Instructions for the Hall Effect

1. Calibration of the Magnetic Field

1. Set up the electromagnet(56213) with the pole pieces spacing by the thickness of the support plate of the Hall effect apparatus(58681). For this calibration, not to set the apparatus(58681) as in figure but place one edge of the support plate between the pole pieces and fix the clumping device when you get the proper spacing.

2. Connect the variable extra-low voltage transformer (52139) with the coils(56213). Connect 20 VDC outputs to 'A' inputs of the coils with an ammeter (a digital multimeter) between VDC+ and the coil. Connect both 'E's with another cord.

3. Set the teslameter (51662) so that the probe can measure the magnetic field of the space between the pole pieces. Take care not to break the probe as it is fragile and very expensive.

4. Turn on the extra-low voltage transformer (52139) and the teslameter (51662). Measure the magnetic field in the range of 0.1-0.9 Tesla while increasing the current, I_B, from 0 to 9A. More data points are required when slope became less steep. Plot the magnetic field (B) versus the coil current (I_B) with uncertainties.

2. Setup and Measurements of the Hal effect

1. Take off the teslameter (be careful!) and turn off the extra-low voltage transformer. Set up the Hall effect apparatus (silver/tungsten) with connection to the high current power supply (52155) with black/read thick cords. (Connection to an ammeter (+side) is not necessary as it is measurable at the window of the power supply. Don't use a small analog multimeter here.) Connect the plate to the input of the microvoltimeter(53213).

2. Set the transverse current I_Q of the high current power supply (52155) to 15 A. Reset the microvoltimeter to zero by pushing the 'Auto comp.' button. Apply the coil current I_B by the extra-low voltage transformer and measure the Hall voltage U_H by the microvoltimeter in the range of I_Q=0-9A.

3. Repeat the measurement of 2 by setting the transverse current I_Q=20A.

4. Plot the hall voltage U_H versus the magnetic field B using the calibrated values in Part.1. Find the slope using the least square fitting for each I_Q. Find the Hall constant R_H

and the concentration of charge carriers, n, with uncertainties. Compare with the theoretical values: $\mathrm{R}_H = 8.9 \times 10^{-11} m^3 C^{-1}$, n= $6.6 \times 10^{28} m^{-3}$.

$$U_H = \frac{1}{n \cdot e} \cdot \frac{B \cdot I_Q}{d} = \frac{R_H \cdot B \cdot I_Q}{d}, \tag{1}$$

where $e = 1.602 \times 10^{-19} C$ is the elementary charge and $d = 5 \times 10^{-5} m$ is the foil thickness.

5. Repeat above measurements for different materials (silver/tungsten).