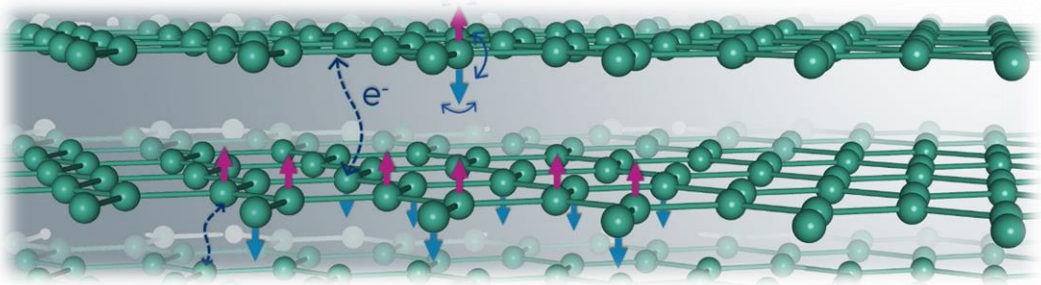
UNIVERSITY OF BIRMINGHAM

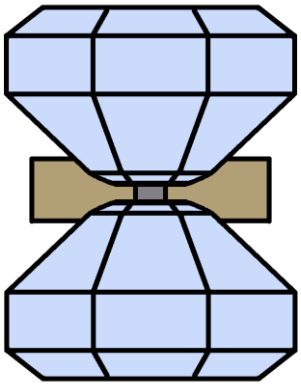
Lecture 1 – Atomic Structure

Who am I?

- Experimental condensed matter physicist
- Properties of exotic 2D materials – ‘magnetic graphene’



- Electrical conduction, magnetism, superconductivity, crystal structure, heat transport.. of extremely quantum materials
- Measurements at extreme low temperatures (0.05 K) in my lab in Physics East (ask me for a tour!)
- Controlling material properties with extreme pressure



What is this course?

“Anyone who is not profoundly shocked by quantum theory has not understood it” – Niels Bohr

- Quantum mechanics is weird and not intuitive – in this course we will build up the case for why we had to come up with this mad theory historically, and why we are confident it works.

- Each week is a self-contained concept and/or historical experiment that led to our finale – the Schrödinger equation and wave-particle duality.

How to learn from these lectures

- Attend the lectures! Recordings will be available as well.
  - Lectures **Thursdays 9am**, Gisbert Kapp - GKAP-LT1 (Lecture 1 on 3rd Oct - Lecture 11 on 12th Dec)
  - Office hours 11:30-12:30 Thursdays, Physics East 207

- Recommended textbook: *University Physics*, Young & Freedman (library)

- Visualiser – lecture notes. Anything I write live is intended for you to write down too. Anything I don't (like this document!) you do not need to worry about writing down.
  - Hand-writing notes in class is evidenced to be a very good way to learn concepts and facts [1,2] -tactile response and physical map to information

- Live lecture notes should give you a comprehensive set. My scanned notes (and these intro handouts) will be on Canvas. But I strongly recommend writing your own notes as we go.

- 'Handouts' on Canvas are extra material for enthusiasts or in answer to FAQs – these are not required and can be quite advanced.

- Every other week has an assessed problem set, but there are non-assessed problems with solutions in the weeks between – I encourage you to do those too (in groups even?)

- You do not need to memorise names & dates

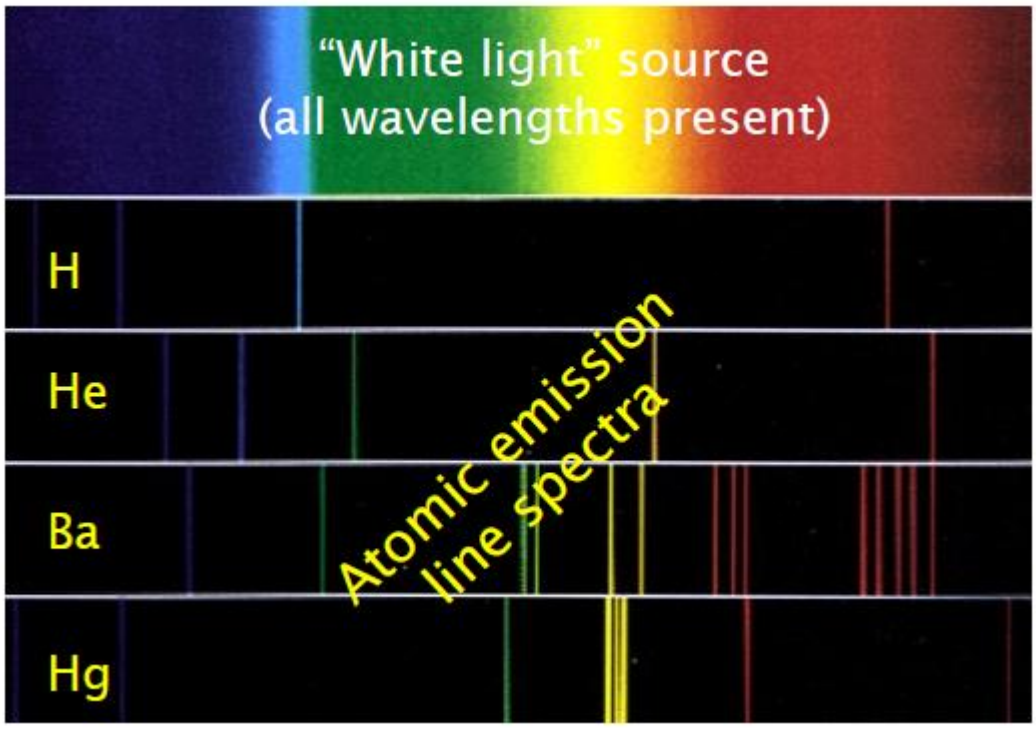
[1] *Why writing by hand is still the best way to retain information*, C.E. Haury The Stack Overflow Blog (2022)

[2] *The Importance of Cursive Handwriting Over Typewriting for Learning in the Classroom: A High-Density EEG Study of 12-Year-Old Children and Young Adults*, E.O. Askvik, F.R. van der Weel, A.L.H. van der Meer, Frontiers in Psychology 11, 1810 (2020)

In Lecture 1..

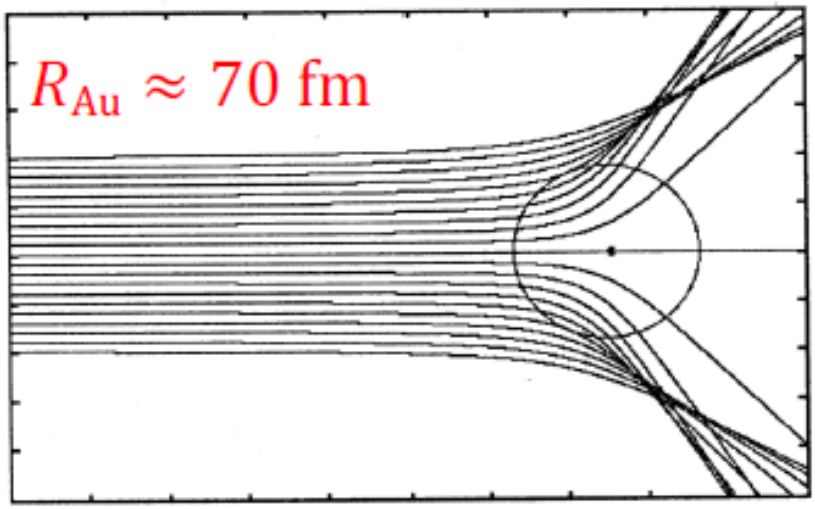
The structure of the atom – experiments that raised problems with old classical understanding, leading to the Bohr Model.

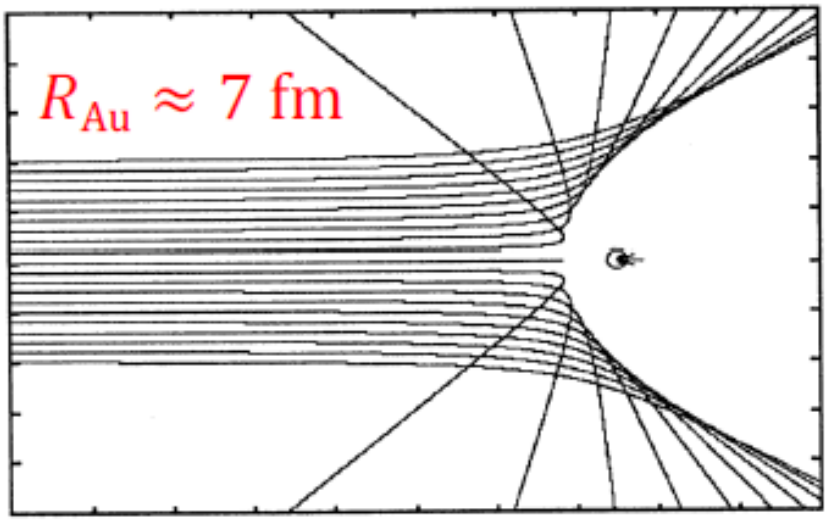
Atoms emit/absorb light at discrete wavelengths



I had to look up what a ‘Plum Pudding’ actually is..

Scattering distribution tells you the size of the nucleus





The Solar System model

Ernest Rutherford
(1871–1937)