Hall C User Howto

Experiment: HKS

Operation and Tracking of HKS Drift Chamber

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Abstract

This document describes the operational parameters,commissioning procedure and tracking method for HKS drift chamber.

1 Purpose

The HKS drift chambers were built at Jefferson Lab by Hampton University group. The two chambers (DC1 and DC2) are mounted directly on the HKS dipole magnet and are the first detetors after dipole exit. They measure particle trajectory at HKS spectrometer focal plane. This combined with spectrometer optics can be used to reconstruct particle momentum and angles at target.

2 Operational Parameters

The cathode foil planes and field wires are applied the same HVs. Each chamber has 4 HV input connectors, two for foil planes and two for field wires. The signals from sense wires goes into Nanometrics N277 cards for preamplifying and discriminating. There are 20 preamplifier cards for each

Table 1: Geometrical parameters

Dimension (L×W×T)	59.25”×22.75”×3”
Active Region	48.2”×12”
Wire plane configuration	U,U’,X,X’,V,V’

Table 2: Operational parameters

Operation HV	1970 V
Threshold	3.0 V
Gas content	Argon/Ethane 50:50 mixture
Gas pressure:	$\sim$ 16 psi

chamber, 10 on one side and 10 on the other side of the chamber. These Nanometrics cards need both +5 and -5 power input. The voltages are supplied by two Acopian power supplies, for +5 V and -5 V respectively.

The working gas inside the chambers is Argon and Ethane 50:50 mixture. It also contains a small amount of (about 1%) alcohol vapor to prevent aging of the wire chamber. The gas is mixed in the outside gas shed. For detail information about Hall C gas system, Please refer to Hall C How-To: Drift Chamber Gas System.

3 Commissioning Procedure

Following is the list of major steps to bring the chamber into working condition:

1. Check gas system for correct setting of pressure and flow rate. Flush working gas into the chamber for at least several days to drive out air and moisture.

2. Apply HV up to setting point (currently 1970 V). Monitor leakage current at the same time.

3. Turn on threshold voltage and LV power for the preamp cards. The

threshold voltage supply will be located inside the eletronic room of the counting house.

4. Taking some data to check the tracking efficiency and wire map, drift time and tracking residue histograms. Ajusting the drift velocity and plane position offset parameters if necessary. Refer to section 5:Traking Parameters.

4 Wire Layout and Coordinates System

The wire planes measure positions in three directions X,U and V. These coordinates are then transformed into focal plane coordinates X,Y and Z.

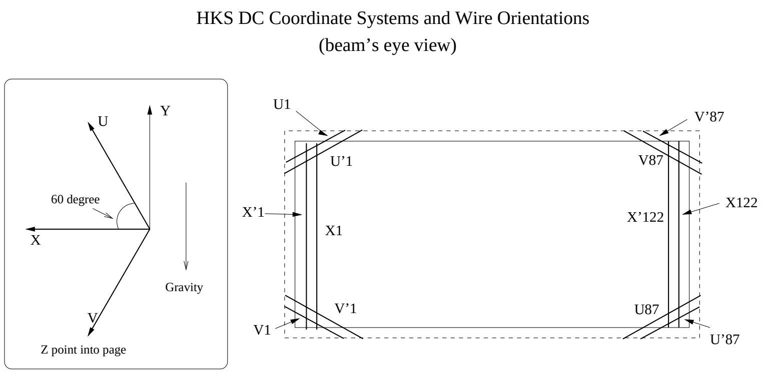

Figure 1: HKS DC wire layout and coordinate system

5 Tracking Parameters

The parameter set for HKS DC tracking comprises geometrical constants, tracking criterion and other wire chamber constants. They are needed in the tracking routine to convert raw wire hit into coordinates and fitting the tracks.

Each wire plane of the chamber is described by the following constants:

1. Plane number: From 1 to 12.

2. `hdc_zpos`: The coordinate in the particle traveling direction.

3. `hdc_beta`, `hdc_gamma` and `hdc_alpha`: These are the three rotation angles of wire plane about the Y axis, X axis and Z axis.

4. `hdc_nrwire`: number of wires in plane.

5. `hdc_central_wire`: The fictitious wire number of the middle wire. It is used in calculation of the wire center position:

```
" hdc_wire_center(goodhit) = hdc_pitch(plane)
     &                   * ( (hdc_nrwire(plane) + (1 - wire))
     &                   - hdc_central_wire(plane) ) - hdc_center(plane)"
```

6. `hdc_wire_counting`: A flag that indicates whether wire is counted along positive (-1) or negative (+1) x direction. For HKS DC, all wires are counted from the positive X side. So it is +1 for all the planes.

7. `hdc_center`: offsets of the planes along local coordinates.

8. `hdc_length_x` and `hdc_length_y`: The dimensions of the DC active area in x and y directions.

9. `sigma`: the Gaussian width of the tracking fitting residues

Currently, the parameter values used in the tracking are:

Table 3: Tracking parameters

Plane	No	Zpos (cm)	α (degree)	nrwire	Central Wire	sigma (cm)
1u1	1	-1.905	30	87	43.75	0.02
1u2	2	-1.270	30	87	44.25	0.02
1x1	3	-0.635	90	122	61.75	0.02
1x2	4	+0.3175	90	122	61.25	0.02
1v1	5	+0.9525	150	87	43.75	0.02
1v2	6	+1.5875	150	87	44.25	0.02

The β, γ angles are 0 degree for all planes. `hdc_center` are 0 now. The wire plane Z positions in the table are relative positions within one chamber. Assuming a 1 meter seperation between the 2 chambers after they are mounted on the spectrometer, the actual Z positions for DC1 wire planes will be $Zpos - 48.095$ cm from the HKS reconstruction plane, for DC2, it will be $Zpos + 51.905$ cm.

An important tracking criterion constant is `space_point_criterion`, the minimum squared distance to combine two hit pairs into one space point. `hpace_point_criterion` is 1.2 cm currently.

These tracking parameters are set in files according to standard Hall C CTP file structure.

```
                      HKS DC Tracking Parameter File Structure

e01011.param.#  ----> general.param.1: TDC slot #; debug flags
                 |
                 |--> edc.param.1: Enge wc parameters, just a place-holder for
                 |       now
                 |
                 |-- HKS DC parameters
                       |
                       |--> hdc.param.#: tracking parameters, sigmas of
                       |       tracking residues, plane time zeros, wire velocity
                       |
                       |--> hdc.pos.1: all geometrical parameters of chamber
                       |
                       |--> htracking.param.1: tracking criterions and switches
                       |
                       |--> hdc_offsets.param: Preamp. card numbers, position
                       |       and  delays
                       |
                       |--> hdriftmap.#: table for drift time to drift
                               distance map created by hdrift.kumac
```

Figure 2: File structure of DC tracking parameters

6 Flowchart of DC tracking code

Following is the flowchart of chamber tracking code:

```
                 HKS DC Tracking Code Flowchart

h_track ----> h_trans_dc: calculate wire center position and drift time from
         |                 wire # and TDC.
         |
         |--> h_pattern_recognition ----> find_space_points: find points within
         |     (get space point)      |     wc by looking at nonparallel planes
         |                            |
         |                            |--> h_choose_single_hit: choose one hit if
         |                            |    one sp has multiple hits in one plane
         |                            |
         |                            |--> select_space_point: accept sp with
         |                            |    good # hits and good # of combos
         |                            |
         |                            |--> do wire velocity correction, calculate
         |                            |    exact drift time and drift distance
         |                            |
         |                            |--> h_fill_dc_dec_hist
         |
         |--> h_left_right -------------> h_find_best_stub: fit track to sp's in
         |  (fits stubs to all            single chamber (assumes yp=0)
         |   possible L-R combinations)
         |
         |--> h_link_stubs (look at sp stubs and links them into tracks)
         |
         |--> h_track_fit --------------> solve_four_by_four
         |   (fit tracks and find
         |    fitting residues)
         |
         |--> h_fill_dc_fp_hist
```

Figure 3: Flowchart of DC tracking code