



UCL

PHAS0004

Atoms,
Stars
and The
Universe

NASA Astronomy
Picture of the Day

© Steve Mazlin, Jack Harvey
& Daniel Verschatse (SSRO/PI)

Atoms, Stars and the Universe



image: wikipedia



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image: nationalgeographic.com

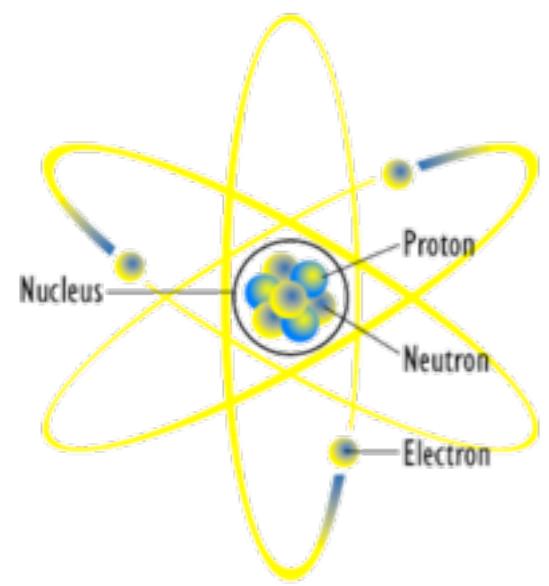


image: wikipedia

Course Structure

<i>UCL Weeks 6 - 10</i>	<i>Week 11</i>	<i>Weeks 12-16</i>	<i>Week 16</i>
	Reading Week		Last week of term
Atoms, Photons and the Quantum World	In-course Assessment 1	Stars and the Universe	In-course Assessment 2
Lecturer: Prof. Ryan Nichol		Lecturer: Prof. Ofer Lahav	



Course timetable

- ***This is a 30 hour lecture course***
- ***Our lecture hours will be***
 - Mondays 11:00-13:00
 - Darwin Lecture Theatre
 - Wednesdays 10:00-11:00
 - Student Central – 3rd Floor
- ***Note we will not be teaching on Wednesday's from 09:00-10:00***
- ***Please check your online timetable regularly***

ATOMS, STARS AND THE UNIVERSE

PHAS0004

ACADEMIC WEEK 6
BETWEEN 01/10/2018 - 07/10/2018

timetable
zoom

CURRENT WEEK



	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
MON										
TUE										
WED										
THU										
FRI										

lecture
PHAS0004-A4U-T1
Atoms, Stars and the Universe
NICHOL, Ryan (Prof), LAHAV, Ofer (Prof)
Darwin Building B40 LT
6-10, 12-16

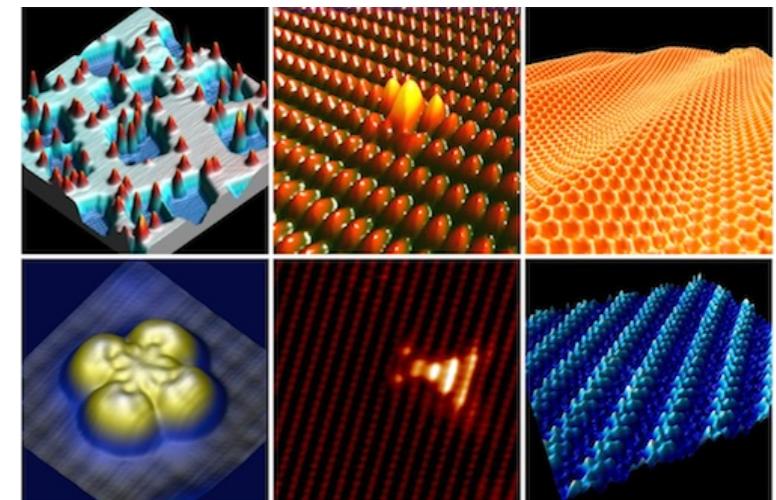
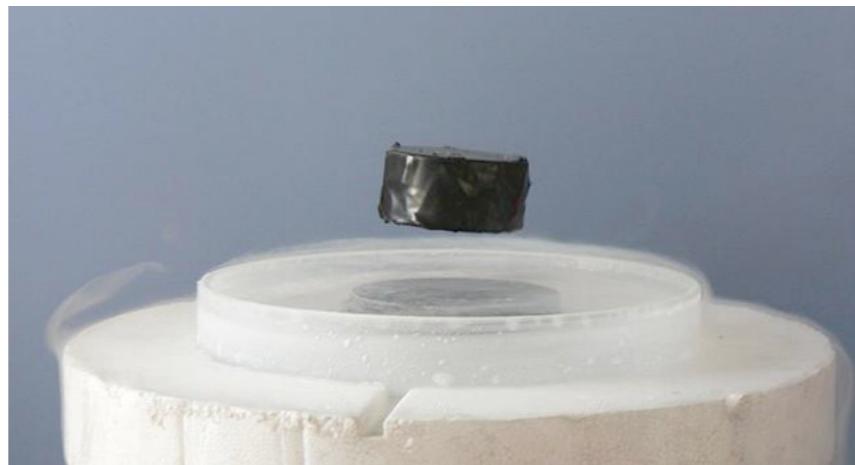
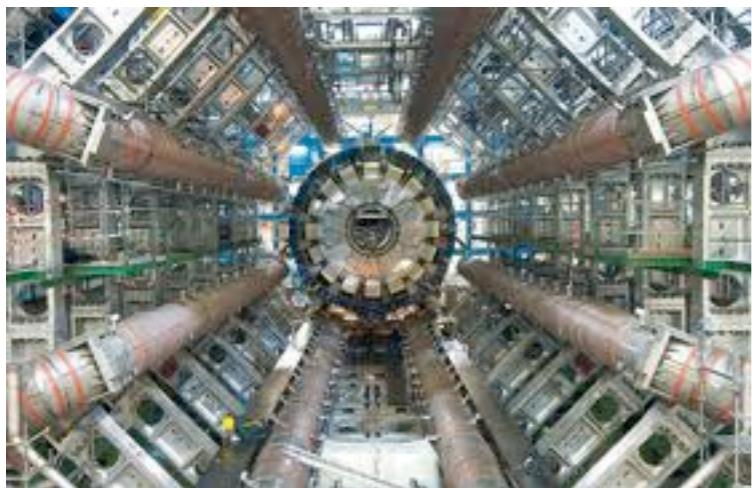
lecture
PHAS0004-A4U-T1
Atoms, Stars and the Universe
NICHOL, Ryan (Prof), LAHAV, Ofer (Prof)
Student Central - 3rd Floor - Upper Hall
6-10, 12-15

Aim

- **Atoms, Photons and The Quantum World**
 - To learn
 - the principles of **atomic physics**
 - and key elements of **quantum mechanics**,
 - to underpin the Astrophysics component of
PHAS1202
 - and prepare students for the **2nd year Quantum course**.
- ***Requisites:***
 - A-level (or equivalent) Maths and Physics

Real Aim

- To get a taste of the wonderful and surprising world of **Quantum Mechanics**.
- The **bedrock of modern Physics**.

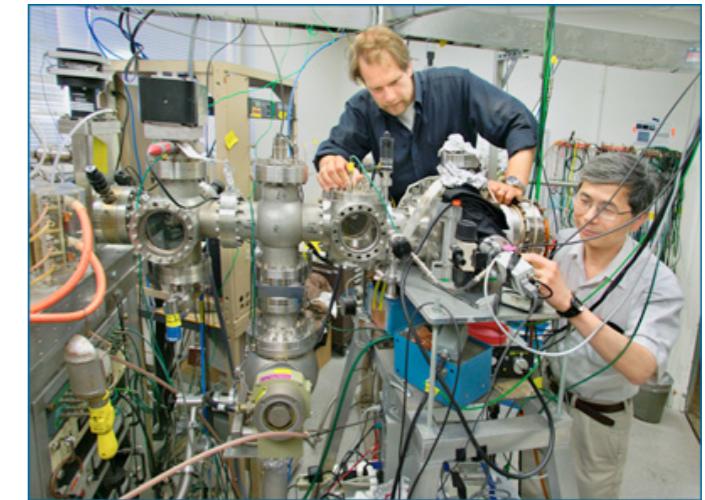
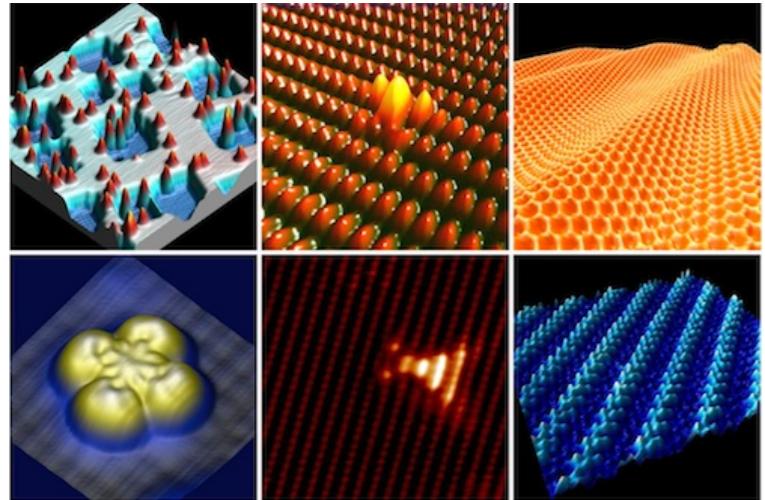


Particle
Physics

Superconductivity

Nanotechnology

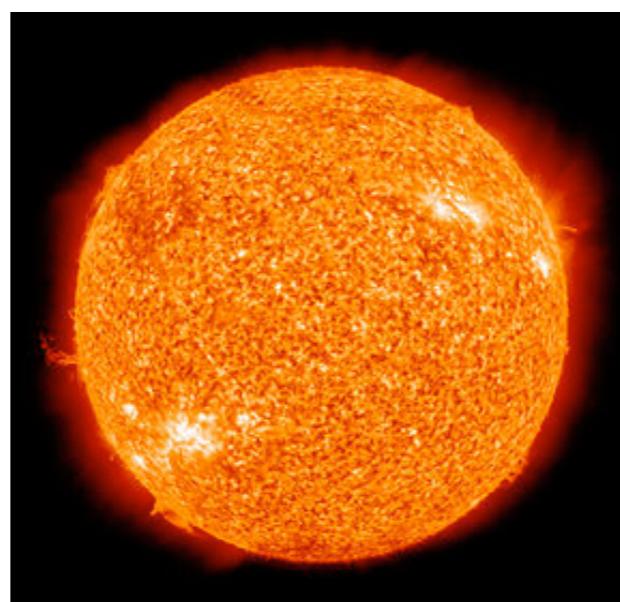
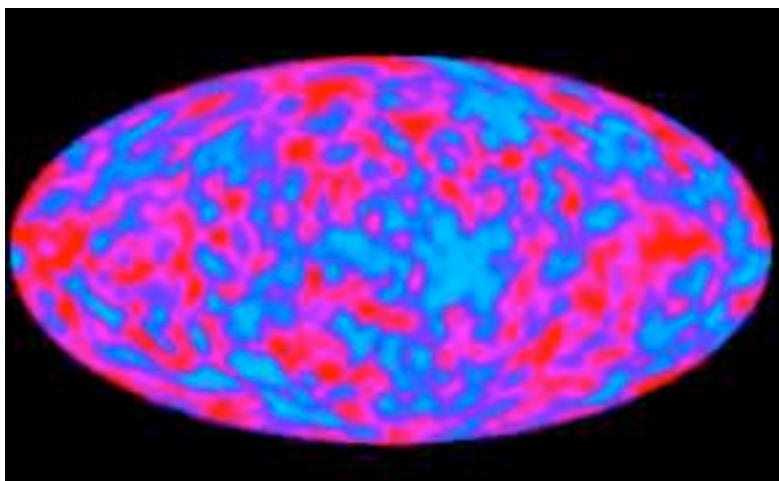
Real Aim



Nanotechnology

String Theory

Quantum
Computers



Cosmology

Solar Physics

Lasers

Quantum Quotes

“God does not play dice with the universe.”

— **Albert Einstein, The Born-Einstein Letters 1916-55**

“In fact, the mere act of opening the box will determine the state of the cat, although in this case there were three determinate states the cat could be in: these being Alive, Dead, and Bloody Furious.”

— **Terry Pratchett, Lords and Ladies**

“The cosmos is within us. We are made of star-stuff.
We are a way for the universe to know itself.”

— **Carl Sagan**

“Not only does God play dice but... he sometimes throws them where they cannot be seen.”

— **Stephen Hawking**

I think I can safely say that nobody understands quantum mechanics.

• **Richard Feynman, in *The Character of Physical Law* (1965)**

Quantum Quotes

“And then there’s the ... kind of thing which you don’t understand. Meaning "I don’t believe it, it’s crazy, it’s the kind of thing I won’t accept.”

Eh. The other part well... this kind, I hope you’ll come along with me and you’ll have to accept it because it’s the way nature works. If you want to know the way nature works, we looked at it, carefully... and that’s the way it works.

You don’t like it..., go somewhere else!

To another universe! Where the rules are simpler, philosophically more pleasing, more psychologically easy. I can’t help it! OK! If I’m going to tell you honestly what the world looks like to the... human beings who have struggled as hard as they can to understand it, I can only tell you what it looks like.

And I cannot make it any simpler, I’m not going to do this, I’m not going to simplify it, and I’m not going to fake it. I’m not going to tell you it’s something like a ball bearing inside a spring, it isn’t.

So I’m going to tell you what it really is like, and if you don’t like it, that’s too bad.

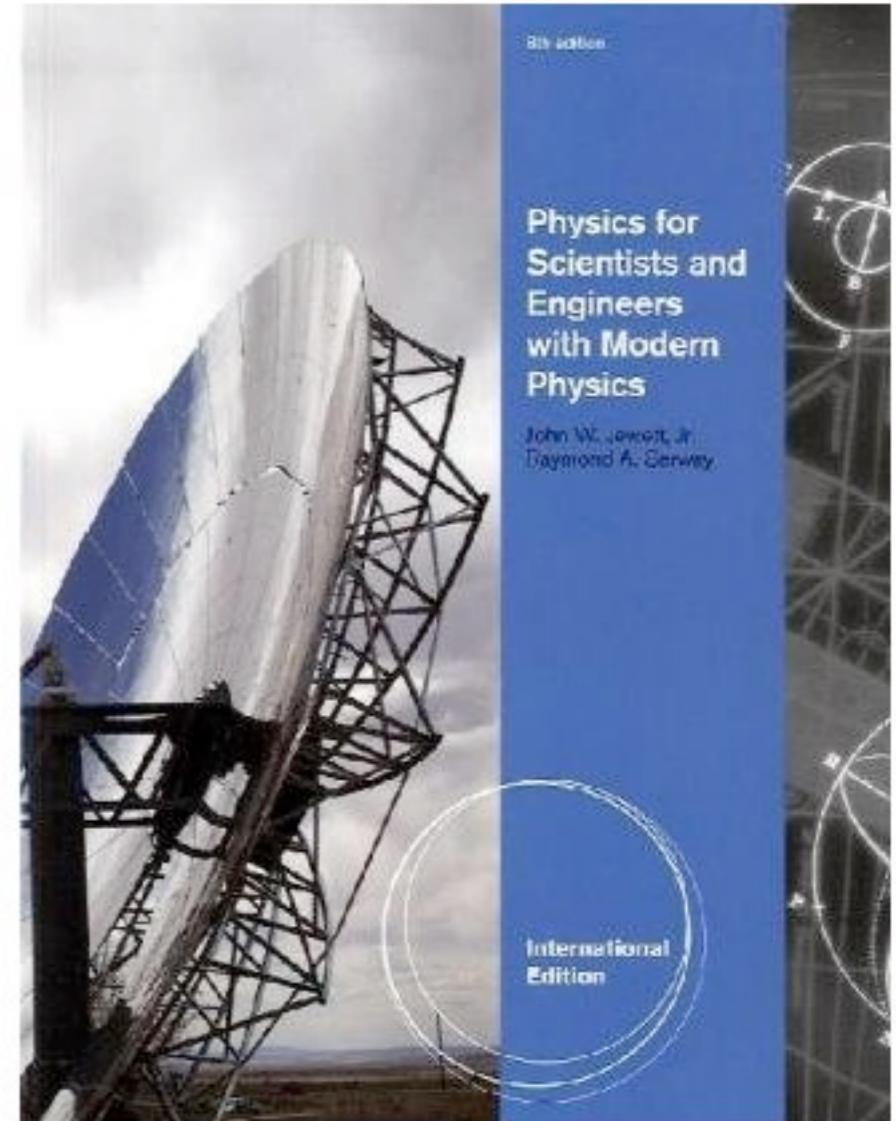
Richard Feynman, The QED Lecture at University of Auckland (New Zealand) (1979)

Course Structure

- 1 - Waves as particles - the Photon [3 hours]
- 2 - Atomic theory from 400 BC to 1913 [2 hours]
- 3 - Particles as Waves [1 hour]
- 4 - Elements of Quantum Mechanics I -
The wave-function [3 hours]
- 5 - Elements of Quantum Mechanics II -
Energy in quantum mechanics [6 hours]

Course Books

- **Atoms, Photons and The Quantum World**
 - There is no course book!
 - Most QM textbooks assume **complex numbers** and **matrices**. These are not suitable, but can be useful **background reading**.
 - Lecture slides are self contained.
 - ***Many topics are covered in***
 - **Jewett and Serway** - Physics for Scientists and Engineers with Modern Physics
- **Stars and The Universe**
 - Prof. Lahav will recommend course books for this section of the course.



Moodle

- UCL's “*Virtual Learning Environment*”.
 - Web-pages for each course (with **interactive features**).
 - **Problem solving tutorial sheets + Solutions, Lecture Slides** and other course material.
 - Grades for your **In-Course Assessments**
- **<https://moodle.ucl.ac.uk>**

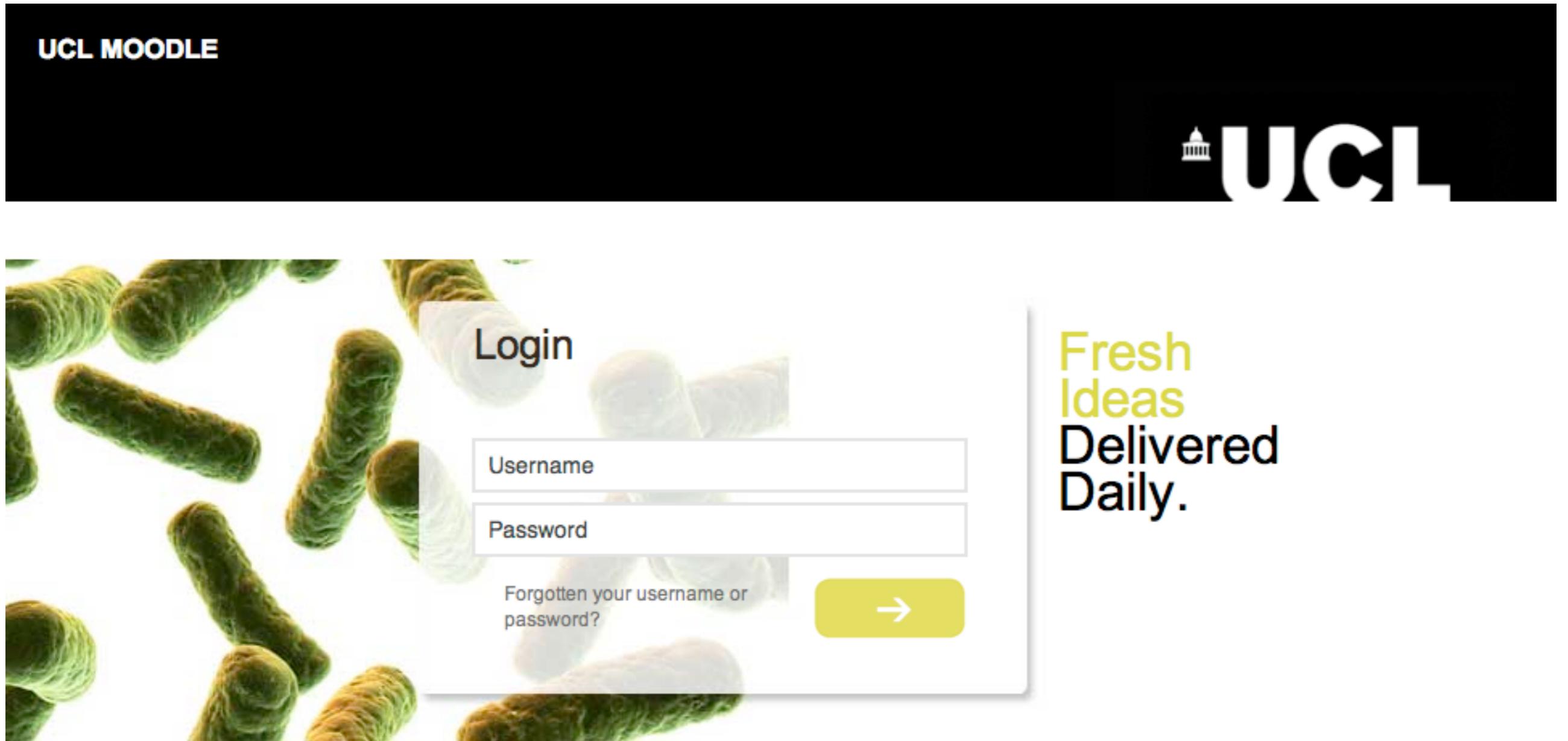
UCL MOODLE



Login

Fresh
Ideas
Delivered

Moodle



The image shows the UCL Moodle login screen. The background features a close-up photograph of green, rod-shaped bacteria. Overlaid on the center is a white rectangular login form. The word "Login" is written in blue at the top left of the form. Below it are two input fields: "Username" and "Password", both with placeholder text. To the right of the password field is a yellow button with a white right-pointing arrow. At the bottom left of the form, there is a link "Forgotten your username or password?". In the top left corner of the slide, the text "UCL MOODLE" is displayed in a bold, black, sans-serif font. In the top right corner, the UCL logo is shown, consisting of a small white building icon followed by the letters "UCL" in a large, bold, white font.

Fresh Ideas Delivered Daily.

- Login with your UCL username and password (e.g. zcapxxx)

Moodle News

Welcome to the new UCL Moodle



Course overview

[Timeline](#)[Courses](#)[In progress](#)[Future](#)[Past](#)

PHAS0004: Atoms, Stars and the Universe (18/19)

Looking for

2017/18 courses?

You are currently on New Moodle, which contains courses for the 2018/19 academic year. To access continuing 2017/18 modules, Late Summer Assessments, summer schools and Professional Services courses, please go to [Legacy Moodle](#).

- On the list of courses you **should** see PHAS0004: Atoms, Stars and The Universe.
- Click on it to access the course page.

Problem Sheets and PSTs

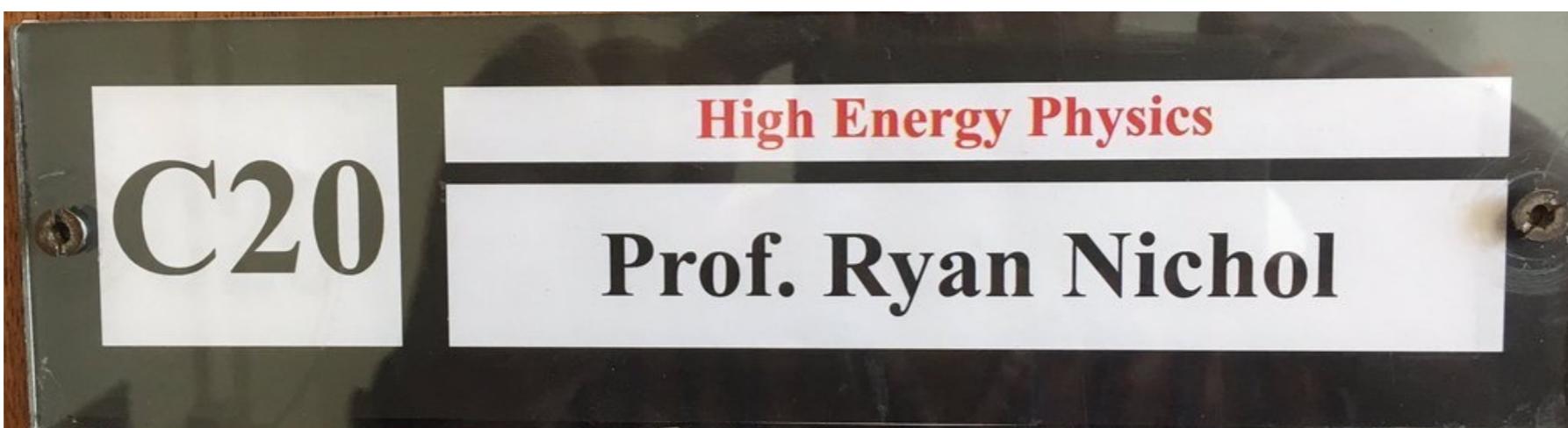
- In course weeks 8, 10, 13 and 15 there will be **Problem Solving Tutorials**.
 - 1 hour tutorial classes in small groups. Check your **online timetables** for times and rooms.
 - PST problem sheets - issued at the start of the previous week (7, 9, etc.).
 - **Very important:** You must attempt the problem sheet questions **before** the PST!
 - PST Tutorials are for **discussion** of the problems.
 - If you solved them, help your peers. If peers can't help, the tutor can.
 - Solutions will be posted on Moodle at the end of the week.
- **PSTs** are very important because.....

Assessment and Problem Sheets

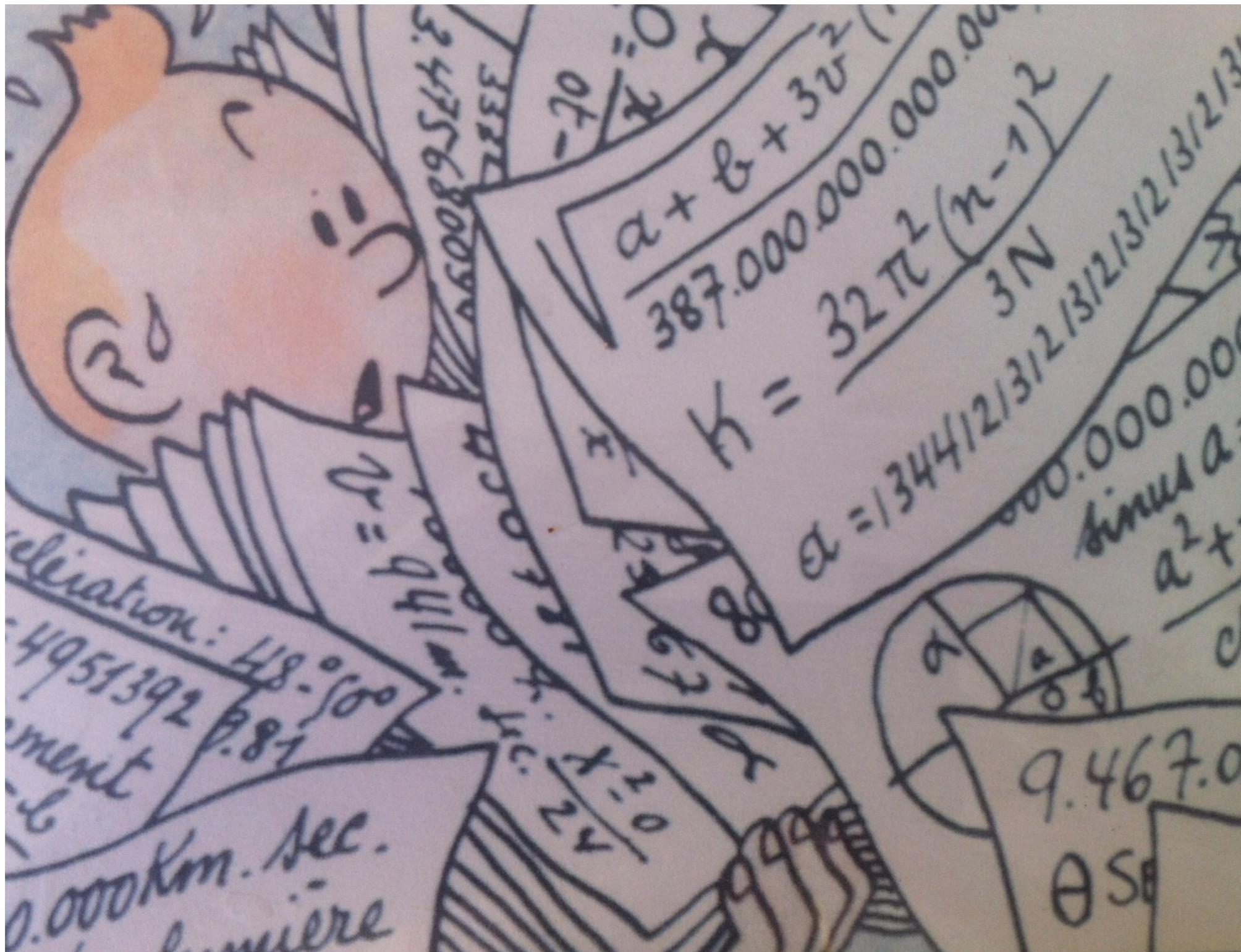
- **15% of mark:** Two In-course Assessments (ICA)s this term (Reading Week and Last Week of Term)
- **In-Course Assessments**
 - Two **1 hour tests** under exam conditions.
 - Based on the problems in the **PSTs**, with some changes and additions
 - The **solutions** to PSTs will all be posted on **Moodle** to help you prepare.
 - Marks will be returned via Moodle (Gradebook)
 - 1 ICA will cover Atoms, Photons and The Quantum World, 1 ICA will cover Stars and The Universe
- **85% of mark:** 2.5-hour exam during term 3

Office hours

- **Thursday: 10am-11am**
- Email (see below) for other availability
- Please come along to discuss course, problems, PSTs etc.
- NB Prof. Raman will have his own office hour for his half of the course
- **How to find me:**
 - Office: **C20** - Second floor (depending on where you count from) of Physics, opposite end of corridor to lift
 - email: r.nichol@ucl.ac.uk



Note taking



Note taking

- The course will mainly be taught from **slides**.
- **Lecture slides** will be available to download from **Moodle** prior to each lecture.
- You may annotate these or take your own lecture notes.
- I strongly recommend you write your own **handwritten notes** during **lectures**.
- **Mathematical derivations** in this course will be by hand using a tablet (assuming it works!). These will be **uploaded** to **Moodle**.
- I recommend that you take your **own notes** particularly for the hand-written sections - but use the method of learning that **suits you best**.