Hall C Expert Howto

Experiment: HKS

HKS Design

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Abstract

This Howto outlines the purpose of the HKS magnets and their operation and monitor.

1 Purpose and Optics

The HKS magnet consists of three magnets, Q1, Q2 and D. Their basic parameters are given in the following tables. The HKS is used as a High resolution Kaon Spectrometer combined with the Splitter magnet. HKS detector package has two drift chambers (HDC1, HDC2), three TOF layers (HTOF1X, 1Y and 2X), three layers of Aerogel Cherenkovs(AC1, AC2 and AC3), and two layers of Water Cherenkovs (WC1 and WC2). The momentum and angular reconstructions are performed with HDC information and particle identification is carried out with AC and WC informaiton in trigger level as well as done with TOF information in off line analysis.

The kaon central momentum is 1.2 GeV/c with a bite of $\pm$12.5% (1.05 - 1.35 GeV/c). The designed momentum resolution is 2×10^{-4}. The solid angle acceptance is about 30 msr without the Splitter and 16 msr with the Splitter. The kaon detection angle is 1-13 degrees in horizontal.

Table 1: Q1 and Q2 parameters

Item	Q1	Q2
Bore radius (mm)	120	145
Pole length (mm)	840	600
Max. Ampere turns (A turns)	224000	144000
Number of turns	256	320
Conductor size	8 × 8 (ϕ6 hole)	13.5 × 11.5 (ϕ6.3 hole)
Coil Winding	Double Pancake Winding	Solenoid Winding
Field Gradient (T/m)	6.6	4.2
Max. Current (A)	875	450
Resistance (mΩ)	181 (@55 °C)	119 (@45 °C)
Cooling Water Flow rate (l/m)	49.6	17.3
Pressure drop (MPa)	0.36	0.38
Number of Coolant circuits	16	8
Total Magnet Weight (ton*)	8.2	10.5

*metric ton.

2 Setting the magnet

Since this magnet is not directly effect the beam, thus it will be controlled and operated by Hall C experimentalists. However, due to fringe field does have slight effect to beam and other magnets nearby, such as Splitter and Enge, it is preferred to turn off the beam during the process of setting up the magnet. Since Q1 and Q2 magnets are sharing the same power supplies with SOS Q and D1 magnets, existing control will be used in setting up the magnet by referring to steps of "Getting started" and "Setting the magnets" in "How to set the SOS magnets" in Hall C online Howto document. Since no polarity change in operating this magnet for hypernuclear experiment, step of "Degaussing" is not necessary. As for HKS-D power supply (252Vmax, 1254Amax), it is newly fabricated but follows similar procedures above.

The following table shows a designed magnetic field and monitor infomation for 1.2 GeV/c kaon beam.

Table 2: Dipole magnet parameters

Item	D	
Pole gap height (mm)	200	
Pole length (mm)	1560	
Max. Ampere turns (A turns)	291840	
Number of turns	256	
Conductor size	22×22 (ϕ12 hole)	
Max. Field (T)	1.53	
Max. Current (A)	1140	
Resistance (@47.5 °C) (mΩ)	145	
	Gap side	Yoke Side
Cooling Water Flow rate (l/m)	66.3	68.8
Pressure drop (MPa)	0.32	0.35
Number of Coolant circuits	8	8
Total Magnet Weight (ton*)	210	

*metric ton.

3 Monitor

The Q1, Q2 fields are monitored by a fixed hall probes placed just out side of the vacuum chamber. The stability should be controlled within an error of $\pm 10^{-3}$. The D field is monitored by a fixed NMR probe placed in the vacuum chamber. The stability should be controlled within an error of $\pm 10^{-4}$. Scaling between field gradient and fixed probe readout can be done by following formula:

$$FG(T/m) = \text{Fixed probe (T)} \times 6.6836 \quad \text{for Q1},$$

$$FG(T/m) = \text{Fixed probe (T)} \times 20.470 \quad \text{for Q2}.$$

Table 3: Designed magnet setting for 1.2 GeV/c kaon

	field gradient (T/m)	Current (A)	Fixed Probe readout (T)
Q1	-5.78	585	0.865
Q2	3.40	364	0.166
	central field (T)	Current (A)	NMR readout (T)
D	1.44	1050	1.4364