HKS/HES Collaboration meeting

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Outline

– Replay engine changes
– Particle identification
– HDC resolution
– Data summary
Replay change summary

HKS drift chamber

Changes made:
- Start time calculation\(ightarrow\) resolution, chi2
- Inefficiency of space point selection \(\rightarrow\) less reconstructed tracks
- Calibration of HDC plane position
- Calibration of drift time to drift distance map
Replay change summary

Enge drift chamber
Changes made:
- Start time calculation \rightarrow \text{resolution, chi2}
- multiplicity
- Calibration of drift time to drift distance map

<table>
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<th>Multiplicity</th>
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<th>NEW code</th>
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<td>RMS</td>
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PID tools

- Changes of position and slope parameters of AC and WC
- Recalibrated HKS hodoscopes
Particle identification

• Goal:
  – Maximize number of surviving kaons
  – Get the cleanest possible sample

• PID tools:
  – Aerogel Cerenkov
  – Water Cerenkov
  – Particle beta
  – Coincidence time

• PID analysis:
  – Beta spectrum
  – Coincidence time
  – $\Lambda,\Sigma$ events
Aerogel Cerenkov

- Performance of Tubes and layers varied
- Normalize AC number of photoelectrons with unbiased (pion) events

\[ NPE_N(AC : i - k) = \frac{NPE_{peak}(AC : i - m)}{NPE_{peak}(AC : i - k)} NPE(AC : i - k), \]

\( NPE_N \) - normalized number of photoelectrons; i-layer number; k-tube;

- Kaon selection (cut condition) used is:

\[ AC1norm + AC2norm + AC3norm < X_{AC} \]
Water Cerenkov

- Performance of Tubes and layers varied
- Normalize WC number of photoelectrons with kaon events
  - If multiple WC segments on particle trajectory, first normalize each tube signal and then sum them together

- Kaon selection (cut condition) used is:

\[ WC1_{\text{norm}} + WC2_{\text{norm}} > X_{WC} \]
Particle beta

- for PID difference between time of flight beta and beta reconstructed is used
- Fluctuations in time of flight beta on run to run basis were noticed (left fig)
- There is linear correlation between pion and kaon offset (right fig)

- Kaon selection (cut condition) used is:

\[ |\beta_{TOF} - \beta_{K^+} - offset| \leq X_\beta \]
PID with beta spectrum

- Impose PID cut on AC, WC
- Fit beta spectrum with three functions for proton, kaon and pion events
- Extract number of kaons, protons and pions
- Calculate kaon survival rate, proton and pion rejection for the set of cut conditions \( X_{AC}, X_{WC}, X_\beta \)
PID with coincidence time

- Impose PID conditions ($X_{AC}$, $X_{WC}$, $X_\beta$)
- Fit coincidence time with 9 Gaussians
- Extract number of kaons

$$N_{K^+} = N_{\text{True}} - \frac{1}{8} \sum_{i=1}^{8} N_{\text{Accidental},i}$$

- Extract S/A ratio
PID with coincidence time

- Apply AC, WC and beta cuts on coincidence time distribution
- Fit it with 9 Gaussians
- Calculate number of events in each peak
PID analysis on CH2 data

- CH2 data is used in the spectrometer calibration
- In the calibration important are:
  - Number of $\Lambda, \Sigma$ events
  - good S/A ratio
HDC resolution – focal plane variables

- Monte Carlo simulation with real data reconstructed tracks and residual distributions
  - Use real data HDC information
  - Simulate drift distance errors by using residual distribution
- Simulate HDC information
- Reconstruct trajectories
- Calculate errors of the focal plane variables (X,Xp,Y,Yp)
HDC resolution – reconstructed momentum

- Momentum is reconstructed from focal plane variables
- Obtained momentum resolution 210 (12) keV
- Expected 180 keV
Momentum resolution across focal plane
Correction factors-drift chambers

- EDC and HDC tracking efficiency
- Discard tracks with high Chi2
- Create tracks by other detectors, check if EDC(HDC) found it as well
### Data summary

<table>
<thead>
<tr>
<th>Target</th>
<th>Data Set</th>
<th>Beam Charge [mC]</th>
<th>Current Ave [μA]</th>
<th>Trigger</th>
<th>Grouping</th>
<th>Runs</th>
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<table>
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<tr>
<th>Target</th>
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<th>Note</th>
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**Table 2.11:** Data acquisition settings during the E01-011 experiment.
Summary

Thanks to HKS/HES collaboration I successfully defended my thesis!!!

My thesis:
• Detailed description of analysis
• Detector performance and efficiencies
• PID cut efficiencies
• Cross section