# PHY117 HS2024

Today:
- Kirchoff's rules
- magnetism
- Lorentz force
- mass spectrometer

what's left to do:
- magnetic field
- waves
- electromagnetic waves
- optics

Week 10, Lecture 1
Nov. 19th, 2024
Prof. Ben Kilminster

**GESUCHT!** **‚Note-Taker:in' für Studentin mit einer studienerschwerenden Beeinträchtigung**

Die Fachstelle Studium und Behinderung FSB sucht für das HS24 eine:n Student:in welche:r Notizen in Form einer Mitschrift **in einem oder mehreren der folgenden Modulen** nimmt und diese zuverlässig übermittelt:

- 07SMPHY117.1 Physik für die Life Sciences
- 07SMPHY117.2 Übungen Physik für die Life Sciences
- 07VLBIO113.1 Evolution und Biodiversität 1
- 07PRBIO113.2 Evolution und Biodiversität 1 Praktikum
- 07VLBIO112.1 Zellbiologie
- 07PRBIO112.2 Cell Biology (Practical Course)

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**Kontakt**
Fachstelle Studium und Behinderung | Universität Zürich
E-Mail: lejla.ademi@sib.uzh.ch

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Global Volunteer

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Thur, Nov 21st

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18:30 - 19:45

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- Introduction to AIESEC's Global Volunteer Program (6-week projects)
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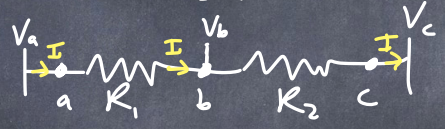
- Open Q&A Session to Address All Your Questions
- Success Stories from Past Global Volunteers Sharing Their Experiences

# LAST WEEK:

Resistors in series:




Note: opposite rules as for capacitors

Equivalent resistance

$$R_{eq} = R_1 + R_2 + \dots$$

$$V_b = V_a - IR_1$$

$$V_c = V_a - IR_1 - IR_2$$

Potential decreases, current stays same.

$$I_a = I_b = I_c = I$$

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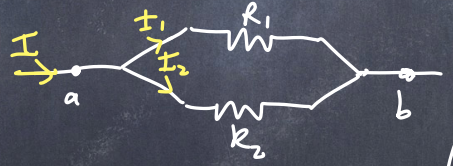
Resistors in parallel:



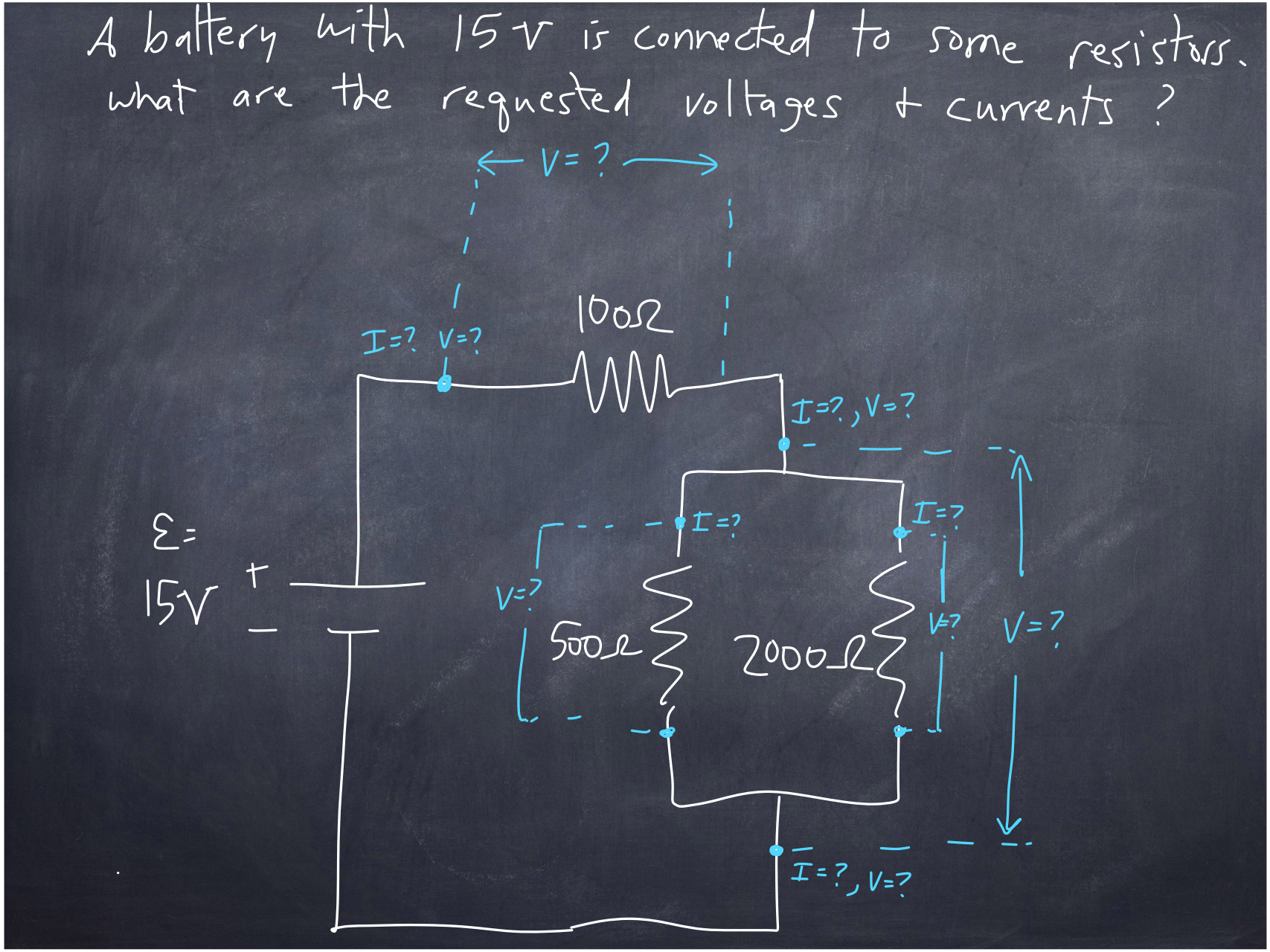

Equivalent resistance decreases. (More ways for current to flow)

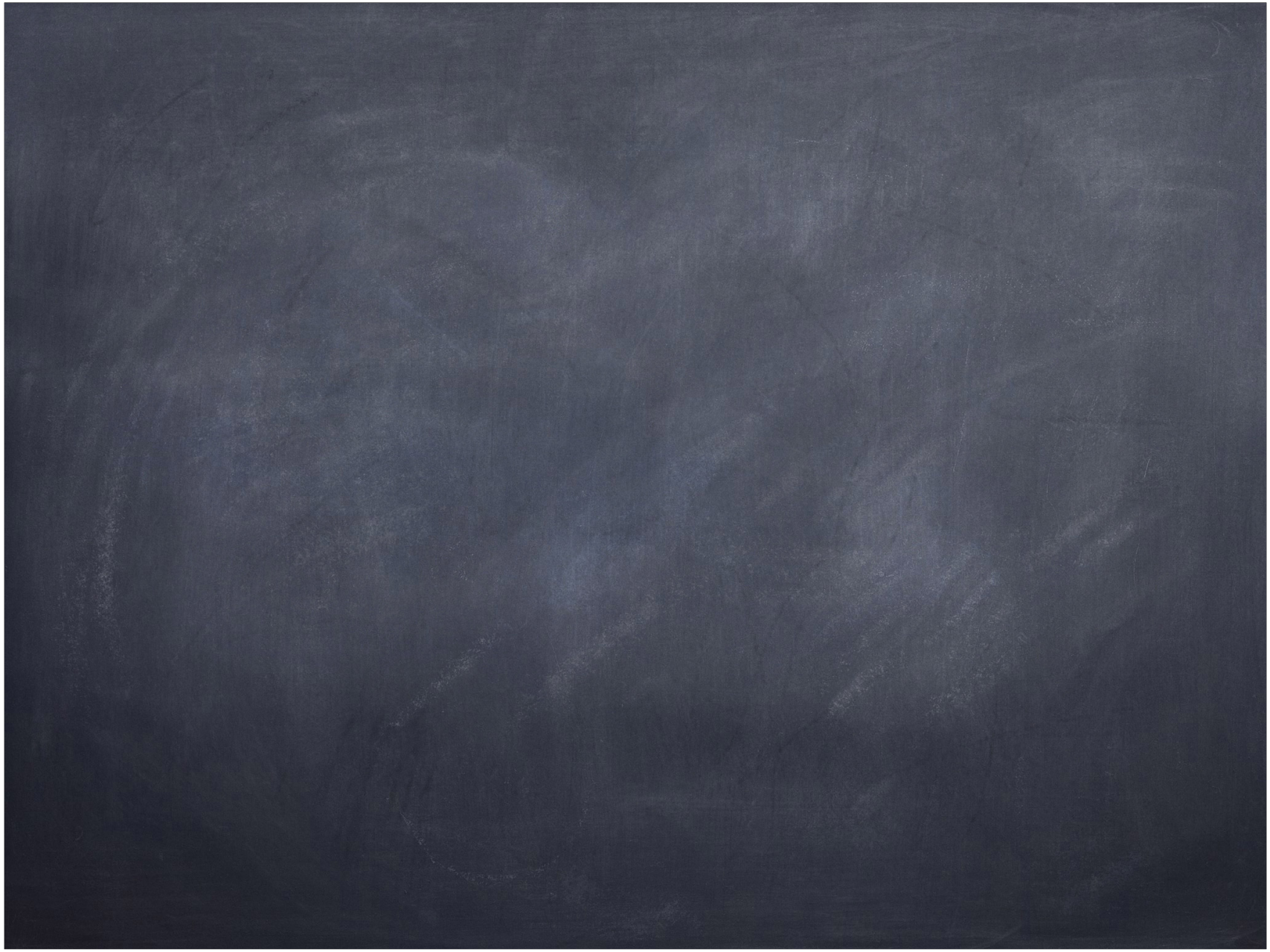
$$I = I_1 + I_2$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

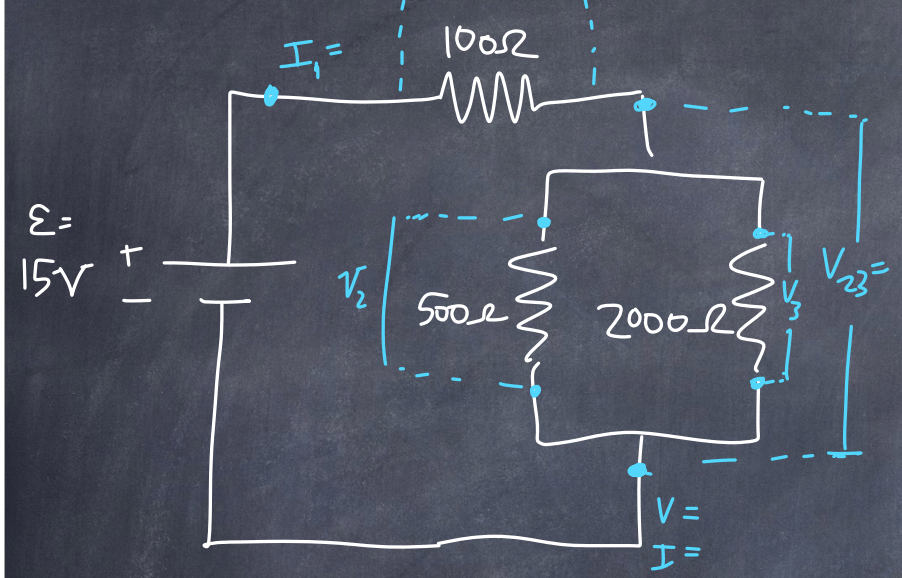
voltage drop $V_a - V_b$ is same across both paths: $V_{ab} = I_1 R_1 = I_2 R_2$

A battery with 15 V is connected to some resistors. what are the requested voltages & currents ?

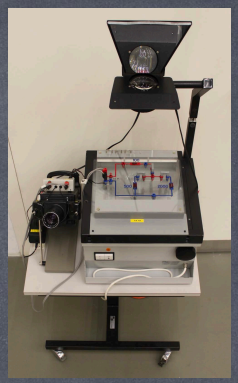


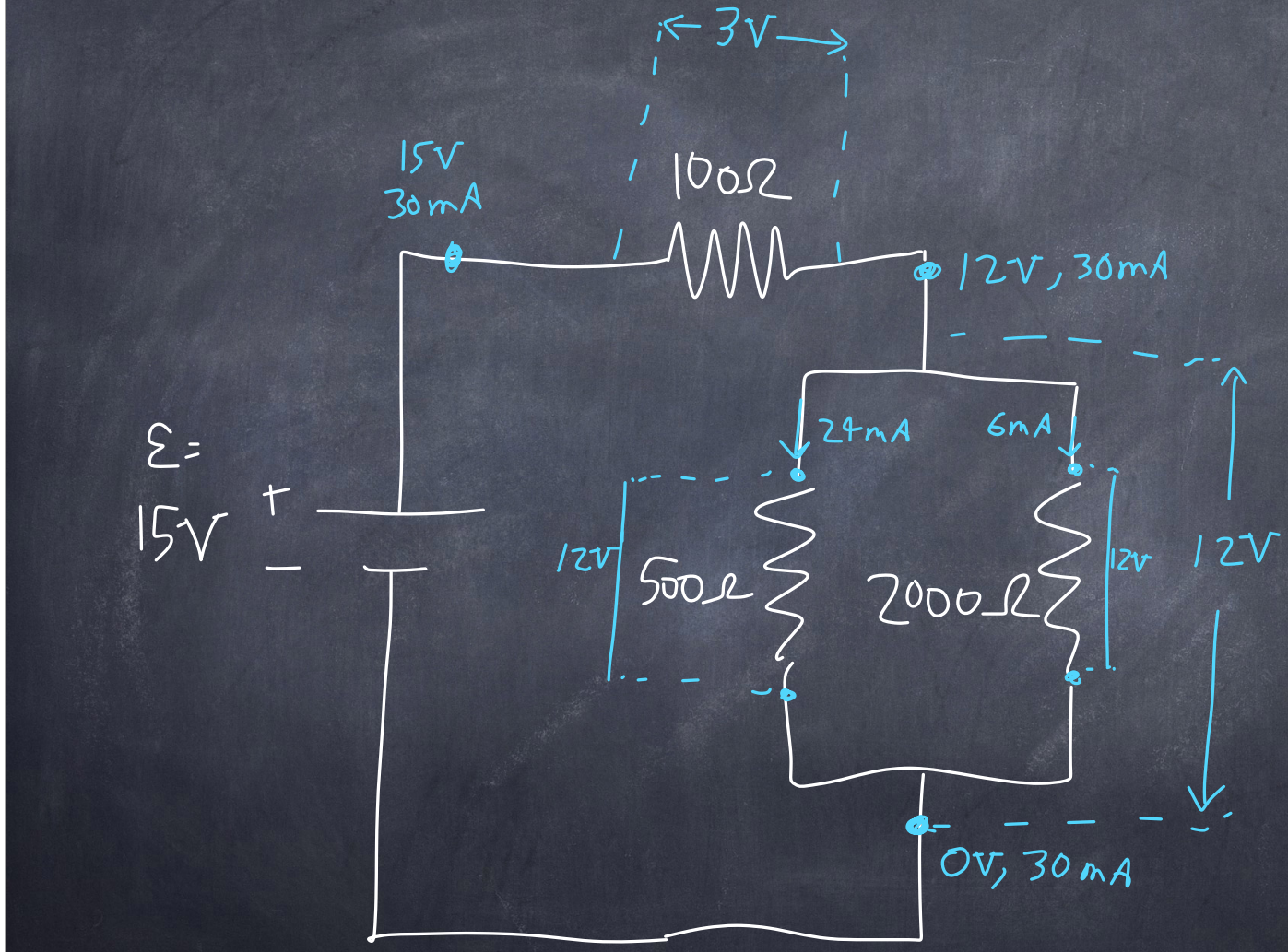


Example of circuit with resistors in parallel + series: what are values of labeled currents + voltages?



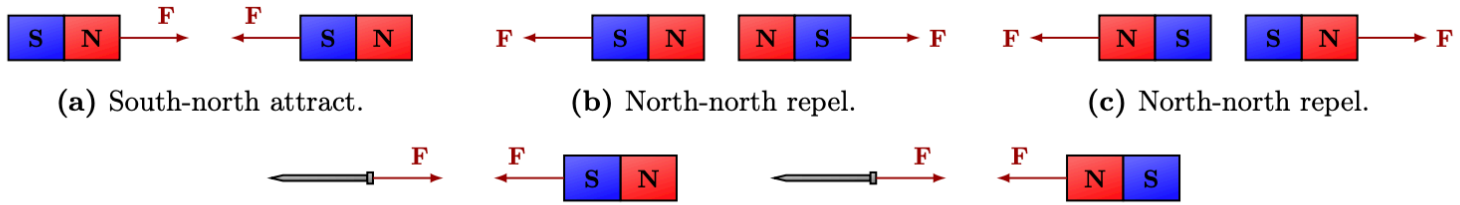
# Solution:




3V
15V
30mA
100Ω
12V, 30mA
ε=
15V
+
−
24mA
6mA
12V
500Ω
2000Ω
12V
12V
0V, 30mA

# Magnetism

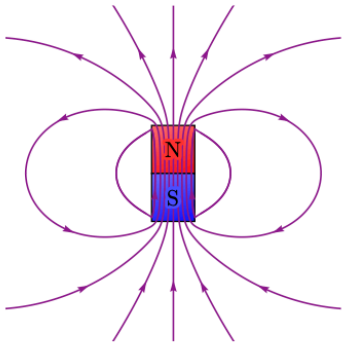
Basic observations:



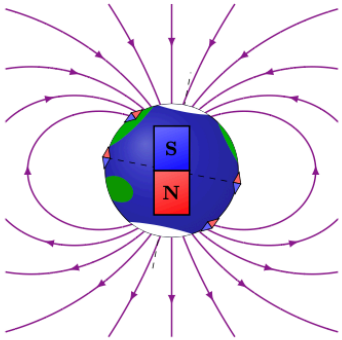

**(a)** South-north attract. **(b)** North-north repel. **(c)** North-north repel.

**(d)** South attracts the nail. **(e)** North attracts the nail.

**Figure 7.1:** The magnetic force between two bar magnet depends on their orientation, but between a non-magnetic nail and bar magnet, orientation does not matter.



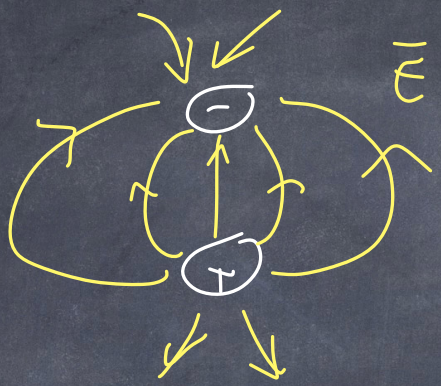

**(a)** The magnetic field of bar magnet looks like the electric field of an electric dipole. The field lines close their loops inside the bar magnet.

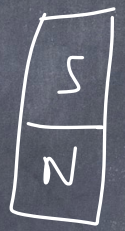


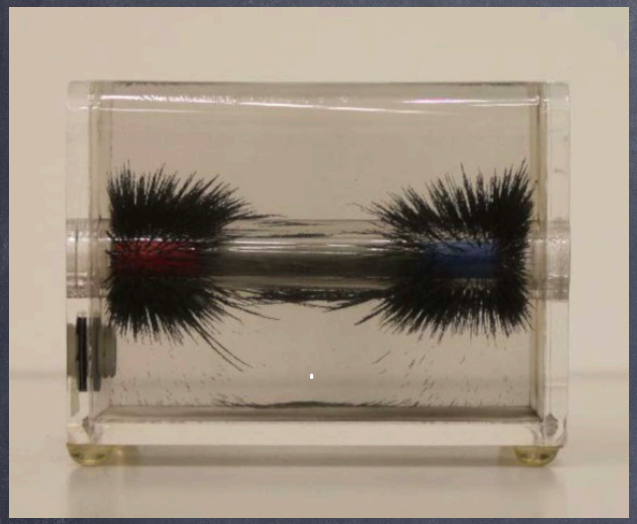

**(b)** Earth's magnetic field looks like that of a bar magnet. Magnetic compasses point to Earth's geographic north pole, the magnetic south pole.

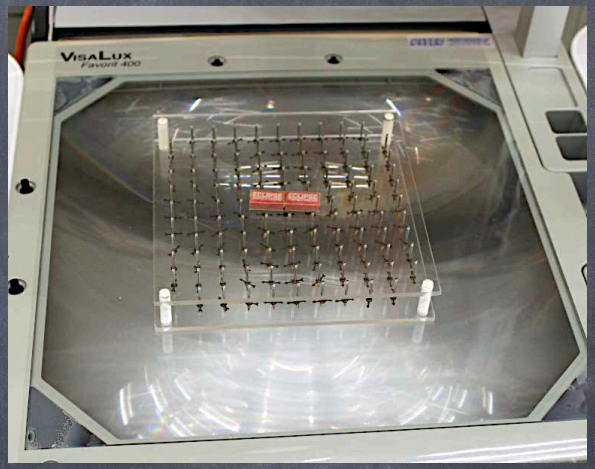
**Figure 7.2:** Bar magnets and the Earth create a magnetic dipole field (purple).

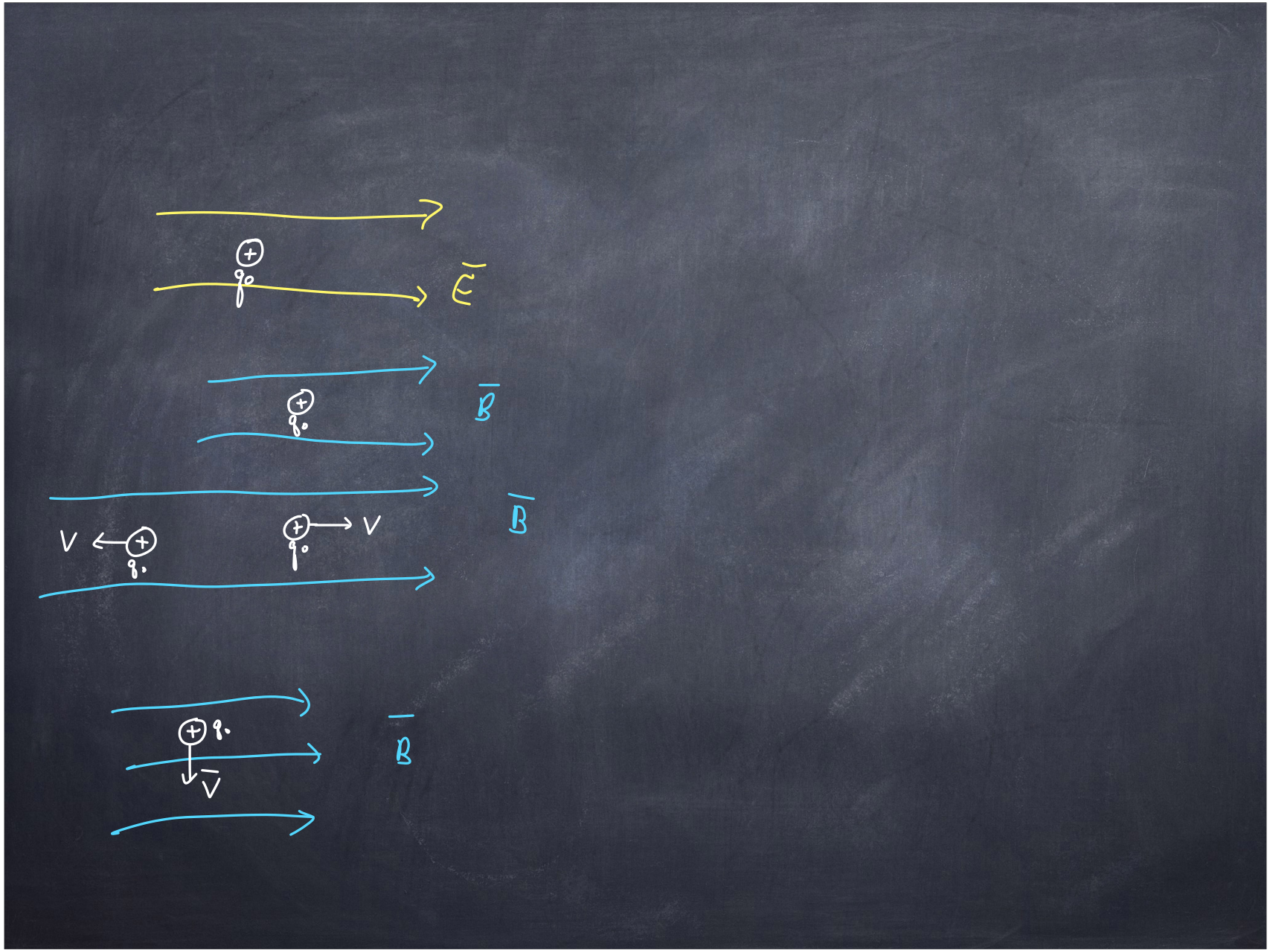
This may remind you of the $\bar{E}$-field of a dipole.






VisaLux


$q_0$
$\vec{E}$
$\vec{B}$
$\vec{B}$
V
V
$q_0$
$\vec{B}$
$\vec{V}$

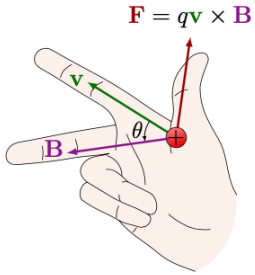
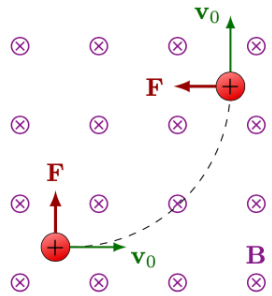
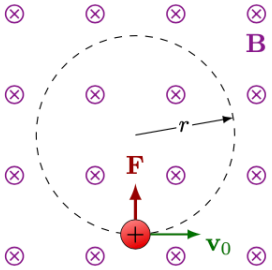


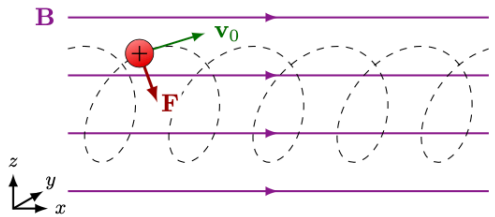

**Figure 7.4:** Right-hand rule for the magnetic force on a positive charge $q > 0$.




**(a)** Charge is bent in a magnetic field **B**.




**(b)** Charge with a constant velocity, perpendicular to **B** makes circles.

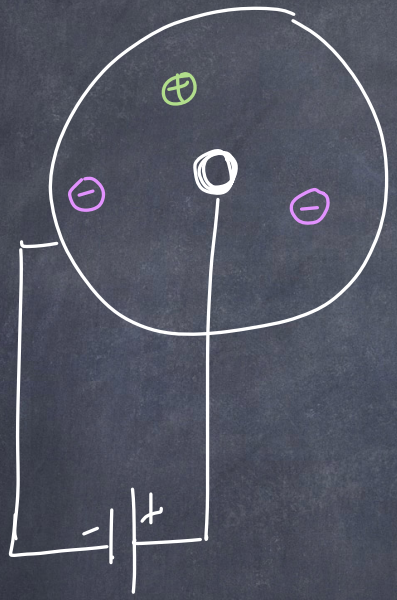


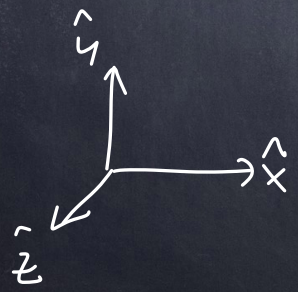

**(c)** Charge with constant velocity, not perpendicular to **B**, makes makes spirals.

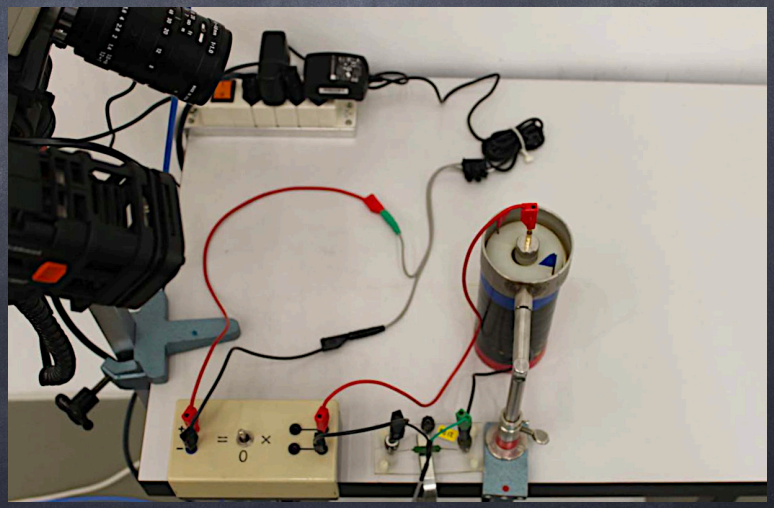
**Figure 7.5:** Charge with a non-zero velocity, not parallel to a uniform magnetic field **B**, experiences a force perpendicular to the velocity and magnetic field.

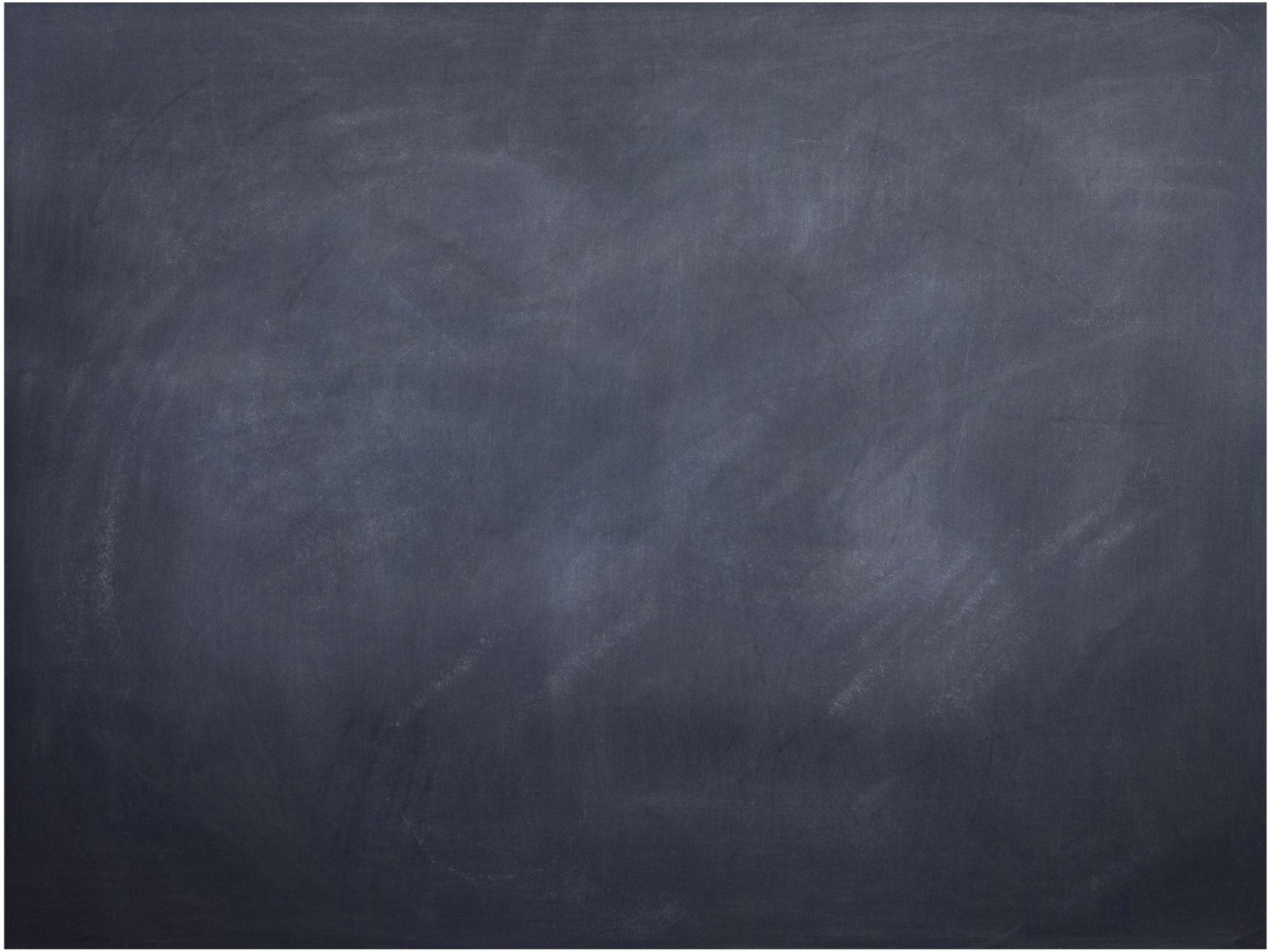
⊕ = $Na^+$

⊖ = $Cl^-$

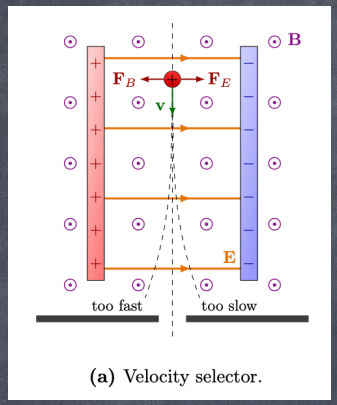


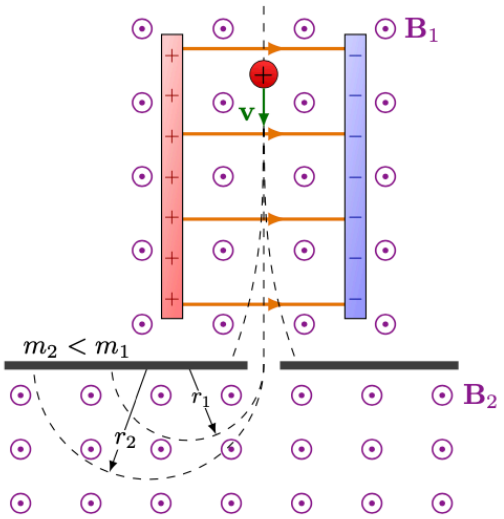





# "velocity selector"

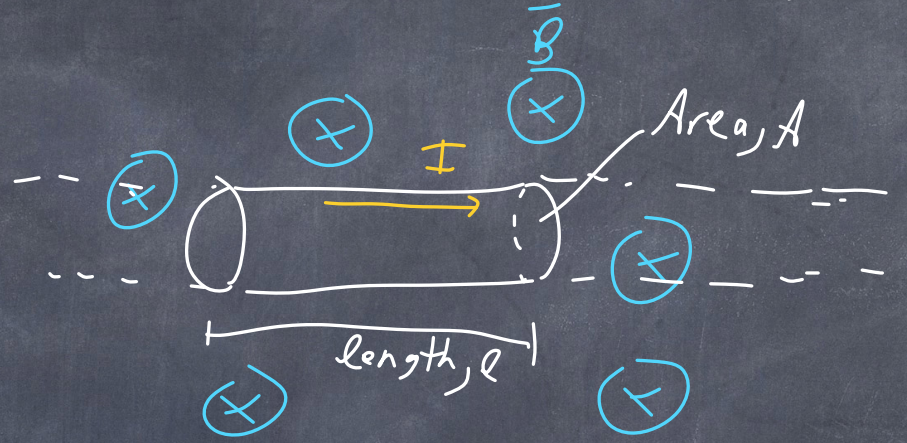


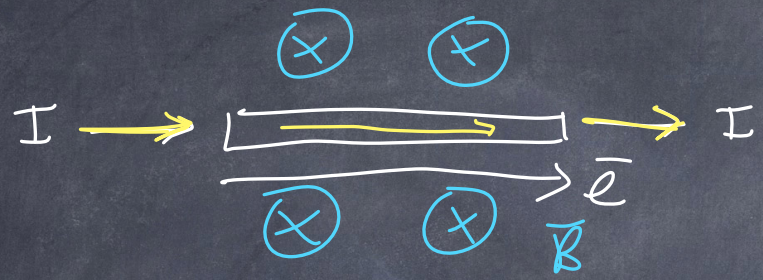

**(a)** Velocity selector.

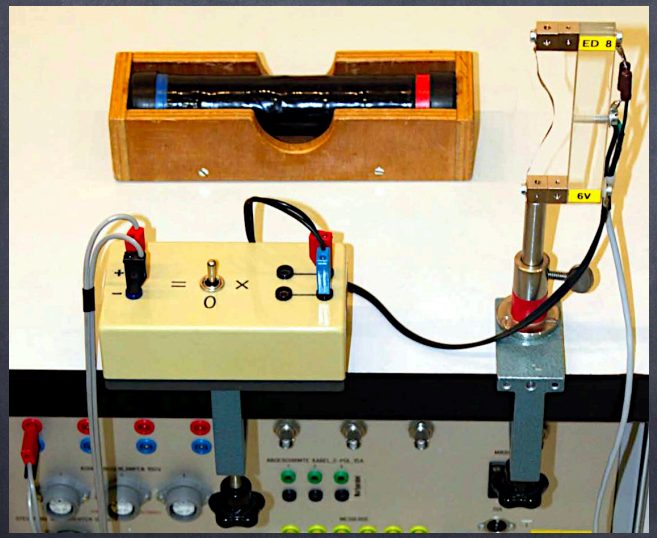



**(b)** Mass spectrometer.

What if we have current of electric charges moving $\perp$ $\bar{B}$-field ?




I
I
B

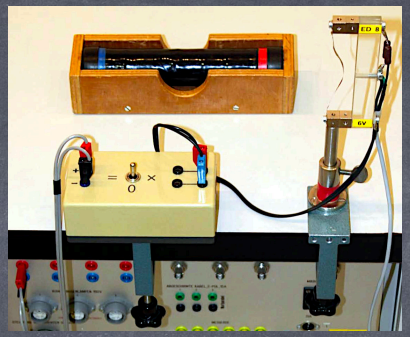

ED 8
6V

ED2

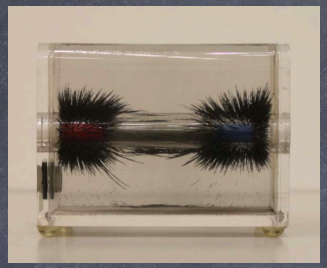
ED1

ED5

ED7



ED8



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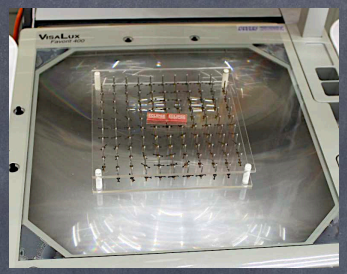

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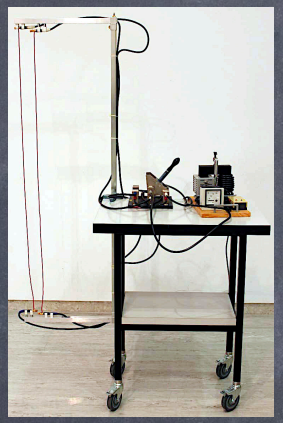

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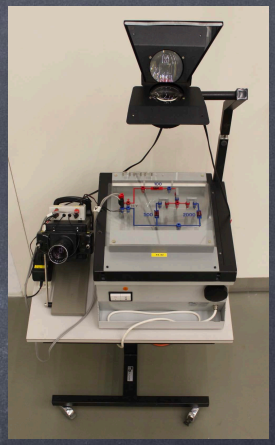

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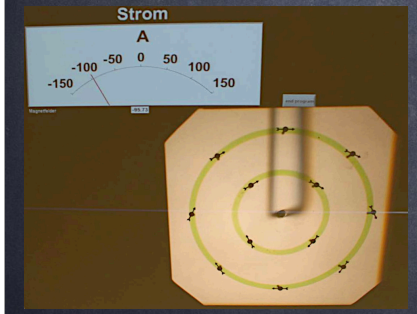


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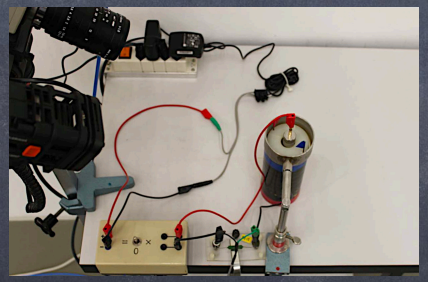

ED12