

University of Durham
Physics and Astronomy

Reviewing the Quality of Education

The Quality Assurance Agency for Higher Education (QAA) was established in 1997. It has responsibility for assessing the quality of higher education (HE) in England and Northern Ireland from 1 October 1997 under the terms of a contract with the Higher Education Funding Council for England (HEFCE).

The purposes of subject review are: to ensure that the public funding provided is supporting education of an acceptable quality, to provide public information on that education through the publication of reports such as this one, and to provide information and insights to encourage improvements in education.

The main features of the subject review method are:

Review against Aims and Objectives

The HE sector in England and Northern Ireland is diverse. The HEFCE funds education in over 140 institutions of HE and 75 further education (FE) colleges. These institutions vary greatly in size, subject provision, history and statement of purpose. Each has autonomy to determine its institutional mission, and its specific aims and objectives at subject level.

Subject review is carried out in relation to the subject aims and objectives set by each provider. It measures the extent to which each subject provider is successful in achieving its aims and objectives.

Readers should be cautious in making comparisons of subject providers solely on the basis of subject review outcomes. Comparisons between providers with substantively different aims and objectives would have little validity.

Review of the Student Learning Experience and Student Achievement

Subject review examines the wide range of influences that shape the learning experiences and achievements of students. It covers the full breadth of teaching and learning activities, including: direct observation of classroom/seminar/workshop/ laboratory situations, the methods of reviewing students' work, students' work and achievements, the curriculum, staff and staff development, the application of resources (library, information technology, equipment), and student support and guidance. This range of activities is captured within a core set of six aspects of provision, each of which is graded on a four-point scale (1 to 4), in ascending order of merit.

The aspects of provision are:

- Curriculum Design, Content and Organisation
- Teaching, Learning and Assessment
- Student Progression and Achievement
- Student Support and Guidance
- Learning Resources
- Quality Management and Enhancement.

Peer Review

Reviewers are academic and professional peers in the subject. Most are members of the academic staff of UK HE institutions. Others are drawn from industry, commerce, private practice and the professions.

Combination of Internal and External Processes

The review method has two main processes:

- Preparation by the subject provider of a self-assessment in the subject, based on the provider's own aims and objectives, and set out in the structure provided by the core set of aspects of provision.
- A three-day review visit carried out by a team of reviewers. The review team grades each of the aspects of provision to make a graded profile of the provision, and derives from that profile an overall judgement. Provided that each aspect is graded 2 or better, the quality of the education is approved.

Published Reports

In addition to individual review reports, the QAA will publish subject overview reports at the conclusion of reviews in a subject. The subject overview reports are distributed widely to schools and FE colleges, public libraries and careers services. Both the review reports and the subject overview reports are available in hard copy and are also on the world-wide web (see back cover for details).

Introduction

1. This Report presents the findings of a review in November 1998 of the quality of education in physics and astronomy provided by the University of Durham.
2. The University of Durham was founded in 1832. It is a collegiate University with 12 Colleges and two Societies, including the Graduate Society and University College Stockton. The Colleges and Societies play no direct role in specialist teaching. The University has some 11,900 students in total, 9,600 of whom are full-time. Almost 20 per cent of the students are postgraduates. The University's 29 departments and schools are organised into three faculties. The Department of Physics is one of eight departments within the Faculty of Science. It is based in a single building on the University's science site, which also houses the main library.
3. There are approximately 450 undergraduate students on the BSc and MSci programmes; in addition, there are two postgraduate students on the MSc Elementary Particle Theory programme. There are 40 academic staff, amounting to 37.5 full-time equivalent staff.
4. The following provision forms the basis of the review:
 - BSc (Hons) Physics
 - BSc (Hons) Applied Physics
 - BSc (Hons) Physics and Astronomy
 - BSc (Hons) Maths and Physics (Joint Honours)
 - BSc (Hons) Natural Science (Physics elements)
 - BSc (Ord) Physics
 - MSci Physics
 - MSci Applied Physics
 - MSci Physics and Astronomy
 - MSci Theoretical Physics
 - MSci Maths and Physics (Joint Honours)
 - MSc Elementary Particle Theory.
5. The statistical data in this Introduction are provided by the institution itself. The aims and the objectives are presented overleaf. These also are provided by the institution.

The Aims and Objectives for Physics and Astronomy

Aims

Reflecting the University's overall mission to achieve and sustain excellence, we aim to recruit students of high calibre and potential whose previous performance makes them qualified for the study of physics to advanced level. The provision available to students aims:

- to provide a thorough understanding of the principles of physics as a basis for continuing development;
- to develop generally applicable skills to enable our students to pursue careers where a scientific training is advantageous;
- to generate an interest in, and the means to explore, wider aspects of physics;
- to develop an appreciation of the relationship of physics to the world at large;
- to provide a challenging but supportive educational environment, sustained by and dependent on international excellence in specific fields of research, within which our objectives can be achieved;
- to provide programmes which are accredited by the Institute of Physics.

We aim in the:

- MSci programmes in Physics - to provide a rigorous education and training suitable for students who may wish to become Chartered Physicists;
- BSc programmes in Physics - to provide a rigorous education in physics for those who will generally pursue careers in other professions;
- BSc programmes in Applied Physics and Electronic Engineering - to address a regional skill shortage by providing vocational education and training for students wishing to pursue a career in the microelectronics industry;
- MSc programme in Elementary Particle Theory - to provide advanced study of theoretical high energy physics and preparation for research in this field.

Objectives

For our undergraduate programmes, our overall objectives are that students should have:

- developed a detailed knowledge and understanding of physics and its applications at a level appropriate to that of the programme followed;
- acquired specific skills, such as experimental techniques and the use of modern technologies (including information technology), mathematical

manipulation, construction of theoretical models and the confrontation of theory and experiment;

- developed generic skills such as independent planning of work, effective retrieval of information, problem solving, teamwork and, communication and presentation skills;
- explored the subject and expanded their knowledge in areas of their choice;
- reached a level of understanding and achievement commensurate with their ability and endeavour.

Specific additional objectives for individual programmes are:

- MSci degree in Physics: students should be able to demonstrate that they have been educated to a level from which they can begin work as professional physicists, comparable with MSci (or MPhys) degree physics students in other front rank universities in this country, and which permits mobility of graduates across member states of the European Union.
- MSci degree in Mathematics and Physics: students should be able to demonstrate that they have achieved a high level of understanding in, and fluency in the use of, mathematics for the study of advanced topics in theoretical physics.
- BSc degree in Physics: students should be able to demonstrate that they have developed their intellectual faculties to a level, comparable with BSc degree physics students in other front rank universities in this country, that equips them to enter a wide range of professions and careers, including those in science.
- BSc degrees in Applied Physics and Electronic Engineering: students should be able to demonstrate that they have reached a level of knowledge and understanding of the physics and engineering of materials such that they are equipped to enter specialist employment within the microelectronics industry.
- BSc degree in Natural Science: students should be able to demonstrate that they have acquired a grounding in the quantitative aspects of physics to a level of knowledge and understanding of specific topics equivalent to that of BSc Physics students.

For our postgraduate MSc programme in Elementary Particle Theory, our objectives are that students should have:

- acquired specialist knowledge;
- developed their creative and critical abilities;
- examined the literature;
- written a coherent account of an advanced topic.

Summary of the Review

6. The graded profile in paragraph 7 indicates the extent to which the student learning experience and achievement demonstrate that the aims and objectives set by the subject provider are being met. The tests and the criteria applied by the reviewers are these:

Aspects of provision

1. Curriculum Design, Content and Organisation
2. Teaching, Learning and Assessment
3. Student Progression and Achievement
4. Student Support and Guidance
5. Learning Resources
6. Quality Management and Enhancement

Tests to be applied

To what extent do the student learning experience and student achievement, within this aspect of provision, contribute to meeting the objectives set by the subject provider?

Do the objectives set, and the level of attainment of those objectives, allow the aims set by the subject provider to be met?

Scale points

1

The aims and/or objectives set by the subject provider are not met; there are major shortcomings that must be rectified.

2

This aspect makes an acceptable contribution to the attainment of the stated objectives, but significant improvement could be made.

The aims set by the subject provider are broadly met.

3

This aspect makes a substantial contribution to the attainment of the stated objectives; however, there is scope for improvement.

The aims set by the subject provider are substantially met.

4

This aspect makes a full contribution to the attainment of the stated objectives.

The aims set by the subject provider are met.

7. The grades awarded as a result of the review are:

Aspects of provision	Grade
Curriculum Design, Content and Organisation	4
Teaching, Learning and Assessment	4
Student Progression and Achievement	4
Student Support and Guidance	4
Learning Resources	4
Quality Management and Enhancement	4

8. The quality of education in physics and astronomy at the University of Durham is approved.

The Quality of Education

Curriculum Design, Content and Organisation

9. The curriculum supports the achievement of aims and objectives. The courses are rigorous and challenging, with the development of both generic and subject-specific skills embedded in the curriculum. During the first two years, all students undertake a common core programme, which provides a sound basis for the development of a thorough understanding of the principles of physics. In line with the Department's aims, the courses enjoy full Institute of Physics accreditation.

10. The department provides four-year MSci and three-year BSc programmes. The former programmes are specifically designed for students who are expecting to proceed to a professional career in physical sciences. Workshops on communications skills and the extensive use of projects help achieve these objectives. The BSc programmes are designed for students who are not expecting to become professional physicists. In line with aims and objectives, they provide scope for intellectual development and opportunities for acquiring generic transferable skills through the quantitative analysis of physical phenomena. A BSc Ordinary route is available for students who do not demonstrate honours potential in the first two years.

11. The curriculum is coherent and progressive with appropriate depth and breadth. Choice is offered through the provision of a range of programmes. At the start of year three, students opt for degree courses in Physics, Theoretical Physics, Applied Physics or Physics and Astronomy. These all contain a common double module of core physics in the third year combined with four modules associated with the specific degree topic. The curriculum is challenging and current. It is well matched to the expertise of the staff, with specialist topics taught by leading researchers in their fields. Many of the Level 3 and 4 courses are research led.

12. Final-year project work is an important constituent of the undergraduate curriculum. BSc students undertake team projects whereas MSci students complete projects within departmental research groups. In both cases, project work develops specialist knowledge and both subject-specific and generic skills.

13. The Department, in conjunction with the Department of Mathematics in the first year, takes considerable efforts to develop the mathematical abilities of students to meet the needs of the physics content. Much care is taken over monitoring these acquired skills

and ensuring that all students attain and maintain a satisfactory level of competence.

14. The MSc in Elementary Particle Theory is flexibly integrated with the lectures given to first-year postgraduate research students. It provides a rigorous programme which is well matched to aims and objectives.

15. This aspect makes a full contribution to the attainment of the stated objectives. The aims set by the subject provider are met.

Curriculum Design, Content and Organisation:
Grade 4.

Teaching, Learning and Assessment

16. The teaching strategy is well matched to the highly qualified student intake. Lectures to large classes form the dominant teaching mode, often supported by supplementary printed notes and demonstrations. The Department's research and industrial links contribute significantly to teaching and learning, for example, in the final-year MSci projects and in the third-year BSc team projects.

17. Lecture courses are supported by a well co-ordinated programme of problem sheets and small-group tutorials. The problem sheets, issued weekly to students in the first two years, reinforce the lecture material and help to develop skills of mathematical manipulation and problem solving. Some problems provide formative activity in tutorials; others contribute to continuous summative assessment, marked by postgraduate students. Other key skills are developed through essay writing and oral presentations, also under the direction of the tutor. Attendance at tutorials is compulsory and is closely monitored; this system works effectively in maintaining student interest and commitment.

18. The high quality programme of laboratory work has been carefully designed to develop students' practical skills in experimental physics as well as generic skills in data presentation and analysis. Oral skills are strengthened through a poster session at Level 3 and a seminar presentation at Level 4. The reviewers noted several recent examples of areas where the Department has reacted positively to correct perceived weaknesses in programme structure or methods of delivery.

19. The reviewers observed 21 teaching and learning sessions. The overall quality of classes was good. Staff were knowledgeable and authoritative. Sessions were generally well planned with clear objectives, although these were not always effectively transmitted to students. Content was appropriate to the level, and was current. There were examples of good links made to previous and

future sessions and some good student contributions. Laboratory and tutorial classes were particularly effective, and were high quality learning experiences.

20. Some weaknesses reduced the effectiveness of a few classes. The pace of delivery of lecture material was sometimes unvaried and unrelenting, with the result that students failed to maintain full attention. Learning resources, notably overhead projectors, were not wholly effective in some lecture theatres.

21. Students are highly motivated and engage well with the subject. Expected learning outcomes are generally well articulated to ensure that student enthusiasm is properly channelled.

22. Assessment is appropriately balanced between unseen written examinations, laboratory classes, coursework assignments and project work. Good co-ordination among staff ensures a steady workload for students, who are well informed of the criteria for assessment and are kept informed of their own performance. Assessment is carried out with appropriate rigour, and external examiners have been complimentary about examination procedures.

23. The teaching, learning and assessment criteria of the MSc programme in Elementary Particle Theory are consistent with its aims and objectives. This programme follows the conventional model of two terms of specialised lectures assessed by written examinations, followed by an extended dissertation.

24. This aspect makes a full contribution to the attainment of the stated objectives. The aims set by the subject provider are met.

Teaching, Learning and Assessment:
Grade 4.

Student Progression and Achievement

25. The Department aims to recruit students of high calibre and potential. This aim is realised by the admission of approximately 100 students per annum from over 500 applicants. Nearly all students admitted to the BSc and MSci programmes are school-leavers with GCE A-Level qualifications. The average GCE A-Level points score is 26 with a lowest score of 20. Approximately 20 per cent of the students are women. The postgraduate taught MSc course in Elementary Particle Theory attracts small numbers of students. However, the high quality, intensive and rigorous programme also serves the needs of first year PhD students in Theoretical Particle Physics.

26. The statistics on progression and completion rates demonstrate that the courses are well matched to the abilities of the students. The withdrawal, failure and

transfer rates are low, with less than 10 per cent failing to complete Level 1 and few students withdrawing after this stage. Achievement of final awards reflects that in other parts of the University, with 55 per cent achieving Upper Second class honours or better.

27. Students make a final choice between the BSc and MSci programmes at the end of the second year, with guidance from staff. Students must achieve an overall mark of 50 per cent or more to proceed to the MSci programmes. In a large majority of cases, students progress satisfactorily on the programme of their choice. Final achievement shows that high calibre students enter both types of degree course. There was some evidence that a few students may be inappropriately progressing to the MSci programme and having to leave with a BSc award at the end of the third year. The reviewers recommend that the progression rules be kept under review.

28. The reviewers looked at 21 batches of student work, including coursework, examination scripts, laboratory reports and projects. Evidence from this and class observations indicated that students acquire knowledge and understanding in line with the aims and objectives. Classroom contributions indicated a high level of understanding, whilst much project work was of impressive quality. Students also demonstrated high levels of subject-specific skills, notably in laboratory sessions. External examiners' reports confirm the high quality of work being produced, both by undergraduates and postgraduates.

29. Students develop generic transferable skills in line with aims and objectives. High level communication, organisational, information technology (IT) and group working skills are demonstrated through, for example, team project work, poster presentations and tutorial contributions. In discussion, students and graduates confirmed the high demands of the programmes and the development of knowledge, understanding and appropriate skills.

30. The detailed statistics on first destinations indicate that some 80 per cent of graduates progress immediately to appropriate employment and further study, including a significant number who progress to research in physics.

31. This aspect makes a full contribution to the attainment of the stated objectives. The aims set by the subject provider are met.

Student Progression and Achievement:
Grade 4.

Student Support and Guidance

32. Academic support and guidance is provided by the Department, whilst pastoral support is provided by the Colleges and by the University centrally. The roles of each in the provision of support is well documented and understood by students, who particularly value the role played by the colleges and the support they receive through the tutorial system. Minutes of meetings, survey outcomes and discussions with students indicate a high level of student satisfaction with the support and guidance offered.

33. There is a range of well-produced supportive documentation. Course booklets provide detailed written guidance on such issues as option choices, assessment procedures and the mechanism by which students' views are sought. There is a range of informative booklets from central services.

34. Applicants who receive an offer of a place are encouraged to attend an open day and many take this opportunity. Admission processes enable the University to identify and advise potential students with special needs. Students reported that induction processes are effective in providing an introduction to the Department, the University and the Colleges.

35. The Department's arrangements for academic guidance and support work well. They are well matched to the high quality of the student intake and are well supported by the University's 'Keeping of Term' processes. These impose obligations on students regarding attendance and completion of work and involve speedy reaction at the first sign of difficulties. There are effective tutorial arrangements. Support for students after the first year had been criticised and appropriate action taken to rectify the problems. Additional support is available for those students who require it and staff were reported to be accessible. Overall, students develop self-reliance in a supportive department. MSc students receive expert individual supervision and guidance.

36. The University and its Colleges provide a wide range of pastoral support services. Students showed awareness of what is available. Central services are pro-active in providing services directly to students. There are good links between the Department, the Colleges and central services.

37. Careers information and guidance in physics is organised by a designated member of the careers service. The service is pro-active at an individual and departmental level. Departmental staff provide information on opportunities for further study and

research in physics. Current students and recent graduates expressed satisfaction with the assistance they received. Some 80 per cent of graduates were in employment or undertaking further study after six months, many in professional science-based activities.

38. This aspect makes a full contribution to the attainment of the stated objectives. The aims set by the subject provider are met.

Student Support and Guidance:
Grade 4.

Learning Resources

39. The Department has an appropriate resource strategy linked to its aim to provide a research environment with state-of-the-art computing and experimental facilities for undergraduate use. Substantial resources are being devoted to this with the extensive refurbishment of laboratories and the provision of IT equipment. There is a coherent strategy for replacement and renewal.

40. Most general teaching accommodation is appropriate with some recently refurbished rooms of good quality. Poor quality audiovisual resources were seen in some classes, and there was some poor match between the nature of the accommodation and the activities undertaken. The reviewers acknowledge the continuing programme of refurbishment.

41. IT resources provide good support for the curriculum and for teaching, learning and assessment. Computing equipment in the Physics Department has recently been greatly enhanced and students reported that it is amongst the best available in the University. Computers are networked with software supported centrally and available across the university system. Use of standard commercial software supports the objective to teach generic skills while the alternative UNIX environment is appropriate to research training. Access to facilities is good and includes provision within the Colleges. Consideration is being given to further improving this through the cabling of student residencies.

42. Laboratories are excellently equipped and students are complimentary about the technical help provided. Inclusion of MSci students into research groups in the final year supports the objective to educate students to begin research degrees.

43. The University library provides an excellent learning environment, and an extensive stock of books and journals. The individual initiative within the Department to link reading lists into the computerised library catalogue provides a valuable service to students.

Induction arrangements are available for those students who require them. The Sir James Knott Library provides students with valuable study space and resources within the Department.

44. The library's flexible-loan arrangements, including a short-loan facility, ensure appropriate access to texts in heavy demand. Opening hours are extensive. There is good liaison between the library and the Department through the subject liaison librarian and the Department's library representative. The provision covers the needs of the MSc programme.

45. This aspect makes a full contribution to the attainment of the stated objectives. The aims set by the subject provider are met.

Learning Resources:
Grade 4.

Quality Management and Enhancement

46. The University has well defined quality assurance procedures. The Teaching and Learning and the Graduate School Committees of the Senate bear overall responsibility for quality assurance. The process of implementation of the procedures is devolved to the Board of Studies of the Department. There is significant input from the Faculty, which carries out periodic reviews. The Quality Assurance Agency for Higher Education report of the 1998 Quality Audit of the University acknowledged the guidance given by the University Senior Management to the implementation of quality assurance procedures.

47. The Board of Studies in Physics has developed a strong commitment to its own quality management and enhancement procedures. It has created a teaching and learning sub-committee to make recommendations on quality assurance. It takes note of issues raised by the staff-student consultative committee and in student questionnaires. In addition, the Course Monitoring Group ensures that issues relating to teaching, learning and assessment are given due weighting.

48. External accreditation of the programmes has been sought from, and granted by, the Institute of Physics. The opinions of the external examiners are given due consideration and action has been taken to comply with their views. Revisions have been made to programmes, and the procedures for Boards of Examiners have been improved, in response to external examiners' comments.

49. Student representation on the Board of Studies and on the staff-student consultative committee, together with module and course questionnaires, ensure that students have adequate opportunities to raise issues of

concern. Their views carry weight in the deliberations and decisions made in the Department. For example, the recent enhancement of the teaching laboratories was due in part to constructive criticism made through these consultative mechanisms.

50. A large number of staff have involved themselves in the University staff development scheme. To cater for its specialised needs, the Department has introduced its own system of peer review to oversee the quality of its teaching and to make recommendations for improvements. There is a strong commitment to the dissemination of good practice, and the Department is to be commended for this initiative.

51. The University has well-established procedures for the development of probationary staff. The Department has introduced a mentoring system in which an experienced member of staff provides guidance to each probationer.

52. The self-assessment document provided an acceptable basis for the visit. In particular it provided a clear rationale for curricular and teaching, learning and assessment strategies firmly rooted in aims and objectives. Other aspects were less well covered and their treatment was largely descriptive.

53. This aspect makes a full contribution to the attainment of the stated objectives. The aims set by the subject provider are met.

Quality Management and Enhancement:
Grade 4.

Conclusions

54. The quality of education in physics and astronomy at the University of Durham is approved. All aspects make a full contribution to the attainment of the stated objectives and the aims are met. The reviewers come to this conclusion, based upon the review visit together with an analysis of the self-assessment and additional data provided.

55. The positive features of the education in physics and astronomy in relation to the aspects of provision include the following:

- a. A coherent, progressive and challenging curriculum based upon a sound common core, which is well matched to the expertise of staff (paragraphs 9; 11).
- b. Programmes which develop a wide range of generic and subject-specific skills in line with aims and objectives (paragraphs 9; 10; 12; 13).
- c. Good quality teaching and learning within a well-considered teaching, learning and assessment strategy (paragraphs 16 to 19).

- d. Highly motivated students who engage well with the subject (paragraph 21).
- e. A large proportion of students complete the programmes and progress to appropriate destinations (paragraphs 25; 30; 37).
- f. The high quality of achievement in written work, laboratories and in the classroom (paragraphs 28; 29).
- g. Excellent arrangements for academic support and guidance within the Department which are well supported by the University's 'Keeping of Term' processes (paragraph 35).
- h. Comprehensive central support services, including the careers service (paragraphs 36; 37).
- i. The development of high quality resources in line with aims and objectives (paragraphs 39; 41 to 44).
- j. Effective processes for the management and enhancement of quality with a number of departmental initiatives (paragraphs 46 to 51).