

# The Photoelectric Effect



Matthew Houston  
10/1/2010

# Explanations—Classical and Quantum

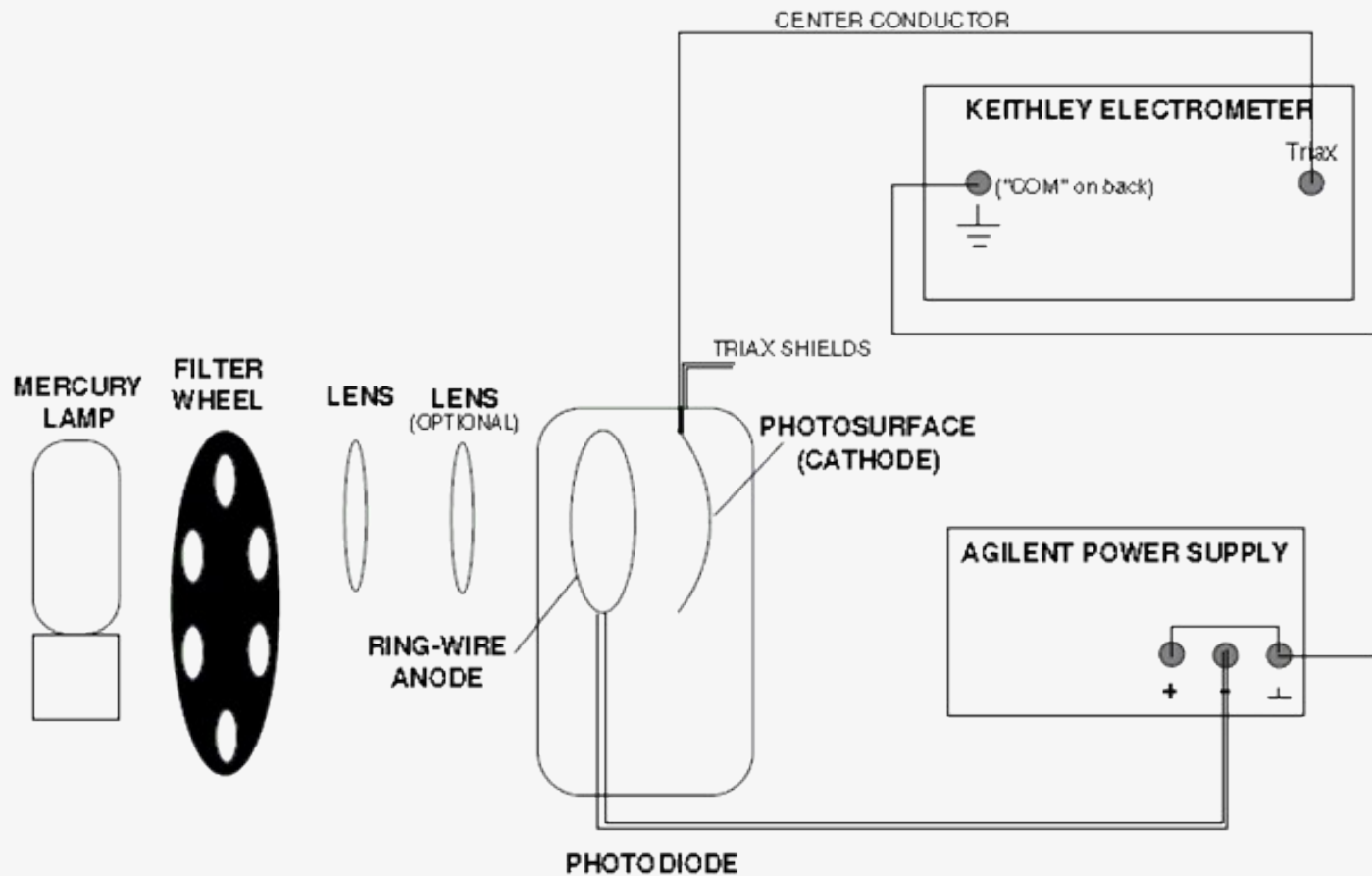
In 1887 Hertz observes a new phenomena

No classical explanation exists

In 1905 Albert Einstein proposes a quantum explanation

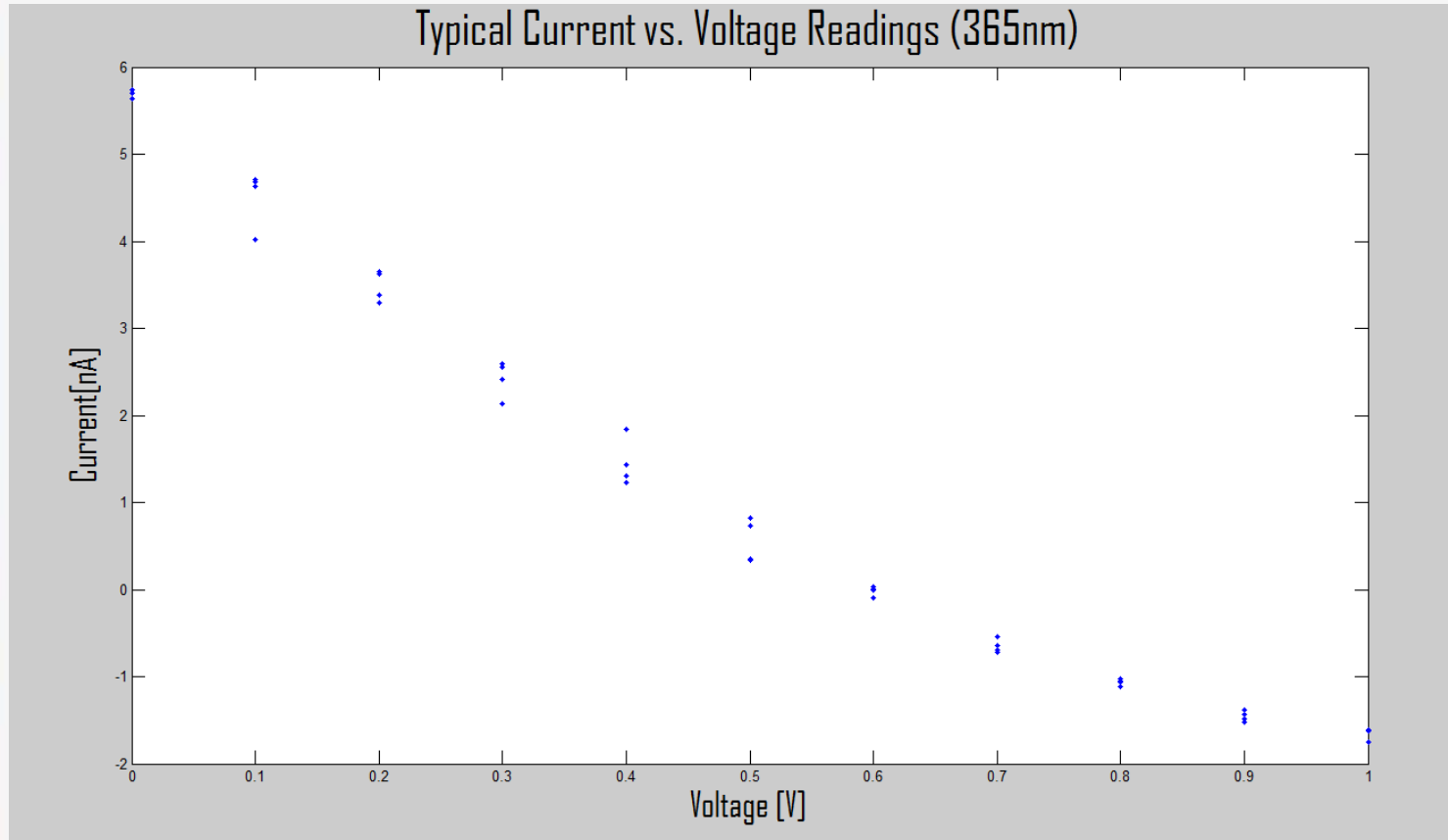
$$E_{\text{photon}} = h\nu \quad KE_{\text{max}} = h\nu - \Phi$$

# Experimental Setup



# Raw Data - Voltage vs. Current

275 Current, Voltage pairs collected over 5 different wavelengths

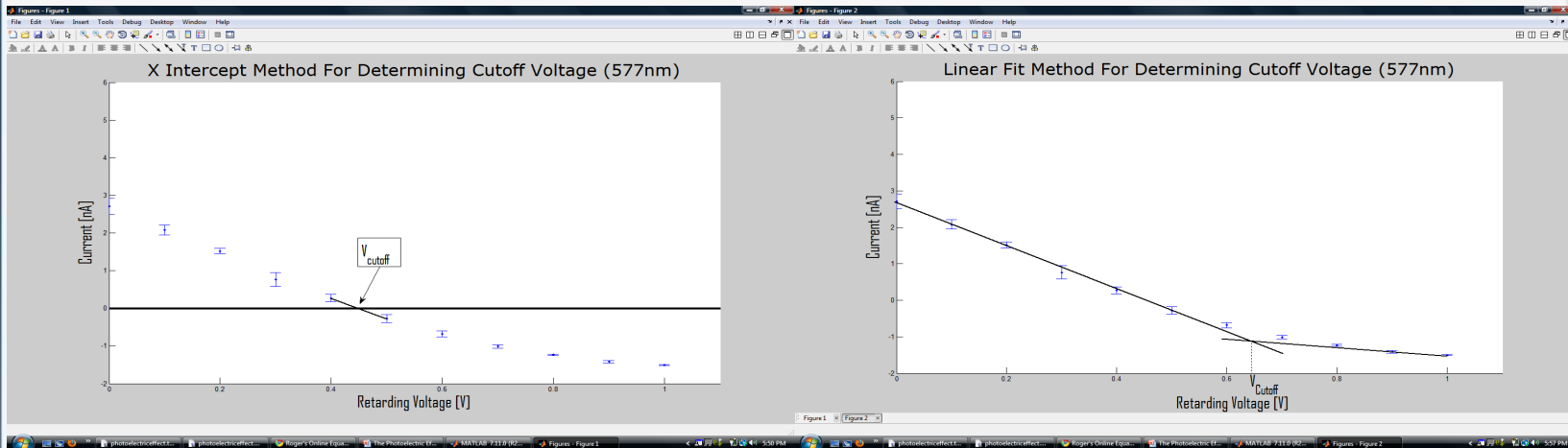


# Finding the Cutoff Voltage

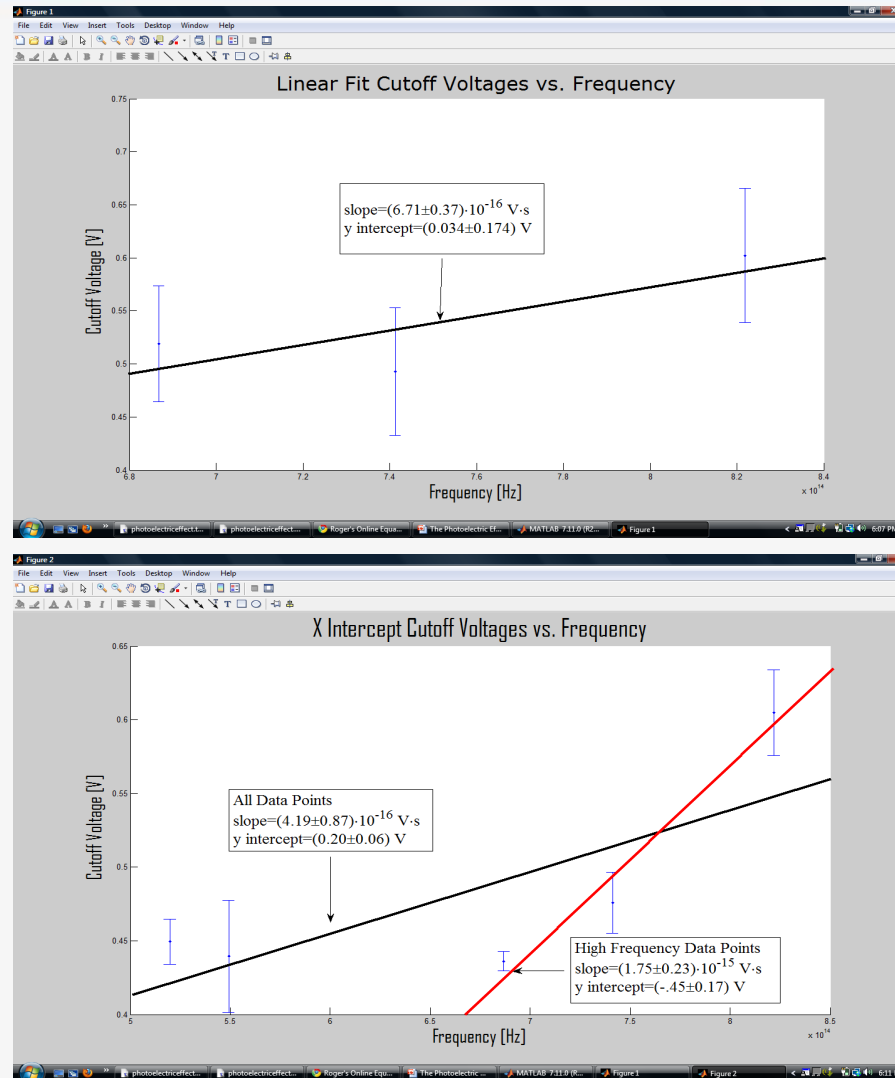
$$KE_{max} = h\nu - \Phi - eV_{retarding}$$

$$V_{cutoff} = \frac{h}{e}\nu - \frac{\Phi}{e}$$

Two Methods to determine  $V_{cutoff} = \frac{h}{e}\nu - \frac{\Phi}{e}$



# Graphical Results



# Numerical Results

| Method                    | Plank's Constant (Js)            | Work Function (eV) |
|---------------------------|----------------------------------|--------------------|
| Linear Fit<br>High Freq.  | $(1.07 \pm 0.37) \cdot 10^{-34}$ | $0.03 \pm 0.175$   |
| X-Intercept<br>High Freq. | $(2.04 \pm 0.37) \cdot 10^{-34}$ | $-0.45 \pm 0.175$  |
| X-Intercept<br>All Data   | $(6.72 \pm 1.40) \cdot 10^{-35}$ | $0.20 \pm 0.06$    |
| Actual                    | $6.63 \cdot 10^{-34}$            | 2.3                |

Experimental results differ from known values by at least an order of magnitude (several standard deviations)

# Systematic Error

---

Potassium build up on the anode  
causes reverse photoelectric currents

Insufficient Higher Voltage Data

Questions  
?