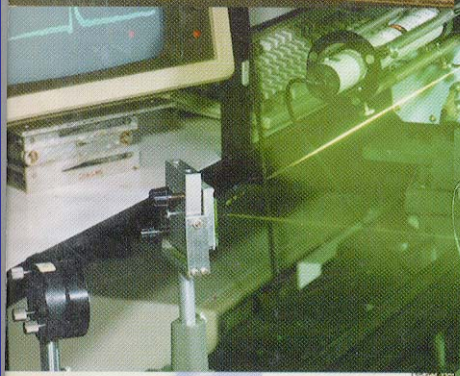
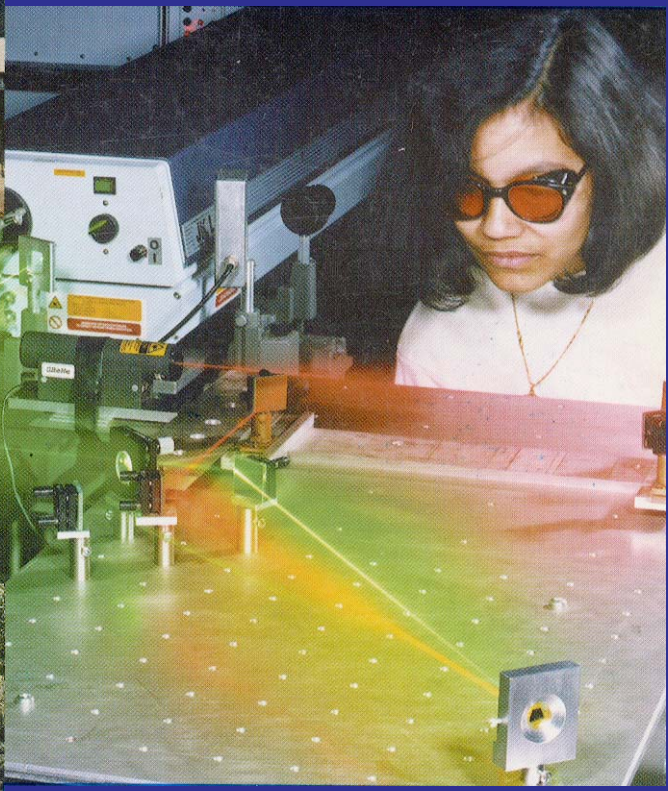
Department of Physics





Queen Mary and Westfield College

UNIVERSITY OF LONDON

It is my privilege to be Head of an excellent Department with good facilities and staff of very high calibre. Our teaching was reviewed in 1993 by the Academic Standards Committee and we received a favourable report. Our Department is equally well known for its international reputation in research and its friendly atmosphere and attitude to students. I hope that you will find this booklet of interest. If you wish to apply for admission please contact the Admissions Tutor.

Peter Kalmus

(Pictured above with his research group's detector used with the HERA electron-positron collider at the DESY Laboratory, Hamburg)

Cover

Main picture: A student undertaking a third-year project using the facilities of a research group.
Top: The Physics Building, Catering and Commercial complex and St Benets Chapel.
Lower: Main building and Physics Building on Graduation Day.

Abstract designs throughout this booklet are taken from murals on the front of the Physics Building and represent themes in physics.

Physics at QMW

Enquiries to:

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Telephone: 071 975 5030

A College Video is available free to schools.

Careers: Why study for a degree with 'Physics' in the title?

A physics degree makes a statement. It serves notice that you have acquired several valuable skills transferrable to a great variety of careers:

- an appropriate degree of scepticism about information and data derived from your experience with experiments. With this goes the ability to make realistic judgements based on evidence rather than prejudice;
- fluency in logical and mathematical reasoning, an ability to deal with numbers and abstract concepts;
- problem solving, modelling and computational skills

The discoveries and ideas of physics have had a profound effect on the other sciences and on our understanding of the universe: 'When the history of this century is written, we shall see that political events — in spite of their immense cost in human lives and money — will not be the most influential events. Instead the main event will be the first human contact with the invisible quantum world and the subsequent biological and computer revolutions.' (Heinz Pagels in: *The Cosmic Code: Quantum Physics as the Language of Nature*)

IoP The Institute of Physics, the professional body for physicists, provides a comprehensive information service about careers; write to them at 47, Belgrave Square, London, SW1X 8QX, Tel. 071-235 6111.

Their literature describes and lists many careers, some of which are in education, others in pure and applied research in government, university and industrial laboratories, medical physics, geophysics, environmental physics, forensic science, computing, robotics, meteorology, nuclear and alternative energy, engineering, scientific civil service, materials science, communications and industries such as aerospace, electronics, semiconductor and petrochemical.

Nearly all technological advances have relied on the discoveries of physicists, starting from Galileo's and Newton's discoveries in mechanics, the generation of electricity using the laws of electromagnetic induction discovered by Faraday, the discovery of X-rays and their use in medicine and in unravelling the structure of DNA, `the molecule of life', lasers, transistors (the forerunner of the microchip), nuclear energy... the list is long and distinguished.

Most university graduates do not enter professions for which their degree was a vocational training; physics is no exception. While a physics-based degree can provide a foundation for a career in research and technological development, the knowledge and skills acquired also form an ideal stepping stone to many careers.

A Physics-based degree gives great flexibility in choice of career and our graduates find employment in many different areas. A physics degree is a very acceptable passport to a wide range of careers; few subjects in higher education give such a wealth of employment opportunity. Employers value physics graduates highly because of their broadly based scientific education, with a consequent flexibility and ability to adapt to changes in ideas and technology. On graduation you can enter the private or public sectors as a professional physicist or, with a year or two's postgraduate training or experience, you can become a chartered engineer, an actuary, a teacher, a science journalist, a city analyst, a patent lawyer, manager in industry or commerce . . .

Physics Lecture: Felix Topolski

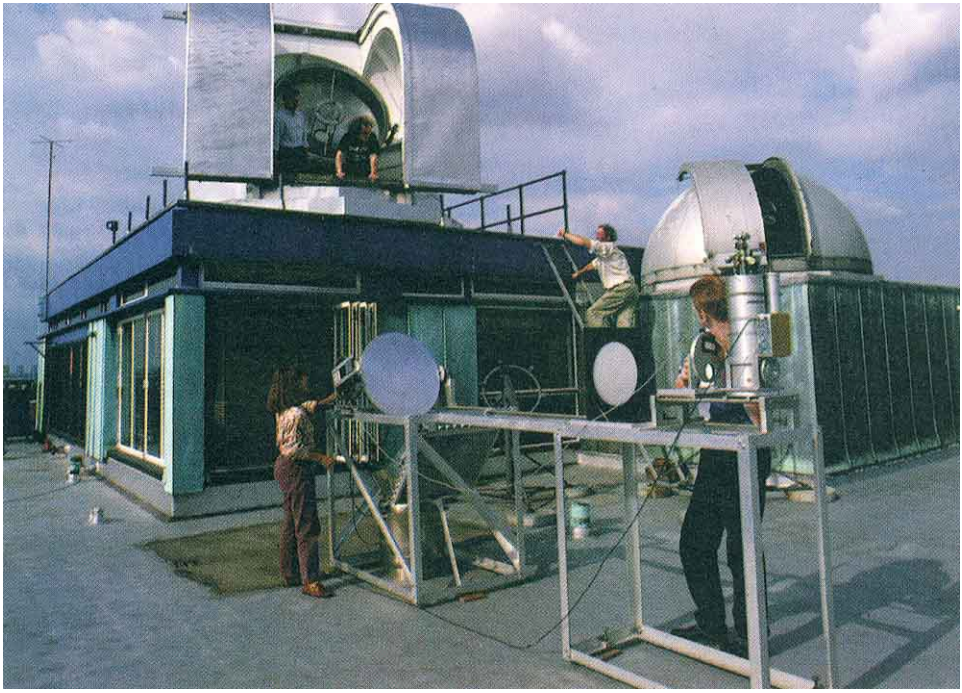
Why Study for Physics-based degrees at QMW?

'. . . I have found a scientific training more useful than most of the economics I learned at graduate school...
[it] trains a person to think logically and look for the essence of a problem; Natural Sciences develop a spirit of scepticism, but also of confidence in man's ability to understand and manipulate the world.'
(the Associate Editor of the

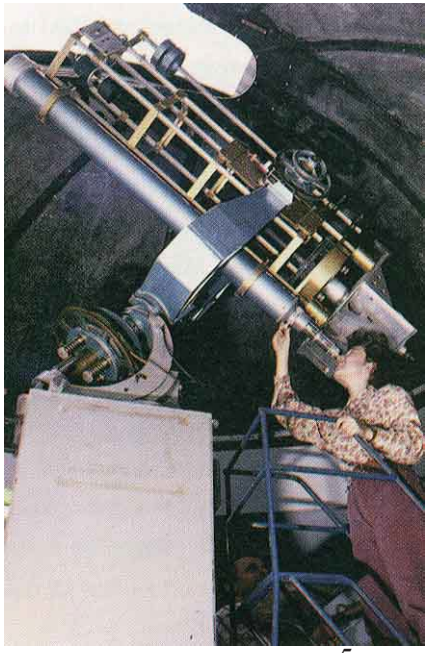
QMW's Physics Department has a national and international reputation for research which was highly ranked by the Higher Education Funding Council in their latest review. Teaching and research in physics has been going on at the College for over a century. Early studies of radioactivity were made here by Marsden in a collaboration with Rutherford, research which eventually led to the discovery of the atomic nucleus. More recently, the key ideas in the Theory of Superstrings originated from work done in our Department by Professor Michael Green.

Here teaching goes hand in hand with research, in an informal and friendly atmosphere, with undergraduate students often working on their coursework or projects in the same laboratories as academic staff and postgraduates. Final year projects are usually closely connected with our research. It is this and the easy access to staff engaged in the frontiers of research which makes our educational environment special, together with our twenty-five years' experience with modular degrees where students are encouraged to design individual programmes of study.

Whether studying for a three-year BSc (Honours) or a four-year undergraduate MSci degree, our students find the Department a friendly and stimulating place to work, with research covering a rich spectrum of disciplines from practical instrument design and development and molecular electronics to the esoteric worlds of elementary particles, cosmology and the large scale structure of the universe. Utilising the full resources of a multi-faculty campus as well as those of the University of London, we also provide a stimulating framework for a wide range of combined courses for students whose main interests lie outside Physics but who wish to combine a study of physics with other disciplines.



Above and right: Students making observations on the roof of the Physics Building.



Three- & Four-Year Modular Degrees
BSc Honours & MSci Honours of the University of London

In the recent past most physics degree courses were believed to '. . . teach a good deal more than the average student can be expected to absorb and understand . . . even reasonably good students absorb and understand rather little . . .' (from an Institute of Physics report by the Edwards committee, *The Future Pattern of Higher Education in Physics*.)

With the introduction of the GCSE and National Curriculum physics departments throughout the country have been changing their three-year BSc degrees to match the new school curricula, allowing students more time to absorb the always profound ideas of physics. QMW's Physics Department, with over twenty-five years' experience of offering modular degrees in the University of London has been in a particularly favourable position to adapt its degree programmes to the new circumstances. We have developed a more accessible three-year BSc Honours programme with courses which allow students to progress through the fundamental ideas in both mathematics and physics at a pace better matched to their school experience. One consequence has been the broadening of the range of students able to undertake physics-based degrees with the introduction of a Science and Engineering Foundation year, but another has been the creation of a four-year MSci degree for students who wish to study up to and beyond the level of the old BSc degree.

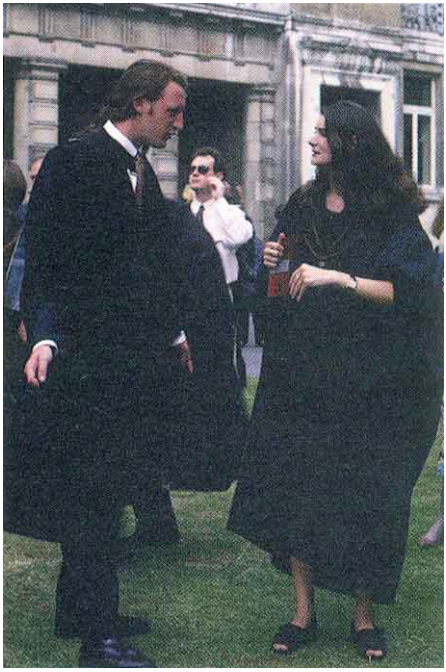
We offer the MSci degree in five areas where the Department has an international reputation in research; these are four-year undergraduate programmes, approved for mandatory LEA awards. The four-year degree is designed to achieve a standard comparable with first degrees in other European countries. The MSci programmes are aimed at students wishing to go on to professional careers involving physics or astronomy, whether in pure research, research and development, or applications in industry, medicine and other interdisciplinary fields. These students are strongly advised to apply for the MSci, while the three-year BSc programme will continue to provide a good basic scientific education as a stepping stone for a wide variety of careers. The MSci degree is likely to become the normal entry requirement for PhD

programmes, although we expect there to be a transition period before this becomes established practice.

The BSc and MSci courses have common programmes and options over the first two years and only begin to diverge in the third year.

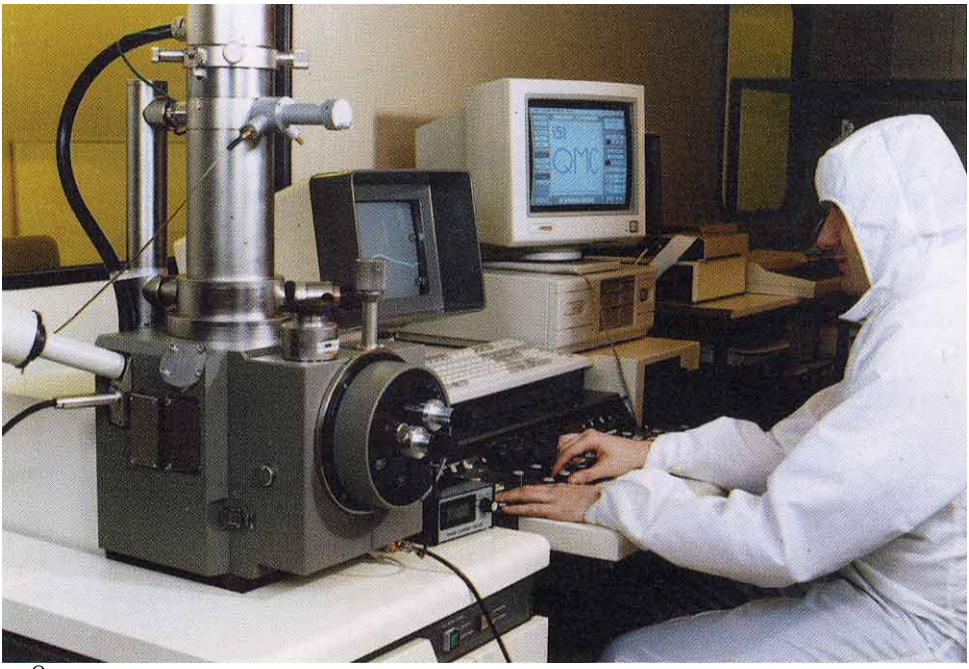
Since LEA regulations usually require the change from BSc to MSci to be made before Christmas in the second year we usually advise applicants to keep their options open by registering for the MSci in the first instance; at the end of the second year they are then free to convert to a three-year BSc programme if they decide not to continue on to a fourth year.

Research: Felix Topolski



Left: Graduation Day.

Below: A student working on a project in one of the Department's clean-rooms



A Science and Engineering Foundation Programme

Physics or Astronomy with Foundation Year

The Science and Engineering Foundation Year (SEFY) is a flexible modular programme aiming to provide a broad education in mathematics and the sciences at a standard equivalent to A-level. It has been designed for a rather wide range of students who do not yet have the qualifications to enter Science-based programmes at University:

- intellectually talented students who took Arts A-levels but who now wish to read for science degrees;
- students from European and other overseas countries who have not yet obtained qualifications to enter a British university;
- students who have taken BTEC courses with insufficient Physics/Mathematics;
- those who have already taken Mathematics and Science A-levels but failed to attain the standard for admission to University.

The SEFY is not an alternative A-level course, but the first part of an integrated four-year programme with the first year providing a thorough grounding and preparation for the subsequent three years leading to a BSc (Honours) degree. If you are interested in our Foundation Year you should apply for UCAS code Y157, 'Science and Engineering Foundation Year' and clearly state in the additional information box the BSc codes which you are interested in taking (e.g. F300, F526 etc.). It should be made clear to your LEA that you are applying for a four-year package (i.e. Physics, or Astrophysics, with Foundation Year). Students successfully completing the SEFY will be awarded a certificate and be guaranteed entry to the first year of their chosen science or engineering degree programme. For those who intend to study Physics or Astronomy with Foundation Year the Physics Department would serve as the parent Department, providing individual advice and tutoring.

The Teaching Calendar

QMW operates the semester system. The teaching year is divided into two halves and most courses are completed in one eleven-week semester. The first semester occupies the whole of the first term, up to Christmas. Before the second semester, which continues to May with a break at Easter, you choose a new selection of courses. You will take four courses (known as half-course units) in each semester, each consisting of about 30 lectures. Examinations in June, for those courses which have them, are followed by a short period often used to teach a single intensive course (such as computer programming), or to prepare for a final-year Project. During the summer some students take a vacation job which, if appropriate, can develop into an Independent Project.

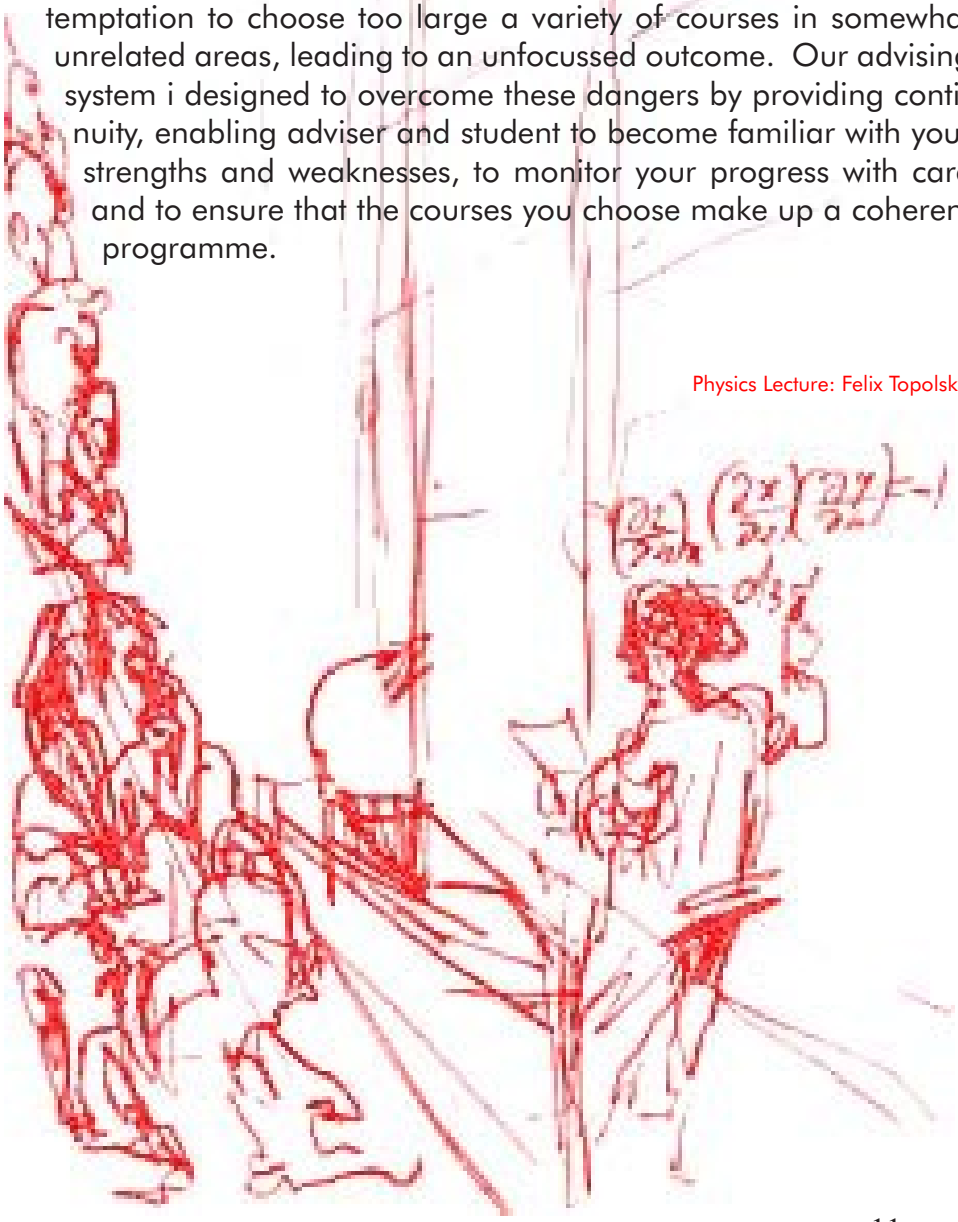
Lectures, Tutorials, Laboratories and Computers

Universities teach mainly by lectures and QMW is no exception. A good lecturer with interesting demonstrations can be an inspiration. We use several other methods though: problem classes, small group tutorials for individual tuition, private study (reading assignments, essays and problems) and laboratory classes. The number of course contact hours varies, from a one hour weekly 'supervision' in an Independent Project, to six or eight hours when practical classes are included.

Computers are provided in the Physics Department so you can write reports, analyse experimental data and run the computer teaching programmes which are used in some courses. Learning to use a PC is one of your first tasks as a fresher.

Advising

On entering the Department you will be assigned a personal Academic Advisor who will remain with you throughout your time in College. One of the pitfalls of a modular system is the possibility of students becoming remote from their home department and the temptation to choose too large a variety of courses in somewhat unrelated areas, leading to an unfocussed outcome. Our advising system i designed to overcome these dangers by providing continuity, enabling adviser and student to become familiar with your strengths and weaknesses, to monitor your progress with care and to ensure that the courses you choose make up a coherent programme.



Physics Lecture: Felix Topolski

Assessment of Honours

The minimum requirement for a BSc degree is a pass in 18 half-course units. Most courses are assessed by a combination of coursework and final written examination. Some courses have no final examination and are examined entirely by coursework including formal reports and perhaps an oral presentation. In a few cases where the subject is particularly appropriate (introductory mathematics, for example) assessment is by a series of graded tests taken at intervals during the semester.

The minimum requirement for a BSc Honours degree is a pass in eighteen half course-units, while students wishing to continue into the four year MSci programme require twenty. To graduate with an MSci Honours degree students need to pass a total of twenty-eight half course-units in their four years.

The classification of degrees—pass, third class, lower or upper second class or first class Honours— is decided by the Board of Examiners for the three-year BSc on the basis of the twelve best half course-units passed in the second and third years, while for the MSci account is taken of the fourth year as well, with a weighting of 1:2:3:4 in favour of the fourth year courses.

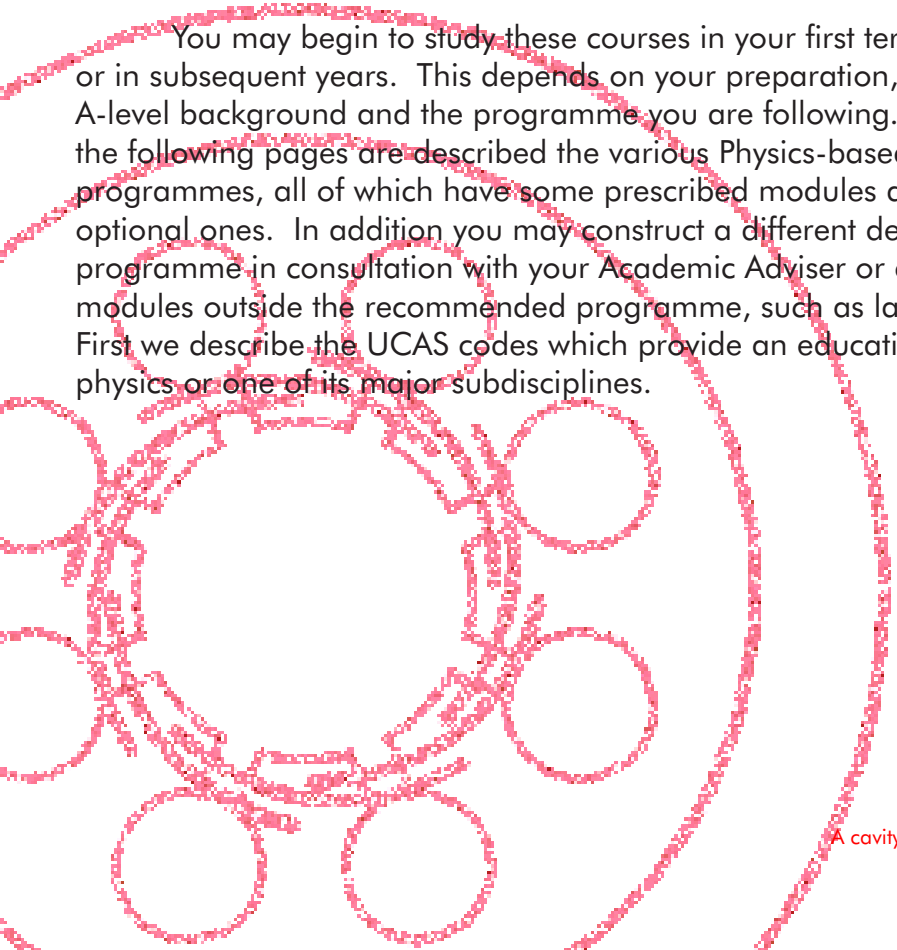
The Physics Department offers a number of Prizes and Awards. They include the Renishaw Prize for project work, the E.J. Irons and the Wignell Prizes for first and second year students, and the Granville Prize (currently £500) for the best Physics graduate of London University. For a number of years QMW monopolised this Prize, winning it as often as the other London Colleges combined.

Degree Programmes

There is a central core of material and techniques which you must study to qualify for any degree containing 'Physics' in its title. At QMW we teach this in our Core courses:

From Newton to Einstein	Electric & Magnetic Fields
Quantum Physics	Measurement & Inference
Waves & Optics	Thermal & Kinetic Physics
Mathematical Techniques I	Mathematical Techniques II
Quantum Mechanics I	Statistical Physics
Computing in Physical Science	

You may begin to study these courses in your first term, or in subsequent years. This depends on your preparation, your A-level background and the programme you are following. On the following pages are described the various Physics-based degree programmes, all of which have some prescribed modules and some optional ones. In addition you may construct a different degree programme in consultation with your Academic Adviser or choose modules outside the recommended programme, such as languages. First we describe the UCAS codes which provide an education in physics or one of its major subdisciplines.



A cavity magnetron

UCAS Codes in Physics

If you are unsure which area of physics to put on your UCAS form, we suggest writing 'Physics' (F300 or F303). Our flexible modular course-unit system allows students considerable freedom to change within UCAS codes during the course of their studies, selecting units which best match their developing interests and abilities as they progress.

Many of our courses bring you straight to the heart of the matter with teachers who are also distinguished in research and scholarship. Subjects in which QMW has an especially high reputation are listed as UCAS codes.

Physics (BSc: F300; MSci: F303 - Physics)

Involvement in research, ranging from experimental studies of antimatter (Professors David Bugg and Peter Kalmus), neutrinos and quarks (Professors Tony Carter and John Edgington) to the fabrication of electronic devices out of single molecules (Professor Guy Wilson), allows us to offer a wide range of options outside the Core. Many students will select Electronic Materials, Solid State Physics, Elementary Particle Physics and Cosmology. Final-year Projects will be carried out in a research laboratory or perhaps in industry. Incidentally, Professor Kalmus is a Past President of the Physics Section of the British Association and arranges lectures for schools at venues such as the Royal Institution in London.

Theoretical Physics (BSc: F320; MSci: F323 - Theor Phys)

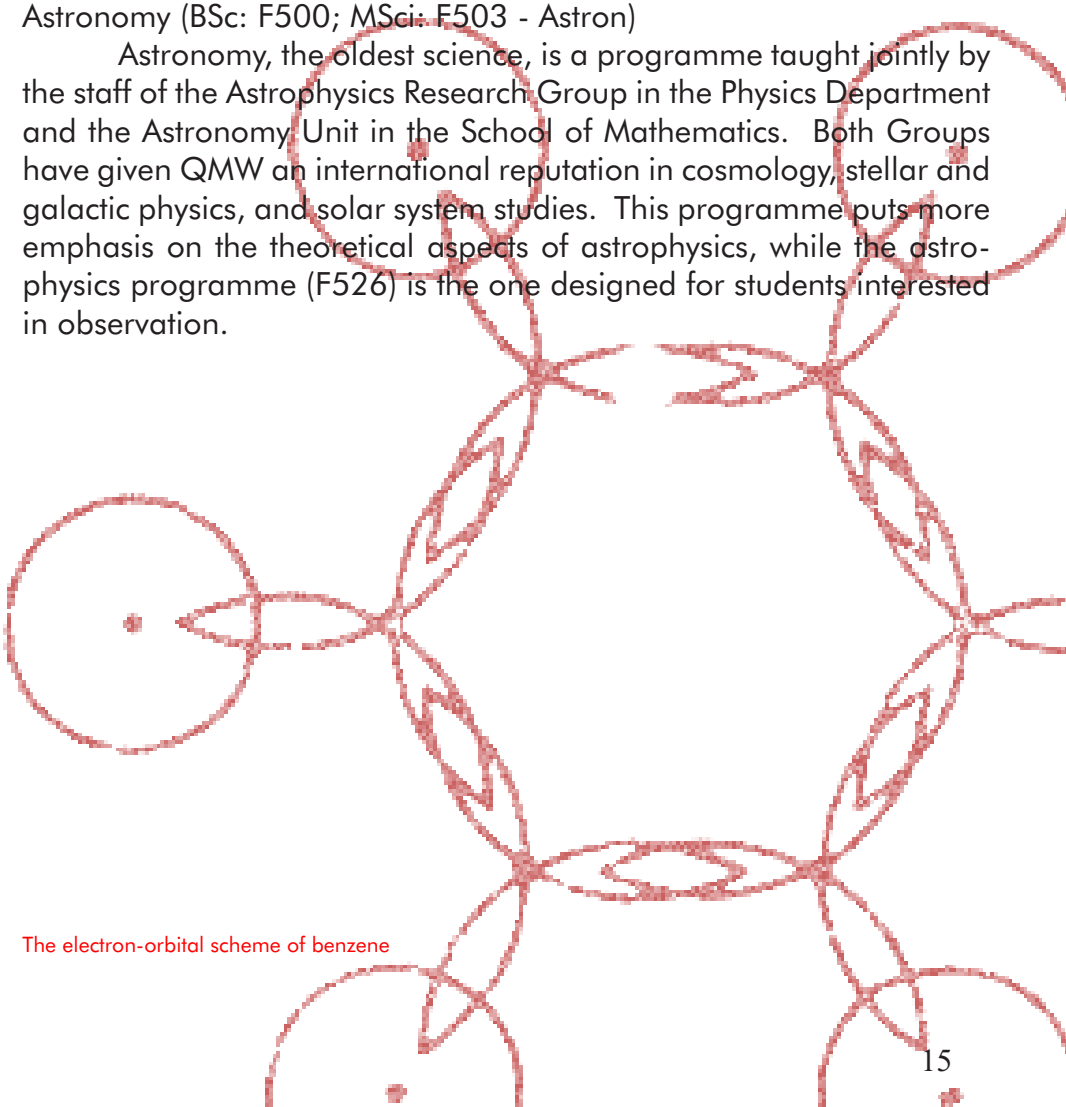
Professor John Charap, an authority on gravitational theory, leads the Elementary Particle Theory Group, with Dr Chris Hull and several postdoctoral research fellows working on the theory of superstrings. Professor Ian Percival, FRS, is not only a well known theorist in chaotic dynamics, but currently works on the foundations of quantum mechanics. Professor Geoffrey Sewell's contributions on the foundations of statistical mechanics has led to a fundamental understanding of the thermodynamics of black holes. Students should have a good grounding in mathematics, and will learn more in such courses as Applied Symmetry and Partial Differential Equations before applying these techniques in courses including Quantum Mechanics, Statistical Physics, Fluid Dynamics, Physical Dynamics, Relativity & Cosmology and Electromagnetism.

Astrophysics (BSc: F526; MSci: F523 - Astrophys)

Professor Peter Clegg, Mission Scientist for the Infrared Astronomical Satellite (IRAS) and Infrared Space Observatory (ISO), leads a team which builds and operates instruments for satellite and ground-based telescopes, making observations of the earth and beyond to the most distant quasars. Students can carry out original optical, infrared and radio observations from our rooftop observatory, and will add the astronomy and astrophysics courses to the Physics Core. Graduates can carry on to take an MSc in Astrophysics which we also teach both full-time and part-time.

Astronomy (BSc: F500; MSci: F503 - Astron)

Astronomy, the oldest science, is a programme taught jointly by the staff of the Astrophysics Research Group in the Physics Department and the Astronomy Unit in the School of Mathematics. Both Groups have given QMW an international reputation in cosmology, stellar and galactic physics, and solar system studies. This programme puts more emphasis on the theoretical aspects of astrophysics, while the astrophysics programme (F526) is the one designed for students interested in observation.



The electron-orbital scheme of benzene

Combined UCAS Codes

Physics makes an ideal partner for many other subjects, not all with their own separate UCAS code. In consultation with your Academic Adviser you prepare an individual programme for each academic year, tailoring your programme to suit your own developing interests. Some of these combinations offer excellent career opportunities.

Physics and Economics (BSc: FL31 - Phys/Econ)

Macro- and micro-economics, combined with the core physics courses, lead to managerial and administrative careers needing a technical background—the usual route for ambitious graduates in continental Europe and now gaining ground in Britain. A combination of science and arts A-levels, including mathematics, is desirable for this programme.

Physics and Electronics (BSc: F3H6; MSci: F3HP - Phys/Electron)

Here again the teaching is inspired by research at QMW. Professor Derek Martin, prize-winning instrument designer, and Professor Peter Clarricoats FRS, antenna design engineer, teach in this programme which includes such courses as Circuits & Digital Logic, Telecommunications, Optoelectronics and Control Systems Technology. Projects may be carried out in industry or in the College's R&D laboratories.

Physics and Materials Science (BSc: FF23 - Phys/Mat Sci)

This vocational programme deals with metals, semiconductors, polymers and ceramics — the basis of much modern technology. The teaching is closely linked to the Interdisciplinary Research Centre in Biomedical Materials, a major national research institute founded at QMW in 1991.

Interdisciplinary studies at QMW

New sciences — biotechnology, ecology, space science — are blurring traditional divisions. That's why the school curriculum is changing.
Double-certificate GCSE, now replacing the separate sciences, is already stimulating student demand for interdisciplinary courses. QMW is developing programmes which encourage students to explore the common aspects of science, and interactions between science and society.

Physics with Business Studies (BSc: F3N1 - Phys/Bus)

Marketing, Accounting & Finance and Organisational Behaviour are some of the courses in this programme. Your Project will involve a business situation — perhaps a bank's decision on investment in new technology — emphasising the links between the City and the University of London.

Physics and Computer Science (BSc: FG35 - Phys/Comp Sci)

All students at QMW are encouraged to become computer-literate, this programme goes further. Using modern facilities in the Physics Department (VAX and SUN computers and workstations, a PC network, transputer-based parallel processing systems) students learn how computing helps science and technology. Courses include Computing in Physical Science, Microprocessor Applications, Numerical Programming and Computer Architecture. You can take QMW's MSc in Information Technology after graduating.

Physics and the Environment (BSc: F374 - Phys/Env)

This programme provides a sound scientific understanding of major environmental issues: natural resources, pollution and climatic processes. There is a large and unsatisfied demand for graduates in this area from the Meteorological Office, environmental agencies, industry and the medical sector.

The spreading of dislocations in a crystal

Sample programmes

Astrophysics (UCAS code F526)

Semester 1
Mathematical Techniques I
From Newton to Einstein
Measurement and Inference

Semester 2
Electric and Magnetic Fields
Quantum Physics
Waves and Optics
Physics and Astronomy of the Stars
Computing in Physical Science

Semester 3
Mathematical Techniques II
Thermal and Kinetic Physics
Circuits and Digital Logic
The Interstellar Medium

Semester 4
Electromagnetic Phenomena
Nuclear and Elementary Particle Physics
Radiation Detection and Techniques
Space, Time and Gravity

Semester 5
Relativity
Quantum Mechanics I
Elementary Particle Physics
Structure and Evolution of Stars
The Physics of Galaxies
Independent Project
Signal Measurement and Analysis

Semester 6
The Solar System
The Theory of Plasmas
Statistical Physics
Cosmology
Astrophysics Essay

A list of fourth-year modules will be available in Spring, 1994

Physics (UCAS code F300)

Semester 1
Mathematical Techniques I
From Newton to Einstein
Measurement and Inference
Physics Colloquium

Semester 2
Electric and Magnetic Fields
Quantum Physics
Waves and Optics I
Computing in Physical Science
The Physics and Astronomy of Stars

Semester 3
Mathematical Techniques II
Thermal and Kinetic Physics
Circuits and Digital Logic
Quantum Phenomena
The Interstellar Medium

Semester 4
Electromagnetic Phenomena
Nuclear and Elementary Particle Physics
Radiation Detection and Techniques
Space, Time and Gravity
Mathematical Methods III

Semester 5
Quantum Mechanics I
Solid State Physics
Signal Measurement and Analysis
Elementary Particle Physics
Electromagnetic Theory
Essay
Independent Project

Semester 6
Statistical Physics
Optical Communications and Optoelectronics
Quantum Mechanics II
Applied Radiation Physics
Essay
Extended Independent Project
Physical Dynamics
Cosmology

Physics with Business Studies (UCAS code F3N1)

Semester 1
Mathematical Techniques I
From Newton to Einstein
Measurement and Inference
Organisational Behaviour

Semester 2
Waves and Optics
Computing in Physical Science
Fundamentals of Management
Intro. Statistics for Economics and Business

Semester 3
Mathematical Techniques II
Thermal and Kinetic Physics
Managerial Economics
Accounting and Business Finance

Semester 4
Electric and Magnetic Fields
Quantum Physics
Marketing
Physics and Astronomy of Stars

Semester 5
Independent Project
Circuits and Digital Logic
Quantum Phenomena
Fundamental Strategy

Semester 6
Statistical Physics
Space, Time and Gravity
Nuclear and Elementary Particle Physics
Management of Technology

A list of fourth-year modules will be available in Spring, 1994

Physics & Computer Science (UCAS code FG35)

Semester 1
Functional Programming I
Imperative Programming I
Mathematical Techniques I
From Newton to Einstein

Semester 2
Imperative Programming II
Quantum Physics
Electric and Magnetic Fields
Computing in Physical Science

Semester 3
Software Engineering
Computer Architecture I
Mathematical Techniques II
Measurement and Inference

Semester 4
Waves and Optics
Parallel Computing with Numerical Applications
Computer Communication Systems
Electromagnetic Phenomena
Nuclear and Elementary Particle Physics

Semester 5
Quantum Mechanics I
Thermal and Kinetic Physics
Project in Computer Science/Physics
Interactive Computer Graphics
Development of Information Systems
Operating Systems
Artificial Intelligence I
Programming Languages
Logic Design and Digital Systems I

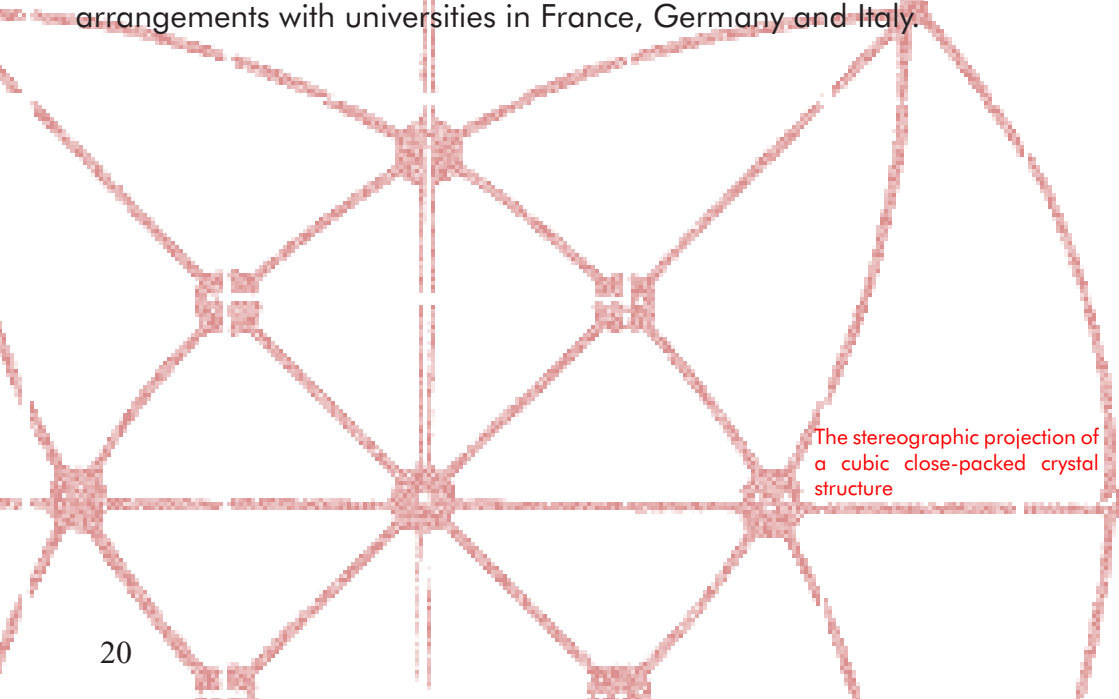
Semester 6
Statistical Physics
Computer Communication Systems
Distributed Systems
Microprocessor Applications in Physics
Optical Communications and Optoelectronics
Quantum Mechanics II

Language Courses

The recently formed QMW Language Centre, using the modern facilities of its language laboratory, offers courses to beginners in French, German and Spanish. Separate programmes are available for those with GCSE passes in these languages as well as to students with no experience. These courses are optional for students studying in the Physics Department but, for those taking them, will carry credit towards their degree.

Study Abroad

The College has reciprocal exchange agreements with eight of the major University of California campuses and the University of Richmond in Virginia, while Business Studies students can take advantage of an informal exchange with the University of the Pacific, Stockton, California. Third-year students may make use of the opportunity to spend three months studying at a European university with financing by the European Community ERASMUS scheme; we currently have arrangements with universities in France, Germany and Italy.



The stereographic projection of a cubic close-packed crystal structure

Admission Requirements

Normal Entry Requirements

- 2 A-levels, 1 A-level and 2 AS-levels or 4 AS-levels—passes must include Mathematics and Physics.
- BTEC (ND)—must include a minimum of three full units of merit in core Mathematics and Science subjects in final year.
- BTEC (HND)—students can be considered for second year entry.
- Scottish Highers/Irish Leaving Certificate—passes in five approved subjects at the Higher level with not less than Grade B in one and a minimum of Grade C in the others.
- International or European Baccalaureate—pass

Mature Entry Requirements (over 21)

- Science Access course—pass
- Open University-two full credits, one at Foundation and one at Higher level.

Some of our more successful students have had unconventional educational backgrounds, and we have an established policy of encouraging such people to apply. Entrants lacking A-levels even in key subjects can also do well. Prospective

Our experience over the years has shown that the most important factor in a successful university career is motivation; with the broadening of the school curriculum and its increasing emphasis on skills at the expense of detailed content this will become increasingly so. We therefore place great emphasis on interviewing all our UCAS applicants and inviting them to visit the Department and College. In most cases a conditional offer is posted the day after interview. The pleasant and friendly atmosphere of the Department plays a crucial role in persuading students to choose to study at QMW, and we welcome informal visits at any time of the year; just contact our Admissions Tutor, Dr Peter Ade (071-975 5030).

Living in London

Accommodation is available in either College or London University Halls of Residence, in College-owned houses, or in privately rented flats and bedsits. The main College Halls are situated on a 13 acre site in the leafy setting of South Woodford, just a short tube journey away; there are also 300 other places in student residences on the campus. The cost of living is cheaper in east London than in many other parts of the capital, with accommodation more plentiful and easy to find. All housing is checked for suitability by the Accommodation Office.

Applicants who accept an offer of entrance through UCAS before August, and live outside London, will be offered priority accommodation in Halls.

Physics Museum: Felix Topolski

QMW and its Surroundings

QMW is one of the five multi-faculty colleges of the University of London, with about 6,000 students. Nearly twenty percent are from overseas, while only one in four is a Londoner. This diversity of backgrounds and cultures matches the College's situation in the heart of the East End near the Docklands Development. The face of the area has changed dramatically from that of a century ago when the poverty ridden slums moved Thomas Barnardo to open his first childrens' shelter in the 1860's and William Booth to found the Salvation Army in 1865. The legacy of the philanthropic, teetotal brewer Frederick Charrington, himself an East-ender, may be seen in the many pubs around the College.

The past

The former Queen Mary College had its origins in the technical schools of the People's Palace, an innovative philanthropic attempt to provide East London with an institution offering education as well as social and cultural activities. It was admitted to the University of London in 1915. Queen Mary College took its name in 1934 on the presentation of the Royal Charter by Queen Mary, and in 1985 celebrated its centenary.

The former Westfield College also has a distinguished past stretching back to its founding as a college for the higher education of women in 1882.

The present

Queen Mary & Westfield College was given a new Royal Charter in 1989, on the merger of Queen Mary College and Westfield College. The Faculty of Basic Medical Sciences is formed by a confederation of QMW with the Medical Schools of St. Bartholomew's Hospital and the Royal London Hospital on the Mile End campus. The College has attained great distinction in teaching and research whilst maintaining a pride in its origins. The area is experiencing a dramatic change with the development and rehabilitation of the Docklands, putting QMW at the centre of one of the most exciting areas of London.

QMW has undergone a major expansion in teaching and research as a result of these mergers. The campus has expanded to twice its former size—the biggest development in U.K. education in a decade. The Faculty of Basic Medical Sciences

occupies a new £12m building; there is a superb new library, the second phase of which opened in October, 1990. A new building houses the enlarged Arts Faculty, including the last of the departments to move over from the former Hampstead campus of Westfield College; an award winning Informatics building contains the Computer Science teaching laboratories. A new catering and commercial complex provides bookshop, banking, travel agent and eating facilities adjacent to the Library and Physics Department. These developments add further distinction and variety to the College's academic life. Generous donations have allowed the College to build new student residences on campus beside the banks of the Regents Canal and others are under construction on or very near the campus.

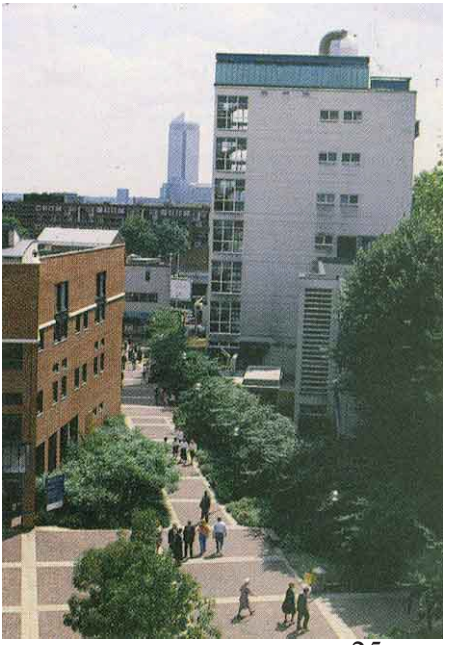
The surroundings

Along the eastern boundary of the campus runs the Regents Canal. Starting on the canalside path, overlooked by the new College student residences, joggers and cyclists can follow the canal through the nearby elegant Victoria Park to the West End and beyond with only brief diversions on the public highway. Hugging the canal's eastern bank is the Lee Valley Park which runs as far as the Thames in the south, and can be followed north out to the Essex countryside.

Further east, the London City Airport brings Europe's major cities within easy reach; a mile or so to the south, past the Docklands Light Railway with its direct connection to the City of London, lies the Thames. Through the foot tunnel, a marvel of Victorian engineering, is the Cutty Sark, Greenwich Park and the Old Royal Observatory where our students can use the historic 28" refractor telescope.

Westward the Mile End Road leads to Whitechapel, thence to Aldgate pump, the City of London's eastern limit, all within sight of the Canary Wharf tower in the burgeoning Docklands. Home of the explorer James Cook; birthplace of the Salvation Army; site of Britain's oldest bell foundry, newest mosque and best Kosher restaurant —the road is a lively microcosm of London's history.

Above: Student residences on the campus beside the Regents Canal



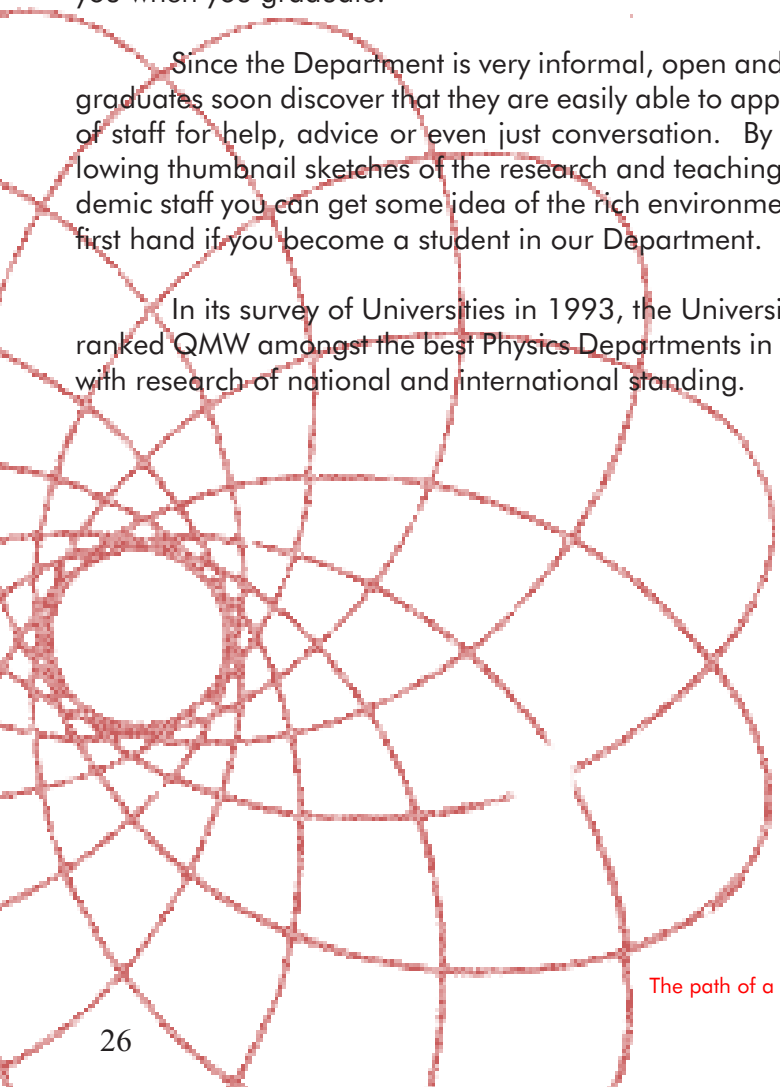
Right: The Physics Building and College Library with Canary Wharf in the background

Research in the Department

In a university department such as ours all staff take part in research, working to maintain our high reputation in the research areas we cover. Not only does the subject matter of our research influence our teaching, but our research facilities are used extensively for projects, experiments and lecture demonstrations. Our research staff —postdoctoral research associates, post-graduate students, technicians, visitors from industry or overseas universities — all play a part in providing an active, stimulating and varied environment in which to learn about physics, physicists and the opportunities that await you when you graduate.

Since the Department is very informal, open and friendly, new under-graduates soon discover that they are easily able to approach a whole range of staff for help, advice or even just conversation. By dipping into the following thumbnail sketches of the research and teaching activities of the academic staff you can get some idea of the rich environment you will encounter first hand if you become a student in our Department.

In its survey of Universities in 1993, the Universities Funding Council ranked QMW amongst the best Physics Departments in the United Kingdom, with research of national and international standing.



The path of a particle in a precessing orbit

The research of individual staff cover six areas:

• Experimental Elementary Particle Physics ranges from studies of phenomena at ultra-high energies to measurements of the nuclear properties of constructional materials. Experiments are conducted at international laboratories: the European centre CERN in Switzerland, the German laboratory DESY in Hamburg and the Rutherford Appleton Laboratory in Oxfordshire. The Group participated in the Nobel Prizewinning experiment which discovered the W and Z bosons at CERN.

• Astrophysics. This Group, one of the largest in the UK, operates a programme of ground-based and satellite observations at infrared and millimetre wavelengths, developing new instrumentation for the major British telescopes in Hawaii, and for satellites such as the forthcoming European Infrared Space Observatory (ISO).

• Molecular Electronics. Working closely with industry, members of the Group study the electrical, mechanical and optical properties of novel materials. An electron-beam lithography laboratory was opened in 1990 for fabricating circuit components in a programme to investigate the feasibility of creating molecular electronic devices.

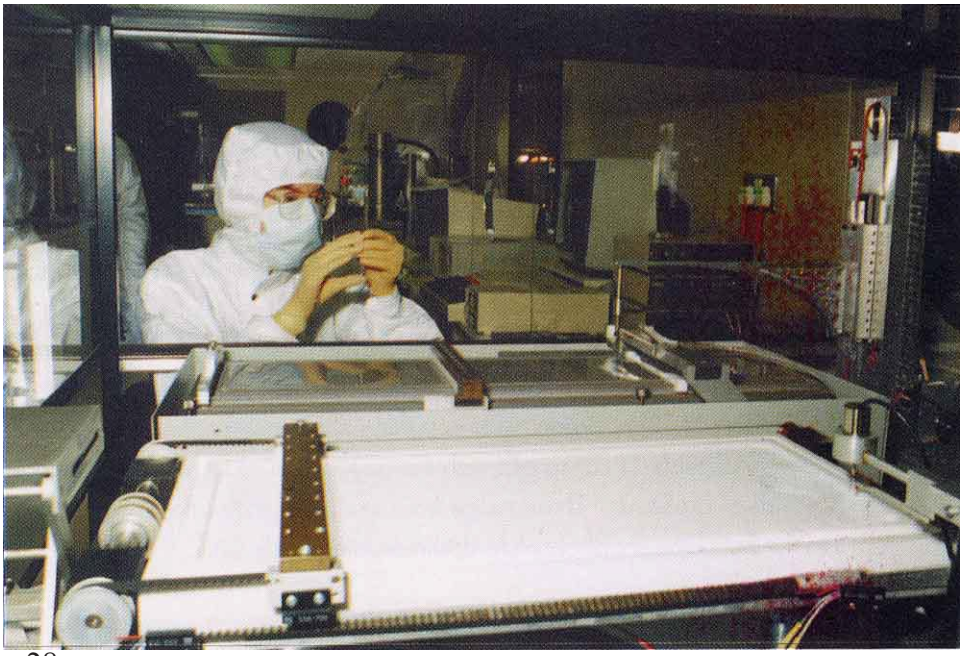
• Theoretical Physics. A major area of research is the theory of fundamental interactions, particularly superstring theory which promises to unify all the forces of nature, including gravity, into a single 'superforce'. Other work is in general relativity, quantum and statistical mechanics, and the study of materials with technological relevance such as high temperature superconductors, colloidal suspensions and random media.

• Engineering Physics. With strong ties to our astrophysicists, this Group conducts research into advanced communication and receiver systems and related topics, in collaboration with the Faculty of Engineering and industrial research laboratories.

• Radiation Physics. This Group, with its visiting staff from the Royal London and St. Bartholomew's Hospitals, is concerned with the application of techniques in nuclear physics to biomedical problems. These range from studies of molecular binding of radioisotopes to the development of absolute dosimetry standards.

Above: A small group-tutorial session.

Below: Students working on an Independant Project in a research group



Dr Peter Ade is Reader in Experimental Physics and our Admissions Tutor. He is an astronomer specialising in the development of far infrared astronomical instrumentation for use on satellites and ground-based telescopes. Other interests include Earth observations aimed at understanding ozone destruction chemistry. Currently he lectures our course on astronomical instrumentation, 'Radiation Detection & Techniques'. He supervises final year project students in his laboratory while they prepare their instruments before using them to make astronomical observations from the Department's roof observatory.

Professor David Bugg is Professor of Nuclear Physics. He studies collisions between protons and antiprotons at CERN in Geneva and at the Los Alamos Laboratory in New Mexico. He is searching for new particles, meson resonances, which live for only a very short time before decaying. One of these is the glueball, a meson made entirely of gluons, the source of the strong nuclear forces between quarks.

Professor Tony Carter is Professor of Particle Physics and leads our experimental team working at CERN, Geneva on the OPAL experiment. This is one of the giant detectors used at the Large Electron-Positron (LEP) accelerator which collides a beam of electrons into a counter-rotating beam of their antiparticles, the positrons. He was responsible for designing and building the innovative microvertex detector at the heart of the experiment. This is made of an array of silicon microchips which are able to follow and measure the path of very short-lived B-mesons before they decay. He lectures the course on 'Nuclear and Elementary Particle Physics'.

Professor John Charap is Professor of Theoretical Physics. He studies some of the fundamental problems posed by the mathematical complexity of Einstein's general relativity theory. He runs our first year course 'Physics Colloquium', in which he not only introduces students to a wide range of exciting topics in physics and astronomy, but also teaches several transferrable skills such as scientific writing and computer literacy. He also teaches the third year course on 'Electromagnetic Theory'.

Professor Peter Clegg is Professor of Astrophysics and leads the international team building a new spectrometer to be launched in the European Space Agency's Infrared Space Observatory (ISO) in 1995. He also played a leading role in the UK contribution to the Infrared Astronomical Satellite (IRAS) which provided the first all-sky survey in the infrared. His research interests are in cosmology and include the study of galaxies beyond our own, especially those discovered by IRAS, where great bursts of star formation are occurring. He presents our introductory course on Einstein's general theory of relativity and its applications to black holes and the universe, 'Space, Time and Gravity'.

Professor Frank Close is one of our Visiting Professors, working on elementary particle theory at the Rutherford Appleton Laboratory. He studies the way quarks are bound together by the gluons to form matter directly observed in experiments, such as protons, and other more exotic mesons known as glueballs, made entirely of gluons. He has written two well known books for the general public: 'The Cosmic Onion' and 'Too Hot to Handle'.

Dr Kevin Donovan is a Lecturer using experiments in molecular electronics to study the motion of electrons in organic materials. The ultimate aim of this research is to develop organic molecular electronic devices to replace some or all of the more expensive silicon ones currently used in computers. He uses ultrafast lasers to cause electrons to move along polymer chains and to follow their motion in times as short as one picosecond (0.0000000000001 sec.) He teaches the course in 'Optical Communications & Optoelectronics' and supervises final year projects in his laboratory.

Professor John Edgington is Professor of Physics with a special interest in the interfaces between nuclear and elementary particle physics, and astrophysics. He leads the UK team studying neutrino interactions at the Rutherford Appleton Laboratory. He teaches additional mathematics to some of our first year students and lectures on 'Nuclear Astrophysics'.

Dr Eric Eisenhandler is a Senior Research Fellow working with the H1 experimental team studying very high energy electron-proton collisions produced by the HERA colliding beam accelerator at the DESY laboratory in Germany. His expertise lies in the development of electronic hardware and software for controlling the complex detectors used in the H1 experiment. He teaches our laboratory-based course on 'Microprocessor Applications in Physics'.

Dr Jim Emerson is Reader in Physics. He uses infrared and millimetre wavelength observations made with the UK telescopes in Hawaii to study the formation of stars in our galaxy. These newly born stars are usually surrounded and partly obscured by a rotating disc of dust and gas, regions where planets may form. He lectures in astronomy and 'Statistical Physics'.

Dr Reg Gibson is Senior Lecturer and our Senior Tutor. He is another member of the OPAL experiment at CERN studying the very highest energy collisions of electrons with their antiparticles, the positrons. He gives the course 'From Newton to Einstein' and supervises final year projects on 'Radiation and the Environment'.

Professor Michael Green, FRS, is now a Visiting Professor having moved from QMW to Cambridge in October, 1993. With his collaborator John Schwartz from CALTECH, who was visiting the Department at the time, he was the originator of the ideas in the theory of Superstrings which led to the belief that this may be a theory capable of providing a grand unification of all the forces including gravity. With his collaborators he wrote the first definitive text on Superstring Theory, published in two volumes by Cambridge University Press.

Dr Matt Griffin is a Lecturer in astrophysics with research interests which include submillimetre wavelength device technology and both astronomical and Earth observations. His observations probe deeply into the atmospheres of the giant gaseous planets enabling him to study their physical and chemical structure. He lectures the introductory course on 'Electric and Magnetic Fields' and teaches astronomical instrumentation.

Dr Paul Harrison is a Lecturer in experimental elementary particle physics. He is another member of the OPAL experiment at CERN studying the very highest energy collisions of electrons with their antiparticles, the positrons. He is particularly interested in the decay of B-mesons which reveal information about the so-called b-quark. He also studies theoretical models about the mixing of quarks and supervises final year projects on this topic. He lectures and runs laboratory classes in ''Electromagnetic Phenomena' and is Deputy Admissions Tutor.

Dr Christopher Hull is Reader in Theoretical Physics. His research is on Superstring Theory, and a recent discovery, W-string theory, both candidates for the ultimate TOE, 'Theory of Everything'. In collaboration with Professor Michael Green and several postdoctoral research fellows he is attempting to extend the range of possible theories which unify all the interactions known to physics. These postulate that matter is made of vibrating quantum strings some twenty orders of magnitude smaller than a proton. They are the only theories so far discovered able to provide a meaningful quantum theory of gravity for studying the collapse of black holes and the very beginning stages of the universe. He teaches the third year 'Mathematical Methods' course.

Dr Robert Jones is Senior Lecturer in theoretical physics with an enormously varied range of research interests. He uses statistical mechanics and computer simulations to study the behaviour of matter in bulk, encompassing topics ranging from the viscosity of emulsions (with applications throughout the chemical industry) to the physical mechanisms enabling bacteria to swim. He also lectures on 'Thermal & Kinetic Physics' as well as 'Physical Dynamics', where he introduces some of the basic ideas about Chaos.

Professor Peter Kalmus is Professor of Physics and Head of Department. He is in the H1 experimental team studying very high energy electron-proton collisions at the DESY laboratory in Germany. These experiments probe the structure of the proton and make it possible to test our theoretical understanding of the forces which hold quarks inside the proton. He received the Institute of Physics Rutherford Medal for his contribution to the discovery of the W and Z particles. He is active in popularising science through his talks to schools and other audiences. He gives the third year course on 'Elementary Particle Physics' which introduces students to quarks and leptons and their interactions.

Professor Stan Klevenhagen is Visiting Professorial Fellow based at the nearby Royal London Hospital where he is Chief Physicist. He is the UK expert on the technique of electron dosimetry and has written two books on the therapeutic uses of beams of electrons for the treatment of diseases such as cancer.

Dr Andy Lawrence, is Lecturer in astronomy. He has spent several years with collaborators throughout the UK producing a map of the large scale structure of the universe by measuring the red-shifts of thousands of distant galaxies. This map has had a strong influence on cosmologists' understanding of how the universe has evolved. His main research expertise is in observations and models of quasars and active galaxies, which are thought to be powered by black holes residing in their centres. He teaches the courses on the 'Physics of Galaxies' and 'Waves and Optics'.

Dr Steve Lloyd is Lecturer in experimental elementary particle physics. He is a member of the OPAL experiment at CERN studying the very highest energy collisions of electrons with their antiparticles, the positrons. These collisions produce large numbers of Z-bosons, the mediators of the weak interactions. He leads the group at QMW who search the data for the short tracks produced by B-mesons before they decay. He organises the first year laboratory course 'Measurement and Inference' and teaches 'Computing in Physical Science'.

Professor Derek Martin heads a world-renowned group developing techniques for generating, detecting and spectrally analysing electromagnetic radiation at millimetre and submillimetre wavelengths. He developed the Martin-Puplett polarising interferometer, an instrument used in laboratories and observatories throughout the world. He led the QMW team which flew this instrument on balloons into the upper atmosphere, obtaining the first evidence that the cosmic background radiation is indeed the relic of the cosmological big bang. The results of this experiment have only recently been confirmed by NASA's satellite COBE (Cosmic Microwave Background Explorer) which carried a Martin-Puplett interferometer and radiometers developed here. He, and members of his Group, have received the National Physical Laboratory Metrology Award no less than three times in recent years. He teaches a course on 'Signal Measurement & Analysis' and supervises projects in his laboratory

Dr Roger Martin is a Lecturer working on the design and development of electronic instrumentation in the Engineering Physics Group. He lectures on 'Circuits & Digital Logic' and supervises final year projects in which students make and use receivers for collecting and analysing information from satellites.

Professor Ian Percival, FRS, is Professor of Theoretical Physics with an international reputation for his work on dynamical systems and chaos. He is now using ideas taken from this work in research on the foundations of quantum mechanics. His model for the diffusion of a quantum state has important practical applications in quantum optics. He is coauthor of a well-known undergraduate text 'Introduction to Dynamics'. He lectures the third year course 'Quantum Mechanics II'.

Professor Geoffrey Sewell is Emeritus Professor of Mathematical Physics and is known for his research on the mathematical foundations of statistical mechanics, the study of matter in bulk. By utilising the mathematical parallels between statistical mechanics and the theory of quantum fields in curved spacetimes, he has been able to provide the most general proof yet for the existence of the Hawking radiation emitted when a black hole evaporates. He has written an elegant monograph on the 'Quantum Theory of Collective Phenomena'.

Dr Wladimir von Schlippe is Senior Lecturer in experimental elementary particle physics and a member of the H1 experiment at HERA. His expertise lies in the analysis of experimental data and its comparison with current theories of the structure of the proton. With his fluency in Russian he has established collaborations throughout the former Soviet Union and is working with colleagues from Moscow University in a search for exotic particles, leptoquarks, predicted by some theories. He teaches our course on 'Computing in Physical Science'.

Dr Alan Smith is Reader in Radiation Physics, a field of research which includes the development of radiation techniques for use in medicine. He studies the interaction of ionizing radiation on biological materials using low energy protons, electrons, positrons and alpha particles. Amongst several practical aims of this research is the hope of obtaining a better understanding of cancer. He teaches the course on 'Applied Radiation Physics' which includes an introduction to applications in medicine and also runs our MSc course in Radiation Physics.

Dr Steve Thomas is a Royal Society Research Fellow who works on the theory of superstrings. As an application of the theory he is studying the creation of topological defects in the early universe which can form centres of attraction for the formation of galaxies. He teaches the first year course 'Mathematical Techniques I'.

Dr Graham Thompson is Reader in Physics working with the H1 experimental team studying very high energy electron-proton collisions produced by the HERA colliding beam accelerator at the DESY laboratory in Germany. He led QMW's design and construction of the time-of-flight device for the experiment, making it possible to select certain types of event from the large background of unwanted events created by the high energy of the colliding electron and proton beams. He teaches in the first year laboratory course 'Measurement & Inference' and lectures on 'Quantum Physics', the first year introduction to the experiments and revolutionary ideas of 20th century physics.

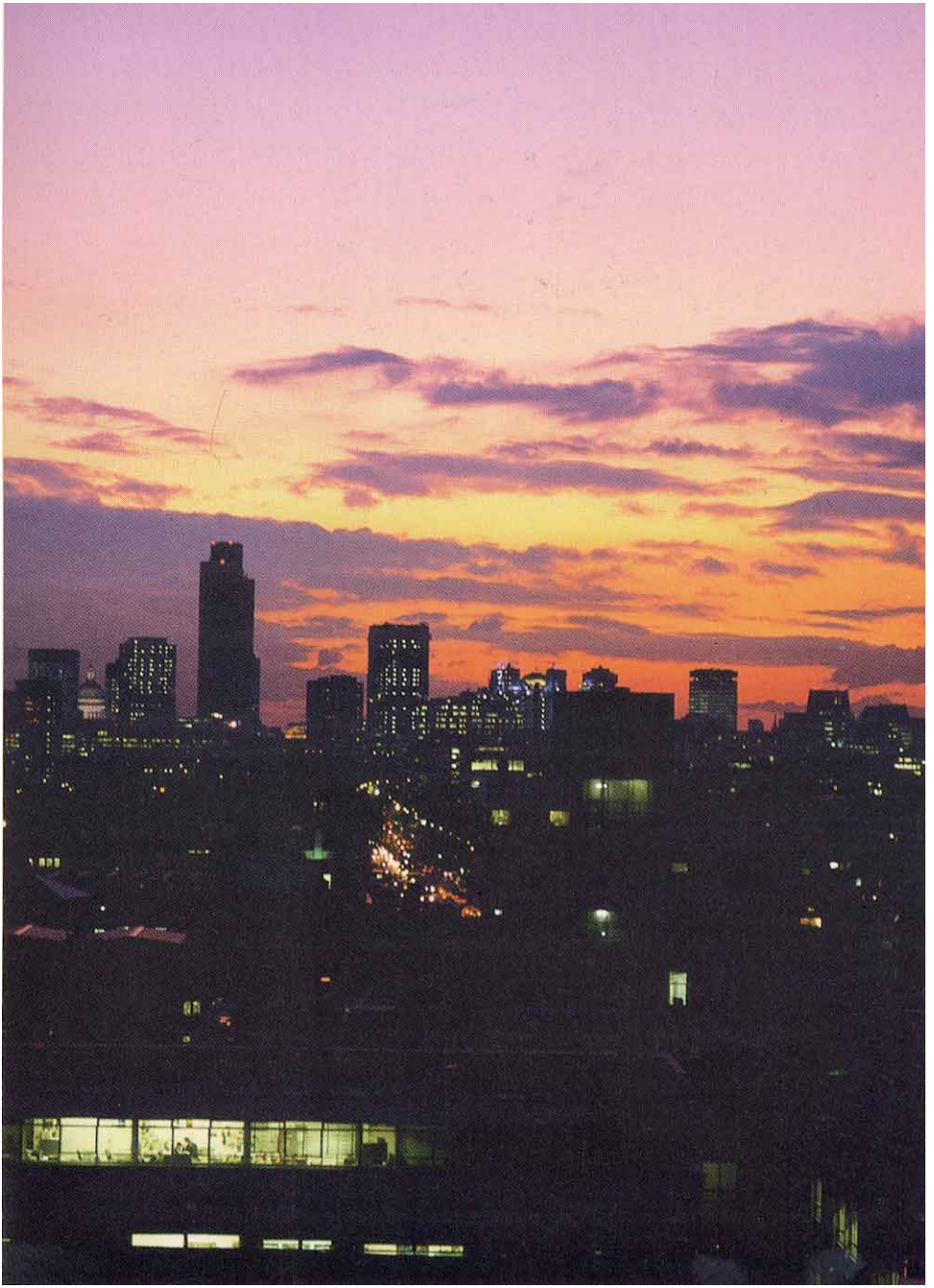
Professor John Thresher is Visiting Professor of experimental elementary particle physics. A former Research Director of CERN, he received the Institute of Physics Rutherford Medal for his contributions to the subject.

Dr Glenn White is Reader in Physics and Astronomy. His research activities range from studies of star formation and interstellar chemistry to the development of submillimetre wave detectors. He pioneered the use of heterodyne millimetre wavelength receivers on telescopes at a time when his receiver was one of very few available in the world. His current research utilises his own detectors installed at the UK's JCMT telescope in Hawaii, carrying out observations at the newly opened submillimetre wavelengths; he is also busy developing the next generation of superconducting detectors. He lectures our introductory course 'The Physics & Astronomy of Stars' as well as a course closer to his own research, 'The Interstellar Medium'.

Dr Peter Williams is a Senior Lecturer. His diverse research interests include star formation and the dynamics of the interstellar medium and the links between cosmology and theories of elementary particles. He uses computer simulations to model the many processes taking place in interstellar molecular clouds which are interacting with nearby newly formed stars. These models are used to analyse and interpret our observations at millimetre and submillimetre wavelengths. He lectures 'Quantum Mechanics I' and organises the final year projects.

Professor Guy Wilson is Professor of Physics, leading the research group in Molecular Electronics. His research aims to develop new electronic devices by controlling electron motion in organic molecules. The long term goal of this work is to produce organic molecular electronic devices, such as a molecular memory, to replace the more expensive silicon ones currently used in microelectronics. A recent discovery has been the 'molecular wire', a polymer chain along which electrons can move in a highly efficient manner. He teaches the course on 'Quantum Phenomena' and supervises final year projects in his laboratory where students can use a state-of-the-art electron beam lithography unit to produce electronic components made of a film just one molecule thick.

Dr William Yeung is Senior Lecturer in theoretical condensed matter and computational physics. Condensed matter physics is the study of assemblies of many molecules or atoms, usually in solid form such as conductors or superconductors where quantum mechanical laws operate. His computational physics group has particular expertise in the applications of parallel computing to condensed matter physics, achieving supercomputer power at comparatively modest cost by carrying out many calculations simultaneously on a network of 'computers on a chip'. He teaches the third year course on 'Solid State Physics' and supervises students whose projects use his parallel processing computers.



The City of London: view from the Physics Building

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