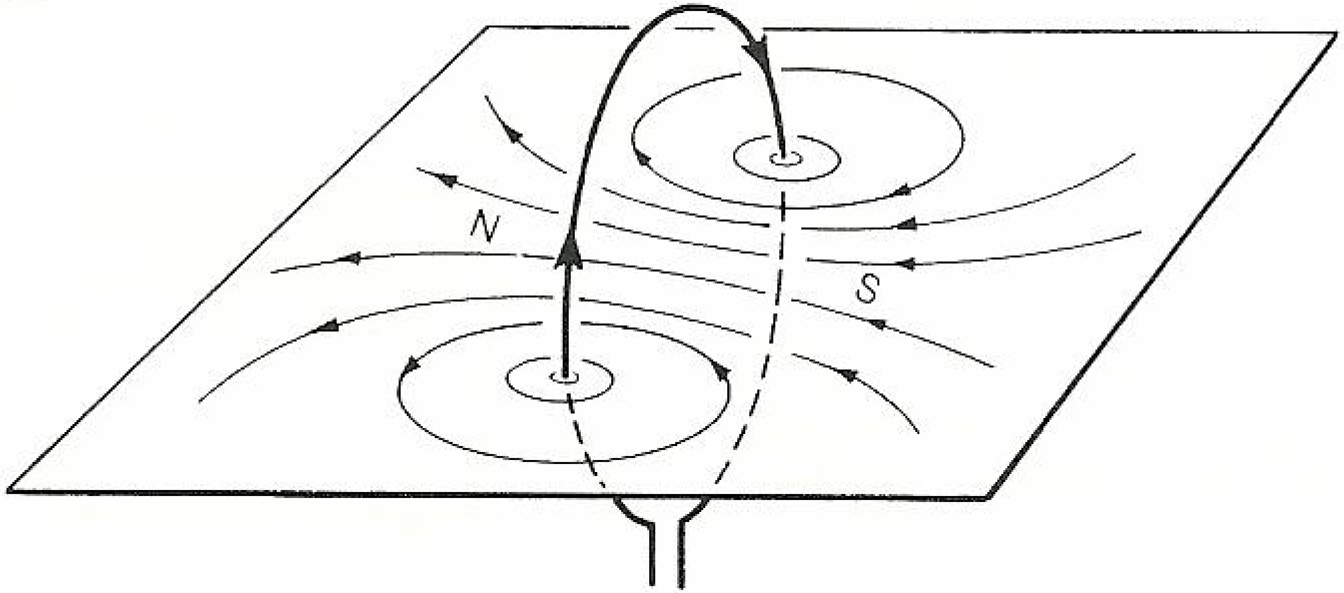
Coil

Figure 4 Field pattern round a single loop of wire



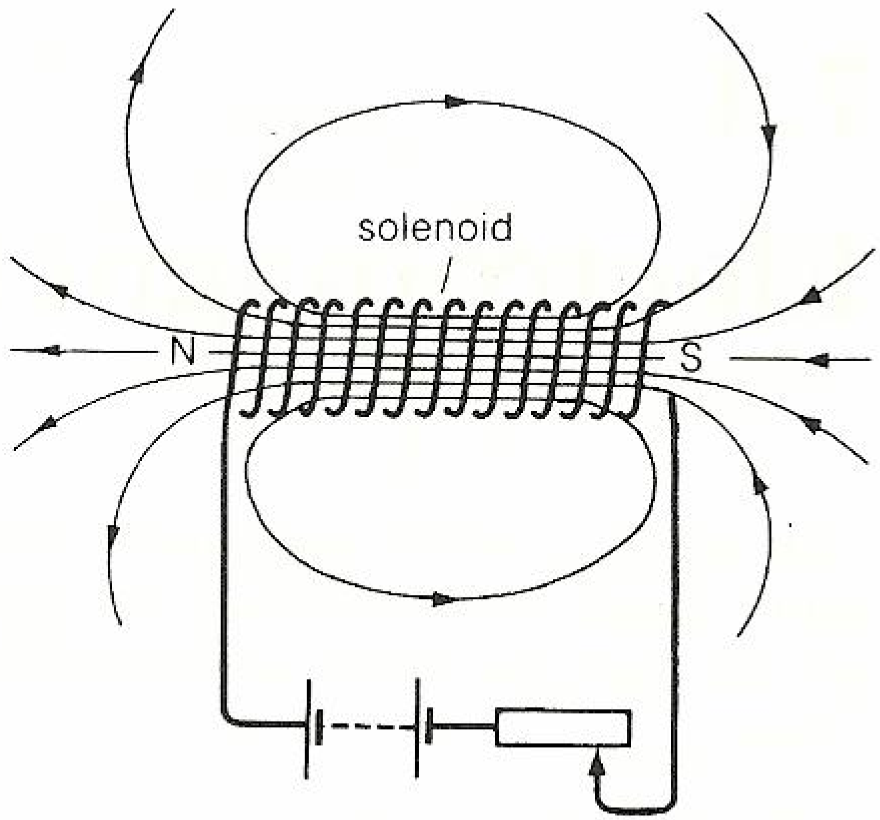


Figure 5 The field pattern round a solenoid is very similar to that round a single loop

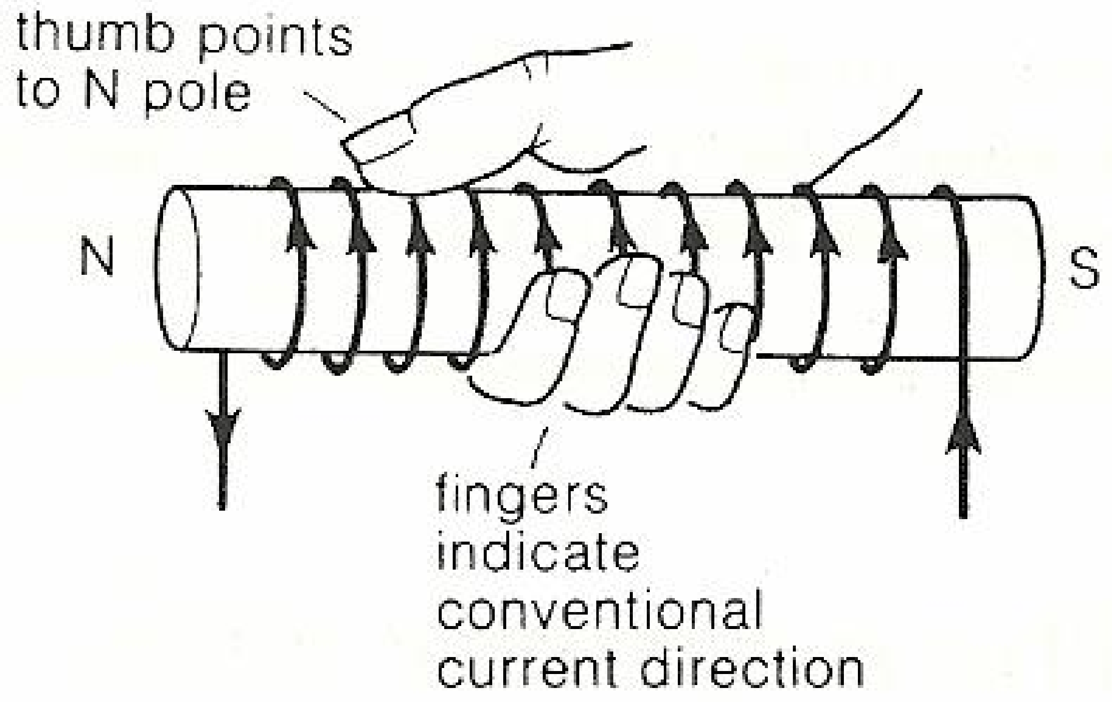
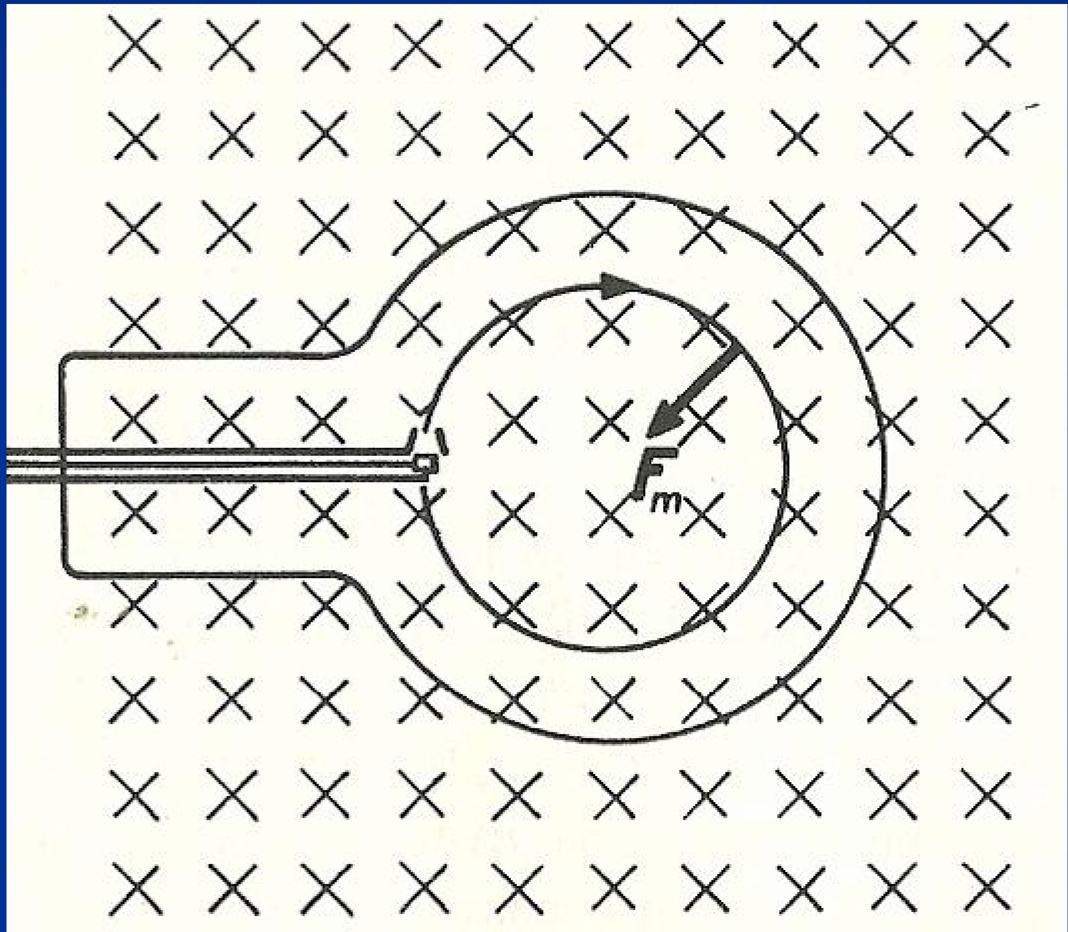


Figure 6 The 'right-hand grip rule'

Helmholz´s coils – source of weak but homogenous magnetic field

Solenoid – long coil

Toroid – a coil of a ring shape



Magnetic field strength of a coil:

$$B = \mu_0 \, N \, I \, / \, l$$

N – number of turns (1)

I – current flowing through the coil

l – length of a coil (m)

μ_0 – permeability ($4\pi \cdot 10^{-7}$ N A^{-2})

B – magnetic field strength (T, tesla)

N / l – density of turns per length (1/m)

- Calculate a current flowing through a coil with $B = 3.14 \times 10^{-3}$ T. $N/l = 2 \times 10^{3}$ m^{-1}.
- Calculate B of a coil with a wire diameter of 0.8 mm, through which there is flowing a current of 1A.

Charged particles in a magnetic field

$I = Q / t$

Q – charge (C, coulomb)

t – time (s)

I – current (A)

$l = v . t$

v – velocity (ms^{-1})

Force acting on a stright wire in a magnetic field: $F = B I l \sin\alpha$

$F = B I l \sin\alpha = B Q v \sin\alpha$

one electron: $Q = e \Rightarrow F = B e v \sin\alpha$

if the electron is moving in a circle:

$B e v \sin\alpha = m v^2 / r$ (centripetal force)

r – radius of the circle (m)

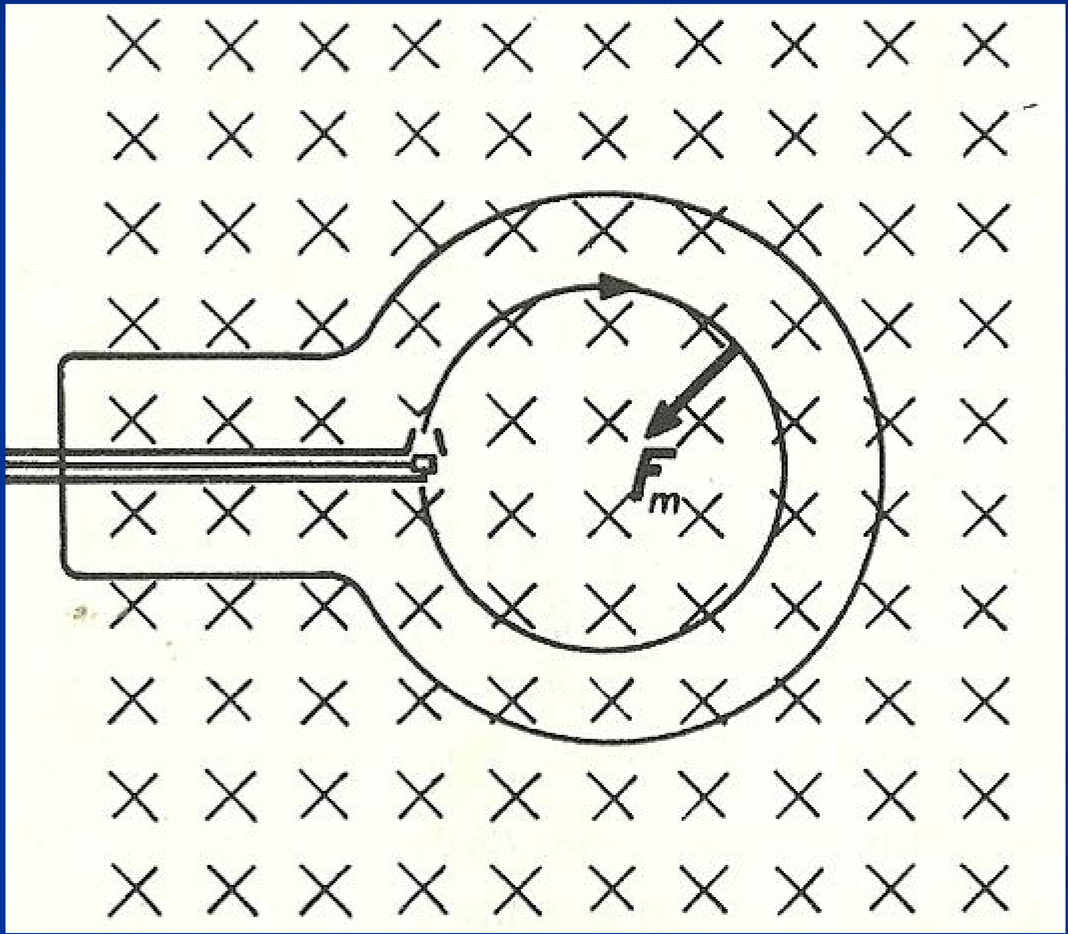
Lorentz force – acts on a moving particle in a magnetic field (spiral motion).

$B\ e\ v\ \sin\alpha = m\ v^2 / r$ (centripetal force)

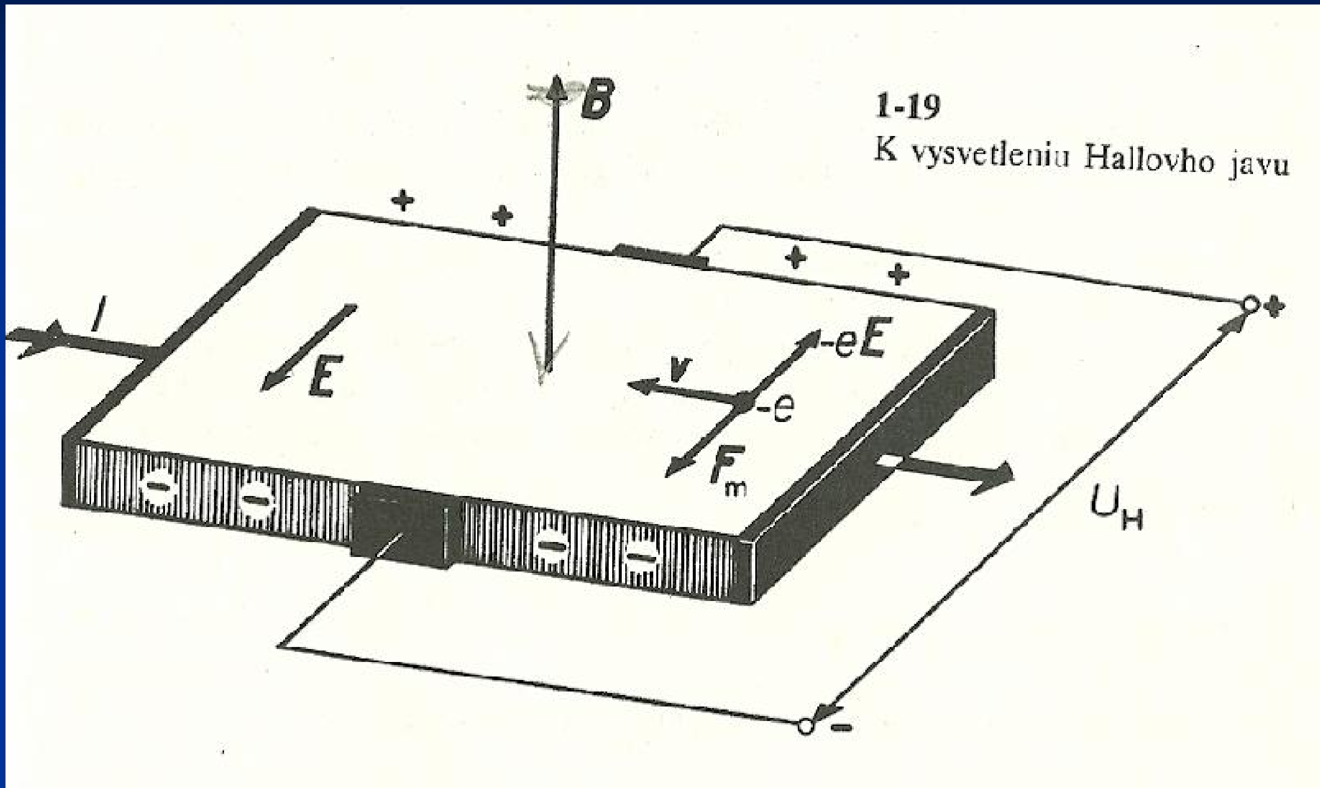
$B\ e\ v\ \sin 90° = m\ v^2 / r$

$\sin 90° = 1$

$r = m\ v / Q\ B$



The Hall effect



•is used for measuring magnetic field strength

- What was the speed of proton in a magnetic field moving in a circle with radius of 0.6m, if B = 1T?

- What was the frequency of the proton?