PHYSICS 571 – Master's of Science Teaching

"Electromagnetism and Light"
Lecture 7 – Labs and demos that you can do with your kit – Part I

Instructor – Richard Sonnenfeld

mpsonnenfeld@gmail.com ← Homework and Questions

575-835-6434

Outline

Magnetism

Homopolar Motor

Galvanometer

Induction

Induction

Transformer

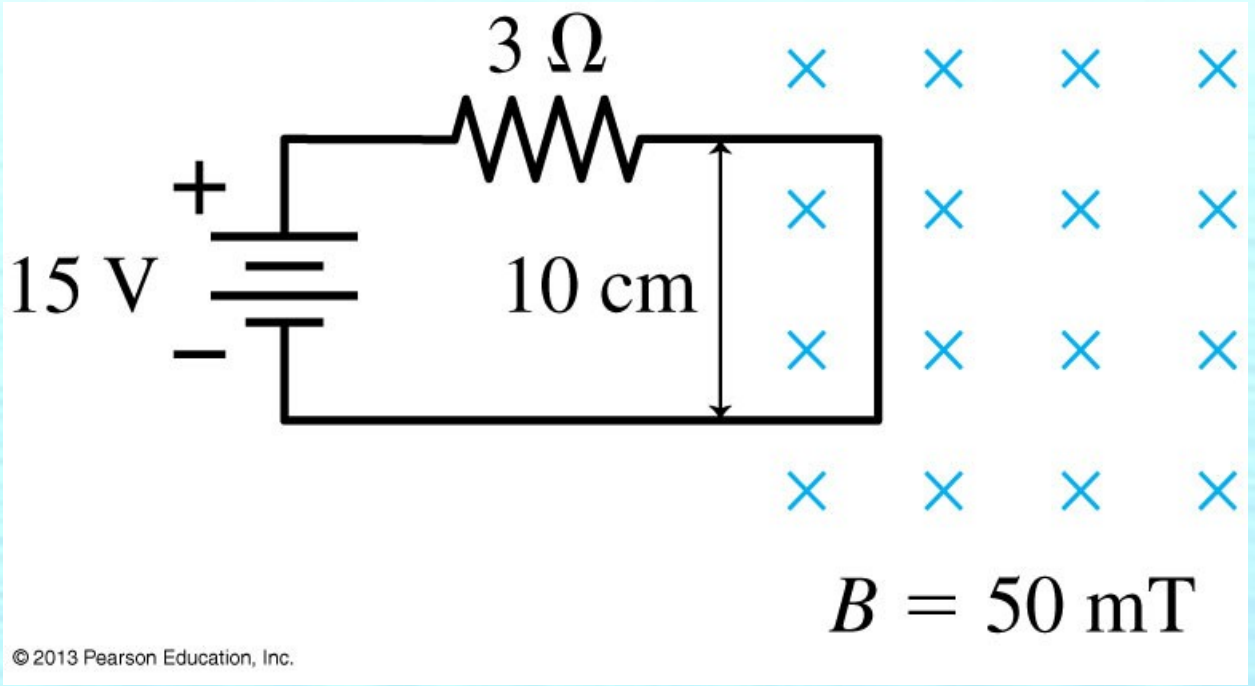
Light

Lenses

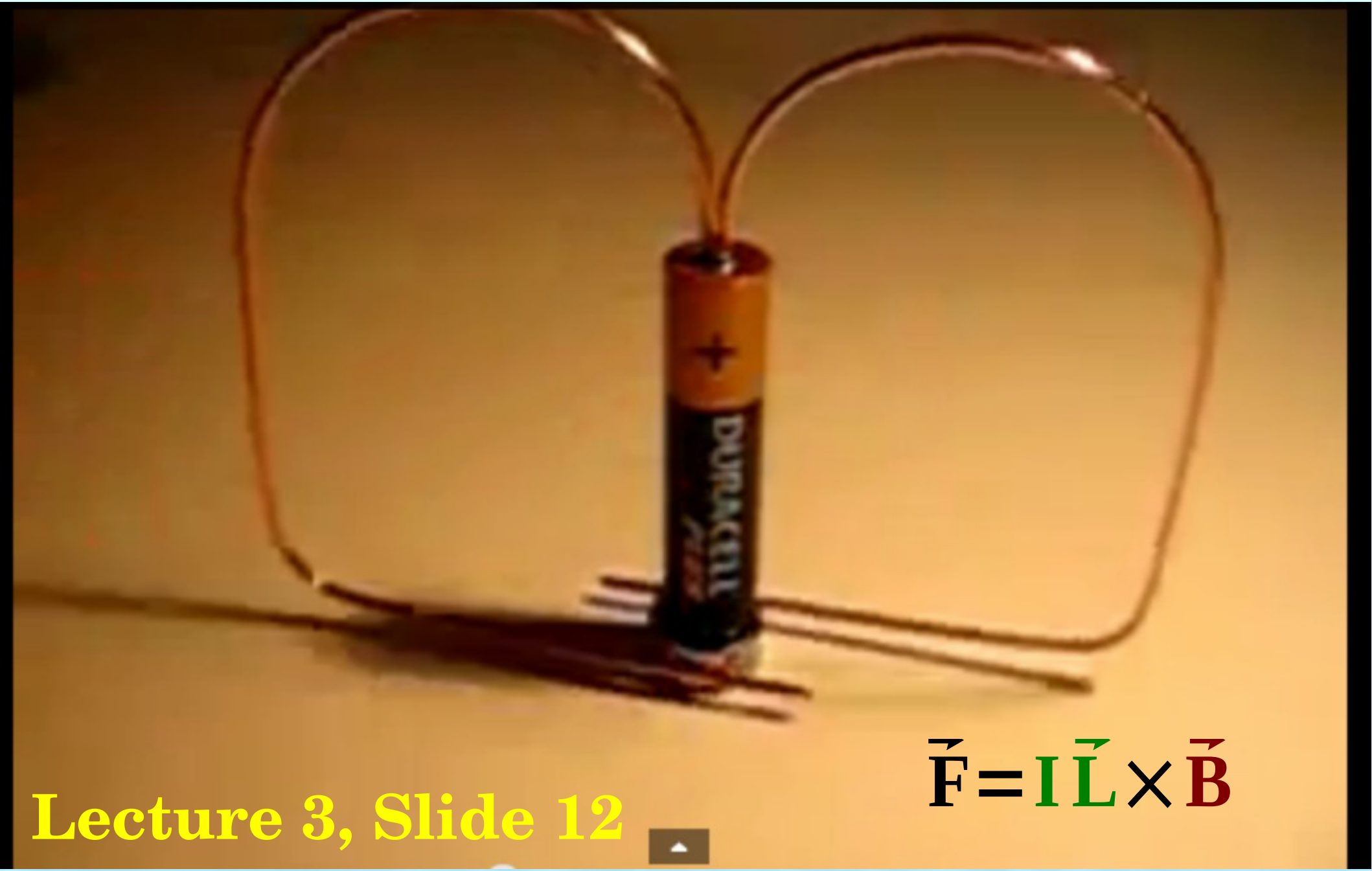
Double Slit experiment

Force on a circuit in a magnetic field

$$\vec{F} = I\vec{L} \times \vec{B}$$



Homopolar Motor



$$\vec{F} = I\vec{L} \times \vec{B}$$

Homopolar Motor:

You can do it! ***(bold items are in your kit)***

<u>Needed:</u>

1 foot of #10 bare copper wire (or #12)

1/2” x 1/2” N48 cylinder magnet

AA battery

Wire dykes

Two pair of pliers

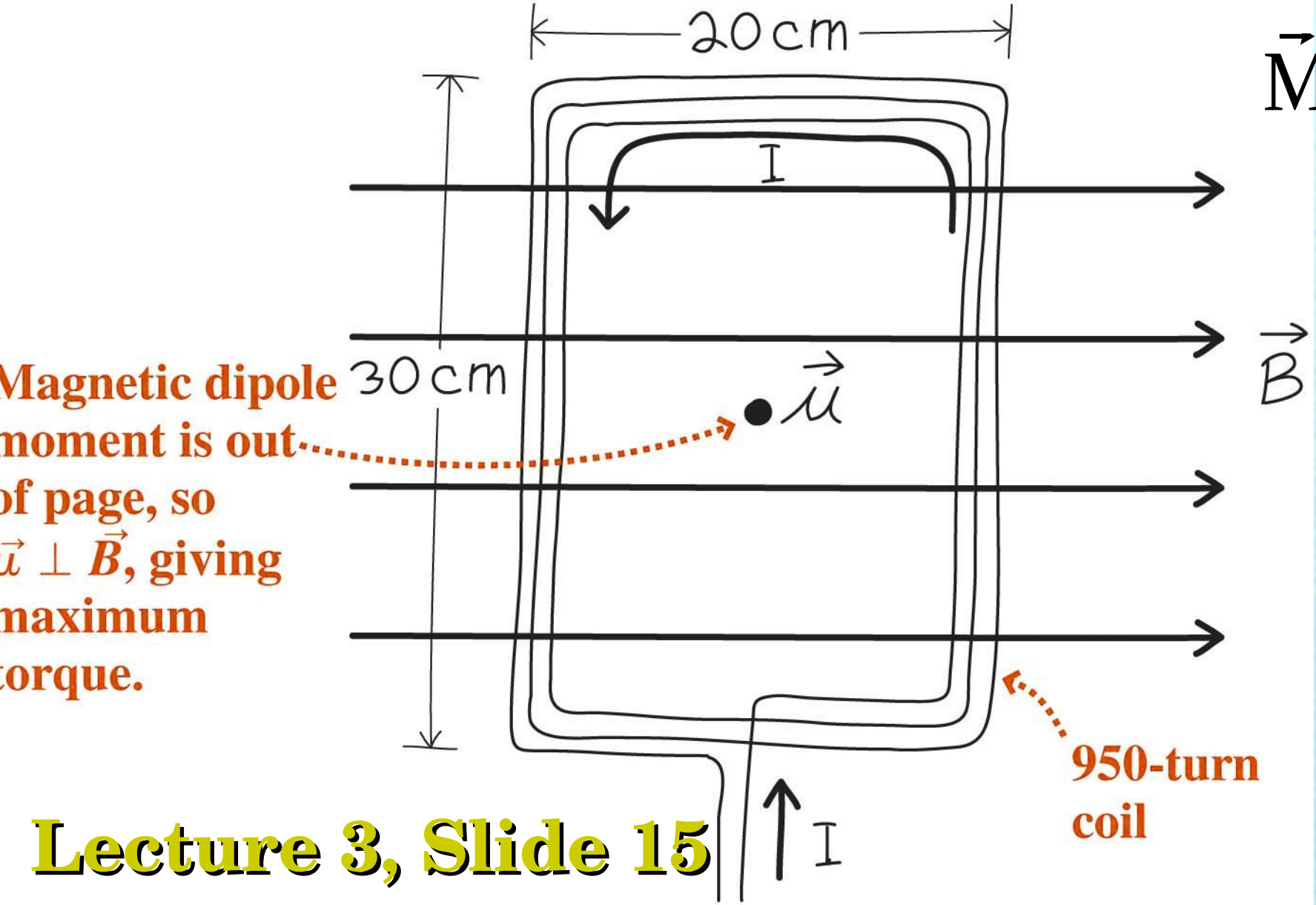
Hammer

Medium size screwdriver

Torque on a current loop
is proportional to magnetic moment.

$$\vec{\tau} = \vec{M} \times \vec{B}$$

$$\vec{M} = I\ \vec{A}$$



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Galvanometer:

You can do it! ***(bold items are in your kit)***

Needed:

Spool of #26 magnet wire

3 clip leads

6-V industrial battery

22, 47, 100, 220, 470, 1kOhm resistors

Magnetic Compass

Soldering iron

One ft x 2 in. x ½ in. wood block (or a wooden ruler)

Toilet paper tube / Scissors

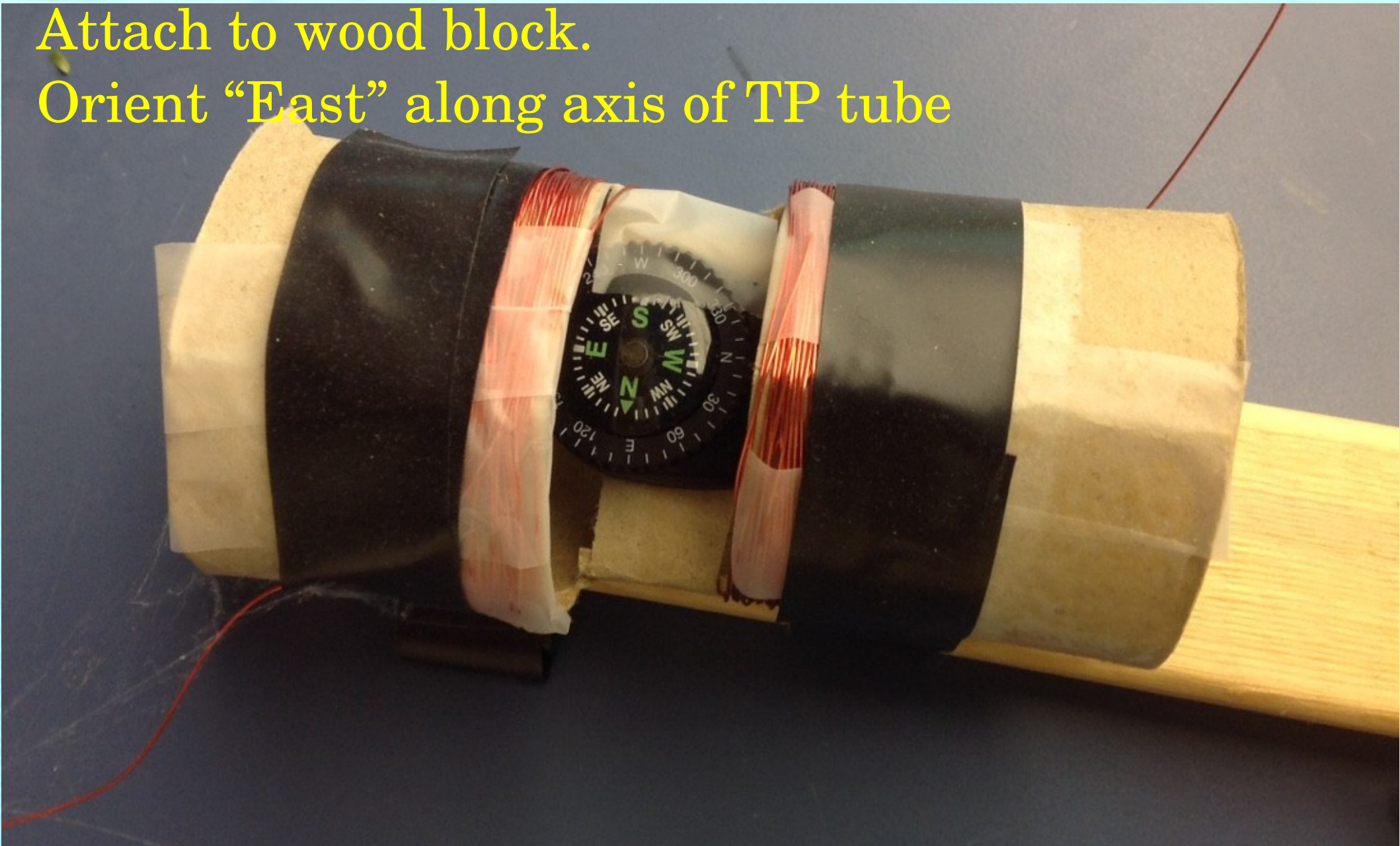
Duct Tape/Electrical tape

Galvanometer:

Build galvanometer into TP tube (per directions)

Attach to wood block.

Orient “East” along axis of TP tube

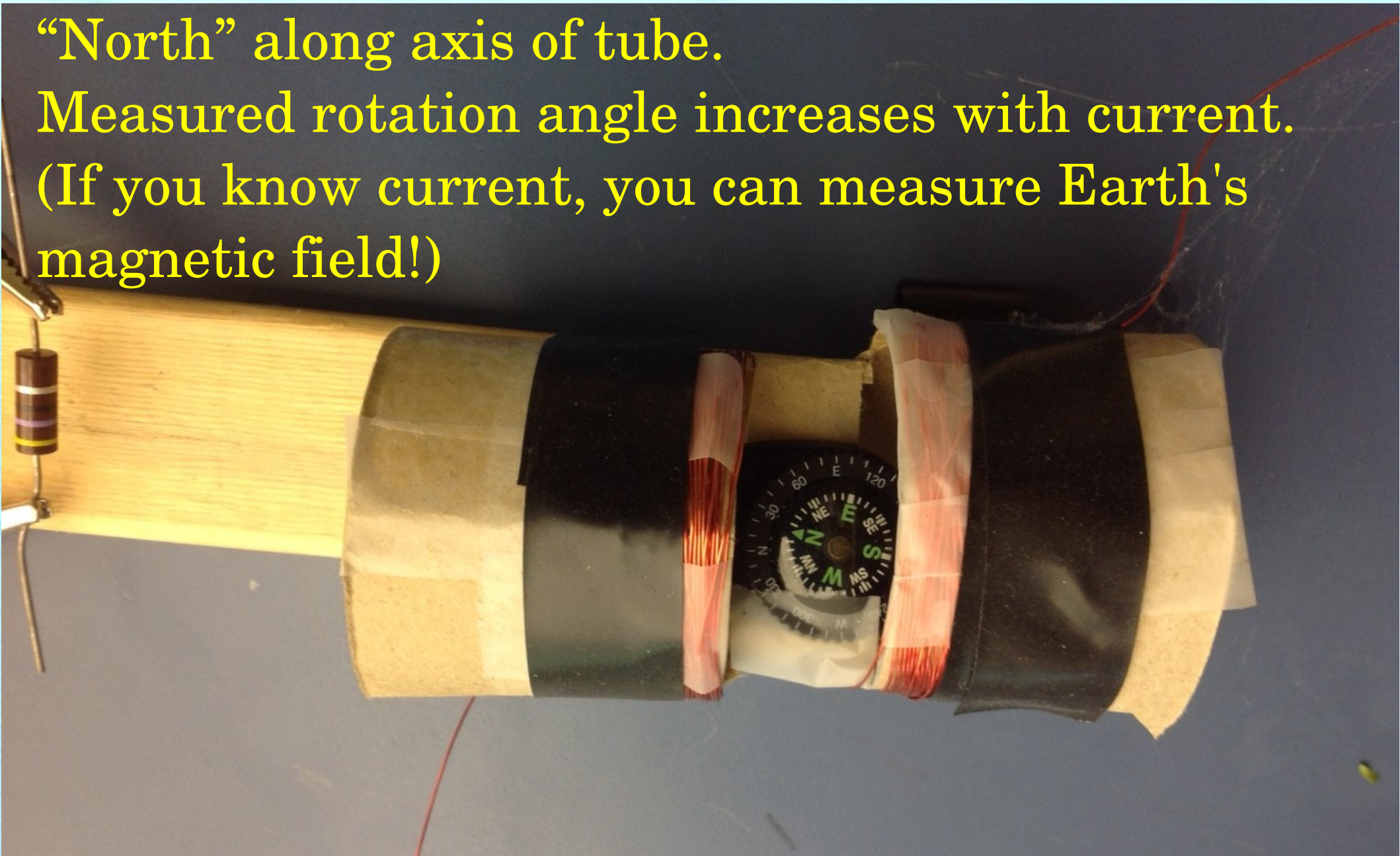


Galvanometer:

Applied current makes compass rotate toward "North" along axis of tube.

Measured rotation angle increases with current.

(If you know current, you can measure Earth's magnetic field!)

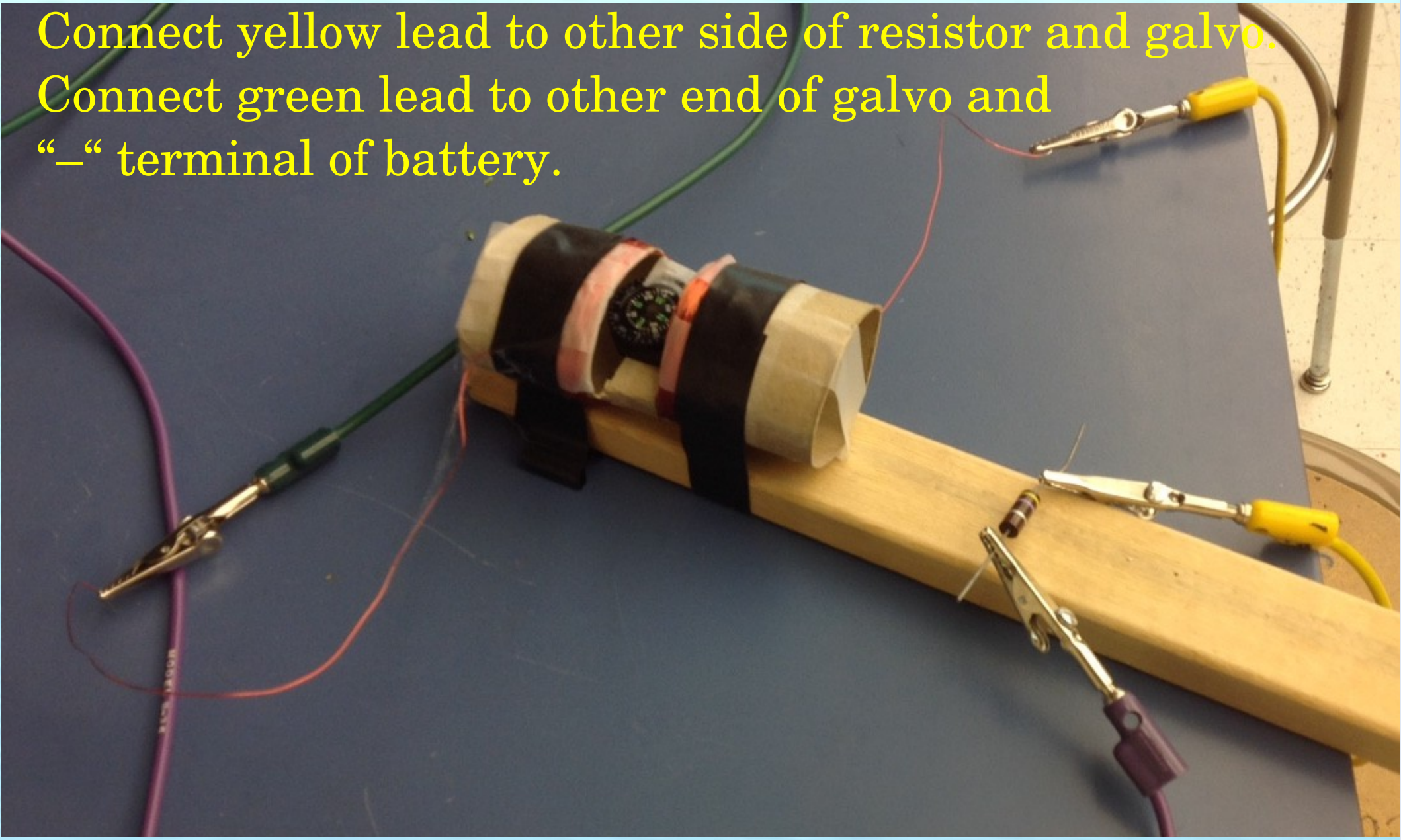


Galvanometer: (“Galvo”)

Connect purple lead to “+” side of battery and resistor.

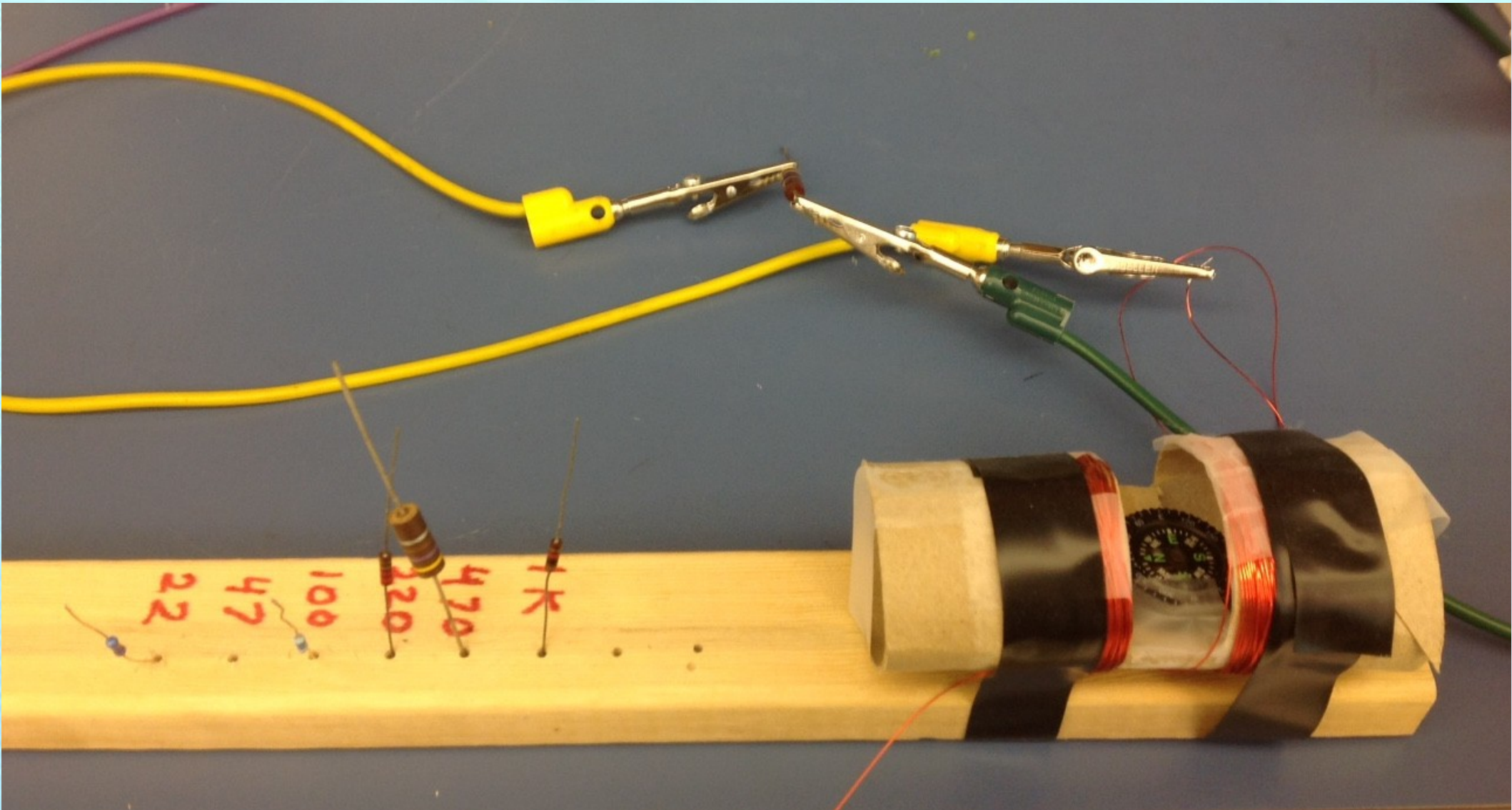
Connect yellow lead to other side of resistor and galvo.

Connect green lead to other end of galvo and “–“ terminal of battery.



Galvanometer:

You can make holes in your wood block to store your resistors.



Galvanometer: Data Analysis

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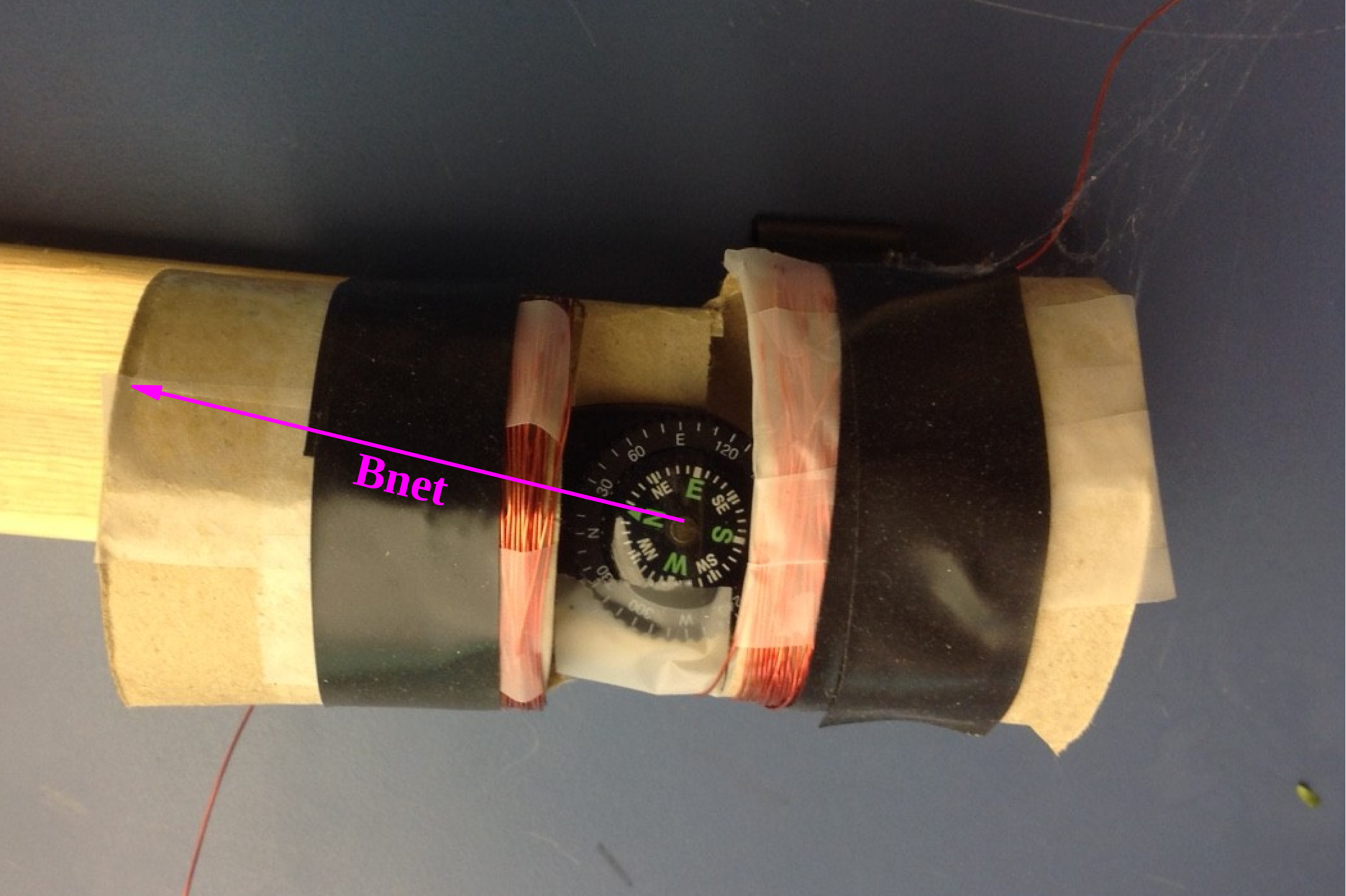
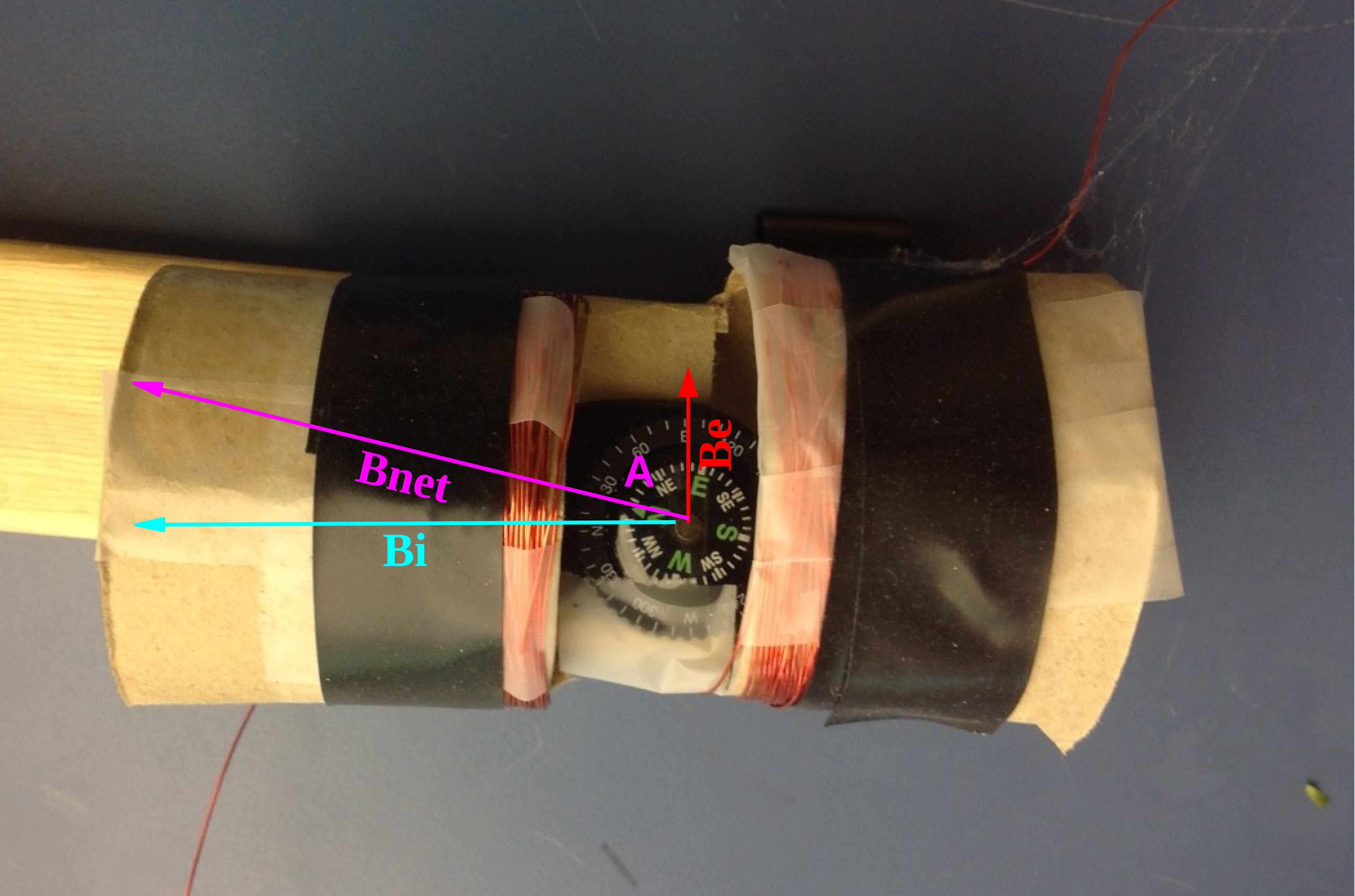
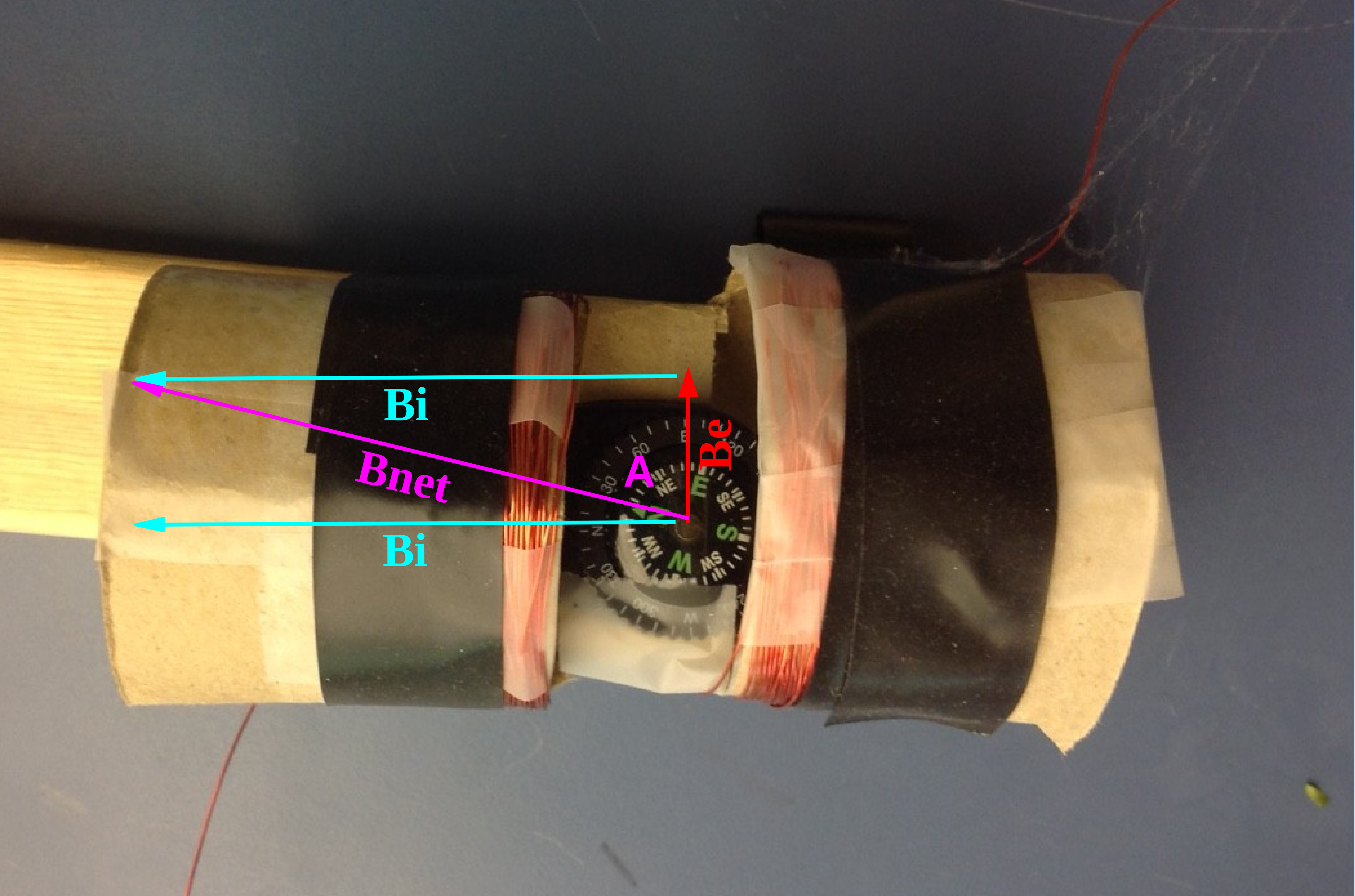


Galvanometer: Data Analysis

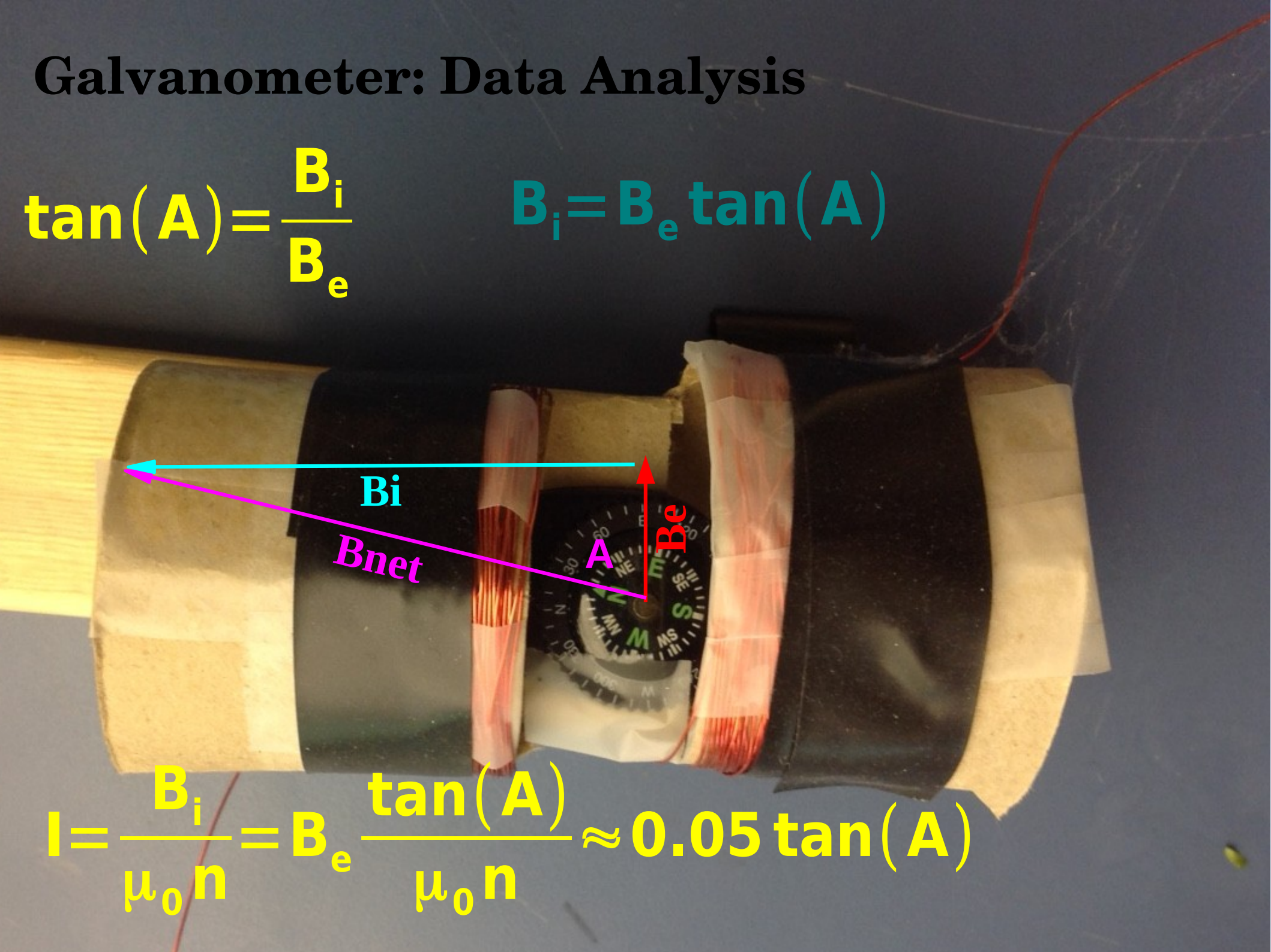


Galvanometer: Data Analysis



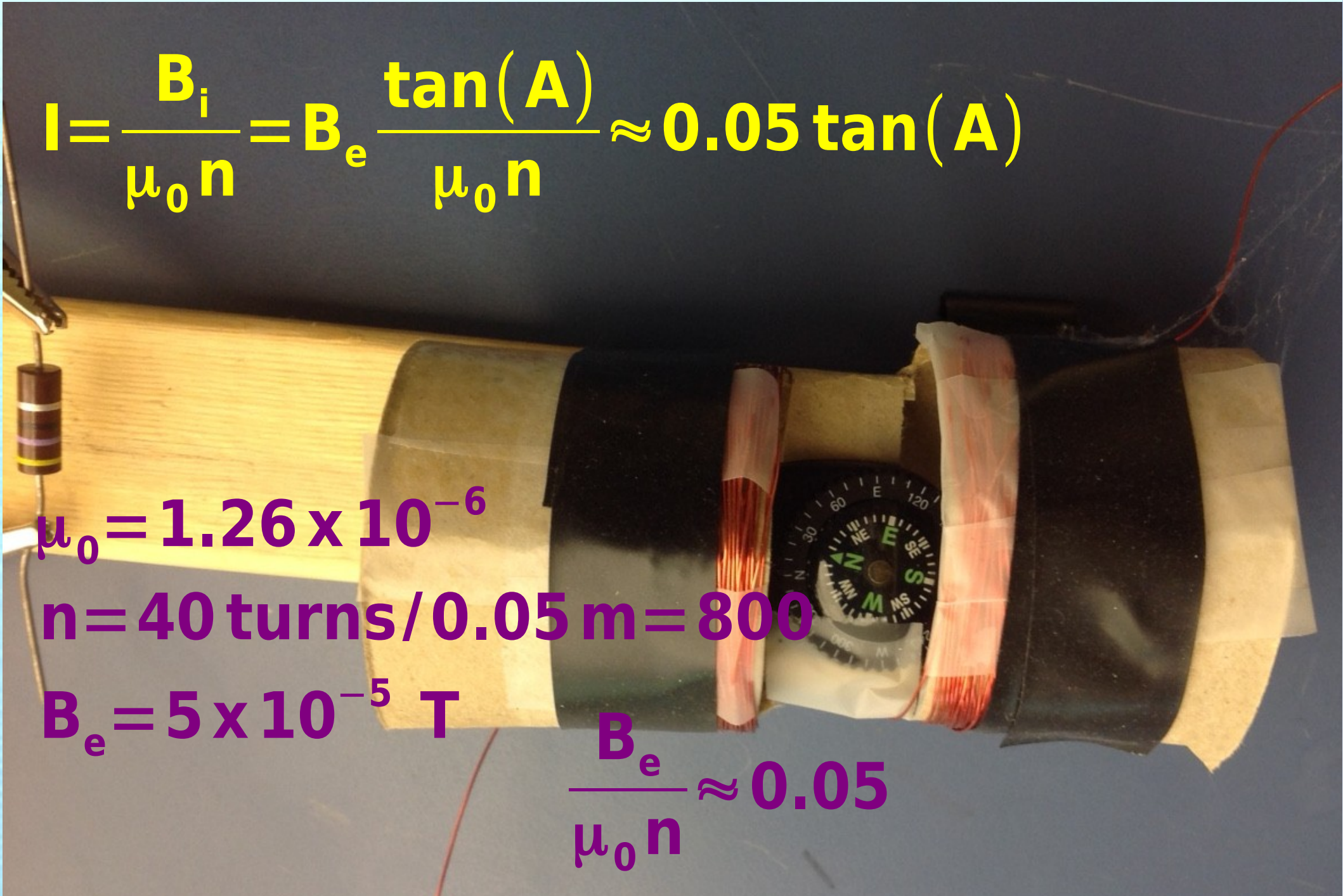
Galvanometer: Data Analysis

$$\tan(A) = \frac{B_i}{B_e} \qquad B_i = B_e \tan(A)$$



$$I = \frac{B_i}{\mu_0 n} = B_e \frac{\tan(A)}{\mu_0 n} \approx 0.05 \tan(A)$$

Galvanometer: Data Analysis



$$I = \frac{B_i}{\mu_0 n} = B_e \frac{\tan(A)}{\mu_0 n} \approx 0.05 \tan(A)$$

$$\mu_0 = 1.26 \times 10^{-6}$$

$$n = 40 \text{ turns}/0.05 \text{ m} = 800$$

$$B_e = 5 \times 10^{-5} \text{ T}$$

$$\frac{B_e}{\mu_0 n} \approx 0.05$$