

Measurements using the Helmholtz – Coil

Magnetic moment M and polarization J

The magnetic moment of a magnet can be determined with the Helmholtz Coil.

After setting the Fluxmeter to 0 (RESET), the magnet is inserted into the coil with its magnetic axis parallel to the axis of the coil.

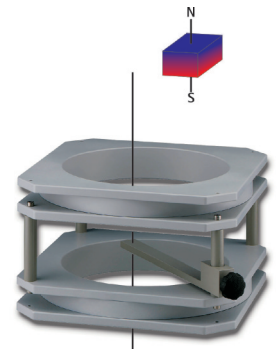
The magnetic moment M is then derived from:

$$M = \phi \cdot K \quad [\text{Vs} \cdot \text{cm}]$$

$$M = \text{display} \cdot \text{range} \cdot \text{coil - constant } K$$

If the size V has been determined, the magnetic moment can be used to calculate the polarization by means of the below formula:

$$J = M / V \quad [\text{Vs} / \text{cm}^2]$$



Example 1: Measurement of moment M and polarization J of a magnet

The magnet to be measured is inserted into the middle of the helmholtz coil with its magnetic axis parallel to the coil's axis.

The fluxmeter connected displays a value of 164 the range is set to 10^{-6} Vs, i.e. a flux of $164 \cdot 10^{-6}$ Vs is measured.

The value of the coil - constant K is found on the nameplate of the BROCKHAUS helmholtz coil used.

The resistance of the coil can be neglected in case it is less than 1 % of the input resistance of the fluxmeter. As the resistance of the coil is 35 Ω , a correction of the measured value is not necessary; in this case the error lies at 0,35 %.

$$M = \phi \cdot K \quad [\text{Vs} \cdot \text{cm}]$$

$$M = 164 \cdot 10^{-6} \text{ Vs} \cdot 0,0154 \text{ cm}$$

$$M = 2,5256 \cdot 10^{-6} \text{ Vs} \cdot \text{cm}$$

The volume of the magnet is $4 \cdot 4 \cdot 4 \text{ mm}^3 = 0,064 \text{ cm}^3$

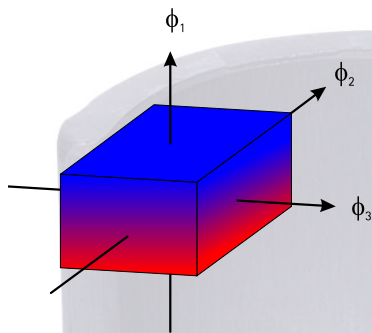
The result for the polarization is then:

$$J = M / V \quad [\text{Vs} / \text{cm}^2]$$

$$J = (2,5256 \cdot 10^{-6} \text{ Vs} \cdot \text{cm}) / (0,064 \text{ cm}^3)$$

$$J = 3,95 \cdot 10^{-5} \text{ Vs} / \text{cm}^2$$

Example 2: Determination of the preferred direction of a magnet



In order to determine the preferred direction the magnet needs to be measured in all three axes with the Helmholtz coil. The first measurement (ϕ_1) is done in the same direction as the direction to which the magnet was magnetized (preferred direction).

The angle α between the mechanic and the magnetic axis is then:

$$\alpha = \arccos \frac{\phi_1}{\sqrt{\phi_1^2 + \phi_2^2 + \phi_3^2}}$$

The following values have been measured:

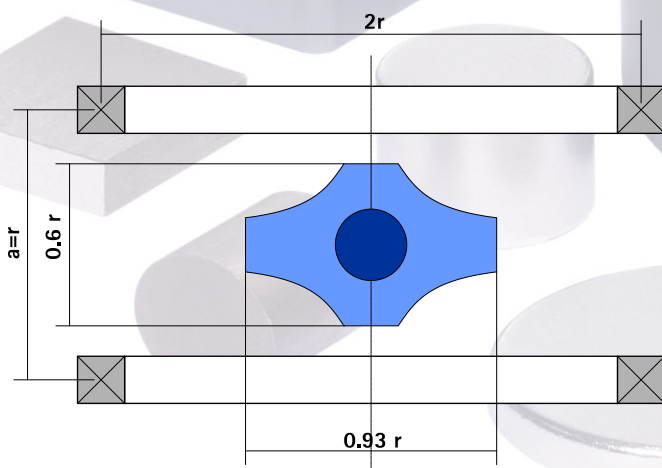
$$\phi_1 = 536 \cdot 10^{-6} \text{ Vs}$$

$$\phi_2 = 25 \cdot 10^{-6} \text{ Vs}$$

$$\phi_3 = 30 \cdot 10^{-6} \text{ Vs}$$

$$\alpha = \arccos \frac{536}{\sqrt{536^2 + 25^2 + 30^2}}$$

Thus the angle between the mechanic and the magnetic axis is 4,17°.



Helmholtz coil with measuring area of 1 % accuracy

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