A_c, A_b with Vertex/Kaon Charge

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Current Status

Currently have three self-calibrated results using these tags:

- $A_c = 0.588 \pm 0.031 \pm 0.025$, VTX+K tag (96-98 R15)
- $A_b = 0.997 \pm 0.044 \pm 0.065$, K tag (97-98 R16)
- $A_b = 0.926 \pm 0.019 \pm 0.028$, VTX tag (97-98 R17)

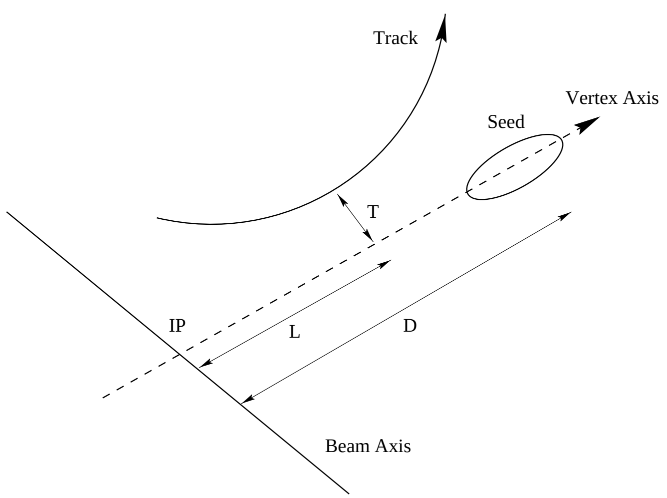
Would like to have one analysis for A_c/A_b:

- for 96-98 R17
- using both tags, for better calibration statistics
- same ZVTOP/tagging/track settings
- incorporate VXD-only vectors/NN tagging
- new K efficiency corrections from Jodi/Stéphane

Neural-Net Tagging

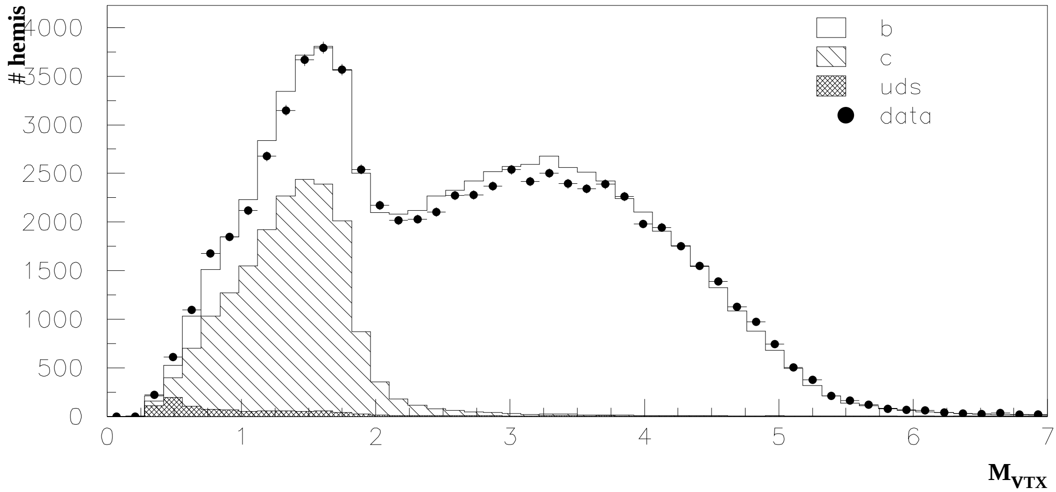
Similar to BZMASS, but with selection cuts replaced by neural-networks.

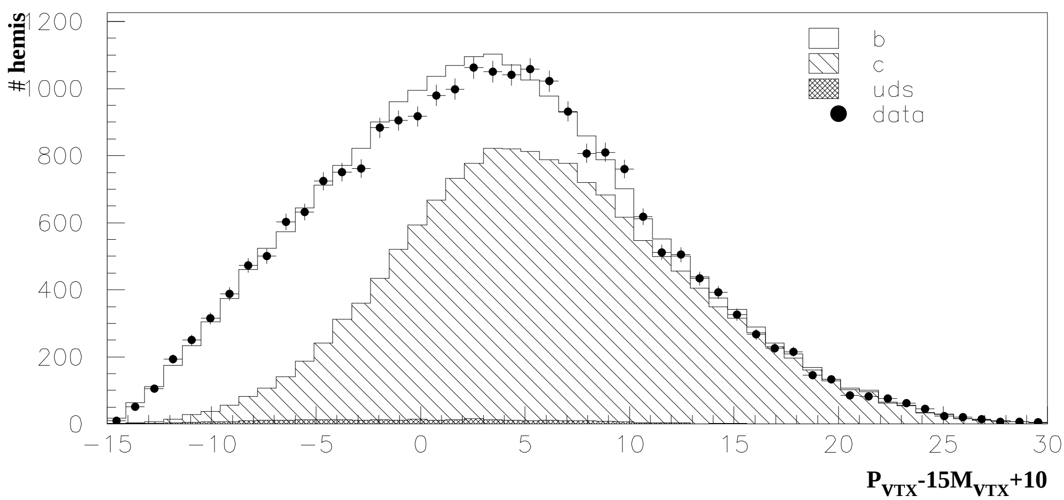
- Seed vertex selection uses:
  - D - distance to IP
  - D/σ_D - normalized by error
  - $\angle\vec{P}\vec{D}$ - angle between $\vec{P}$ and $\vec{D}$
- Attach remaining tracks to selected vertices using:
  - T - transverse POCA of track to $\vec{D}$
  - L - length along $\vec{D}$ at which POCA is found
  - L/D - normalized by D
  - $\angle\vec{p}\vec{D}$ - angle between $\vec{p}$ and $\vec{D}$
  - b/σ_b - normalized 3D impact parameter to IP
- VXD-only vectors attached using same vars as for tracks



Flavor Tagging

charm tag:	$0.5 < M_{VTX} < 2$ GeV
	$P_{VTX} > 5$ GeV
	$P_{VTX} - 15 * M_{VTX} > -10$ GeV
bottom tag:	$M_{VTX} > 2$ GeV



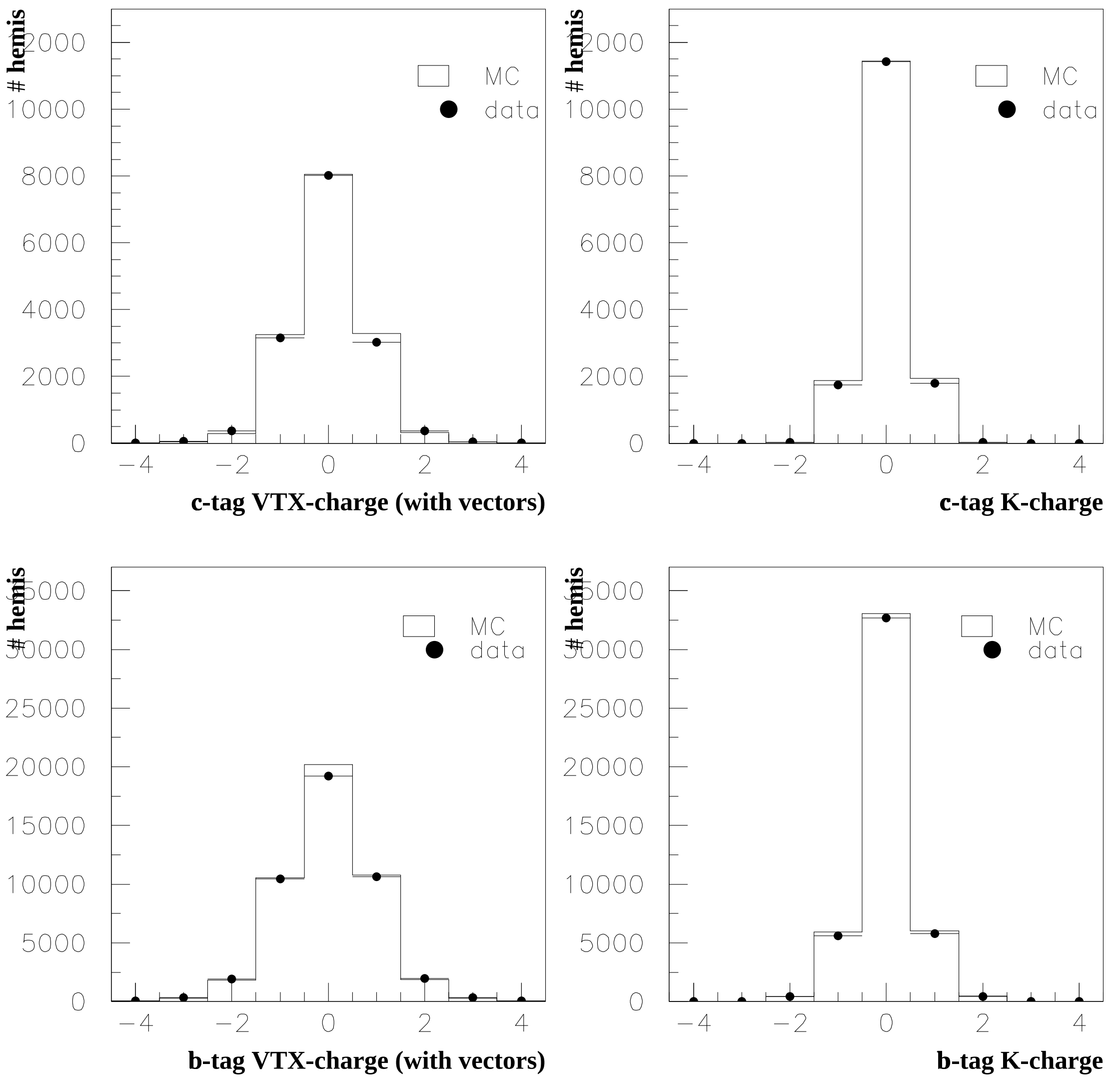


$\eta_c = 0.193$, $\epsilon_b = 0.566$

Quark Tagging

Two methods: Charge of the vertex or of attached kaons

$$\text{charm: } \epsilon_{VTX} \sim 0.47,\ \epsilon_K \sim 0.24$$
$$\text{bottom: } \epsilon_{VTX} \sim 0.57,\ \epsilon_K \sim 0.27$$



Tag Combination

The two tags make four combinations

	p_c	P_b
V=K	0.988	0.910
V,V≠K	0.713	0.613
V only	0.923	0.813
K only	0.918	0.648

The P_b column includes mixing effects.

Should be possible to use a separate tag for each combination, to maximize statistics.

For now, lump them together taking:

V first if nonzero,
else K.

	p_c	P_b
V→K	0.920	0.788

Calibration

Calibrate using max-$\mathcal{L}$ fit to numbers of events observed for each combination of tags, for example double-charm-tagged, same sign or charm-tag+bottom-tag, opposite sign, etc.

Fixing R_b and R_c, can extract:

- charm tag: η_c, η_b, p_c, p_b
- bottom tag: ϵ_b, ϵ_c, P_b

Results for 96-98 data:

	MC	data calib.
η_c	0.194	0.193±0.002
f_c	0.898	0.886±0.003
p_c	0.923	0.908±0.010
p_b	0.504	0.520±0.031
ϵ_b	0.576	0.566±0.002
F_b	0.966	0.955±0.005
P_b	0.805	0.805±0.004

For f, p, F, P the numbers are averages over all events used in the corresponding asymmetry fit.

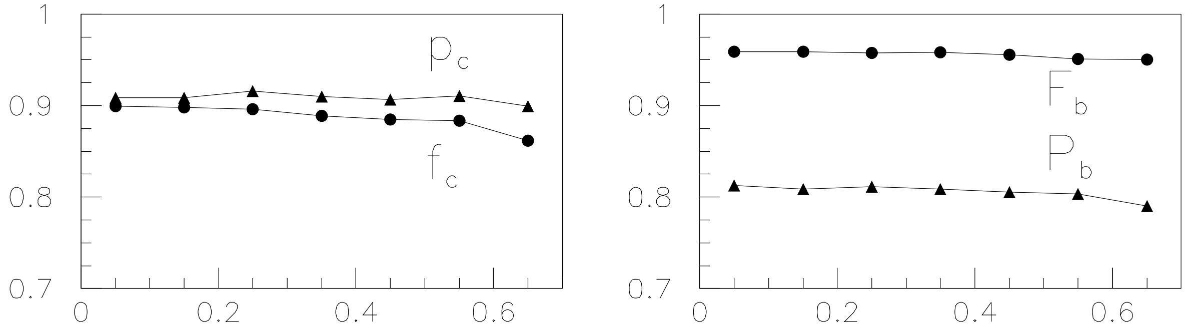
Results

Events are pretty clearly separated into c and b samples
$\Longrightarrow$ do separate A_b and A_c fits

Fits are to usual polarized cross-section, using thrust axis:

$$\mathcal{L} \sim (1 - A_e P_e)(1 + \cos^2\theta) + 2(A_e - P_e) A_f \cos\theta$$

MC shapes are used for the $\cos\theta$ dependences:



Fitting all the 96-98 R17 data gives:

$$A_c = 0.667 \pm 0.028 \pm 0.020$$
$$A_b = 0.928 \pm 0.018 \pm 0.013$$

Where the second error is due to calibration statistics.

The good news:
A_b is in good agreement with the previous results.
The bad news:
A_c is quite a bit higher than what was seen before.

What's up with A_c?

Still have old R15 ntuples - analyze with new code
$\Longrightarrow$ can reproduce old A_c result

Use MC f_c, p_c instead of calibrated ones
$\Longrightarrow$ both sets say $A_c \sim 0.64$

Difference looks to be in calibrated p_c

	MC	data calib.
R15	0.921	0.943±0.012
R17	0.934	0.917±0.011

These numbers don't include hemis with V≠K, which were discarded for the R15 mesasurement.

How can it be so different? Check overlap of double-charged events, used for the calibration.

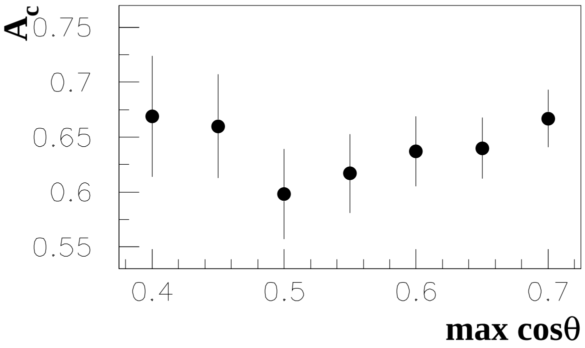
R15:	407 events
R17:	530 events
Overlap:	~180 events

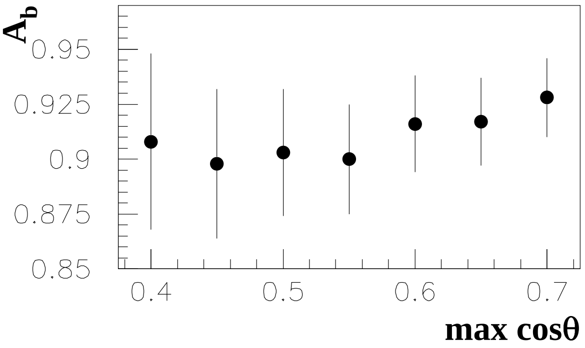
Guess it could just be statistics...

Polar Angle Dependence

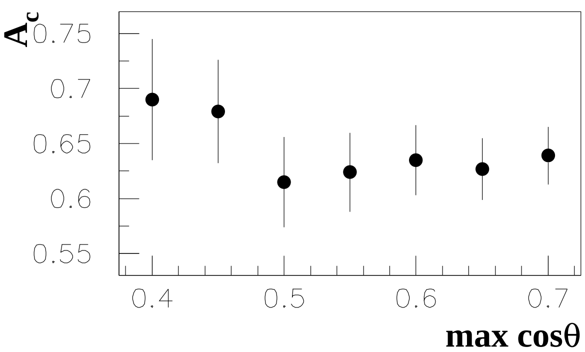
Check stability of result versus polar-angle cutoff.

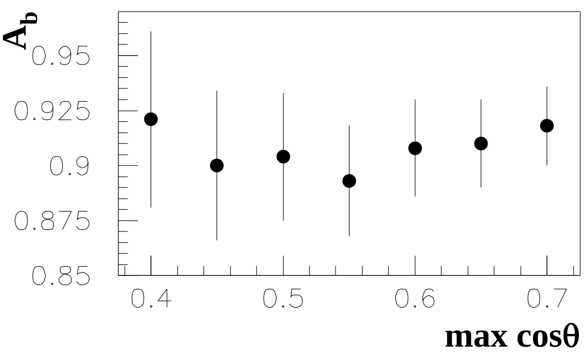
For self-calibrated purity, analyzing power:





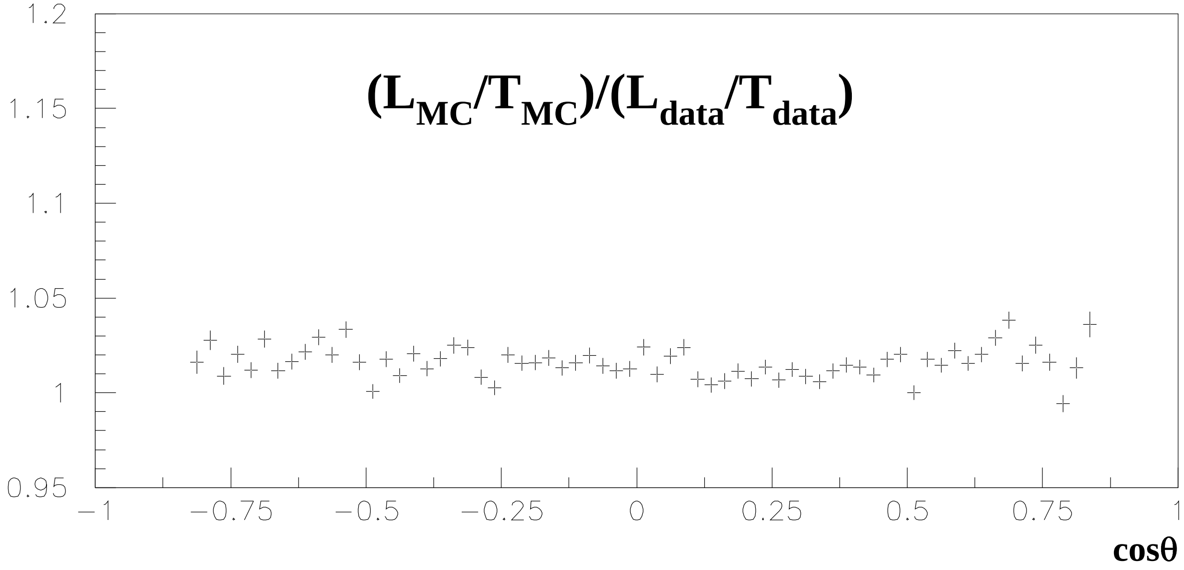
For Monte Carlo purity, analyzing power:

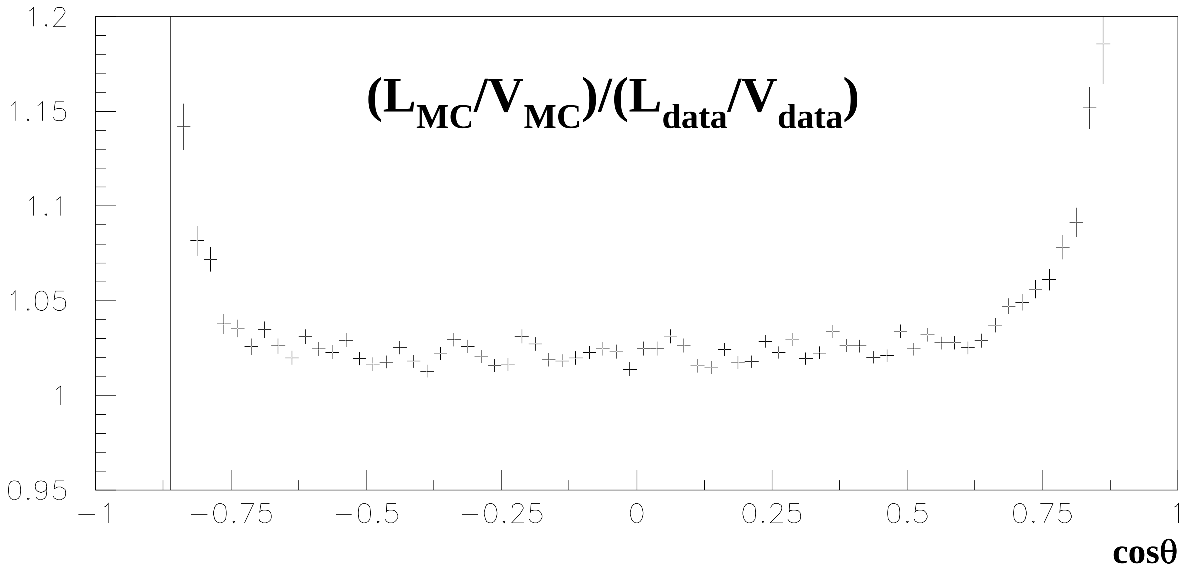




Tracking Efficiency

VXD3 and CDC are (almost) independent trackers. Start with a good track (or VXD vector) and see how often you get the other piece.





L=#linked tracks, **T**=#CDC tracks, **V**=#VXD vectors

Need better simulation of CDC at high $\cos\theta$?

ToDo

- figure out A_c R15/R17 situation
- find optimal tag setup
- tag consistency checks
- study tracking efficiency for $\cos\theta$ shapes
- new QCD corrections
- study hemisphere correlations
- generate results for ICHEP if all goes well