# HKS-HES Collaboration Meeting

S N Nakamura @Tohoku Univ.

2010/03/05 @ JLab

*** March 11,  E05-115 Analysis Status and Strategy

09:00 Nue   Summary of obtained data and general analysis strategy
09:40 Maruta  Summary of EPICS, Scaler, Raster, Survey data
10:20 Kawama  E05-115 replay, first condensed data set
11:00 Reinhold Particle Identification

11:30-13:30   *****   Lunch  *****

13:30 Zhihong  Estimation of energy loss, beam energy stability, time zero adjustment
14:00 Gogami   Focal plane time for HES-HKS, WC, AC analysis
14:30 Chunhua  HDC analysis
15:00 Kawama   EDC analysis
15:30 Nue         General Discussion
15:45 Hashimoto Future collaboration meetings
16:00   Petkovic    A remark of gratitude
on the occasion of 10 years history of the HYspectroscopy at JLab
16:05 Adjourn

18:00 END Run Party @ Kappo Nara

# Summary of obtained data and general analysis strategy

- Number of K, number of QF events
- Multihit TDC analysis
- Timing adjustment, Pulse height normalization
- Kinematics Tuning, Beam Energy Scan, H2O/CH2 data analysis
- Matrix Tuning
- Various Efficiencies Estimation, VP flux estimation, Triple differential cross section.
- Linearity,  Systematic error estimation
- Fitting of spectra

# Quesi-free Λ & expected gs. yields

| Target | Number of Quasi-Free Λ (observed) | Quasi-Free Λ Cross Section (assumed) | Hypernuclei (g.s) Cross Section (assumed) | Expected number of g.s |
|---|---|---|---|---|
| $^{7}$Li | 6.4 x$10^4$ | 1.0 μb/sr | 21 nb/sr | 1300 |
| $^{9}$Be | 4.5 x$10^4$ | 1.2 μb/sr | 4 nb/sr | 150 |
| $^{10}$B | 4.8 x$10^4$ | 1.3 μb/sr | 21 nb/sr | 780 |
| $^{12}$C | 3.4 x$10^4$ | 1.5 μb/sr | 112 nb/sr | 2500 |
| $^{52}$Cr | 1.4 x$10^4$ | 4.7 μb/sr | 69 nb/sr | 210 |

- Cross section of QF Λ is assumed as $0.2*A^{0.8}$ [μb/sr]
- # of g.s is calculated as (# of Λ)*(g.s cross section)/(QF Λ cross section)
- Cross Section of $^{9}$Be is derived by Progress of Theoretical Physics Supplement No.117 (1994) pp. 151-175 (M. Sotona and S. Frullani) and other cross sections are summarized in E05-115 experiment proposal (JLab PAC 28 and 33).

# Number of Kaon, Λ, QF, gs

- Are they consistent to each other?

eg) Number of Lambdas from H2O is much much less than it from CH2.

| target | time [sec] | charge [C] | Lambda | Sigma | Quasi-free |
|---|---|---|---|---|---|
| $CH_2$ | 119225 | 0.244 | 2600 | 480 | $1.0 \times 10^4$ |
| $H_2O$ | 73389 | 0.19 | 320 | 70 | $9.7 \times 10^2$ |

Considering VP yield difference due to collimator position: 5 times less!

| target | Lambda/Sigma | Lambda/QF | Lambda/(QF/$A^{0.86}$) |
|---|---|---|---|
| $CH_2$ | 5.59 | 2.5 | 21 |
| $H_2O$ | 5.50 | 3.3 | 35 |

Λ/Σ ratio OK, Λ/QF not bad

Normalized kaon rate for H2O is about half of it for CH2…

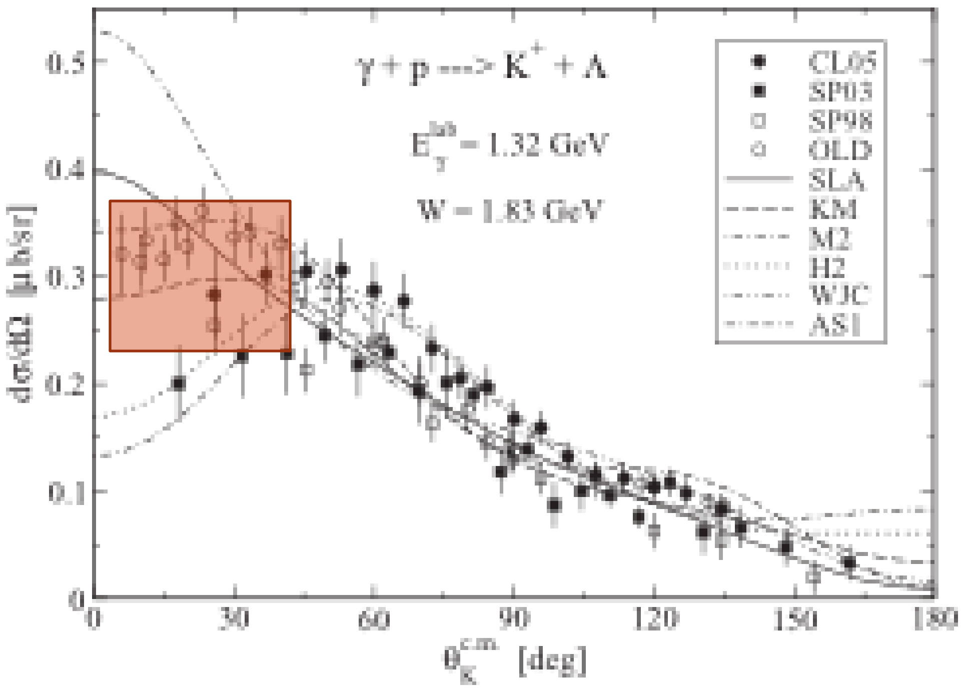
# Should be checked/developed

- Normalized kaon rate (e' rate)
  - really low for high-rate runs?
  - Problem of the multihit treatment in analysis code?
    - Development of new code for multihits is essential
  - Missed events in trigger level?
- DC's tracking routine
  - Quick selection of good tracks (combined with counters' info)
  - Good multi-track handling (better timing, right treatment of MultHit)
- g.s. peak/QF still much lower than expected
  - # of $\Lambda$ for CH2 is not bad
  - Due to untuned matrices?

# Cross section of p(γ, K⁺)Λ, Σ⁰

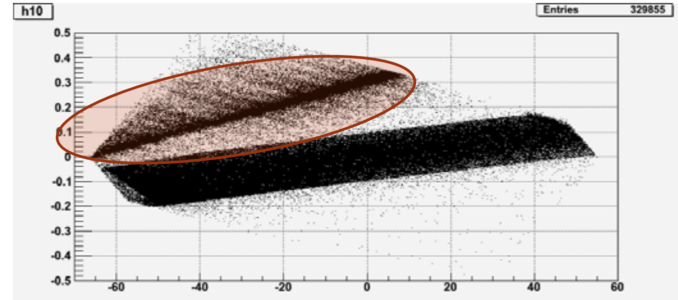
| | w/o H loss Corr. [nb/sr] | w/ H loss Corr. [nb/sr] |
|---|---|---|
| Λ | 189 | 230 |

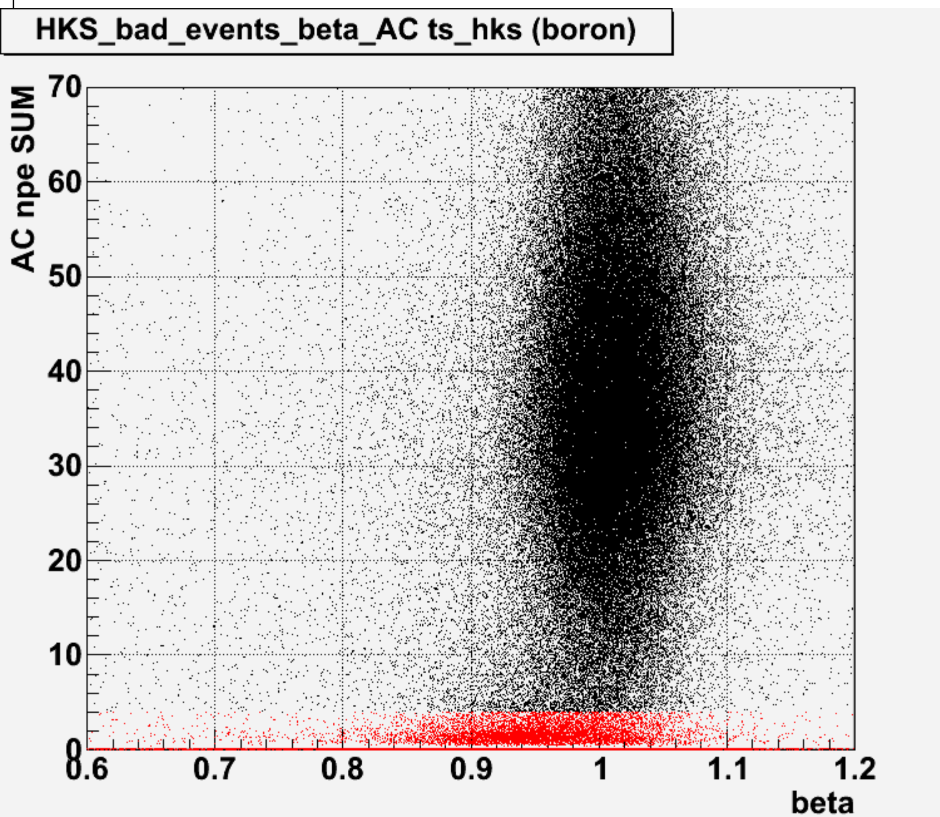
- Assuming 17% ave. H loss from $CH_2$
- $\varepsilon = 100\%$

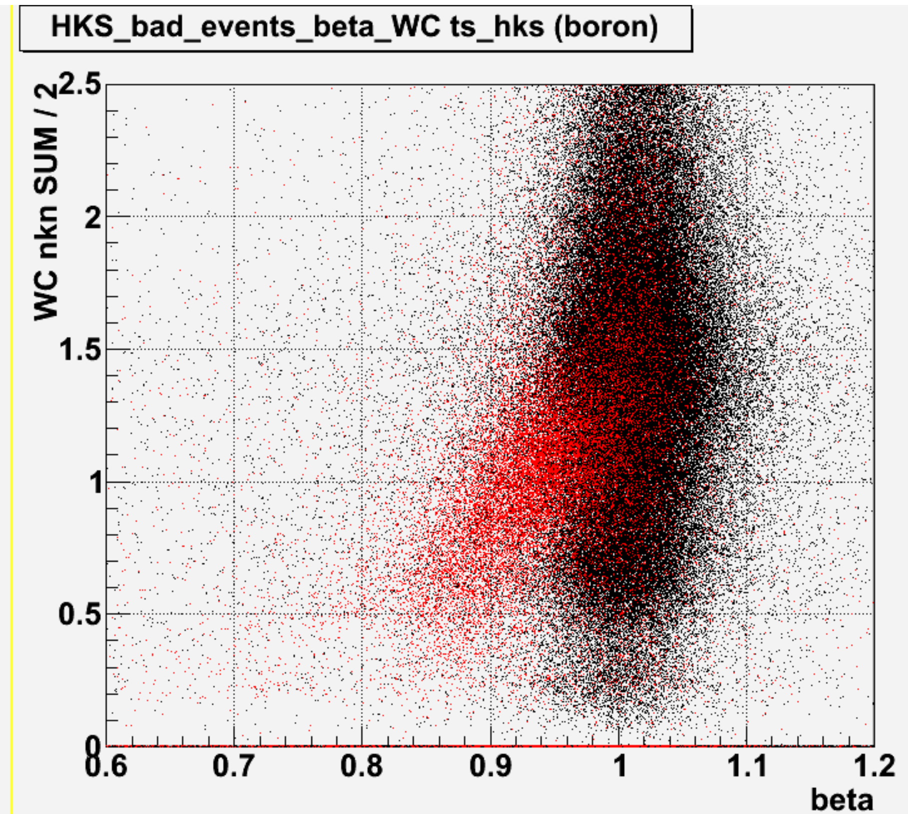



P. Bydžovský and T. Mart, Phys. Rev. C 76, 065202 (2007)

# HKS β=1 background




Kaon contamination is not likely.

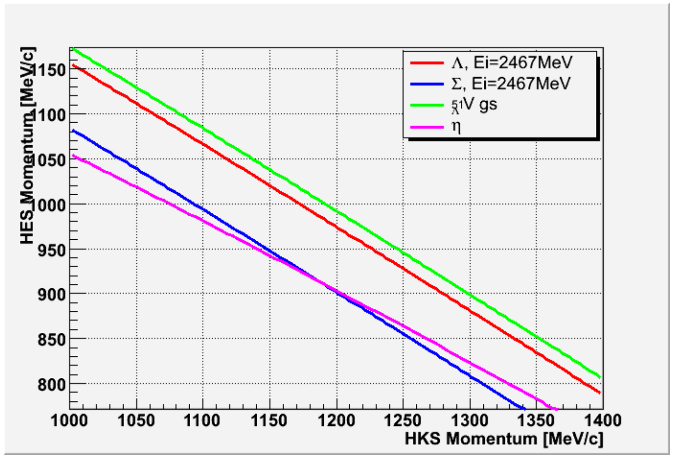
Analysis of multiple hits may cause the problem.

# Timing adjustment

- Shoh adjusted HKS timing (PH corr., TOF=0for low rate runs
- High-rate runs ($H2O$, Cr) need different parameters
- HES timing adjustment : Shoh and Gogami are working
- Consistent fp-time definition is necessary for all analyzers : Liguang discussed

# Kinematic Tuning, Beam E scans

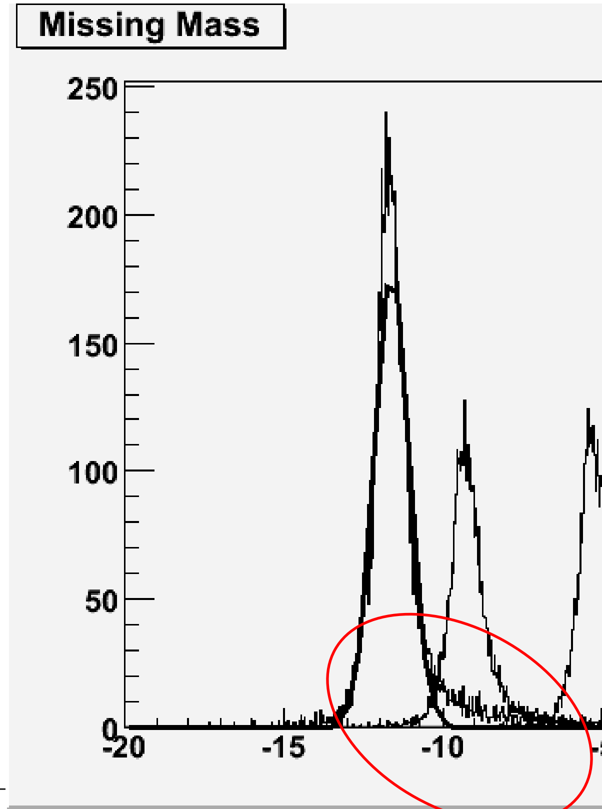
- Kinematic Scan
  - Can we believe HallC:p?
    - Correlation 9th Dipole NMR, BPM
  - +-1MeV run?
  - +20MeV run?
    - H2O Λ peak can be seen.




- Other Calibration?
  - $\gamma p \rightarrow \eta'(958)\, p$ ($d\sigma/d\Omega \sim 100$ nb/sr, $\Gamma = 200$ keV)

# Matrix Tune

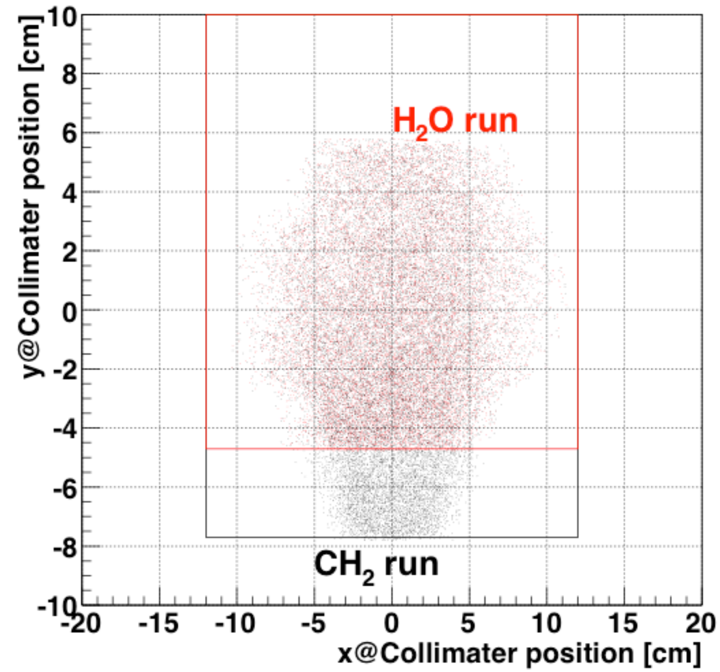
- Semi-automatic method is necessary for blind analysis with large ensemble
- Forward matrices constraint
  - Lower order matrices
  - Linearity check with uniform distribution
- Compare tuned mat. and GEANT matrices
  - Asymmetric shape response function




Tail can be seen in Kawama's blind analysis exercise

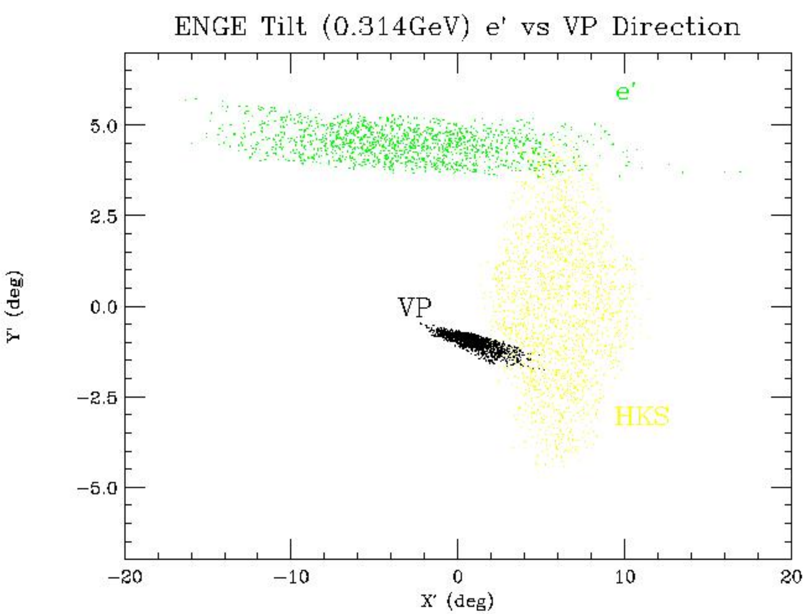
# Various Efficiencies Estimation, VP flux estimation

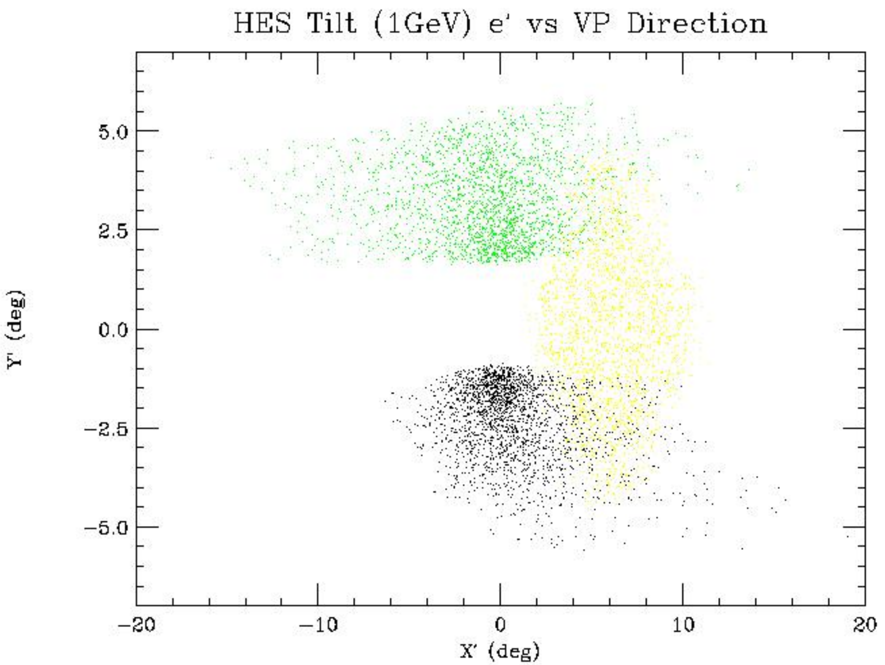
- Various efficiencies estimation
  - Should be controlled by a single table (svn controlled excel file?)




  - VP flux estimation
    - Collimator position ambiguity
      - Survey results and EDC y' problem
      - Do we know collimator position accurately?
      - How we can check?

# X'-Y' correlation of K+, e', VP
# Triple Differential Cross section

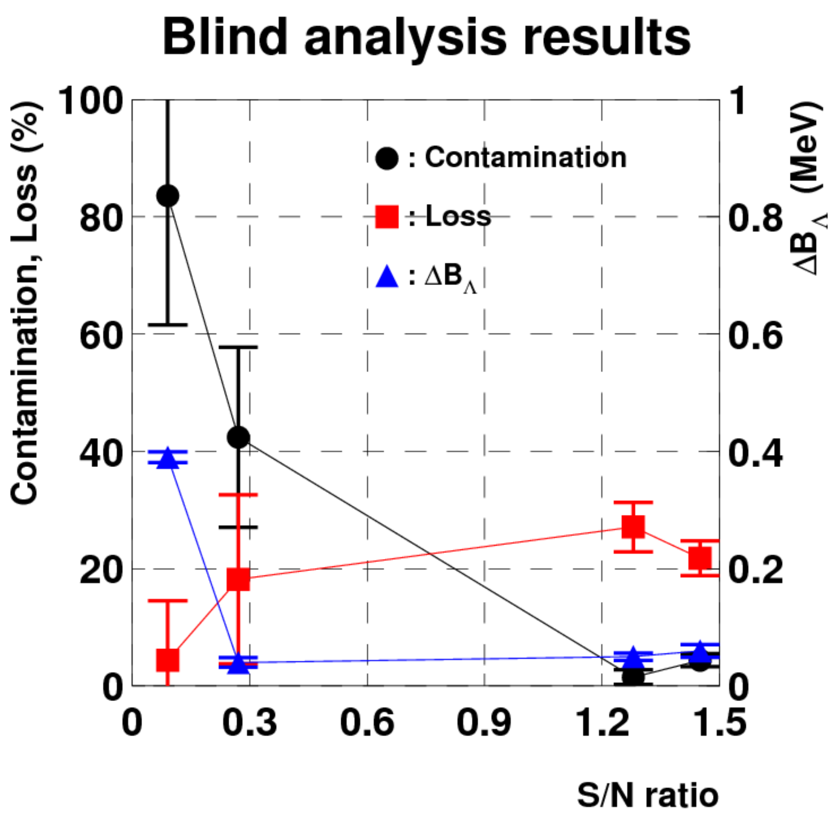



$$\frac{d^3\sigma}{dE_{e'}d\Omega_{e'}d\Omega_K} \stackrel{?}{=} \Gamma \frac{d\sigma}{d\Omega_K}$$

# Linearity, Systematic error estimation

Blind analysis of simulation data




This systematic error plot itself has errors.

Increase ensemble to reduce the errors.