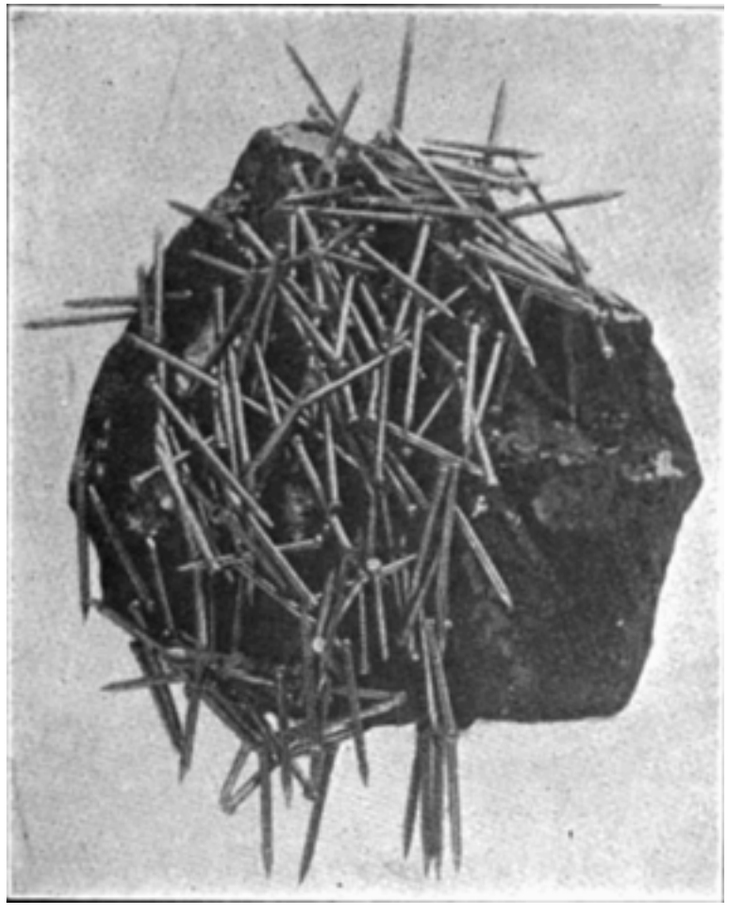
Magnetism

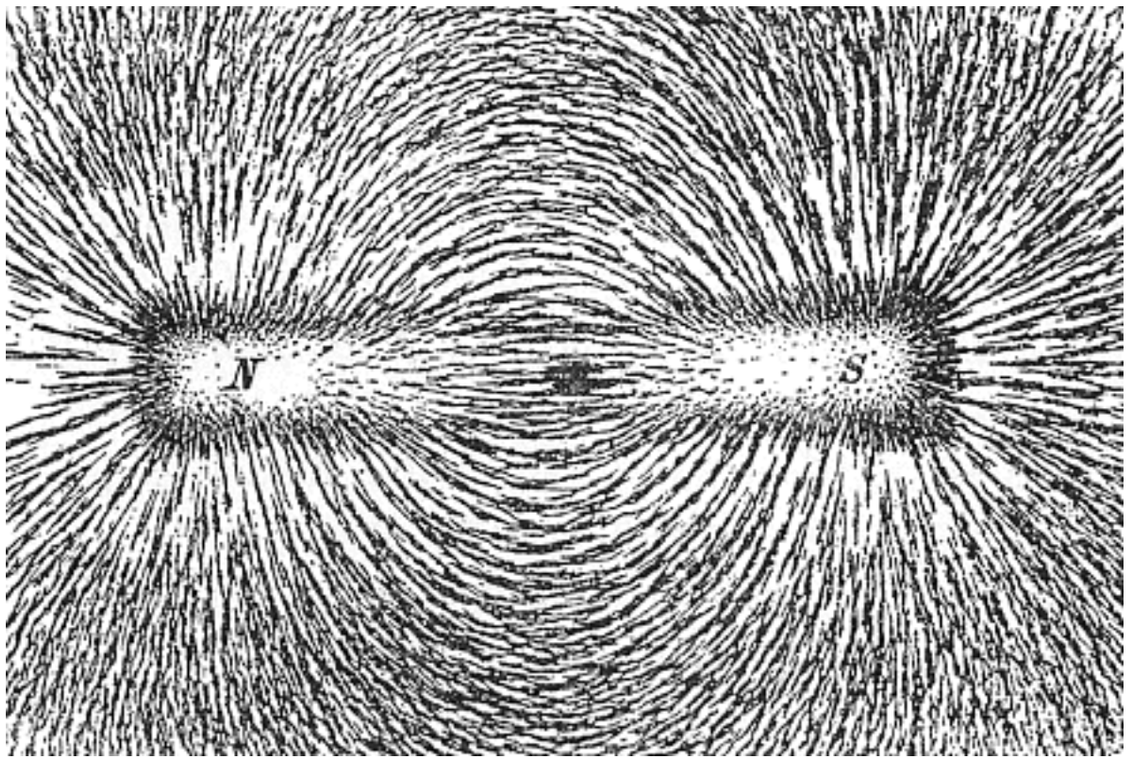
Lecture 17

Announcements

- Grading: Wednesday (probably).

Magnetism through the ages.





- Known to the ancients: Lodestone/Magnetite

Unification

- **Electricity** and **Magnetism** were **unified** into a single theory!

- Current **generates** B and B **applies forces** on currents.

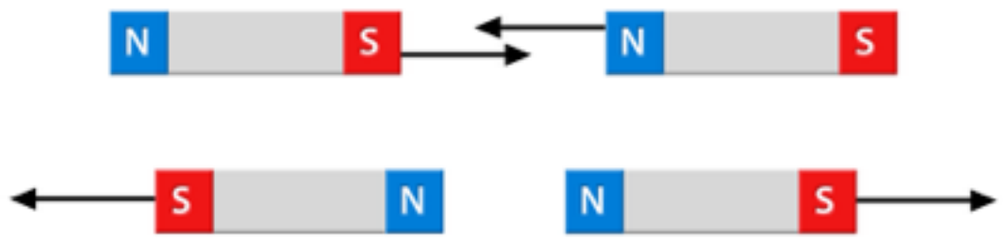
- Lorentz Force Law (J.J. Thomson ++):

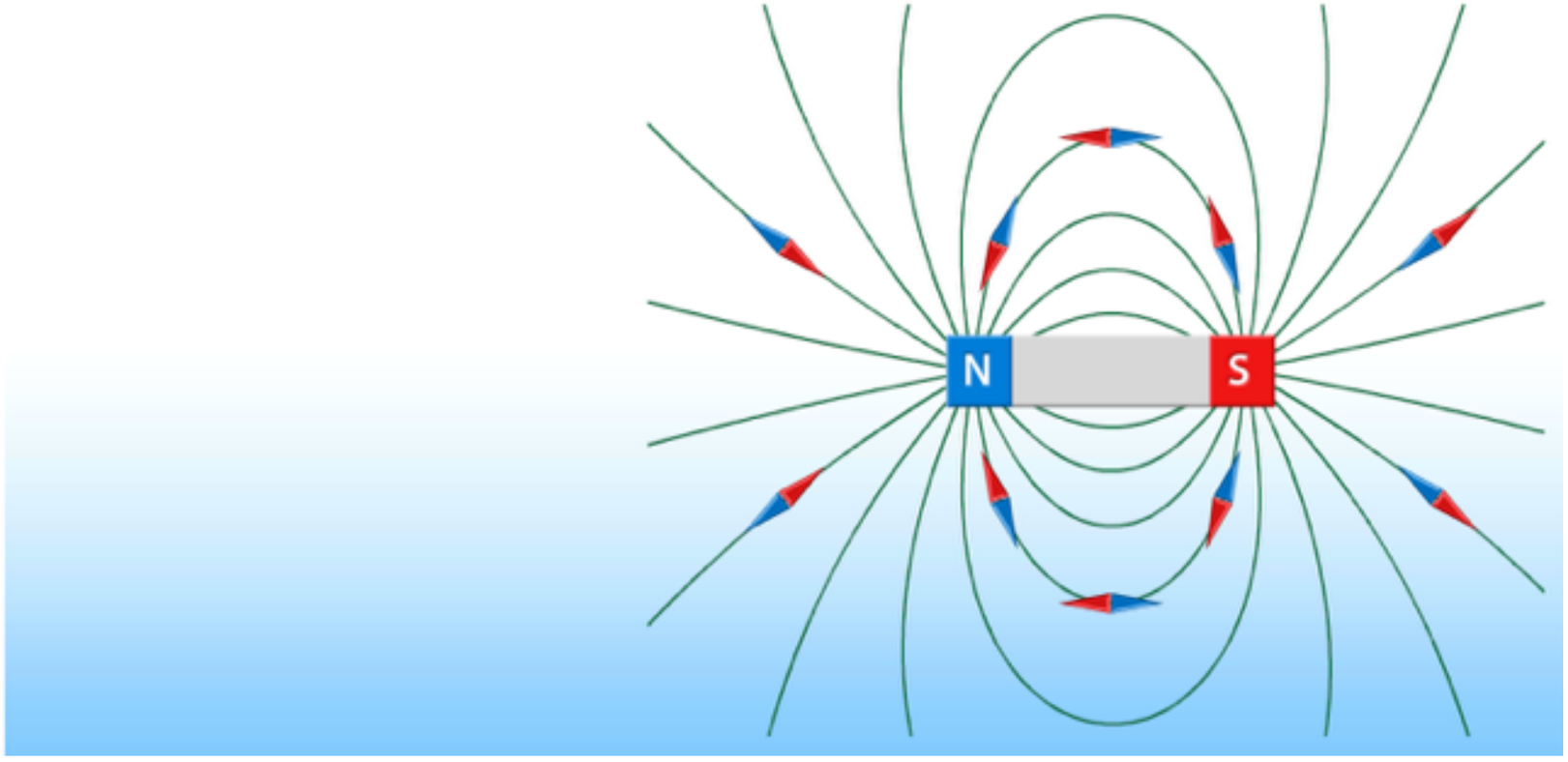
$$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$$

- Ampère Law (w/o Maxwell correction):

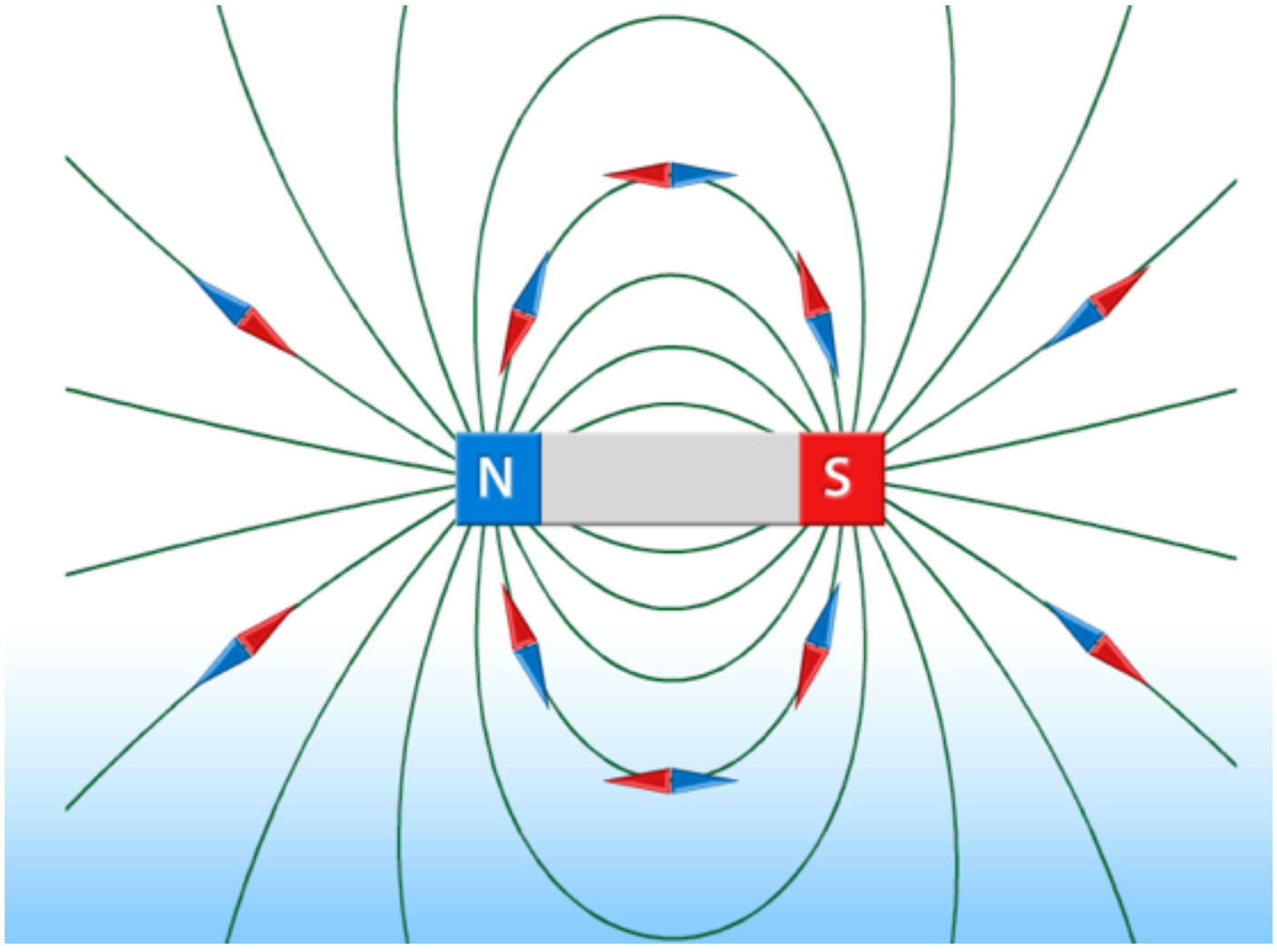
$$\vec{\nabla} \times \vec{B} = \mu_0 \vec{j} \qquad \oint \vec{d\ell} \cdot \vec{B} = \mu_0 I_{\text{inside}}$$

Properties of Bar Magnets (Demo)

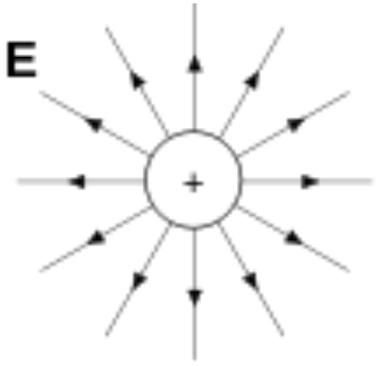


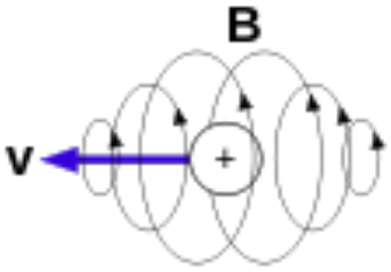


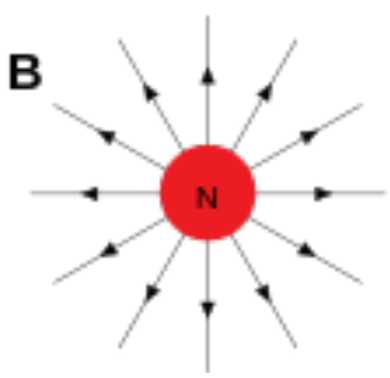
Bar magnets produce a dipole field… but no M. monopoles!

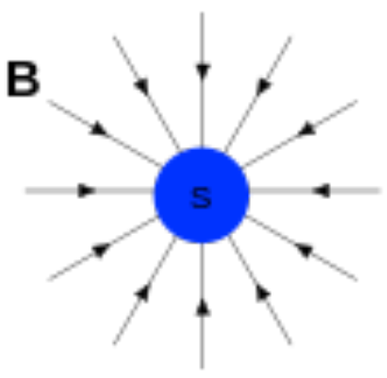


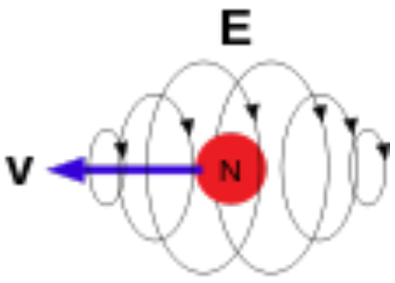
Looking for love:
Search for magnetic monopoles…









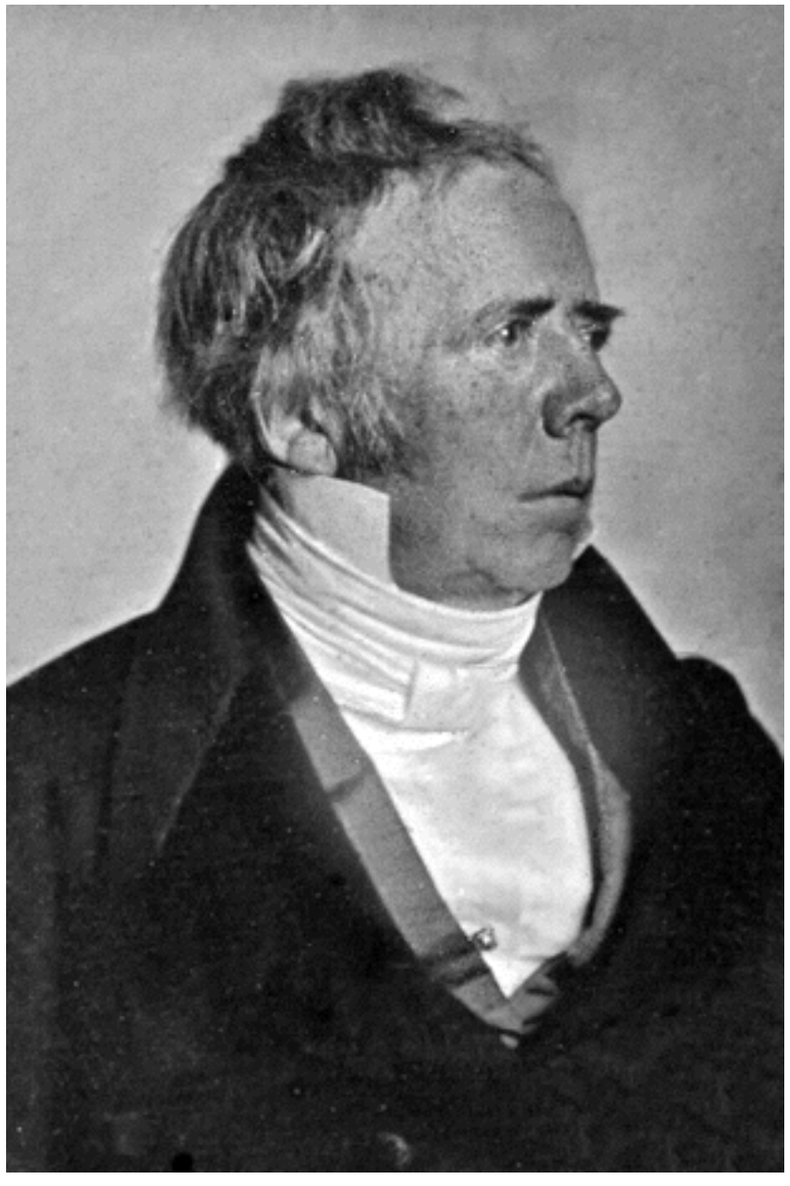


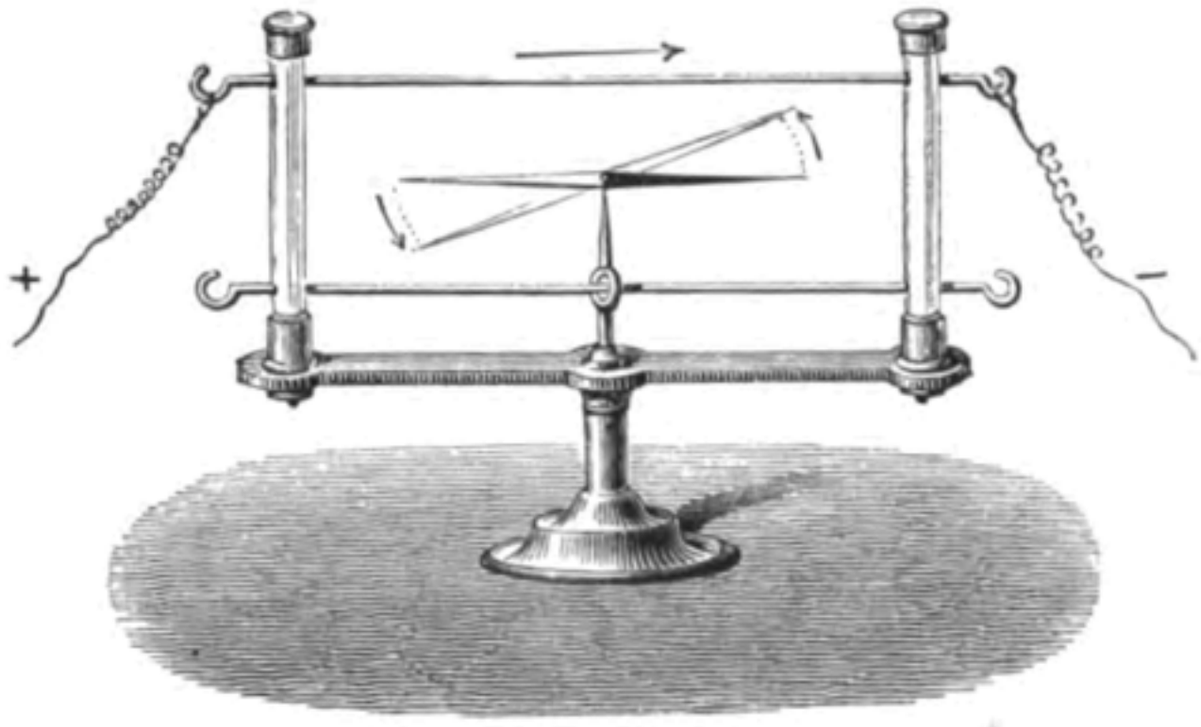
One event…

Blas Cabrera on the night of February 14, 1982

If there are no “charges”, what generates B?

Ørsted and the demo.



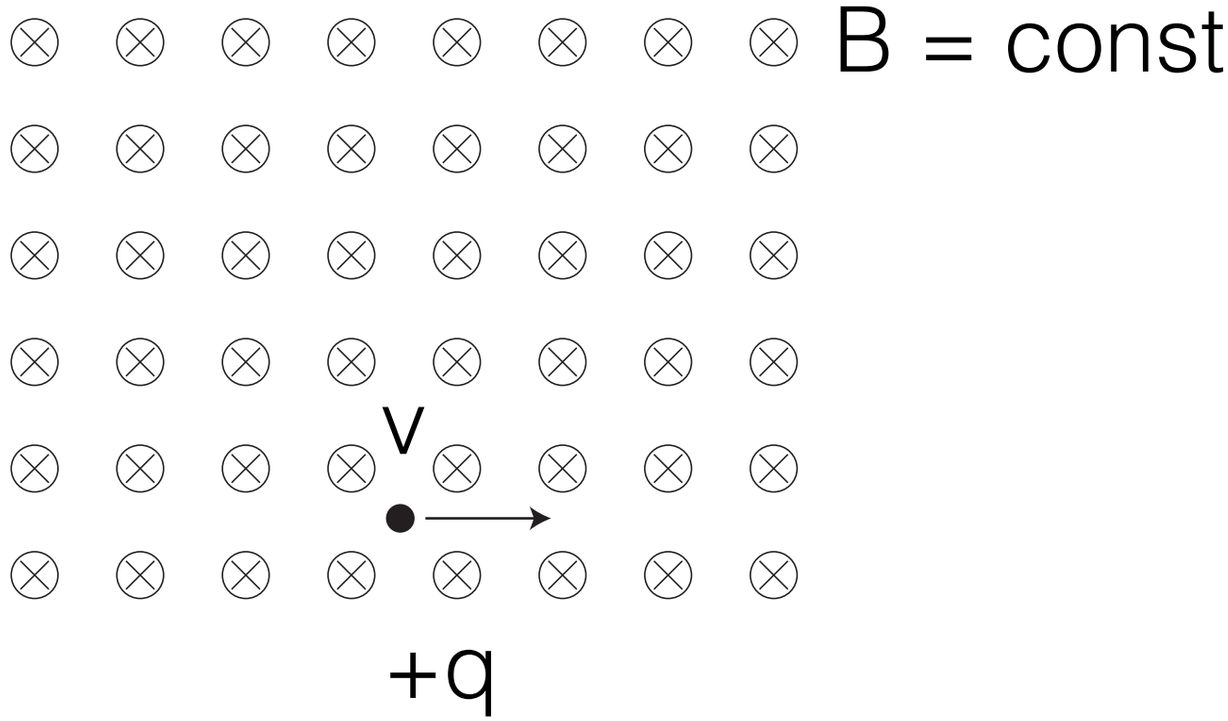


- Electric currents generate magnetic field!
- Bar magnets?

Applying the Lorentz Force Law

- Lorentz Force Law:

$$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$$



Application: Mass Spectrometer