Faraday effect: determining Verdet's constant for flint glass as a function of the wavelength (P 5.4.6.1)

P 5.4.6

Faraday effect

P 5.4.6.1 Faraday effect: determining Verdet's constant for flint glass as a function of the wavelength

Cat. No.	Description	P 5.4.6.1 (a)	P 5.4.6.1 (b)
560 482	Flint glass square with holder	1	1
460 381	Rider base with threads	1	1
562 11	U-core with yoke	1	1
560 31	Pair of bored pole pieces	1	1
562 13	Coil with 250 turns	2	2
450 63	Halogen lamp, 12 V/100 W	1	1
450 64	Halogen lamp housing 12 V, 50/100W	1	1
450 66	Picture slider for halogen lamp housing	1	1
468 05	Monochromatic light filter, yellow	1	1
468 09	Monochromatic light filter, blue-green	1	1
468 11	Monochromatic light filter, blue with violet	1	1
468 13	Monochromatic light filter, violet	1	1
460 02	Lens f = + 50 mm	1	1
472 401	Polarization filter	2	2
460 32	Precision optical bench, standardized profile, 1 m	1	1
460 373	Optics rider, H = 60 mm/W = 50 mm	5	5
441 53	Translucent screen	1	1
524 009	Mobile-CASSY		1
521 39	Variable extralow voltage transformer	1	1
531 281	Ammeter, DC, $I \leq 10$ A, $\Delta I = 0{,}2$ A, e.g. Digital-analog multimeter METRAHit 24 S	1	1
531 835	Universal Measuring Instrument Physics	1	
524 0381	Combi B-Sensor S	1	1
501 11	Extension cable, 15-pole	1	1
300 02	Stand base, V-shape, 20 cm	1	1
300 41	Stand rod, 25 cm	1	1
301 01	Leybold multiclamp	1	1
501 45	Pair of cables, 50 cm, red and blue	1	1
501 46	Pair of cables, 100 cm, red and blue	1	1
501 461	Pair of cables, 100 cm, black	1	1

Transparent isotropic materials become optically active in a magnetic field; in other words, the plane of polarization of linearly polarized light rotates when passing through the material. *M. Faraday* discovered this effect in 1845 while seeking a relationship between magnetic and optical phenomena.

The angle of optical rotation of the plane of polarization is proportional to the illuminated length s and the magnetic field B.

$$\Delta\varphi = V \cdot B \cdot s$$

The proportionality constant V is known as Verdet's constant, and depends on the wavelength λ of the light and the dispersion.

$$V = \frac{e}{2mc^2} \cdot \lambda \cdot \frac{dn}{d\lambda}$$

For flint glass, the following equation approximately obtains:

$$\frac{dn}{d\lambda} = \frac{1{,}8 \cdot 10^{-14}\ \mathrm{m}^2}{\lambda^3}$$

In this experiment, the magnetic field is initially calibrated with reference to the current through the electromagnets using a teslameter, and then the Faraday effect in a flint glass square is investigated. To improve measuring accuracy, the magnetic field is reversed each time and twice the angle of optical rotation is measured. The proportionality between the angle of optical rotation and the magnetic field and the decrease of Verdet's constant with the wavelength λ are verified.