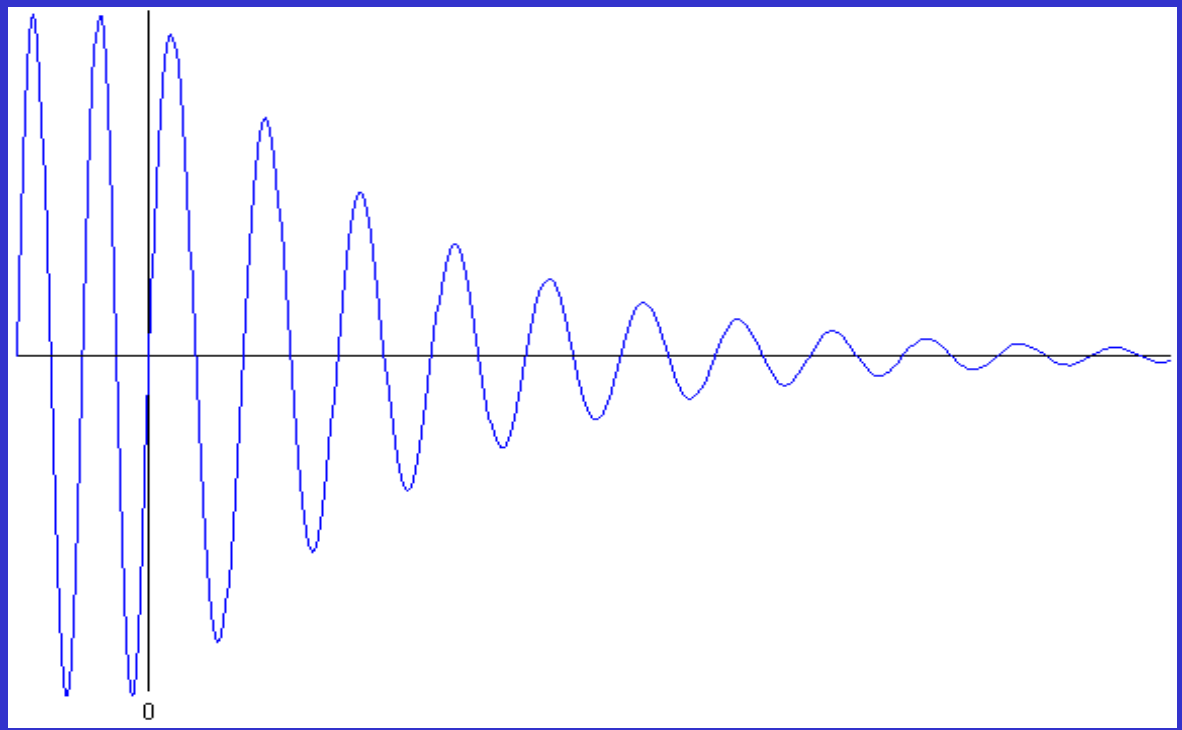
The Internal Friction of Conductive Fibers

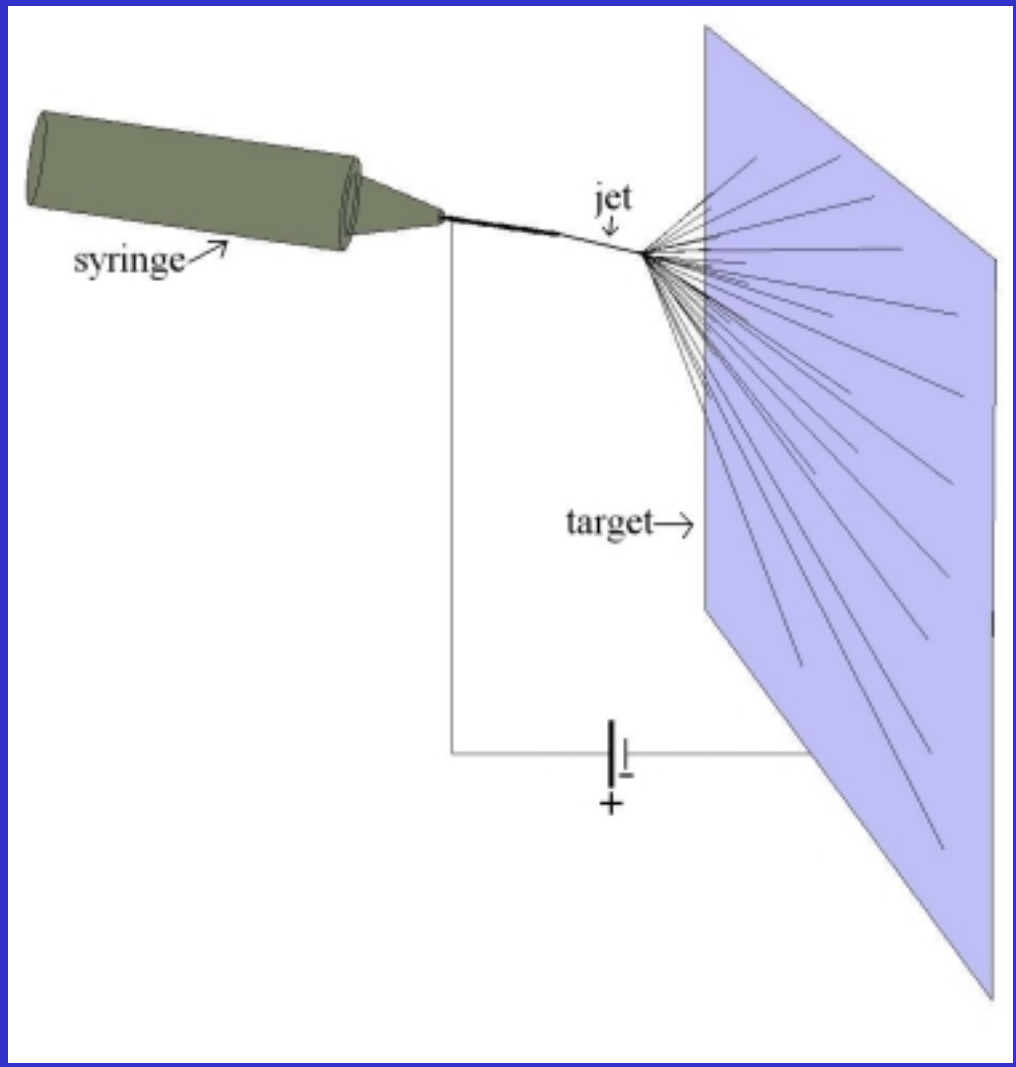


SUNFEST 2001
Mary Kutteruf
Advisor: Jorge J. Santiago-Aviles

Conducting Polymer Fibers

- Uses
- Production
  - Spinning
  - Electrospinning

Electrospinning



Elastic Materials & Hook's Law

$$\sigma = M\varepsilon \quad \text{or} \quad \varepsilon = J\sigma \quad \text{with} \quad M = 1/J$$

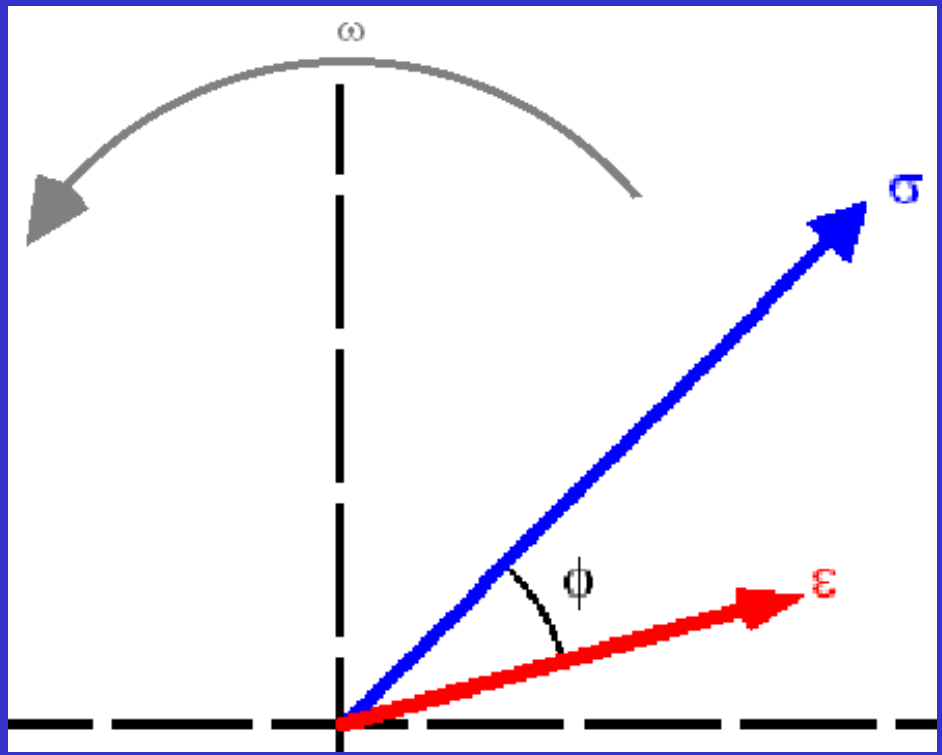
σ = stress & ε = strain

- For every stress there is a unique equilibrium strain
- Equilibrium is reached instantaneously
- The stress strain relationship is linear.

Anelastic Materials

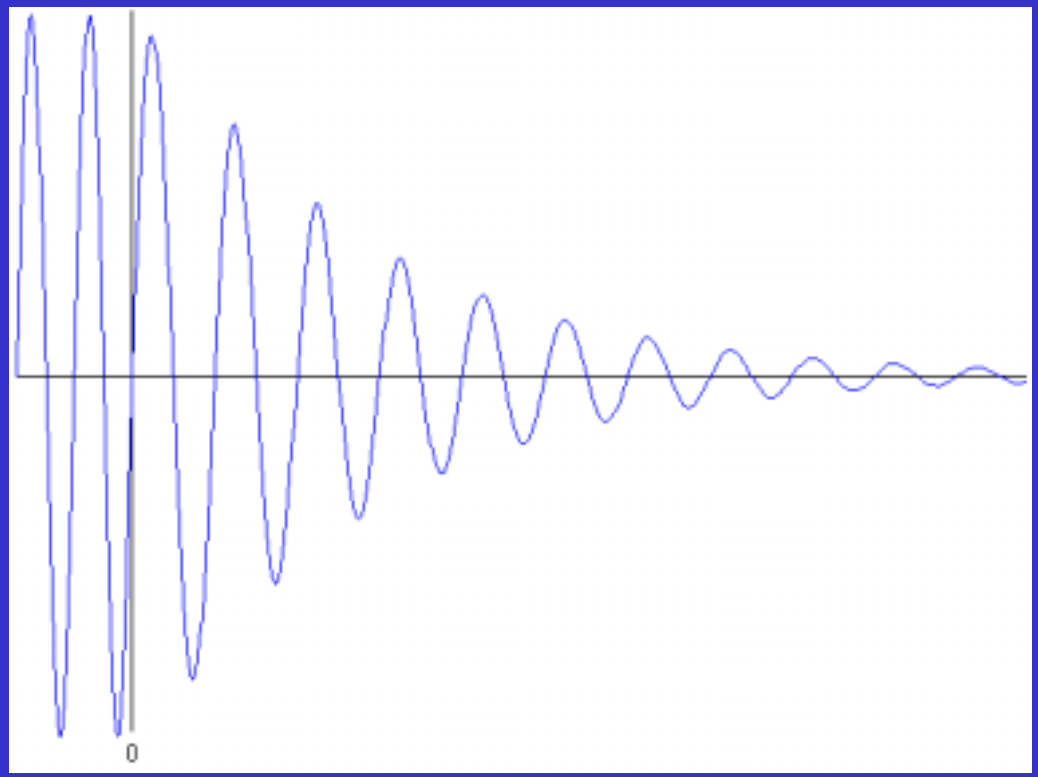
Equilibrium is not reached instantaneously.

Periodic stress leads strain.



ϕ is the internal friction.

Periodic force removed → exponential decay



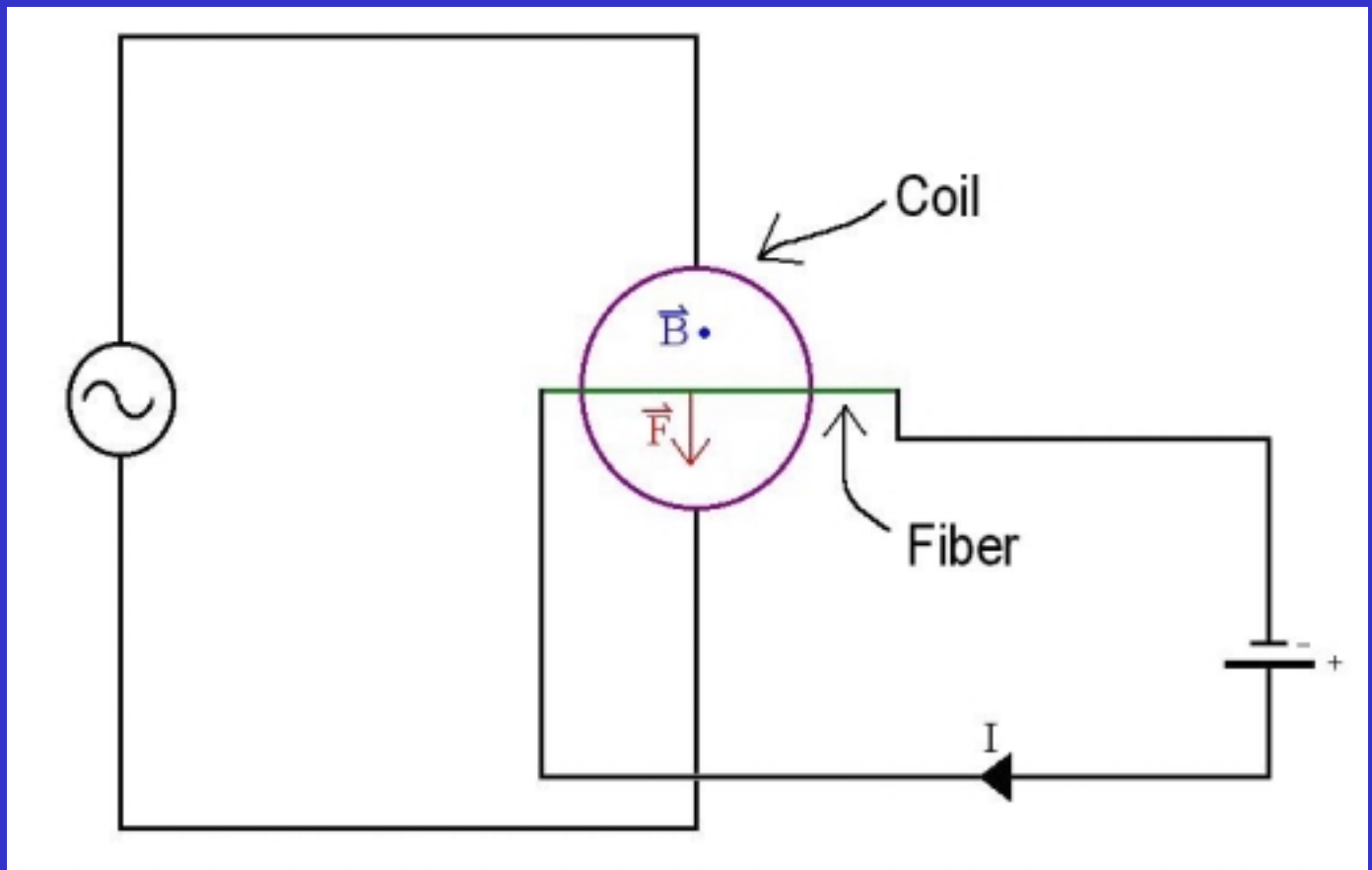
$$A(t)=A_0 e^{-f\,t\delta}$$

A_0=initial amplitude f = frequency

$$\delta = \pi\phi$$

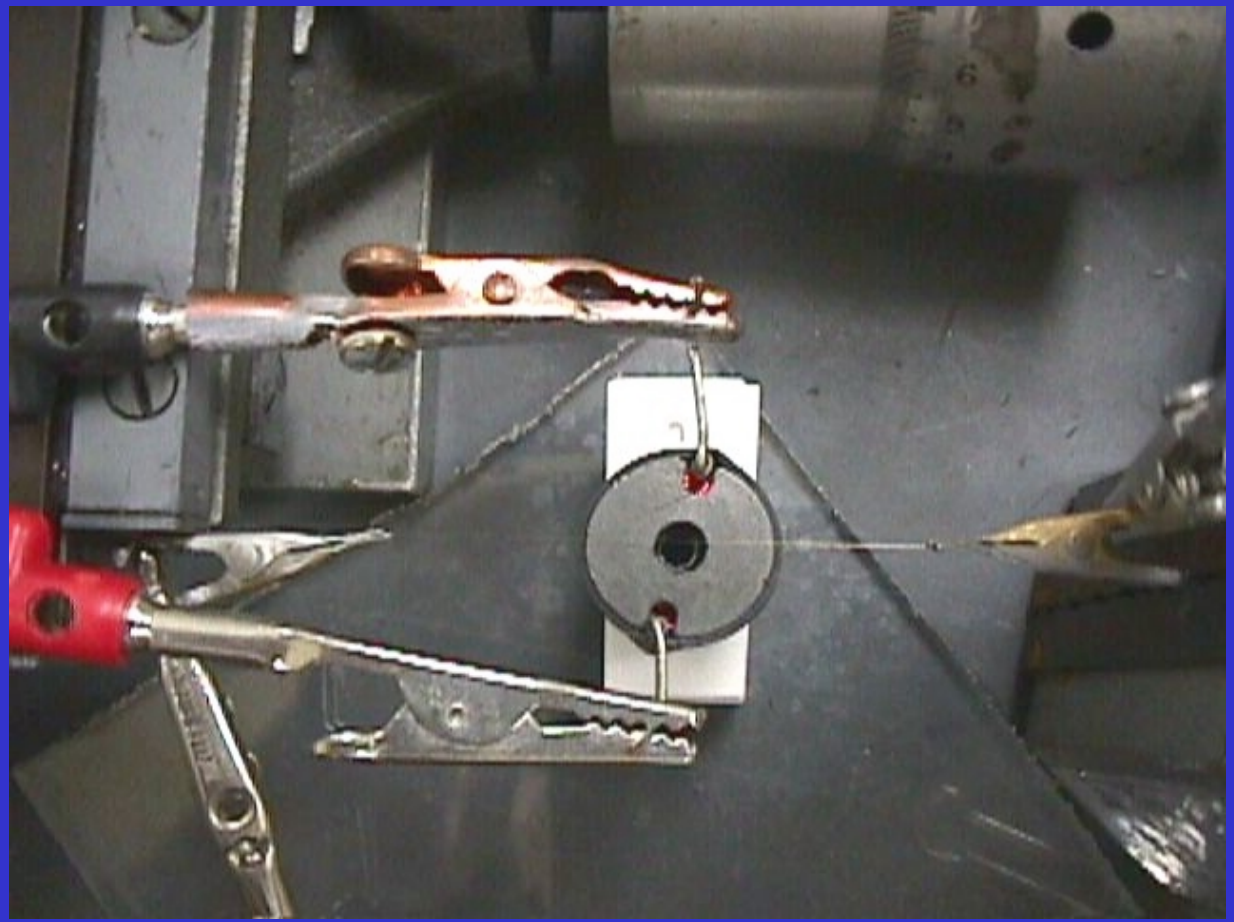
Experiment

- Run current through the fiber in an orthogonal oscillating magnetic field



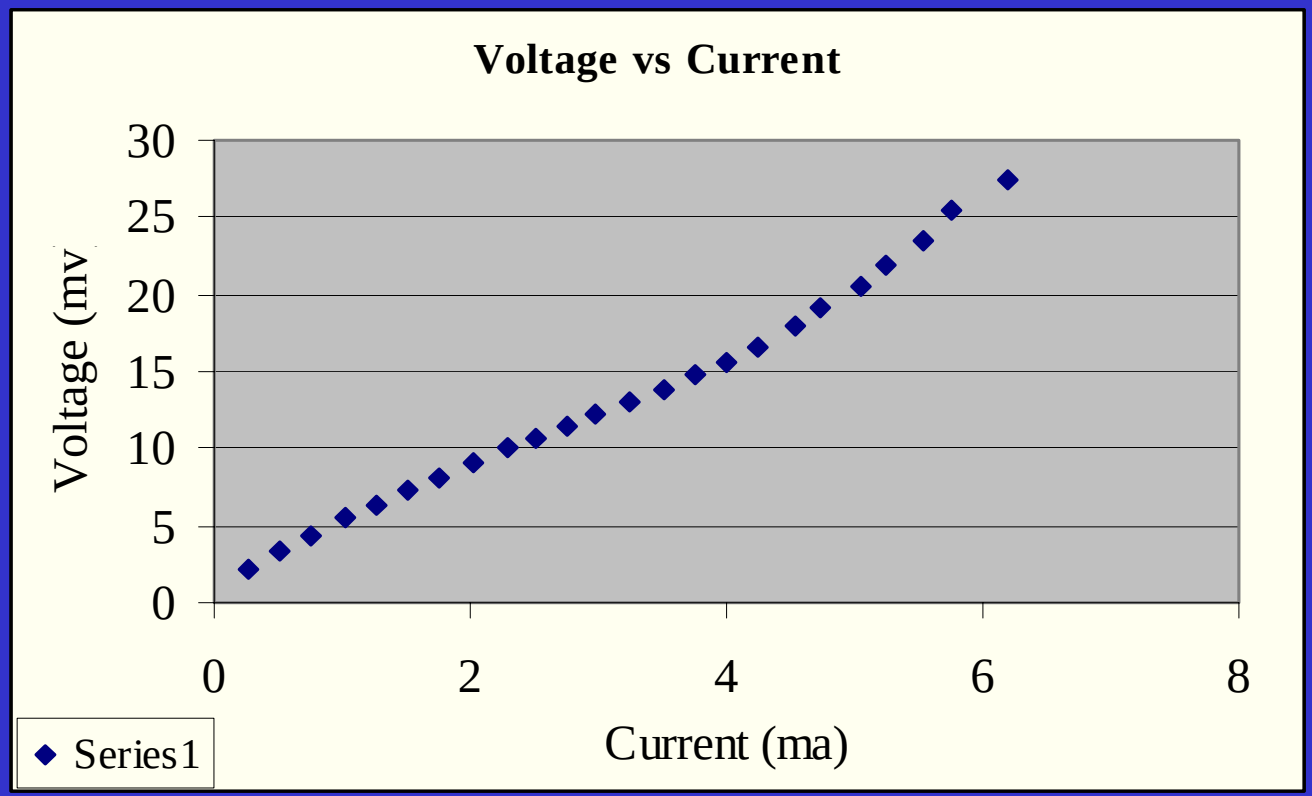
- Adjust frequency of oscillation to obtain resonance
- Turning off the current through the fiber & measure the decay
- Analysis of the decay of the induced current reveals the internal friction of the fiber

Gold Wire Model

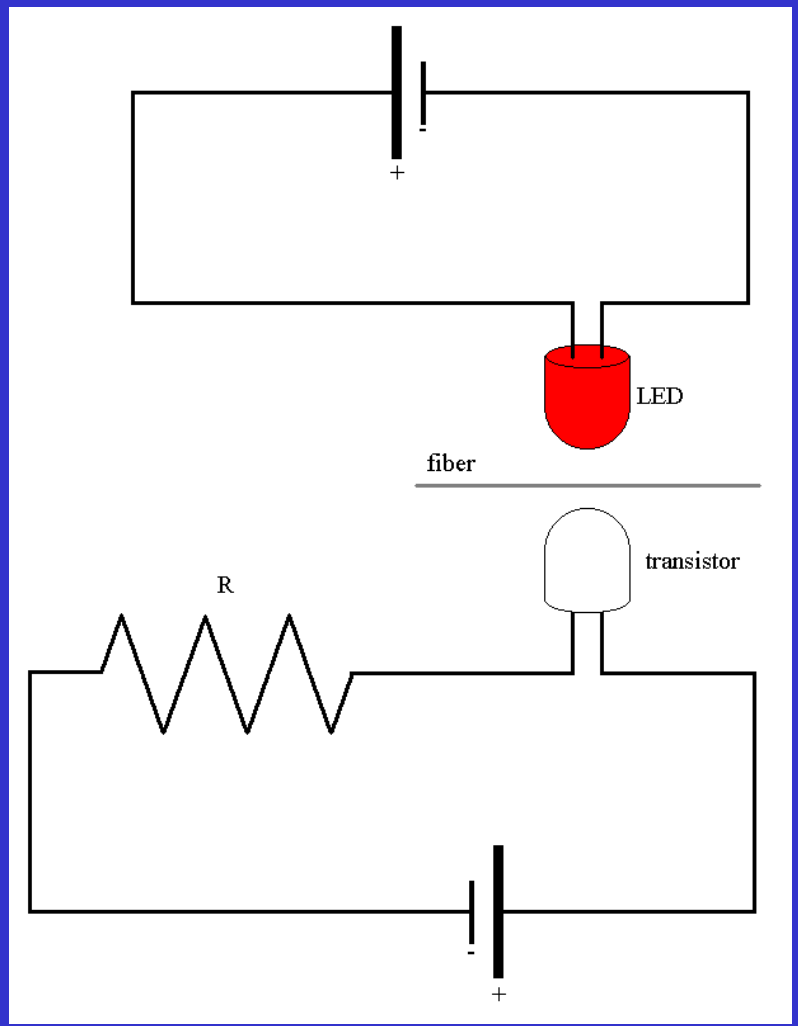


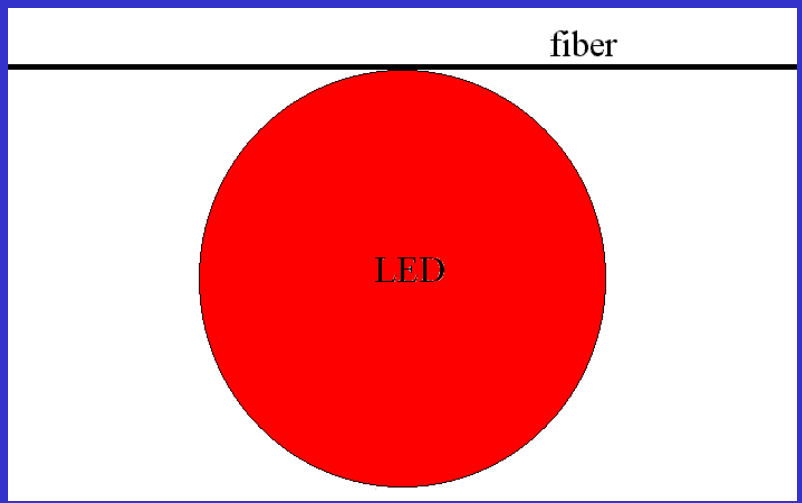
Polyaniline Film

- Conductive film
- Did not pass enough current to move stiff film in magnetic field.



Measuring Decay





It Works!

- The LED-phototransistor setup revealed measurable decay.
- Further experiments and analysis is necessary to determine the accuracy of the measurements.