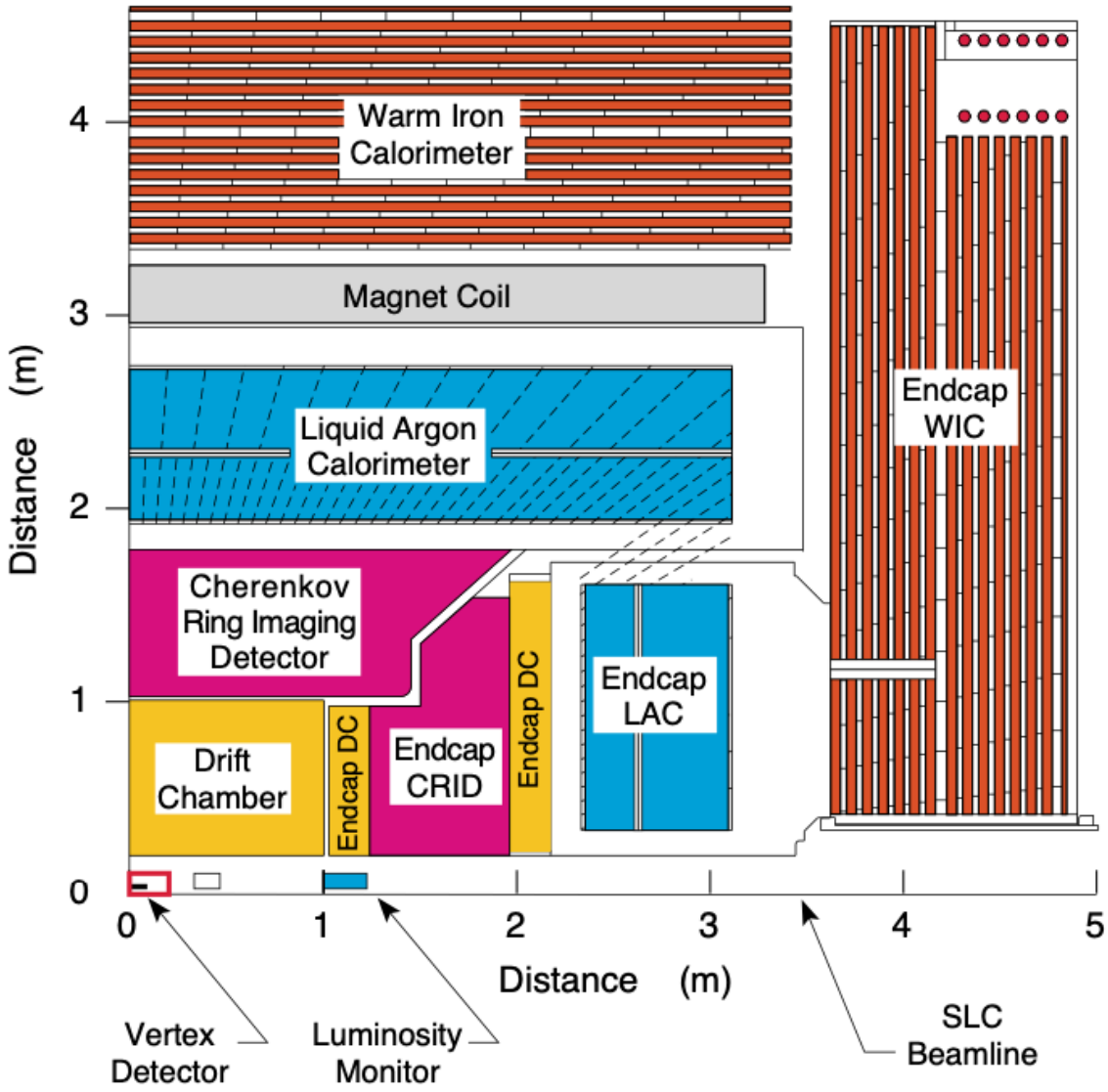
s-tagging at SLD

Su Dong

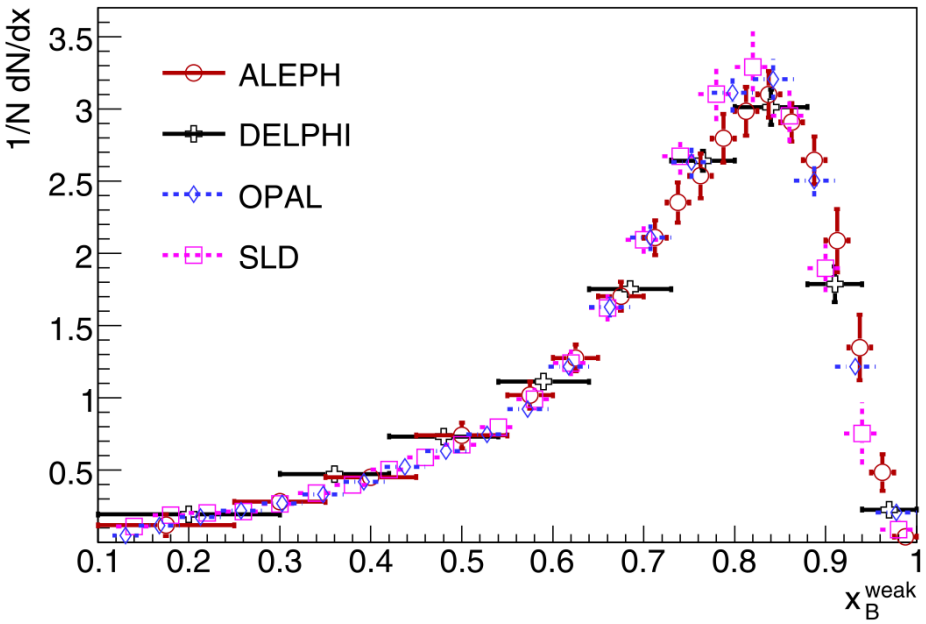
SLD Detector



- CCD pixel vertex detector
- Cherenkov Ring Imagine Detector (CRID) => K/π separation for all momenta
- Polarized electron beam

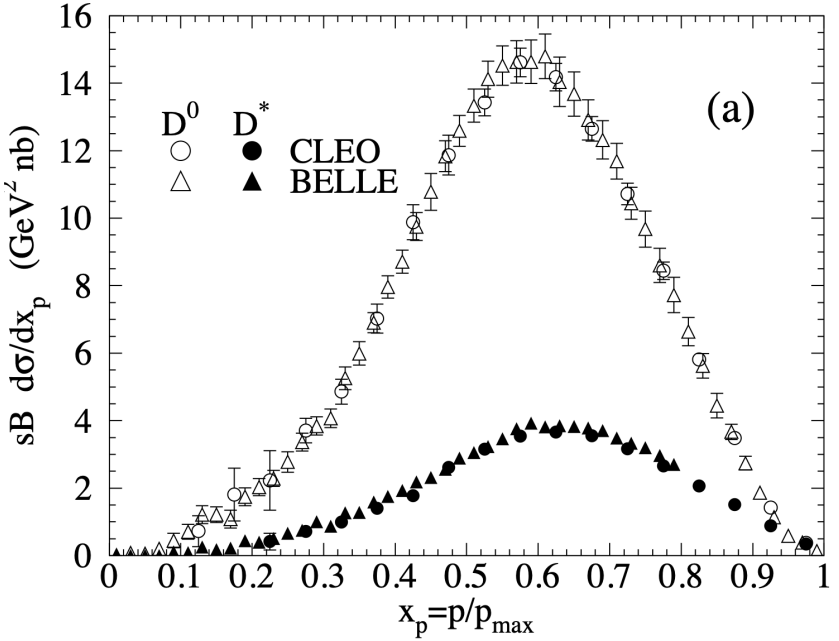
Heavy Quark Fragmentation

b fragmentation



Euro Phys J. C71 (2011) 1557

charm fragmentation



PDG review fragmentation functions

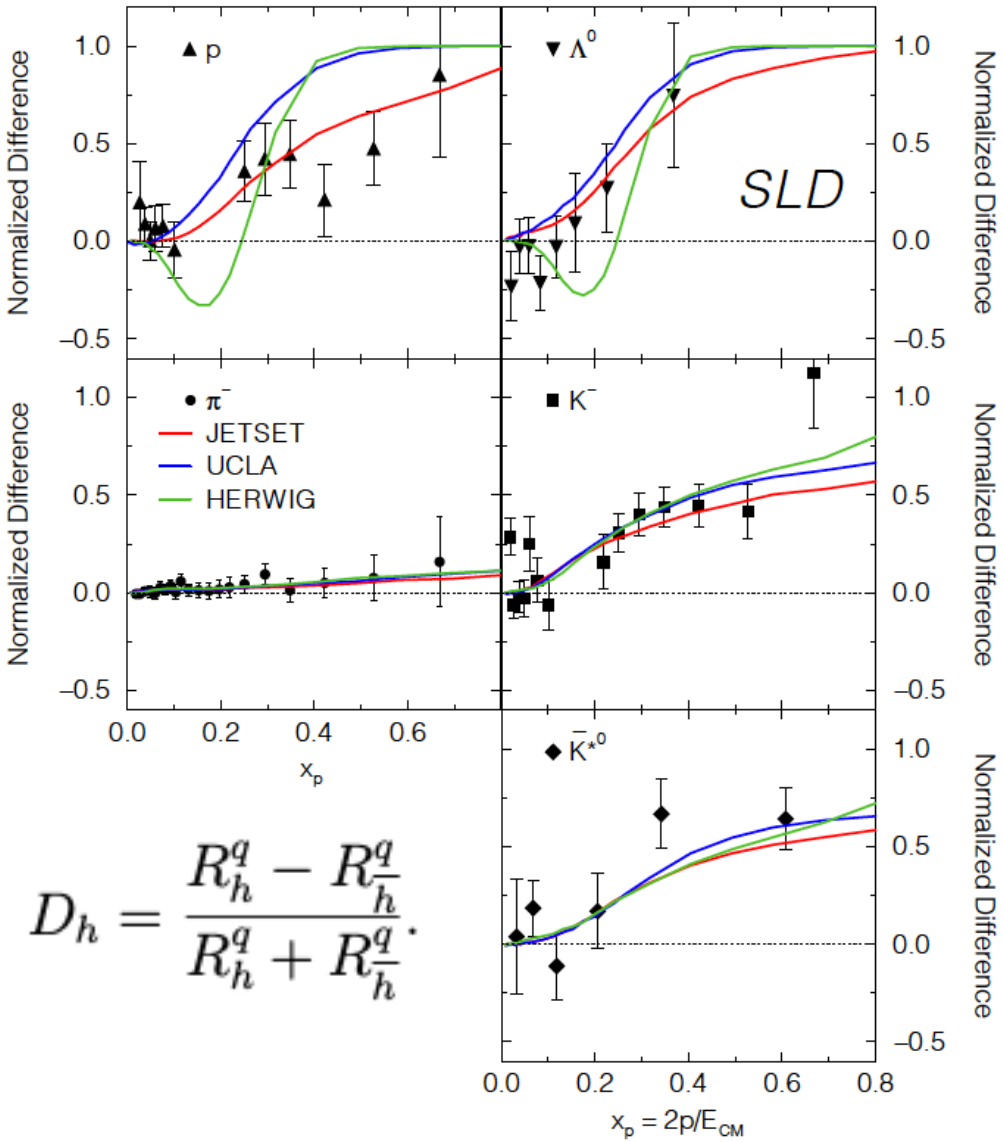
$x_E = \frac{E_{had}}{E_{beam}}$ is fraction of jet energy carried by the heavy hadron

Heavy hadrons carry large fraction of the jet energy.

Does strange quark still have some leading hadron effect ?

Leading Particle Effect

Phys. Rev. D59:052001 (1999)



$$D_h = \frac{R_h^q - R_{\bar{h}}^q}{R_h^q + R_{\bar{h}}^q}.$$

$e^+e^- \rightarrow Z^0 \rightarrow$ hadrons

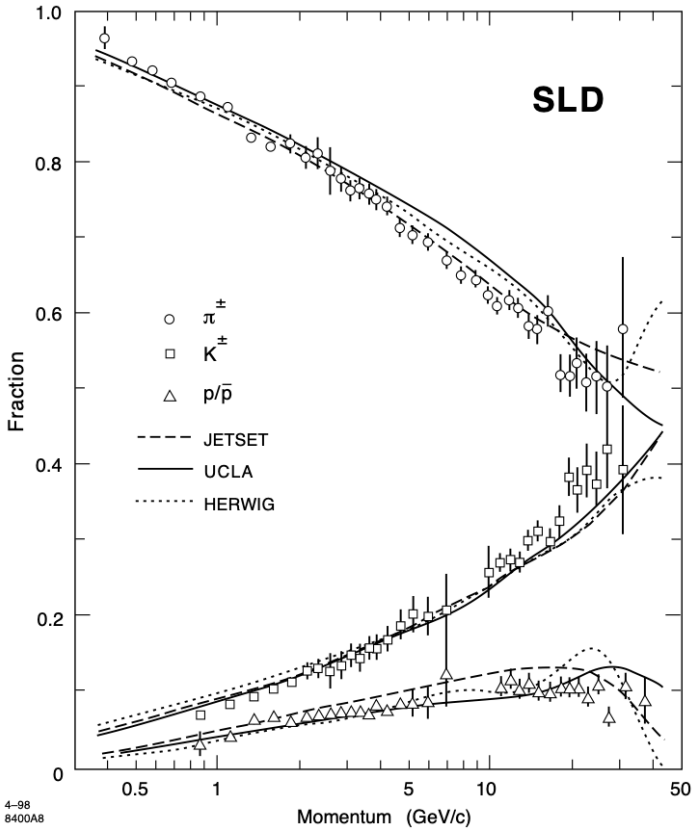
$$R_h^q = \frac{1}{2N_{evts}} \frac{d}{dx_p} \left[N(q \rightarrow h) + N(\bar{q} \rightarrow \bar{h}) \right]$$

$$R_{\bar{h}}^q = \frac{1}{2N_{evts}} \frac{d}{dx_p} \left[N(q \rightarrow \bar{h}) + N(\bar{q} \rightarrow h) \right]$$

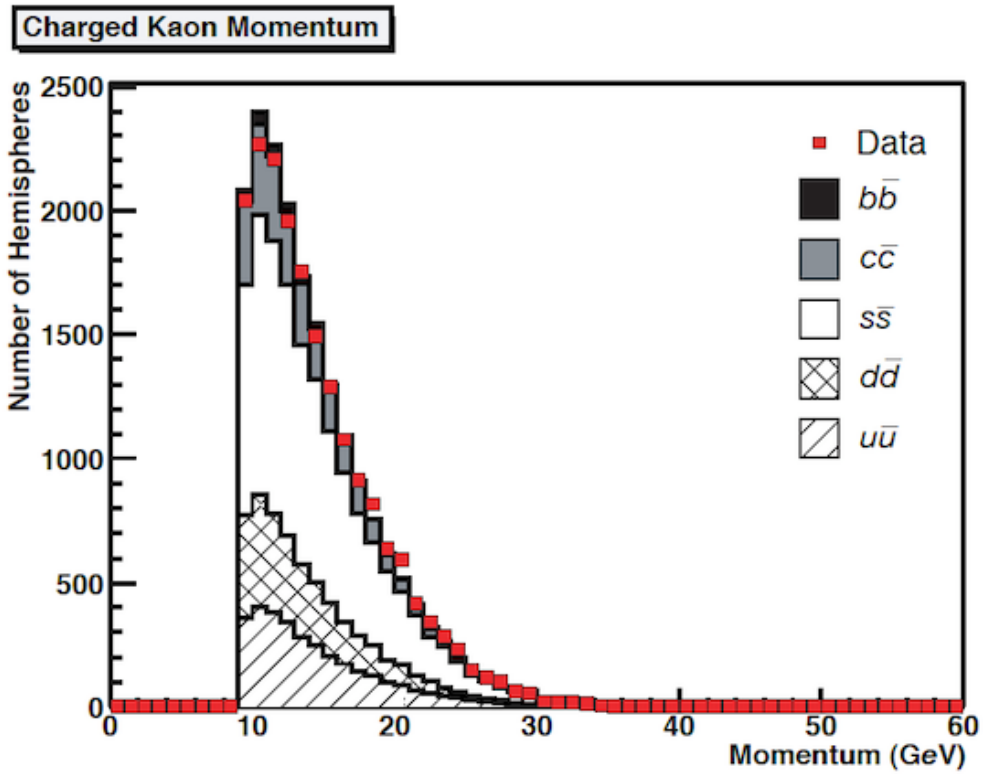
- $q/\bar{q}$ separation utilizing large polarized forward/backward asymmetry
- High x_p K/Λ has enhanced probability to contain valence s quark
- Effect described by JETSET (PYTHIA) well

Kaon production

Phys. Rev. D59:052001 (1999)



Sean Walston Ph.D thesis Univ. Oregon SLAC-R-728



E_{beam}=45.6GeV

Z^0->hadrons: bb/cc/ss/uu+dd ~22/17/22/39%

High momentum K^{+-}, K^0, Λ are primary s-tag signatures

Z->s$\bar{s}$ asymmetry measurement

SLD s-tag with fast leading K,Λ to measure polarized Z->s$\bar{s}$ asymmetry

SLD A_s PRL 85.5059 (2000)

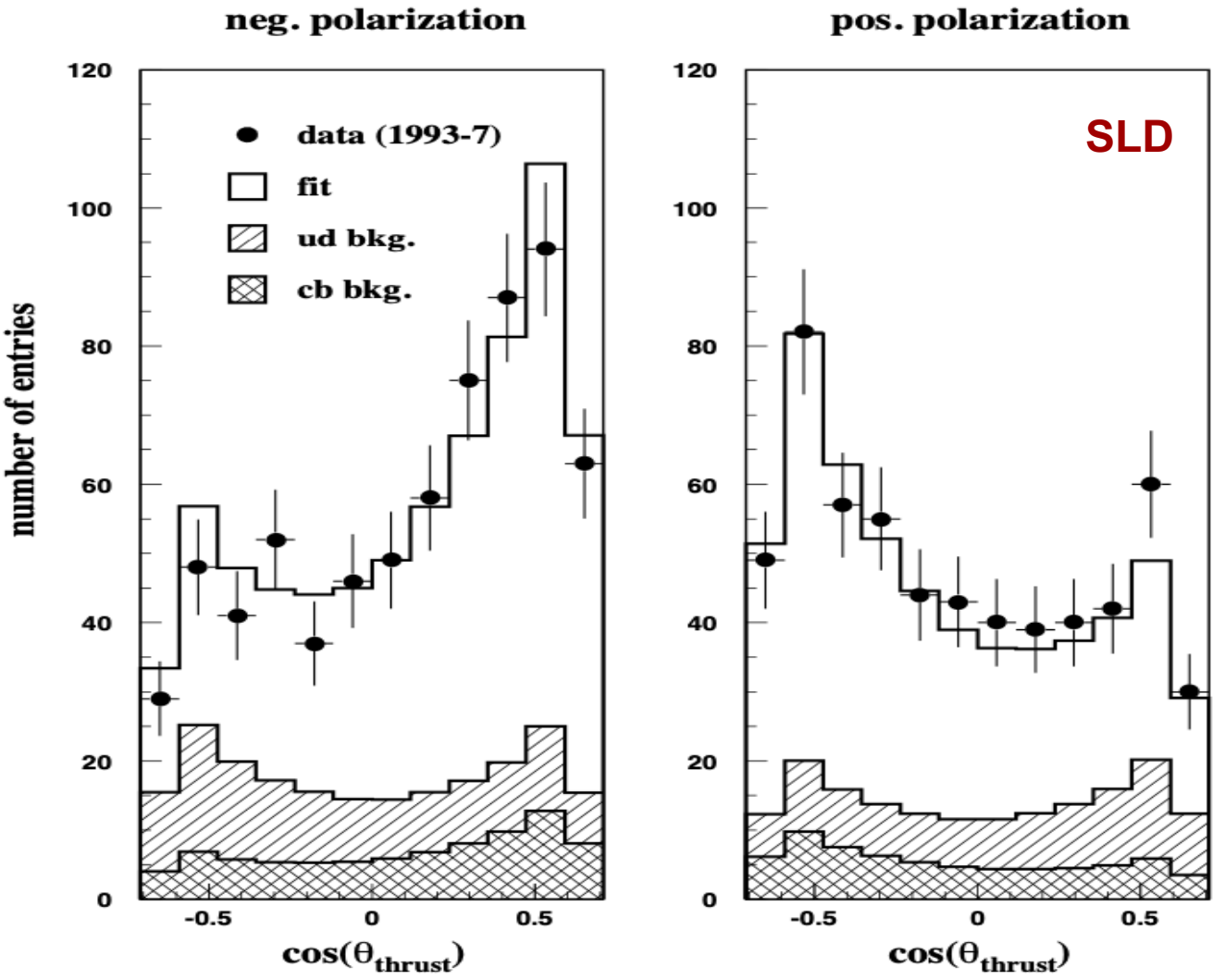
Table 1: Summary of the selected event sample for 5 modes in data and simulation.

Mode	# Data Events	MC prediction	$s\bar{s}$ purity	$s\bar{s}$ analyzing power
K^+K^-	1290	1312	0.73	0.95
$K^+\Lambda^0, K^-\bar{\Lambda}^0$	218	213	0.65	0.89
$\Lambda^0\bar{\Lambda}^0$	17	14	0.52	0.60
$K^\pm K^0_s$	1580	1614	0.61	0.70
$\Lambda^0 K^0_s, \bar{\Lambda}^0 K^0_s$	189	194	0.50	0.35
Total:	3294	3347	0.65	0.81

$K_s^0K_s^0$ not usable for asymm meas

550,000 Z^0->hadrons. Veto b,c tagged events.

Polarized Z->s$\bar{s}$ asymmetry



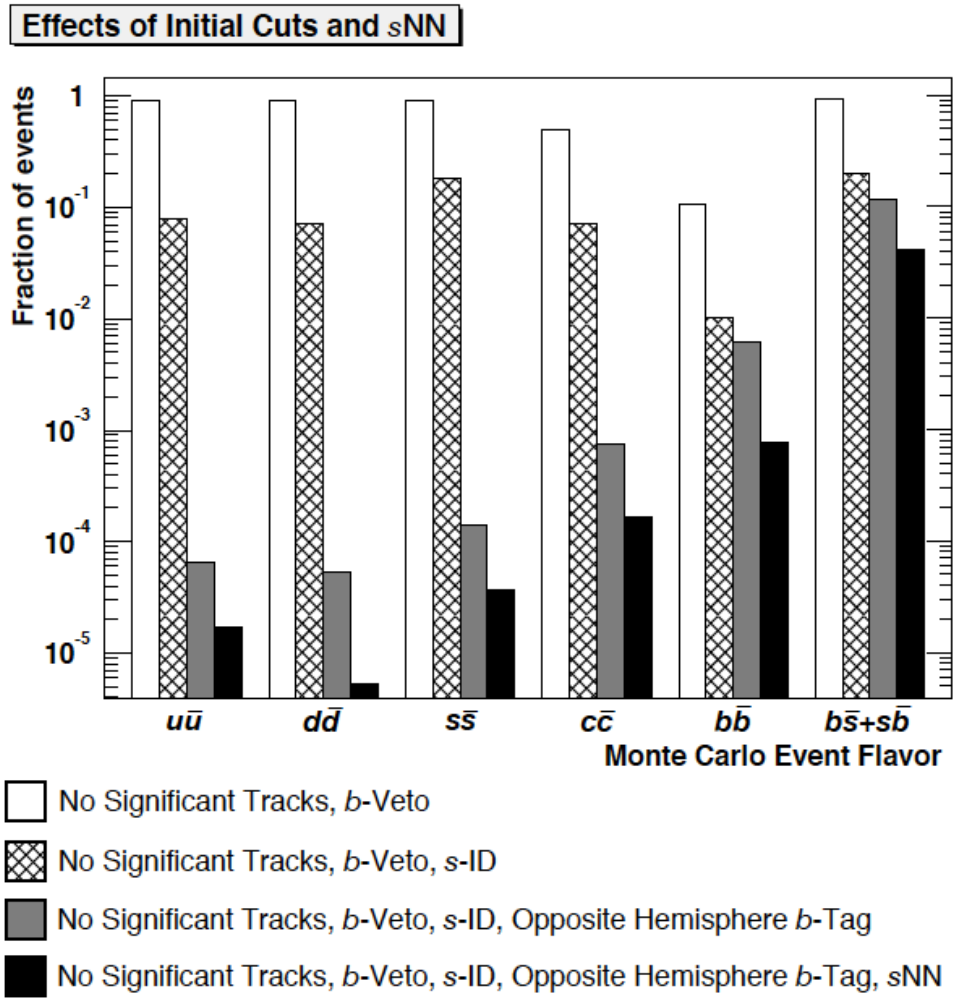
PRL 85.5059 (2000)

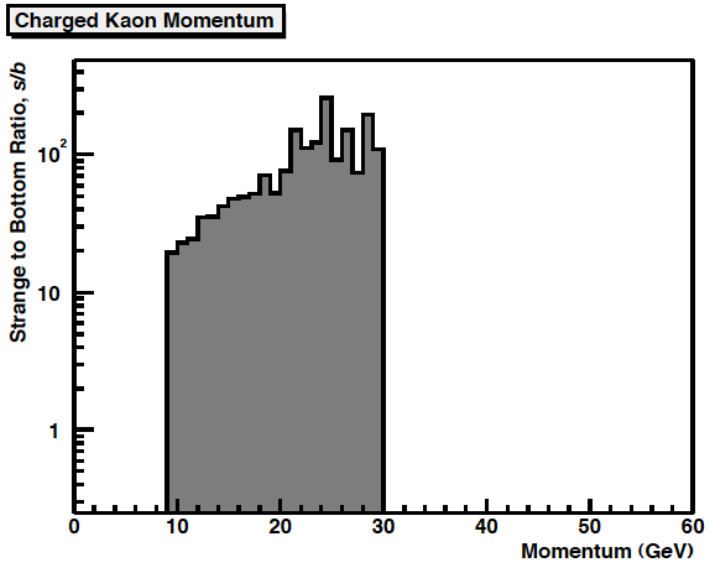
Hermann Staengle
Colorado State U
Ph.D thesis SLAC-R-549

Measured
$A_s=2v_sa_s/(v_s^2+a_s^2)$
$=0.895\pm0.066\pm0.062$
consistent with SM ~0.93

s-tag analyzing power described fairly well by MC

Search for Z->b$\bar{s}$





Sean Walston Ph.D thesis Univ. Oregon SLAC-R-728

H->b$\bar{s}$ should be one of the first tries with s–tag ?

$$R_{bs} = \frac{\Gamma(Z^0 \to b\bar{s})}{\Gamma(Z^0 \to hadrons)} < 0.00147$$

Remarks on Detectors

- Main signature for s-tag are high x (>~0.2) leading strange hadrons K/Λ
- High x K^{+-} may be only possible at e^+e^- colliders
  - Only known effective technique for s-tag momentum range is Cherenkov Ring Imaging detectors
  - TOF (even with fast timing) and dE/dx effective momentum range too low for s-tag
  - Also helps in b,c quark/antiquark separation
  - Have to fight for space/material budget with calorimetry
- K_s^0/Λ are available for all colliders
  - But high momentum K_s^0/Λ decaying deep inside tracking volume requires conscious tracking designs to preserve well