UNIVERSITY OF BIRMINGHAM

Lecture 1 – Atomic Structure
Lecture 2 – The Ultraviolet Catastrophe

Lecture 3 – Particle Nature of Light

Lecture 4 – Atomic Energy Levels and Spectra
Lecture 5 – X-ray Production and Diffraction
Lecture 6 – X-ray Spectra
Lecture 7 – Matter Waves
Lecture 8 – Wave-Particle Duality
Lecture 9 – Wave functions for Quantum Particles
Lecture 10 – A Quantum Mechanical Wave Equation
Lecture 11 – Applications of Schrödinger’s Equation

Recap of Lecture 2

- Failing of classical theories – Ultraviolet Catastrophe

- Quantising energy, $E = hf$, means energy of cavity modes is **wavelength dependent,** not just classical $k_B T$

- Putting this in solves the catastrophe, fits the data

In this lecture

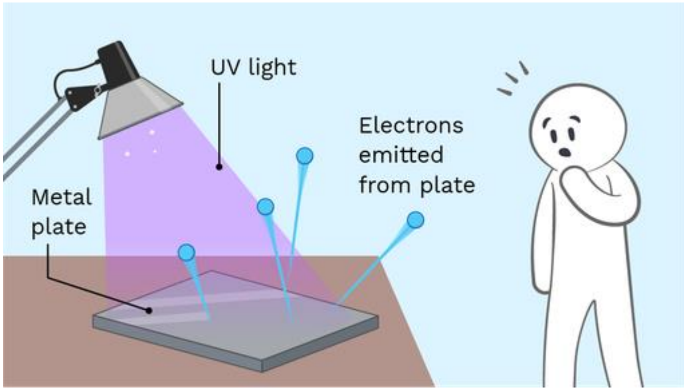
- The interaction of light with matter
  - The photoelectric effect
  - Compton scattering

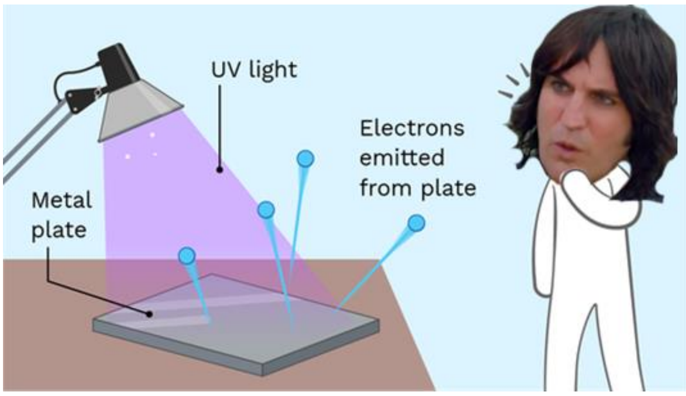
- These are more examples where classical theory, and light-as-a-wave breaks down

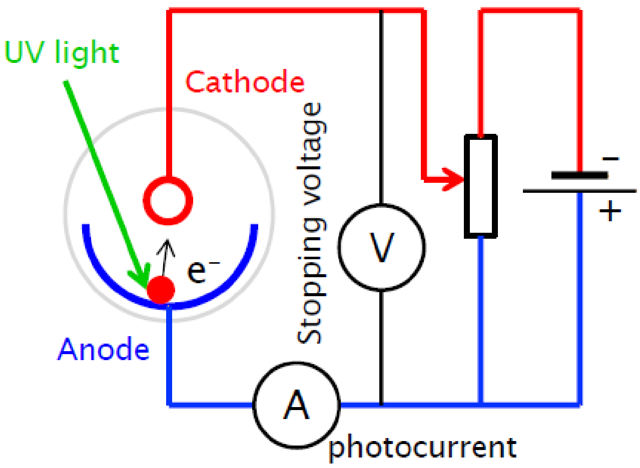
Photoelectric Effect

- Discovered by Hertz, 1887
- Thomson (1889) went further, as did Lenard (1902) and others

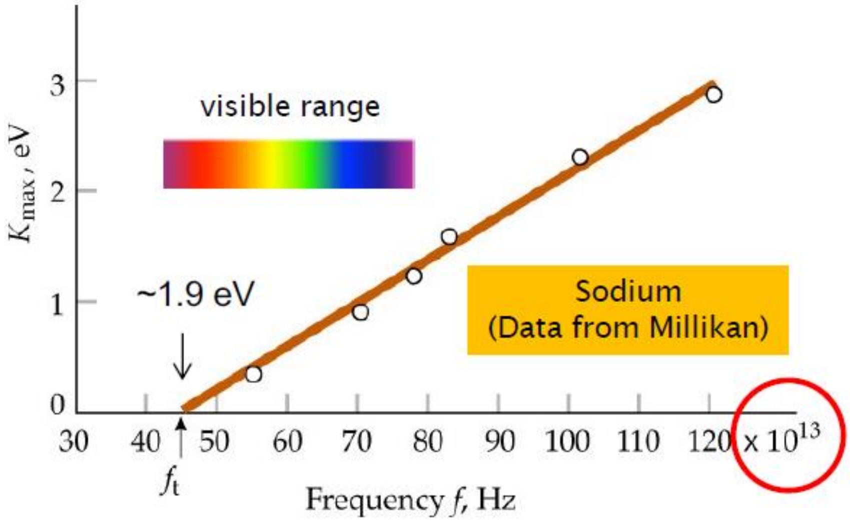
Heinrich Hertz
(1857-1894)





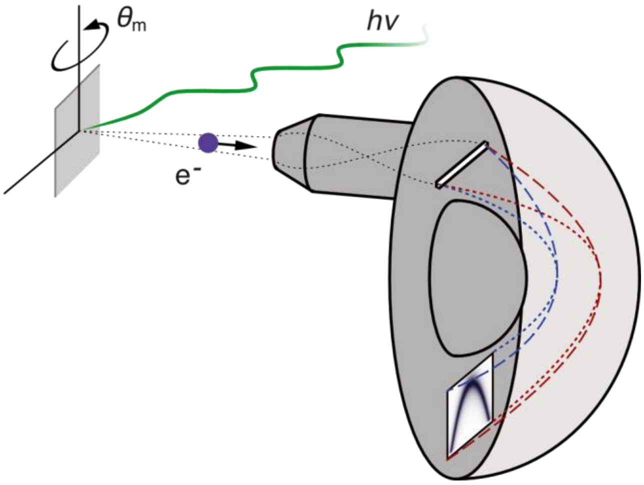


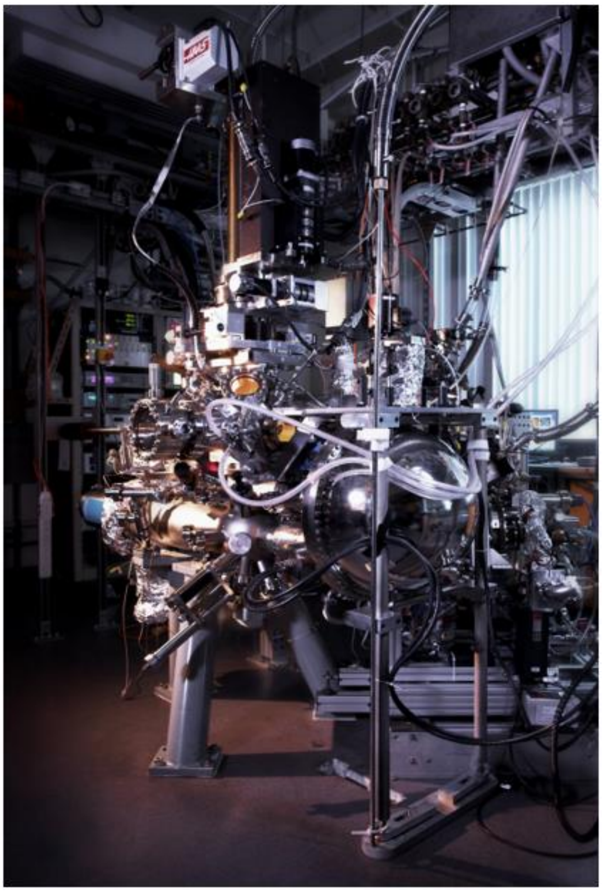
Photoelectric Effect - Results



Robert Millikan
(1868-1953)

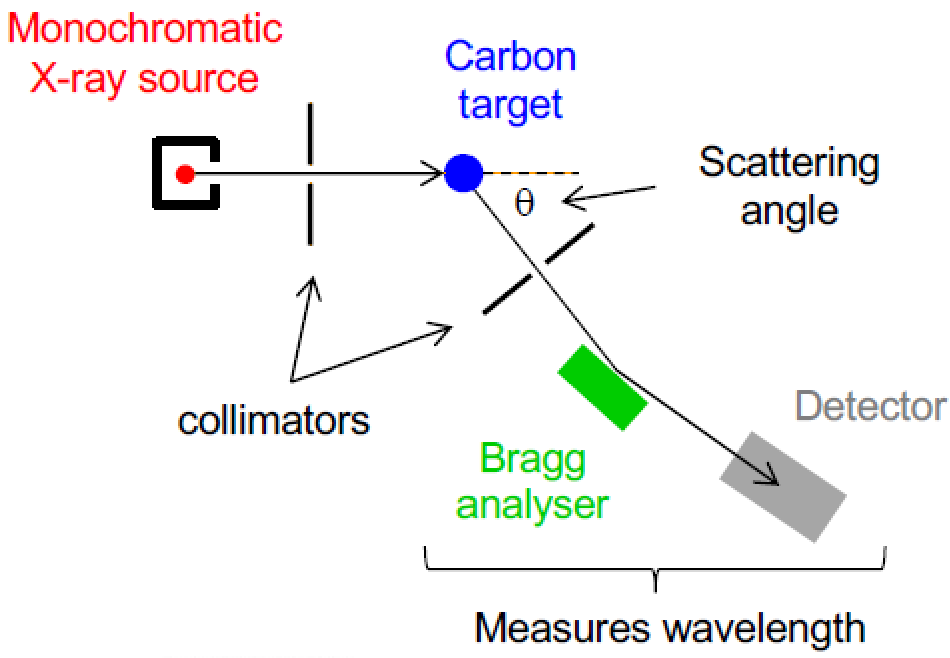
ARPES (Angle Resolved Photoemission Spectroscopy)





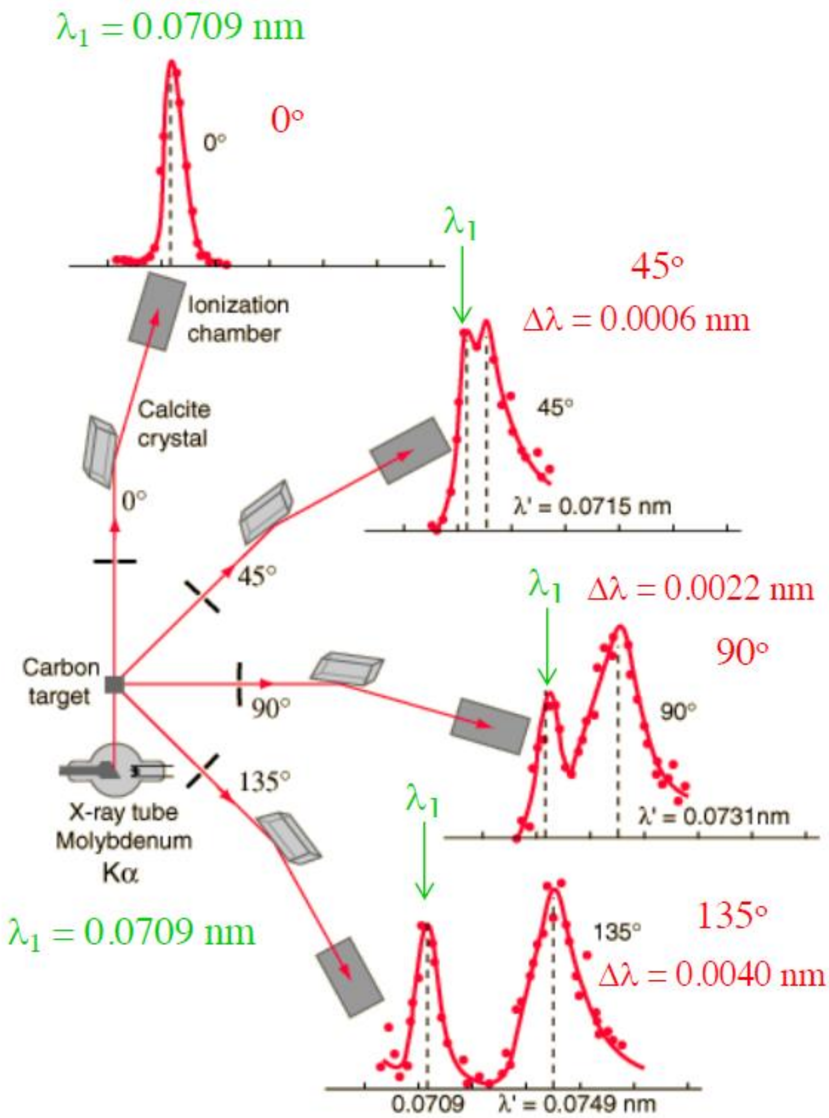
Dr Igor Marković, UoB

Compton Scattering - Setup

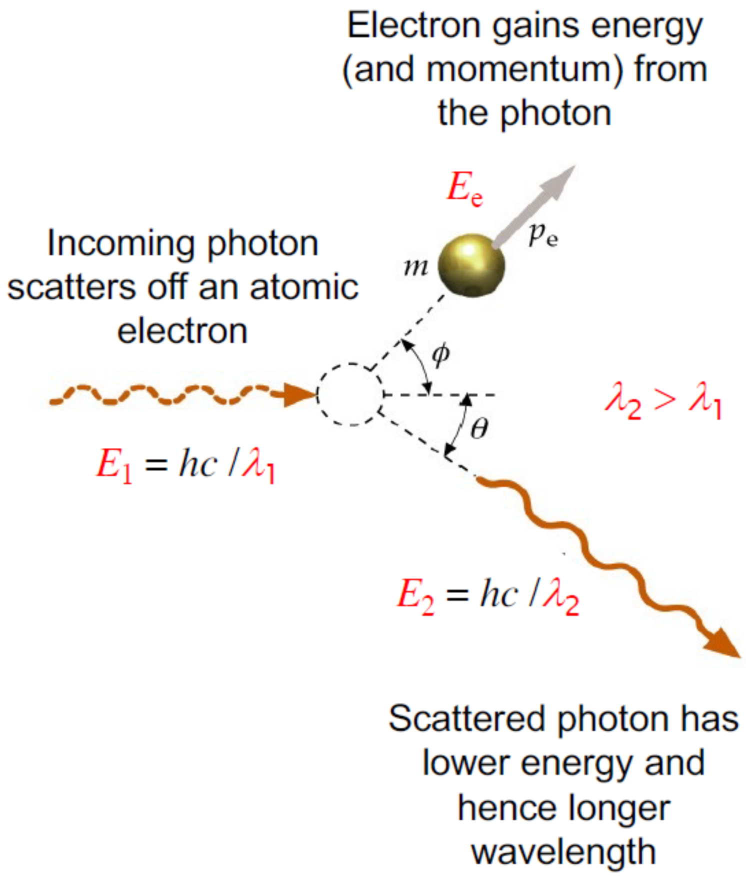


Arthur Compton
(1892-1962)

Compton Scattering - Results



Compton Scattering – Diagram



$$E = hf = hc/\lambda$$