

The Science Education System in Oxford and the UK



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Outline of this talk

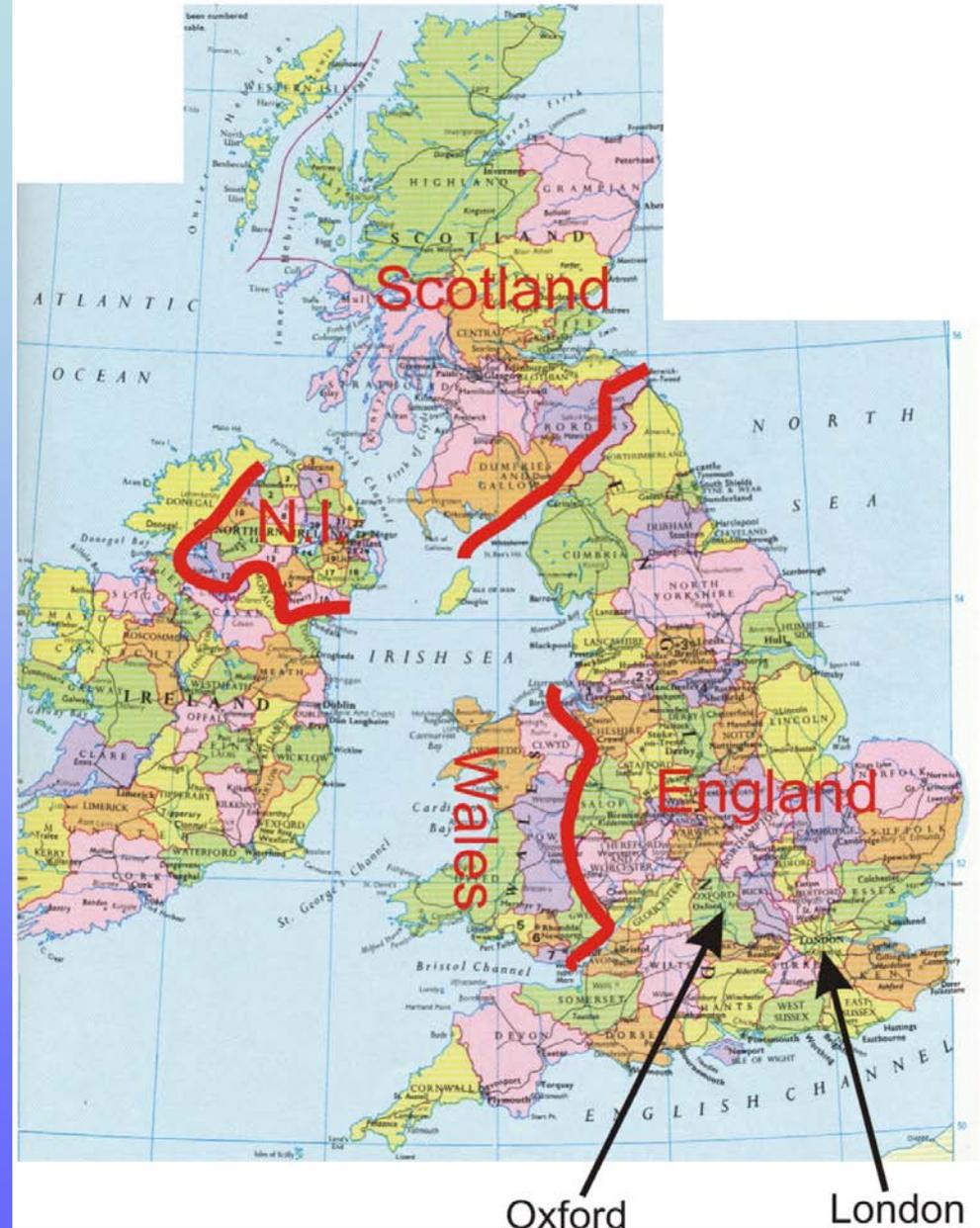
- High school education (brief)
- Undergraduate education
 - Oxford Physics
 - Other sciences at Oxford
 - Other universities
- Postgraduate education
 - Masters
 - PhD



The U.K.

I shall mostly talk about England + Wales + Northern Ireland.

Scotland has a slightly different education system.



Brief outline of school education in UK

- Age ~5: start formal education
- Age ~ 15-16: major **national examinations**: General Certificate of Secondary Education (**GCSE**)
 - Core subjects: English, Mathematics, Science (may be split into 1-3 sciences)
 - Languages (e.g. French, German)
 - Technology
 - Computing
 - Humanities (History, Geography, Religious Studies...)
 - Many other possibilities

- GCSE: The best students may take 10-12 subjects.
- Some students leave school after GCSEs.
- Academically-able ones stay on to study for 2 more years.
- Age ~ 16-17: major national examinations: **AS Levels**. Students may take 3-5 specialist subjects.
- Age ~ 17-18: major national examinations: **A Levels**. Student typically focus on 3-4 of their AS subjects, in greater depth.
- [Alternative: vocational qualifications.]

University requirements for Undergraduate study

- Most universities require passes in **3 subjects** at A Level.
- If the student wishes to study a **science** subject at University, they will usually need to have A Levels in **relevant science subjects**:
 - e.g. for a University *Physics* course, A Levels in *Physics* and *Mathematics* + *one other* science or other subject.

University Terms

- Most UK Universities have 3 terms, 8-10 weeks long:
 - Autumn Term (in October-December)
 - Spring Term (in January-March)
 - Summer Term (in April-June)
- There is a 'Long Vacation' between July and September.

Oxford University Requirements

- Usually, 3 top ("A") grades at A Level.
(Other major universities, e.g. Cambridge, London, have similar requirements.)
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Oxford University Terms are only 8 weeks long, so are highly intensive. Students are expected to do revision and preparation during the vacations.

Oxford Physics Department



About 180-190 Physics undergraduates each year

Physics Undergraduate Degree Courses at Oxford University

- There are two undergraduate degrees:
 - **4-year MPhys** (Master of Physics): mainly for those who wish to continue in Physics, technology, science teaching, etc, after graduating.
 - **3-year BA** (Bachelors degree): mainly for those who wish to move into a different area after graduating.
- The courses are identical for the first 2½ years.

The main structure of the Oxford Physics course

Four main teaching elements:

1. Lectures:
~ 10-12 per week.

For presenting the basic subject material to all 180 students in the year group.



2. Laboratory Practicals: 6 hours per week.
Students work in pairs and in each of the labs:

- General Physics (Mechanics)
- Optics
- Electronics
- Computing



- In later years, more specialised labs as well:
 - Condensed Matter, Astrophysics, Nuclear Physics, Atmospheric Physics, etc.

3. Tutorials (in small groups: 2-3 students taught by a senior academic, or postdoctoral researcher): 2 per week. Students do assignments each week, which are marked by, and discussed with, the tutor. (This system is unique to Oxford and Cambridge.)



4. Classes: 6-8 students with a tutor, mainly for revision of material learned earlier, or for specialist instruction in advanced subjects.

A typical First-Year student's week

	9 a.m.	10 a.m.	11 a.m.	12 noon	Afternoon
Monday	Vector Calculus	Electro-magnetism	Vectors and Matrices		Tutorials
Tuesday	Vector Calculus	Electro-magnetism	Waves		Tutorials
Wednesday	Waves	Vector Calculus	Computing		
Thursday	Vector Calculus	Practical laboratory work			
Friday	Classical Mechanics				

Year-by-year progression

Year 1: Foundation

- Basic Physics and Mathematics principles:
 - Classical Mechanics, Special Relativity, Electromagnetism, Optics, Waves, Calculus, Vectors, Differential Equations, etc.
- 4 examination papers at the end of the year.

Year 2: Core material

- Topics common to many areas of Physics:
 - More advanced Mathematics, Quantum Mechanics, Thermal Physics, Further Optics, Further Electromagnetism, etc.
- A choice of short options in a variety of specialist subjects
- 3 examination papers

Year 3: More advanced topics

- Atomic, Nuclear and Particle Physics
- Condensed Matter Physics
- Astrophysics and **Atmospheric Physics**
[includes Climate Physics and Fluid Dynamics]
- Short options
- 3 examination papers
- For 3-year students: a short research project or essay instead of 1 paper.

Year 4: Advanced options

- Students choose two **advanced subjects** (e.g. Particle Physics, **Atmospheric/Oceanic Physics**, Astrophysics, ...) and attend lectures and classes.
- 2 examination papers.
- Students spend about 8-10 weeks working on a **research project** with one of the Department's research groups, and writing a report on it.

MPhys and BA Degree Classifications

- First Class: obtained by top ~ 35% of students
- Upper Second Class: obtained by ~ 50% of students
- Lower Second Class: obtained by ~ 12% of students
- Third Class: obtained by ~ 3% of students

(The examinations are partly assessed by an external examiner from another university.)

Other Science Subjects at Oxford

- Laboratory-based subjects (e.g. Chemistry, Engineering, Biochemistry) are similar to Physics in structure, with small variations:
 - E.g. the 4th year in Chemistry is entirely devoted to a research project.
- Some subjects (e.g. Earth Sciences, Biological Sciences) may also have a substantial Fieldwork element.
- Mathematics has no laboratory work....

Joint Subjects

- A few students take a combination of subjects, e.g.
 - Physics and Philosophy
 - Mathematics and Philosophy
 - Engineering, Economics and Management.
- These are usually *very* difficult!

Other UK Universities



Cambridge
[I was a student
there]

Reading
[Has a famous
Meteorology
Department]



Others with
Atmospheric, Oceanic or
Planetary Sciences:

- Imperial College
London
- East Anglia
- Leeds
- Edinburgh
- Open University
- Southampton
- Exeter
- ...

About 100 universities in total

Other UK Universities

- Science courses are broadly similar in structure to those at Oxford, but
 - No (or very few) small-group tutorials, except at Cambridge
 - Courses are often more varied, with a larger choice of options and less 'core' material.
 - Often the courses have a more 'applied' emphasis
- The 3-year/4-year Physics degree structure is similar at most other universities.
- Scotland: some courses are 1 year longer.

Post-Graduate degrees

Some standard UK models:

- Taught 1-year Masters degree
- Or 2-year Masters, partly taught and partly research
- 3-4 year PhD degree, mostly research

There is a wide variety, according to subject and university.

Post-graduate degrees in Oxford Physics

- Currently has only a DPhil (= PhD) degree, mostly devoted to research (but with some taught material in the first year).
- UK funding agencies currently provide student grants (for UK students only) for 3, 3½ or 4 years (confusing!)
- But probably moving towards 4 years.

Supervision of PhD students

- Every student has a main supervisor, based in Oxford: a senior academic Faculty member.
- May also have a second supervisor from outside Oxford, if working on a joint project.
- Will also have a postdoctoral 'advisor' from within the research group.
- Will usually have a lot of informal support from other students and postdocs in the research group.

A typical time line for a PhD student

- Year 1: probationary status
 - Takes some taught courses, and does examinations
 - Starts on research project, e.g. writes literature review, project outline, maybe obtains some preliminary results
 - Writes a 20 to 30 page report
 - Has a review with 2 academic staff at the end of the year.
 - If all is going well, is allowed to continue to second year.

- Year 2:
 - Mostly spent on full-time research.
 - Probably attends some national conferences/workshops, to present results.
 - May start writing papers with supervisor.
 - Writes a 30-50 page report.
 - Again is reviewed by 2 academic staff at the end of the year.

- Years 3 - 4:
 - Heavily engaged in research
 - May write papers
 - Writes thesis
 - Attends conferences
- Most students submit their theses after about 3 – 3½ years.
- Maximum thesis length: 250 pages.

PhD examination

- This is an *oral* exam: two examiners (1 from the department, 1 from another university) read the thesis, and then have a *private discussion* with the student to discuss the thesis work.
- This discussion usually lasts 2-3 hours.
- The examiners write a report, and make a recommendation.
- Possible outcomes:
 - Only minor revisions to thesis (\Rightarrow **pass**)
 - Major revisions (\Rightarrow new exam)
 - Award of lower degree (MSc)
 - Failure (very rare)

Application process for Oxford DPhil (= PhD)

- See
www.ox.ac.uk/admissions/postgraduate_courses/apply/index.html
- For Atmospheric, Oceanic and Planetary Physics:
www.atm.ox.ac.uk/main/Graduates/index.html
(or ask me!)
- But there are very few Oxford funding sources for overseas students – usually have to find their own funding.
- AOPP has about 25 DPhil students at any time, of which about 8 are from overseas.

Other Subjects and other UK Universities

- Until recently the PhD system has been very similar in most subjects and at most universities
- But...

A new concept:

Doctoral Training Centres

- The funding agencies have recently started setting these up in different universities, in areas of particular scientific interest and importance, e.g.
 - Physical Sciences students moving into Life Sciences
 - Energy Science
 - Complexity Science
 - Neuroscience
 - Chemical Biology
- Funding is provided for perhaps 12-20 students and for additional teaching faculty.
- Students do 1 year of intensive course work and projects.
- They then do a 3-year PhD.

Master's Courses

- There is a huge variety in the UK.
- Many are for training students to move into a specialised area:
 - E.g. training Physics and Mathematics students in Atmospheric Sciences (Reading University has MSc courses of this type.)
- These equip students for moving on to a PhD, or for working in Government laboratories, etc.

The Bologna Process

- There are plans to coordinate undergraduate and graduate education across Europe:
 - To allow easier comparison of qualifications.
 - To make it easier for students and staff to transfer between countries.
- Proposed progression:
 - 3 years for BA/BSc
 - ⇒ 2 years Masters degree
 - ⇒ 3 years PhD

The UK system in most sciences does not currently fit this model.

The End