

PNN2 Beam Background

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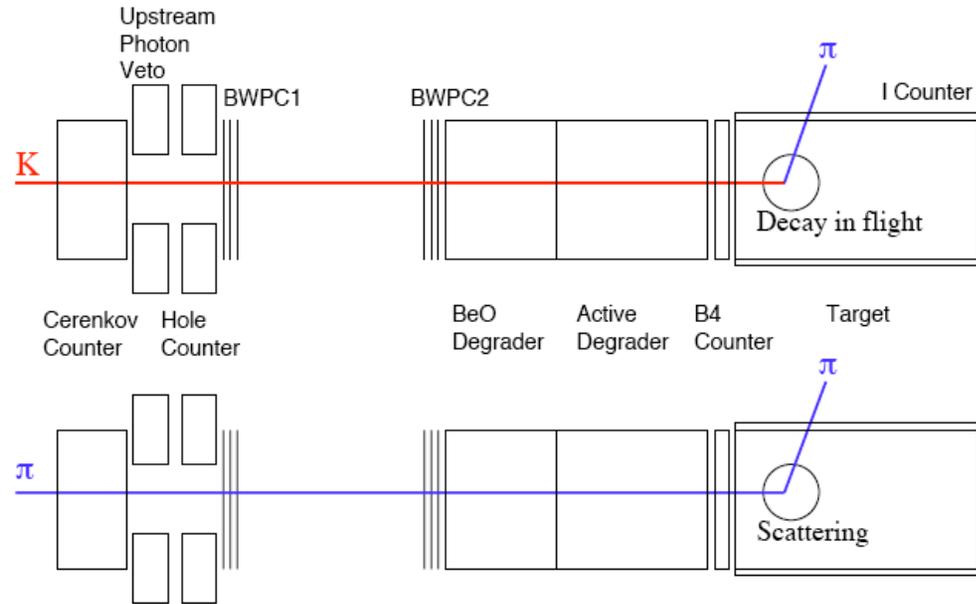
University of New Mexico

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PNN2 Analysis Meeting

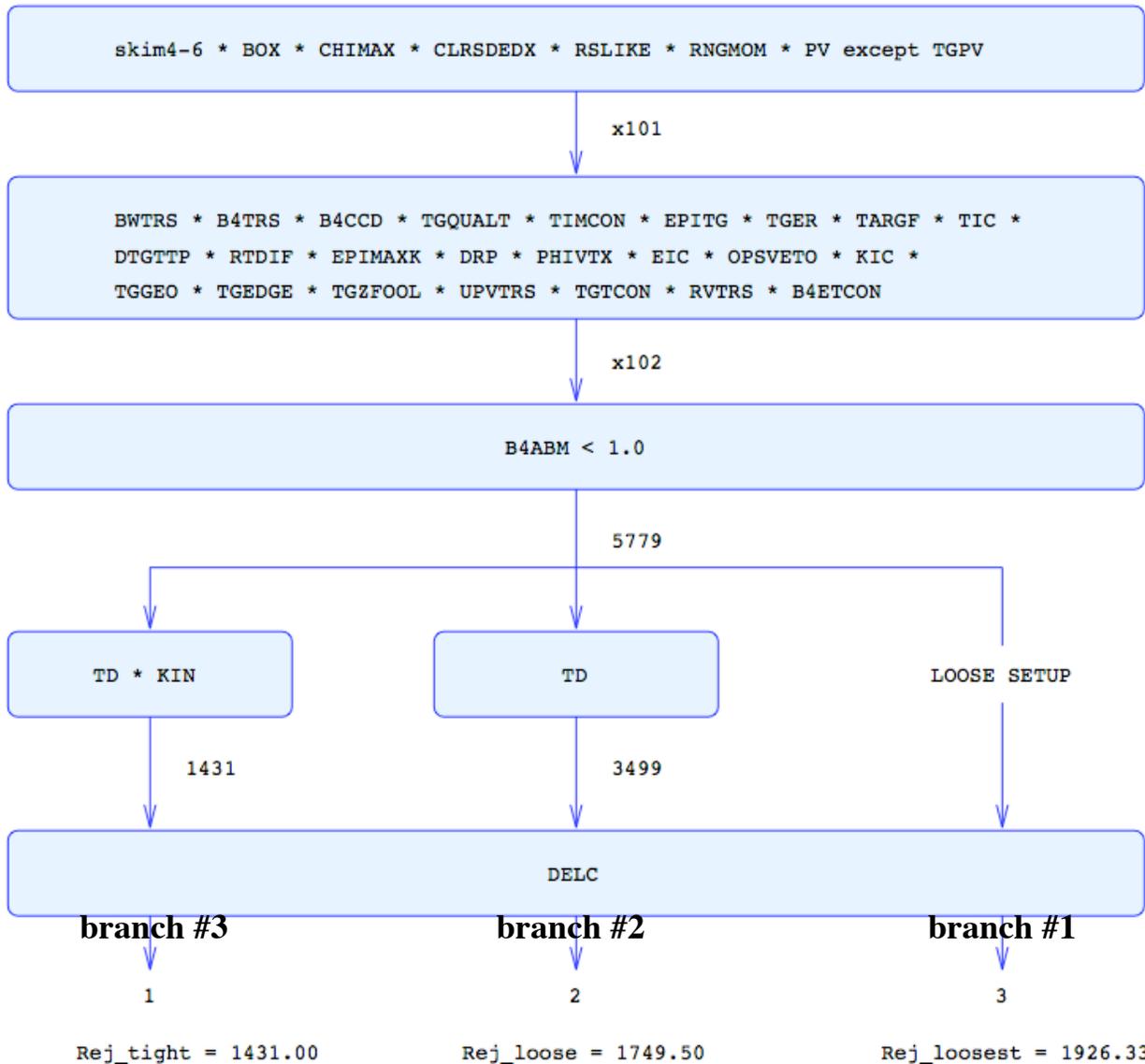
1-Beam

- Backgrounds
 - K^+ decay in flight
 - Beam π^+



- 1-Beam Sample
 - Select π^+ in B4
 - Reverse B4DEDX ($b4abm_atc < 1.0$)
 - Measure Rejection of *DELCO*
 - E787-PNN2 used *DELCO-6*
 - E949-PNN1 used *Delc* (nominally *DELCO~2*)
 - Currently using PNN1-*Delc* cut to prevent looking in box.

1-Beam Rejection Bifurcations



•Select incoming π^+

•Loosen Cuts in an attempt to get more statistics

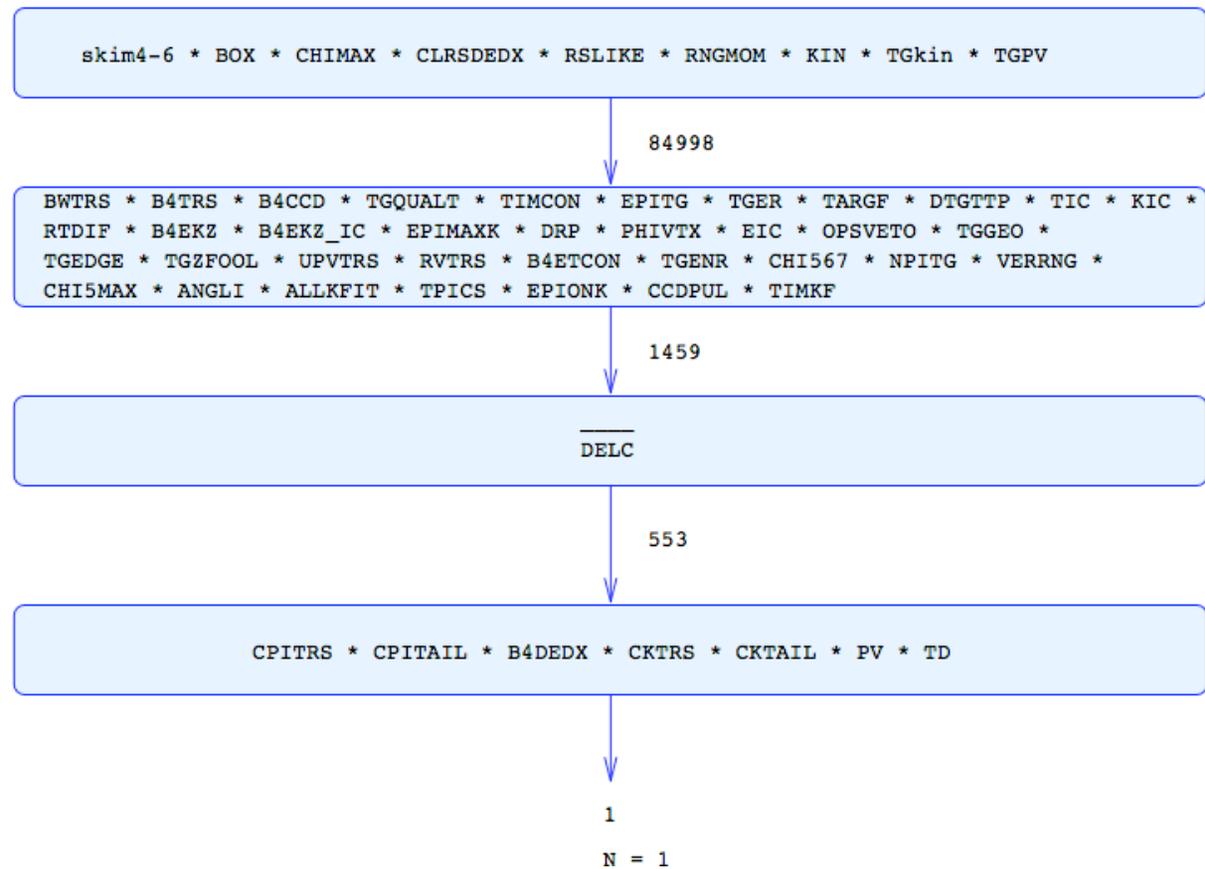
•Measure Rejection of *DELCO*

1-Beam Normalization

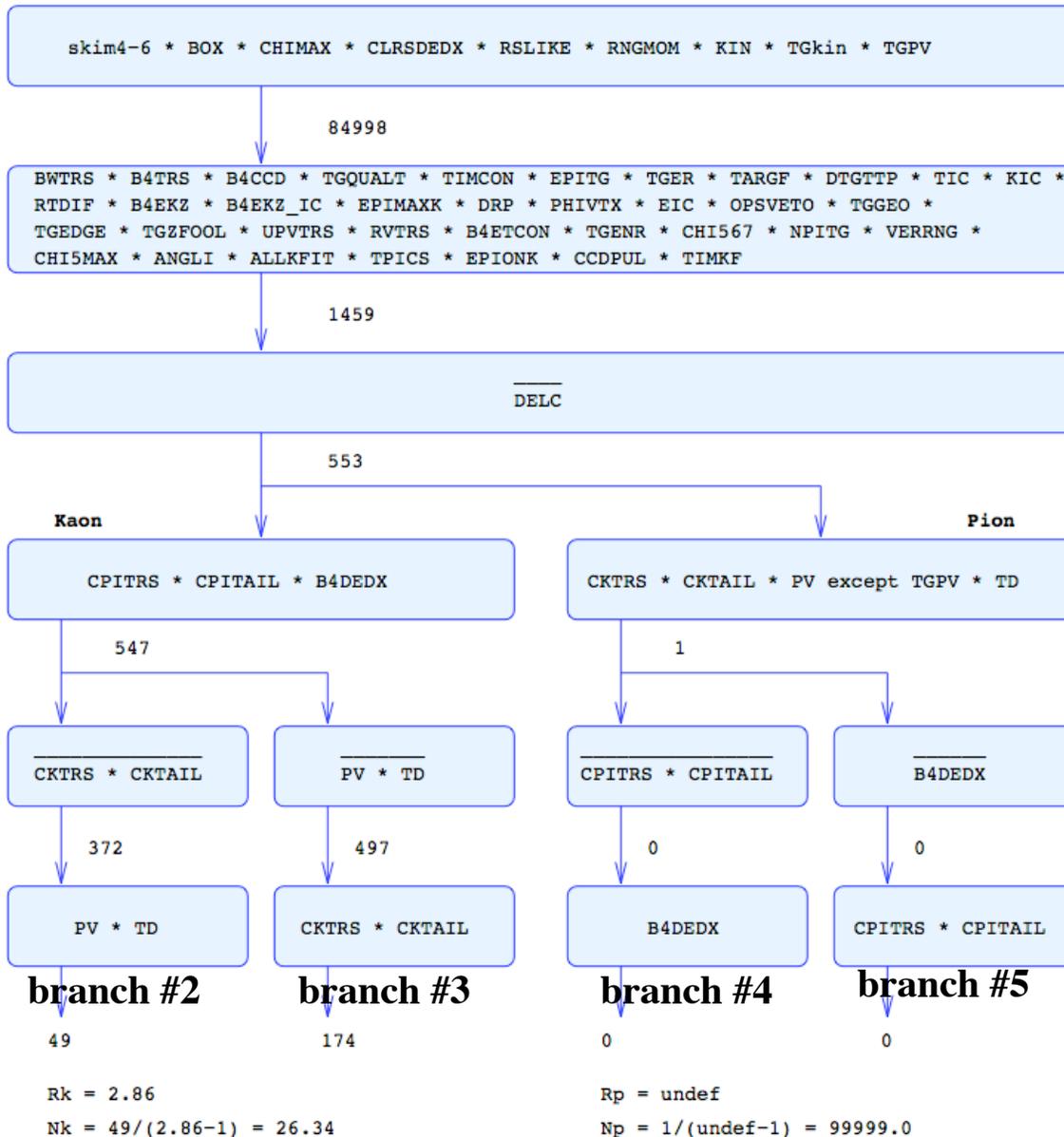
Branch #1

- Simple method:
Invert measured cut and
apply all other cuts.

- Invert *DELCO*



1-Beam Normalization



- Apply setup cuts

- Invert *DELCO*

- Remove π 's from **K**

- Remove **K**'s from π

- bifurcate

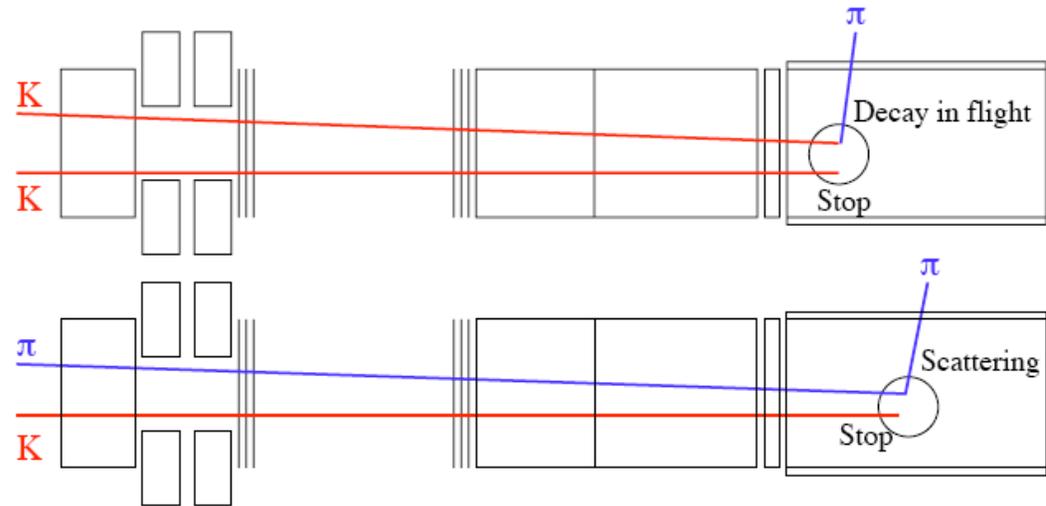
PNN2 are limited in statistics in the π -bifurcation.

1-Beam Background

- Used DELC ($\sim 2\text{ns}$), in final will use DELCO $\sim 6\text{ns}$
- Values reported are scaled to 3/3 sample.
- Additional documents
 - PNN2 (cpi-veto + ps16) [bmbkg_tables_pnn2.pdf](#)
 - PNN2 (cpi-veto only) [bmbkg_tables_pnn2cpi.pdf](#)
 - PNN2 (cpi-veto+ps16 using only e949 cuts) [bmbkg_tables_pnn2e949.pdf](#)
- $N_{1\text{BM}} = 0.00210 \pm 0.00210$ (with CPI-veto online bit applied)
- $N_{1\text{BM}} = 0.00040 \pm 0.00040$ (all PNN2 triggers)
 - E949-PNN1: $N_{1\text{BM}} = 0.00383 \pm 0.00236$
 - E787-PNN2: $N_{1\text{BM}} = 0.00166 \pm 0.00166$
- Small, consistent with e949-PNN1 & e787-PNN2
- π -branch bifurcation in Normalization has no events left.
 - Use Branch 1 (no bifurcation), i.e. apply all cuts & invert *Delc*.
 - Unable to verify normalization as PNN1 was able to do.
 - PNN1: Branch 1 was consistent with norm. results from Branches 2-5
- Satisfied with results for now.

2-Beam

- Background
 - **KK** type
 - $K^+ + K^+$ decay in flight
 - **K π** type
 - $K^+ + \text{Beam } \pi^+$



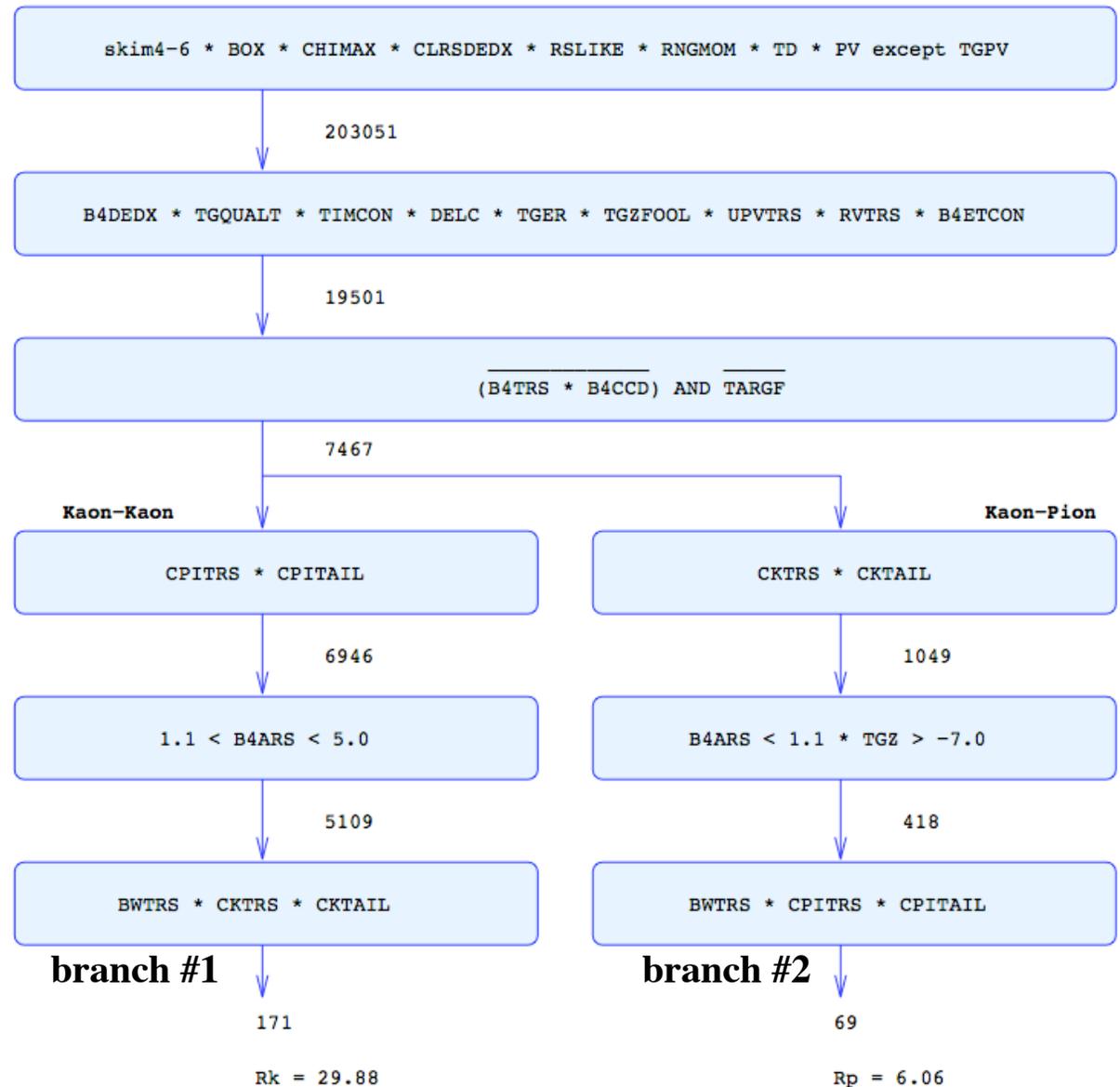
- Rejection Sample
 - Obtain events with beam particles entering at decay time.
 - $\overline{B4TRS} \cdot \overline{B4CCD} \cdot \overline{TARGF}$

- | | |
|--|---|
| <ul style="list-style-type: none"> • Obtain KK's by removing Kπ's <ul style="list-style-type: none"> – $Cpitrs * Cpitail$ – B4DEDX (cut π's) • Measure Rejection of <ul style="list-style-type: none"> – $BWtrs * Cktrs * Cktail$ | <ul style="list-style-type: none"> • Obtain Kπ's by removing KK's <ul style="list-style-type: none"> – $Cktrs * Cktail$ – B4DEDX (cut K's) • Measure Rejection of <ul style="list-style-type: none"> – $BWtrs * CpiTRS * CpiTAIL$ |
|--|---|

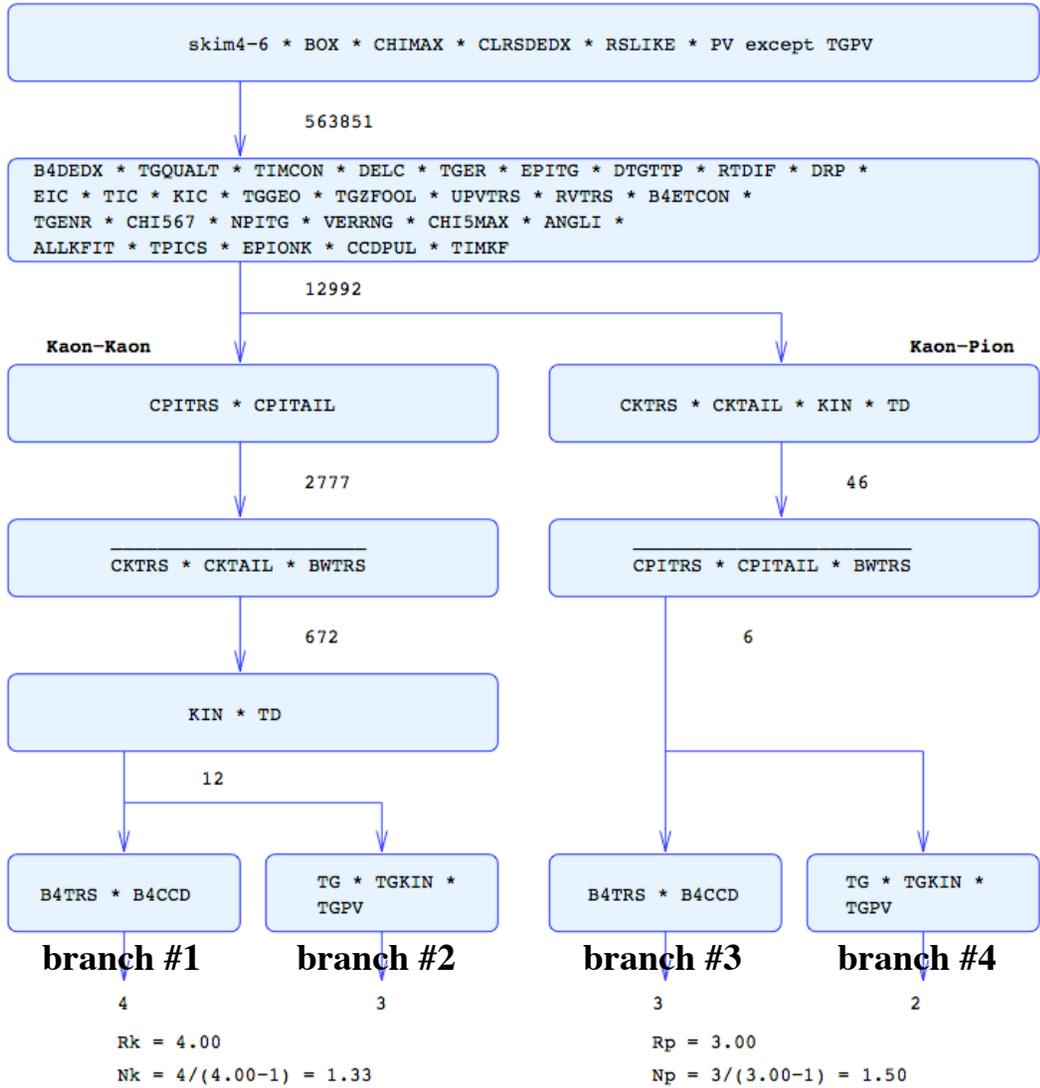
2-Beam Rejection Bifurcations

- Remove Ke4, multiple body decay by inverting *TARGF*
- Tag two beam events in B4
- Select **KK** events by removing **K π**
- Select **K π** events by removing **KK**

• Measure Rejections



2-Beam Normalization Bifurcations



- Select **KK** events by requiring a hit in either BWTRS or C_k
- Select **K π** events by requiring a hit in either BWTRS or C_{π} .
- LOOPHOLE!!!**

•If an event has a **BW** hit w/o a hit in C_k or C_{π} , then double counting will occur.

•Double counting not big effect in PNN1, due to higher statistics.

PNN2 Trigger

- $pnn2_{e949} = pnn2_{e787} \cdot (\overline{C_{pi}} \cdot ps16)$
- Problem for 2-BM $K\pi$ sample.
 - We are able to correctly measure rejection of $CpiTRS$ offline if we require $\overline{C_{pi}}$
 - Use ps16 sample for the $K\pi$ bifurcation.

2-Beam Background

- Values reported are scaled to 3/3 sample.
- **KK**
 - $N_{2BMkk} = 0.139 \pm 0.098$ (with CPI-veto online bit applied)
 - $N_{2BMkk} = 0.139 \pm 0.099$ (all PNN2 triggers)
 - E949-PNN1: $N_{2BMkk} = 0.000983 \pm 0.000983$
 - E787-PNN2: $N_{2BMkk} = 0.1459 \pm 0.1459$
- **K π**
 - $N_{2BMkp} = 0.898 \pm 0.740$ (with CPI-veto online bit applied)
 - $N_{2BMkp} = 0.00884 \pm 0.00720$ (all PNN2 triggers)
 - E949-PNN1: $N_{2BMkk} = 0.000106 \pm 0.000106$
 - E787-PNN2: $N_{2BMkk} = 0.0197 \pm 0.0197$
- Too Large!!!
 - **KK** is x140 larger than PNN1, consistent with e787-PNN2.
 - **K π** is x80 (x8000) larger than PNN1, consistent with (larger than) e787.
- Determine cause of large increases (**May 20th**).

Status 1

- ✓ Built automated scripts.
 - Obtain latest & greatest cuts that have been optimized by other studies.
 - Much less overhead and removes the need to relearn scripts a months later
- ✓ Reproduced Jingliang's e949-PNN1 study.
 - Additional document [bmbkg_tables_pnn1.pdf](#)

<i>Bkgrnd</i> ($\times 10^{-3}$)	k034	e787	pnn1
1- <i>BM</i>	3.86 ± 2.36	1.66 ± 1.66	5.05 ± 5.05
2- <i>BM KK</i>	0.983 ± 0.983	145.9 ± 145.9	0.77 ± 0.98
2- <i>BM Kpi</i>	0.106 ± 0.106	19.7 ± 19.7	0.21 ± 0.13
2- <i>BM</i>	1.14 ± 1.14	165.6 ± 165.6	0.99 ± 0.99
<i>Total</i>	5.00 ± 2.62	167.3 ± 167.3	6.03 ± 5.44

Table 5: **Total Background.** Scaled to the 3/3 sample. k034 column is the result of e949-pnn1 analysis. e787 is the result of the e787-PNN2 analysis. The other columns are current results that is expanded upon throughout the rest of the tables. The errors are statistical. KB_{live} for k034 is 1.77×10^{12} and for e787 is 1.71×10^{12} . e787 background has been scaled up accordingly for comparison purposes.

Status 2

- ✓ Applied additional cuts used only by PNN2.
 - TG-scattering cuts
 - *tgktim, tgenr, chi567, npitg, verrng, chi5max, angli, allkfit, epionk, ccdpul, timkf*
 - Invert *targf* for 2-BM Rej. Sample
 - Removes multiple charged particle decays
 - $K_{e4}, K_{\pi2}$ -scatter w/ Dalitz decay of $\pi^+ \rightarrow \gamma e^+ e^-$
 - Could escape front of target which could result in a B4 hit.
 - Observed by Milind in e787.
 - Not verified in e949
 - » Observe events in pawphoto (May 10th).
- ~ Verify & Know values of cuts parameters (beam cuts May 15)
 - What is more appropriate Bipul's cut positions or PNN1?
 - Need to go thru every cut and determine the appropriate cut position.
 - Acceptance & Rejection of all beam cuts.
 - *epitg* is currently $E_{TG \text{ fiber}} > 5\text{MeV}$ (PNN1 value). Bipul's $> 3\text{MeV}$.

Summary

- N_{1bm} measured and ‘good’.
 - N_{2bm} measured and not good yet.
 - 1st draft numbers ready in 3 weeks (**May 23**).
 - As cuts are modified and/or finalized, I can push the button to get updated values.
- ? What is next for me?
- Acceptance studies
 - Help with target fitter