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:

$$M = \varphi * K \quad [Vs * cm]$$

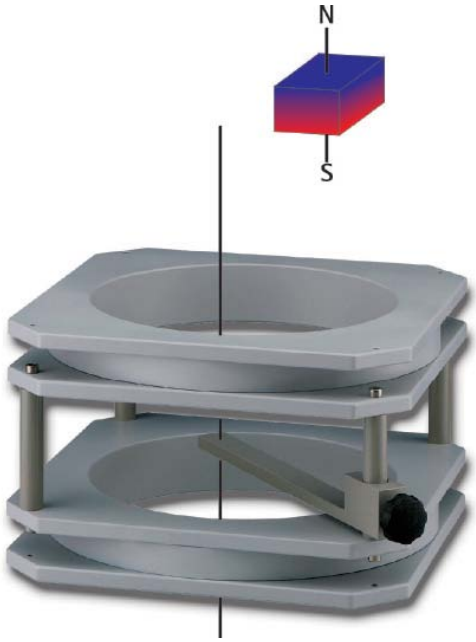
M = display * measuring range * coil constant K

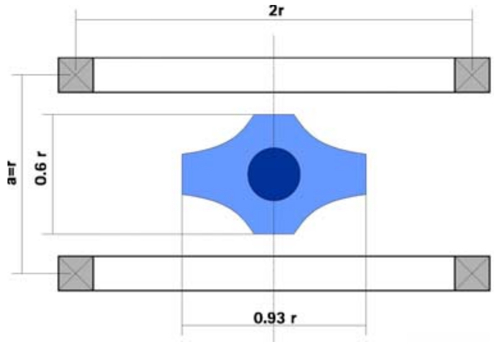
If the volume V has been determined, the magnetic moment can be used to calculate the polarization by means of the below formula:

$$J = \frac{M}{V} \left[\frac{Vs}{cm^2}\right]$$

Before measuring with Helmholtz Coil it is necessary to ensure that in a radius of 50 cm no external influences (magnetizable parts, such as steel -table, -screws, -chairs, etc.) may be present.

The magnet has to be put into the center of the coil for the measurement, because the magnet needs to be in the homogeneous region of the Helmholtz.





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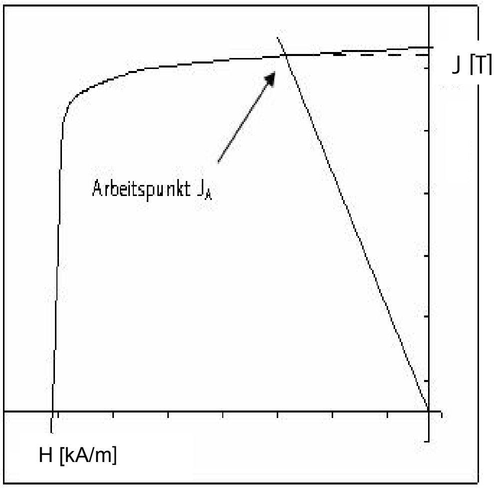
Example 1:

Measurement of moment M_A and polarization J_A of a magnet at the working point



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 connected Fluxmeter displays a value of 13,09, the range is set to 10^{-3} Vs, i.e. a flux of 13,09 * 10^{-3} Vs is measured. The value of the coil constant K is mentioned on the nameplate of the Helmholtz coil.

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 %.

$$M = \varphi * K \quad [Vs * cm]$$

$$M_A = 13{,}09 * 10^{-3} Vs * 0{,}0163\ cm$$

$$M_A = 0{,}213367 * 10^{-3}\ Vs * cm$$

The volume of the magnet is 1,835 cm^3. So the result for the polarization at the working point is:

$$J_A = \frac{M_A}{V} \left[\frac{Vs}{cm^2}\right]$$

$$J_A = \frac{0{,}213367 * 10^{-3}\ Vs * cm}{1{,}835\ cm^3}$$

$$J_A = 0{,}000116 \frac{Vs}{cm^2} = 1{,}16\ T$$

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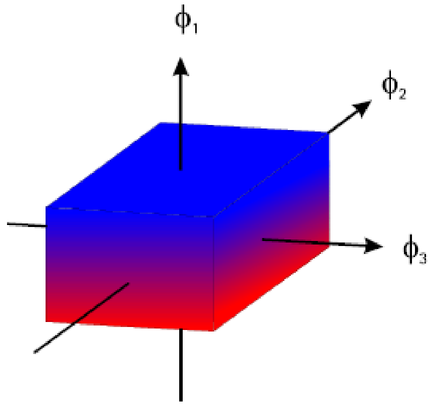
Example 2:

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 mechanical and the magnetical axis is then:

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

The following values have been measured:

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

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

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

$$\alpha = \arccos \frac{536}{\sqrt{536^2 + 25^2 + 30^2}} = \underline{\underline{4{,}17^\circ}}$$

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

This deviation can also be determined with only one simple measurement by our Fluxmeter system 3D-F10. You will find more details on **WWW.BROCKHAUS.COM**

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