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Holding field calibration for E95-001

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Abstract

We summarize here the calibration of the magnetic holding field for E95-001.

1 Calibration of each Helmholtz set

The calibration of both Helmholtz coils sets has been performed just before E94-001 and has not been changed for E95-001. The calibration procedure for each set consists in determining precisely the relation between the field created by the set as a function of the DC voltage applied to the front panel of the corresponding Kepco power supply. The field is measured in the hall using the Hall A ShoreLake gaussmeter read by the Macintosh in the counting house, through the GPIB-ENET interface, as described in [1]. The measured field is the total magnetic field in the hall, including the earth magnetic field component. Temperature stabilization of the set must be reached before the calibration is performed. It takes usually 8 to 10 hours per set to reach the current plateau. The Kepco power supplies are used in the so called Voltage Mode, where the voltage applied to the coils remains constant in time, and the current naturally drifts with any temperature change of the circuit. We could not observe any NMR signal in the Current Mode. Sweeping the applied DC voltage and measuring the magnetic field, we obtain the linear relation :

$$B = \alpha V + \beta \tag{1}$$

From a linear fit, we get :

- Large coils : $\alpha = -3.94 \pm 0.01$ G/V and $\beta = -0.29 \pm 0.01$ G
- Small coils : $\alpha = -4.27 \pm 0.01$ G/V and $\beta = -0.29 \pm 0.01$ G

The given precision is of course limited by the gaussmeter resolution.

2 Field orientations for G_M^n

E95-001 ran with two field orientations : $\theta = 62.5$ deg and $\theta = 242.5$ deg, from the beam line, as shown on figure 1. We give below the current shown on each Kepco power supply front panel, after temperature stabilization for each field orientation. The index 3 represents Kepco 3 for the large coils and the index 4 represents Kepco 4 for the smaller coils.

- At 62.5 ± 0.5 deg, $B = 25.0 \pm 0.1$ G, $I_3 = 5.28 \pm 0.01$ A and $I_4 = 4.86 \pm 0.01$ A
- At 242.5 ± 0.5 deg, $B = 25.0 \pm 0.1$ G, $I_3 = -5.31 \pm 0.01$ A and $I_4 = -4.71 \pm 0.01$ A

The magnetic field is proportional to the current, such as $B_3 = k_3 I_3$ and $B_4 = k_4 I_4$. The proportionality constants k_3 and k_4 are then :

$$k_3^{\theta=62.5deg} = 3.435 \pm 0.005 \tag{2}$$
$$k_4^{\theta=62.5deg} = 3.541 \pm 0.005 \tag{3}$$
$$k_3^{\theta=242.5deg} = 3.415 \pm 0.005 \tag{4}$$
$$k_4^{\theta=242.5deg} = 3.654 \pm 0.005 \tag{5}$$

The proportionality constants are quite different when the current is reversed in each set. A significant current drift has been observed during E95-001 in those configurations. Calculating the magnitude of the holding field and the orientation θ with :

$$B^\theta = \sqrt{(k_3^\theta I_3^\theta)^2 + (k_4^\theta I_4^\theta)^2} \tag{6}$$

$$\theta_3 = Arccos\frac{k_3^\theta I_3^\theta}{B^\theta} \tag{7}$$

$$\theta_4 = Arcsin\frac{k_4^\theta I_4^\theta}{B^\theta} \tag{8}$$

$$\theta \sim (\theta_3 + \theta_4)/2 \tag{9}$$

Table 1: *Holding field orientations during E95-001*

Angle (deg)	I_3 **(A)**	I_4 **(A)**	**B (G)**	θ_3 **(deg)**	θ_4 **(deg)**	θ **(deg)**
62.5	5.27	4.85	25.0	62.6	62.4	62.5
62.5	5.28	4.86	25.0	62.5	62.5	62.5
242.5	-5.27	-4.85	25.3	243.7	243.5	243.6
242.5	-5.31	-4.95	25.6	243.9	243.9	243.9
242.5	-5.29	-4.93	25.5	243.9	243.9	243.9

References

[1] E94010 Technical Note 9

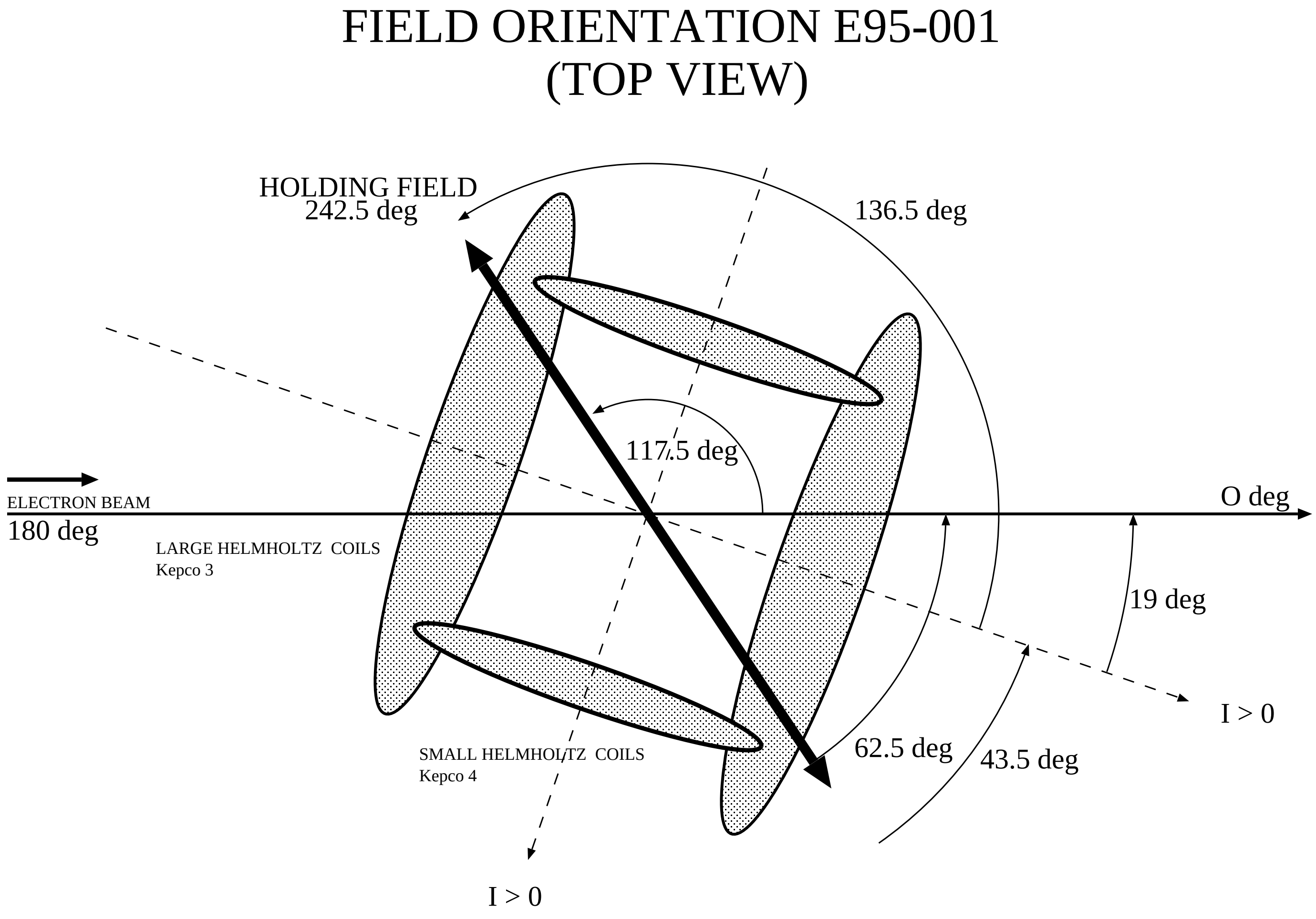

Figure 1: Holding field orientations for E95-001. The two orientations at 62.5 deg and 242.5 deg from the beam line are represented by the thick black arrows.