Hall C Reference

Hall C Superharp System

C. Yan

July 17, 2003

Abstract

A system documentation of Hall C superharps is briefly summarized. It could serve as system check list, maintenance & survey reference, and upgrade consideration for users, maintenance team, and new owners during the transition period of ownership change.

For information on normal operation of the Superharp system, see the Howto "Superharp Operation" [1].

.

1 Layout of Hall C Superharps

Group #1 IHA3C07A and IHA3C07B

Location: Hall C line 1-st granite table Station #: 4075 Wire material: 22 tungsten Wire structure: x1 y x2 Space between: 2.5 m Type of fork: Polyemeade, replaceable

Pickup type: Secondary electron (sensor wire) Radiation (115M PMT)

Function: Absolute beam position Incident angle Beam energy measurement Acromat verification Beam emittance measurement Beam slow motion

Group #2 IHA3C12A and IHA2C12B

Location: Hall C line 2-nd granite table Station #: 4140 Wire material: 22 tungsten Wire structure: x1 y x2 Space between: 1.63 m (?) Type of fork: Polyemeade, replaceable

Pickup type: Secondary electron (sensor wire) Radiation (115M PMT)

Function: Absolute beam position Incident angle Beam energy measurement Achromat Optics verification Energy spread Beam emittance Beam slow motion

Group #3 IHA3C17A and IHA3C17B

Location: Hall C line 3-rd granite table Station #: 4220 Wire material: 30 carbon fiber (IHA3C17A) 22 tungsten (IHA3C17B) Wire structure: x1 y x2 Space between: 1.88 m Type of fork: Polyemeade, replaceable

Pickup type: Secondary electron (sensor wire) Radiation (115M PMT)

Function: Absolute beam position Outgoing angle Beam energy measurement Achromat verification Beam halo (other two PMTs) Beam emittance Beam slow motion

4. Group #4 IHA3H00 and IHA3H00A

Location: Hall C line target girder Station #: 4350 Wire material: 22 tungsten Wire structure: x1 y x2 Space between 2 m Type of fork: Polyemeade, replaceable

Pickup type: Secondary electron (sensor wire) Radiation (115M PMT)

Function: Absolute beam position on target Incident angle Target raster size and uniformity

Group #5 IHA3HG0 and IHA3HG0A

Location: Hall C line G0 target girder Station #: 12.5 m downstream Hall C pivot Wire material: 22 tungsten Wire structure: x y Space between 2 m Type of fork: fixed metal

Pickup type: Secondary electron (sensor wire) Radiation (115M PMT)

Function: Absolute beam position on G0 target Incident angle Target raster size and uniformity Beam halo

6. Group #6 Polarized Target IHA3H00 and IHA3H00A

Location: Hall C line polarized target girder Station #: 4350 (replacement of Hall C target girder) Wire material: 22 tungsten Wire structure: x y Space between 2 m Type of fork: Polyemeade, non-replaceable

Pickup type: Secondary electron (sensor wire) Radiation (Hamamatzu 931B PMT)

Function: Absolute beam position on polarized target Incident angle Target raster size and uniformity (Gen asked 2 cm raster size) Beam halo

2 Electronics of Hall C Superharps

Electronics in Hall C Blue Rack #HC01Z06

Harp Power Distribution Stepper Motor Interface Chassis Harp Preamp Power Supply Hall C Harp CAMAC Crate - HP Harp Trigger Generator (CAMAC crate slot #23) - Series controller (CAMAC crate slot #24/25, Jorway L2)

Slot and Channel Assignment in Hall C Harp CAMAC Crate

Wire Pickup Radiation Pickup ID# Micro Input PGA ADC PGA ADC Stepper register 1008 5333B 1008 5333B

Slot Chan Slot Chan Slot Chan Slot Chan Slot Chan Slot Chan

3C07A 16 J2A 19 1 10 1 13 J1-0 9 1 13 J2-16 3C07B 16 J2B 19 2 10 2 13 J1-2 9 2 13 J2-17

3C12A 16 J1A 20 1 10 3 13 J1-4 9 3 13 J2-18 3C12B 16 J1B 20 2 10 4 13 J1-6 9 4 13 J2-19

3C17A 17 J2A 21 1 10 5 13 J1-8 9 5 13 J2-20 3C17B 17 J2B 21 2 10 6 13 J1-10 9 6 13 J2-21

3H00 17 J1A 22 1 10 7 13 J1-12 9 7 13 J2-22 3H00A 17 J1B 22 2 10 8 13 J1-14 9 8 13 J2-23

Electronics in Hall C Blue Rack #HC01Z17

Harp Power Distribution Stepper Motor Interface Chassis Harp Preamp Power Supply Hall C Harp CAMAC Crate HP Harp Trigger Distributor (CAMAC crate slot #7) - Series controller (Kinetic System 3952-L2, slot # 24/25)

Slot and Channel Assignment in G0 Harp CAMAC Crate

Wire Pickup Only ID# Micro Input PGA ADC Stepper register 1008 5333B

Slot Chan Slot Chan Slot Chan Slot Chan

3G00 16 J2A 19 1 10 1 13 J1-0 3G0A 16 J2B 19 2 10 2 13 J1-2

Driving and Encoder System

- Counts per turn 65536 - Turns of full range 64 - Accuracy 1 part in 65535 - Repeatability LSB - Configuration Electromagnetic resolver - Pitch of lead screw 2.54 mm - Motion Range 76.2 mm (16 bit) - Stepper motor SLO-SYN M063-LF-401 - Interface MS 40 Microstepper - Microstep size 1/256 step - Microsteps per revolution 51200 - Microsteps per 16 bit 25 - Used encoder range 16 bit (eliminate highest and lowest bit) - Readout unit of encoder 16 bit (for survey record)

Connection between PMT signal cable and PGA (slot #9)

PMT ID Central Pin Cable Shielding

3C07A 2A 1A 1B (short) 3C07B 2C 1C 2B (short)

3C12A 5A 4A 4B (short) 3C12B 5C 4C 5B (short)

3C17A 9A 8A 8B (short) 3C17B 9C 8C 9B (short)
3H00 12A 11A 11B (short) 3H00A 12C 11C 12B (short)

3 Offset Adjustment Before Fiducialization

1. To make the full range of encode readout match harp motion range, (16 bit covers 3 inches) an additional procedure of encoder offset adjustment should be done before fiducialization.

2. Connect encoder with encoder interface black box by flat cable.

3. Move the harp manually to upper position limit switch (full retracted), Loose the screw of coupler at motor side, then manually rotate shaft until the display is less than 0600 (decimal data = 1280). Then tight the screw and record the readout data.

4. Move the harp manually to down limit switch position. The readout should be less than E900 (decimal = 59648). Conversion coefficients from binary readout (Hexadecimal) to decimal data:

   Hexadecimal encoder display Decimal data

   X1 X2 X3 X4 4096 X1 + 256 X2 + 16 X3 + X4

   The resultant value of Xi in the binary data of the latches are: 0[0], 1[1], 2[2], 3[3], 4[4], 5[5], 6[6], 7[7], 8[8], 9[9], A[10], B[11], C[12], D[13], E[14], F[15].

4 Upgrade Requirement from Experiments

1. Normalize software of all Hall C superharps in 16 bit in order to convert survey data - Solution: take a 16 bit channel as reference, normalize others

2. Sensor wire - G0 team wants to measure 40 A beam profile directly. - Solution: G0 superharps need carbon wire (Icritical 49 A at 1cm/s)

3. Preamplifier - Defect rate one per year because of radiation degrade of electrometer chip AD 549 (high noise, large offset) - Solution: Move preamp box down to the floor and place shielding surround box. More effective decoupling from motor.

4. Trigger generation - Synchronized with line, helicity or in stand-alone model - 300 Hz trigger frequency came from Lebedevs request for fast emittance measurement. Users want to return to 60 Hz if this is not necessary now. - Solution: Hall C sync generator (manual) /AES VME module (EPICS)?

5. Halo measurement - Needs see 5 6 decade dynamic range counts - Solution: Reduce scan velocity

6. Ultra-low beam current profile measurement - Polarized target experiments need good profile in front of target at 50 100 nA rastered beam (d = 2 cm). - Solution: Use radiation pickup channels, reduce scan velocity by 10. - Problem: PGA and LeCroy HV are out of EPICS control.

7. Unify coordinate of profile display - MCC profile package gives a quick display of profile but the position coordinate is different to absolute encode readout and the fitting code doesnt work well for irregular beam shape - Solution: Modification of original code

References

[1] M. K. Jones. Superharp operation. http://hallcweb.jlab.org/document/howtos/HKS/superharp/. HKS User Howto.