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THE AUSTRALIAN NATIONAL UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF THEORETICAL PHYSICS

ANNUAL REPORT 1976

GENERAL COMMENTS. COURSES

The purpose of courses in theoretical physics is, on the one hand, to provide an appropriate background for those students intending to take up a career in the subject and, on the other hand, to lead to an appreciation of the formal notions which underlie the physical sciences in general.

The relatively high percentage of early withdrawals in B01 was due primarily to students who enrolled "to see what theoretical physics is like", finding the formal work not to their liking or too demanding. In any event, all the weaker students withdrew and those remaining had no difficulty in passing. Remarkably, several students attended at least a substantial part of the course though they were not enrolled; indeed, two of the very best of these persevered right to the end.

It is probably true to say that the wide variety of methods of assessment employed by the various individual departments is gradually leading to a very unhappy situation. Example: students asked for assessment by final written semester examinations with virtually no weight being given to assignments. One can see why: yet further sets of assignments forming part of continuous assessment (and to be handed in by given dates) would constitute the straw which breaks the camel's back. Result: the assignments are simply not done at all. This is pedagogically most unsound, not least because there is then no feedback to and from the students. The situation is becoming ludicrous.

ENROLMENTS AND EXAMINATION RESULTS

See Appendix. In the table actual members are given since these are too small to make percentages meaningful.

STUDENT PARTICIPATION

As in previous years the students in each unit were asked to agree on how they should be assessed. In all cases assessment by final examination was agreed upon, with virtually negligible weight attached to marked assignments done during the semester (see above). Students were quite apathetic towards participation, very little interest being shown in the departmental committee. Indeed the required meeting during the third term was, by common consent, not held. (Of course, in a department of this size in which there is so much personal contact with individual students the departmental committee cannot be expected to be much more than a redundant piece of administrative machinery.)

STAFF

Professor:	H.A. Buchdahl, D.Sc. (Lond.), F.A.A.
Reader:	D.B. Melrose, B.Sc. (Tas.), D.Phil. (Oxon.)
Senior Lecturer:	M. Andrews, B.Sc., M.Sc. (Qld.), Ph.D. (Birm.)

VISITORS

Dr George A. Dulk of the Astro-Geophysics Department, University of Colorado visited Dr Melrose briefly in January.

WORK OF GRADUATE STUDENTS

Mr R.J. Stoneham (Ph.D.) continued his research into the electromagnetic properties of a magnetized vacuum.

Mr J.E. Stenhouse (transferred from Ph.D. to M.Sc. at his own request) has written an M.Sc. thesis entitled "Type III Solar Radio Bursts and Langmuir Waves in the Solar Wind" which will be submitted in December 1976.

OTHER ACTIVITIES

Professor Buchdahl returned from study leave on 17 January. He attended the September meeting, in Sydney, of the Science and Industry Forum of the Australian Academy of Science.

Dr Melrose (i) visited the CSIRO Division of Radiophysics for a week in May; (ii) gave a talk at the meeting of the Astronomical Society of Australia in Sydney in May; (iii) gave an invited lecture at the eclipse meeting of that society in Merimbula in October; (iv) gave an invited lecture and three talks at the USSR/Australia symposium on solar radio astronomy at Pulkovo Observatory, Leningrad, in September; (v) was a joint organizer of that symposium; (vi) gave a lecture course to graduate and Honours year students which was attended by a member of another department; (vii) visited the Department of Theoretical Physics, University of New South Wales, in October and gave a lecture there.

Dr Andrews continued as Sub-Dean of the Faculty of Science. As one of the many duties of that office he prepared a Guide to the Faculty, mainly directed at new undergraduate students.

RESEARCH

M. Andrews

Investigations are continuing into the relationship between microscopic systems and macroscopic systems in quantum mechanics and its bearing on the foundations of quantum theory.

H.A. Buchdahl

Most of this year was devoted to continuing the development of a Lagrangian aberration theory of optical systems without symmetries. The work fell under four main headings (i) the determination of general and accidental identities; (ii) the explicit expressions for the so-called local coefficients of orders 2 and 3; (iii) the theory of the general

continuous system; (iv) the theory of variation of parameters. Manuscripts were prepared under each of the first three headings and all of these were accepted for publication in *Optik*.

Some work in other fields will be reported on next year when it is further advanced.

D.B. Melrose

The major project for the year was the writing of a book on plasma astrophysics. A first draft was completed in July and was used as the basis for a lecture course to graduate students. A second draft is nearing completion.

Investigation of the propagation of low frequency waves in inhomogeneous plasmas was carried out jointly with M. Simpson (Honours student 1975), who published one paper in the *Australian Journal of Physics*. Three other papers, one jointly with Mr Simpson, have been prepared.

An alternative form of the vacuum polarization tensor in the presence of a magnetic was derived. It was shown that the vacuum polarization tensor in the absence of a magnetic field satisfies generalized Kramers-Kronig relations which take special relativity into account explicitly. Two papers written jointly with R.J. Stoneham (Ph.D. student) have been submitted to *Journal of Physics A*.

Development of the theory of solar radio emission has continued. One paper was published in the *Proceedings of the Astronomical Society of Australia*, another paper jointly with J.E. Stenhouse (M.Sc. student) has been submitted to the *Australian Journal of Physics* and a third paper has been prepared. Certain difficulties with the theory were pointed out in a paper presented at the USSR/Australia symposium on solar radio astronomy and is to be published (in Russian) in *Radiofizika*.

PUBLICATIONS

M. Andrews

"Singular potentials in one dimension". *Amer. J. Phys.*, 44 (1976).

H.A. Buchdahl

"Systems without Symmetries. IV: General and accidental identities". *Optik*, 45 (1976).
"Systems without Symmetries. V: The local coefficients of orders 2 and 3". *Optik*, 45 (1976).

D.B. Melrose

"Resonant Interaction between Fast Particles and Collision-Dominated MHD Waves". *Astrophysics and Space Science*, 38, 483-493 (1975).
"Interpretation of Jupiter's Decametric Radiation and the Terrestrial Kilometric Radiation as Direct Amplified Gyro-Emission". *Astrophysical Journal*, 207, 651-662 (1976).
"Precipitation in Trap Models for Hard Solar X-ray Bursts". *Monthly Notices of the Royal Astronomical Society*, 176, 15-30 (1976).
"Can Spontaneously Emitted Langmuir Waves Account for Type III Solar Radio Bursts?". *Proceedings of the Astronomical Society of Australia*, 3, 43-45 (1976).
"Effects of an ambient magnetic field on the properties of Langmuir waves". *Solar Phys.* 46, 511-513.

M.A. Simpson

"The Polarization Limiting Region - An Empty Concept". *Australian Journal of Physics*, 29, 343-346 (1976).

THE AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF THEORETICAL PHYSICS ANALYSIS OF STUDENT PERFORMANCE

	Number Enrolled				Number Sitting					
1	2	3	4	5	6	7	8	9	10	11
Unit	Enrolled	Sitting	Wastage	Failure	Sitting	High Distinction	Distinc-tion	Credit	Pass	Fail
BO1	11	7	4	0	7	3	0	2	2	0
CO1	11	11	0	3	11	2	1	2	3	3
CO2	5	4	1	0	4	0	3	0	1	0
CO3	2	2	0	0	2	0	0	2	0	0
CO4	0	0	0	0	0	0	0	0	0	0
CO5	5	4	1	1	4	0	1	1	1	1

N.B. The actual numbers are given since these are too small to make percentages meaningful.

	Enrolled	Sitting	Result
Final Honours	1	1	H1