body decays?

$\Lambda_c^+$



→ sorry, need to add model

→ plan **finer binning**, **more** data, **play** with sums of **exclusive** modes,  $\Lambda_c p \pi$ ,  $\Lambda_c n \pi$ ,  $\Lambda_c p \pi \pi$ ,  $\Lambda_c n \pi \pi$ ,  $\Lambda_c n \pi \pi$ , ...

● Many more particles to come → Stay tuned!