Intense light and fast electrons: Lasers and electric circuits in the lab

CBB Teacher Workshop
Sensible Circuits

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Outline

- Research: bird's-eye view
- Big capacitors: electron guns
- Electric circuits: safety systems
- Lasers: essential to modern physics
- Conclusion

Overview of accelerator physics

- Basic premise: accelerate charged particles (electrons, protons, etc.) using electromagnetic forces
- Electron guns:
  - Accelerate electrons to very high speeds
  - Uses:
    - Source for large circular accelerators
    - Imaging
    - Sterilization
    - Cancer therapy

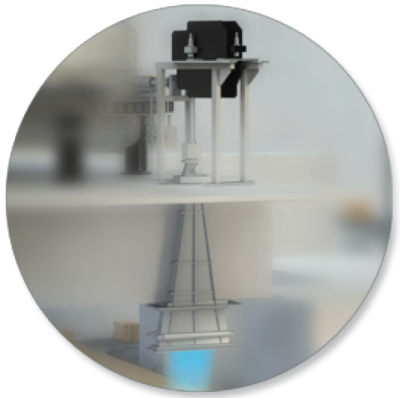
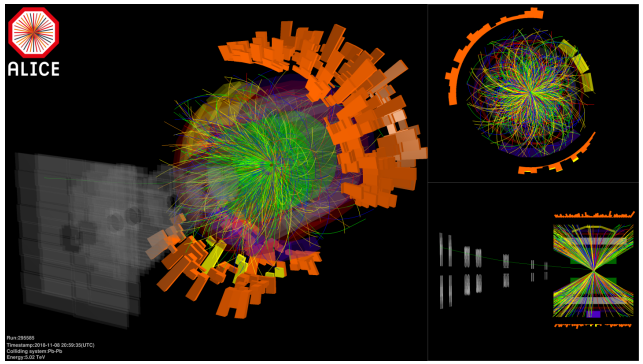


Image credit: IBA Industrial

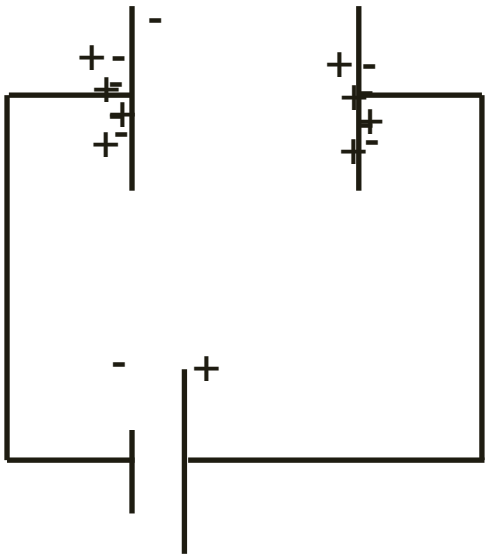
Image credit: CERN



Statistics from J. Ritchie Patterson

Big capacitors: electron guns

- Capacitor: basically chargeable battery
- Electron gun: just a big version



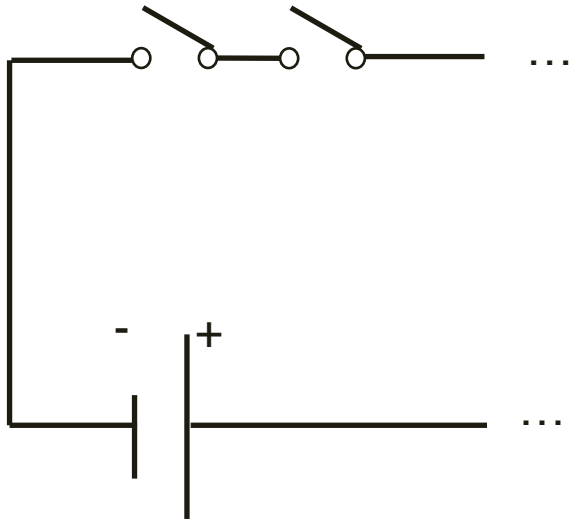
Regular capacitor

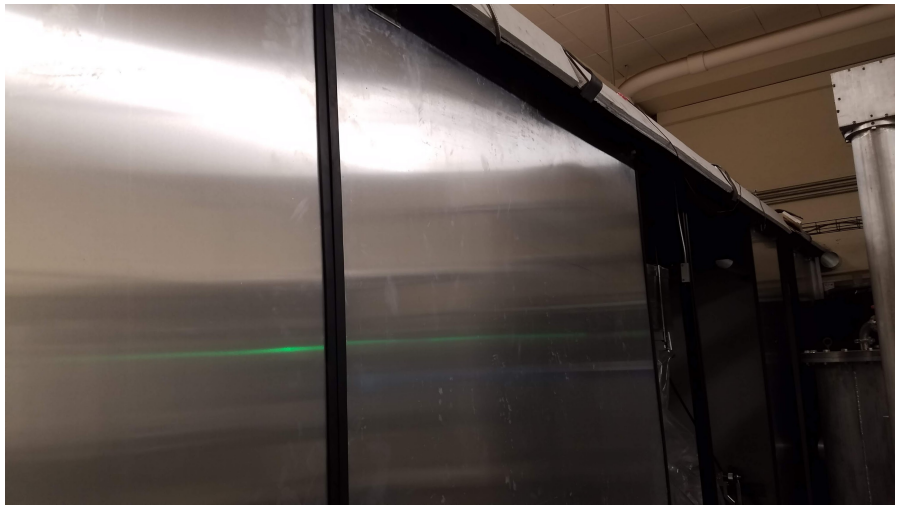
"Capacitor" in our lab

"Battery" in our lab

Electric circuit: safety system

- Electron gun produces a lot of radiation
- Lead doors to keep us safe
- How to make sure doors are closed?
  - Answer: series of switches





Lasers: key to everything

- For us: use lasers to generate electrons
- Other uses:
  - Research: spectroscopy, scattering, microscopy, cooling (!), etc.
  - Cutting, welding, surgery, communication, printers, barcode scanners, CDs/DVDs, etc.

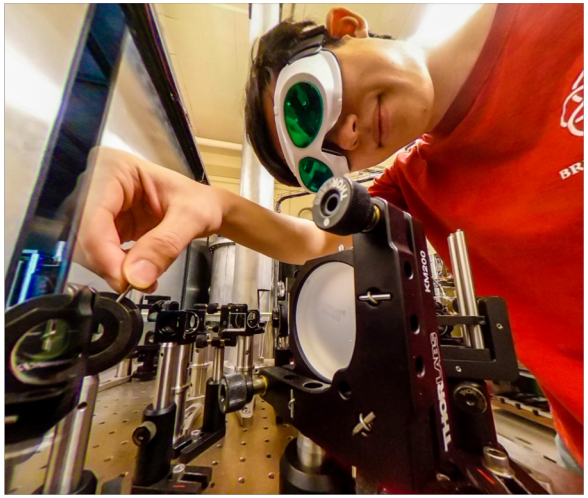


Image credit: Andrew Noyes

Conclusion

- Science demonstrated today has real impacts in the lab
- Broader impacts
  - Medicine
  - Industry
- Not just academic exercise!