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THE AUSTRALIAN NATIONAL UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF THEORETICAL PHYSICS

ANNUAL REPORT 1974

GENERAL COMMENTS

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.

Rather poor enrolments are presumably a reflection not only of the employment position as it exists at present but also of the curious anti-scientific attitudes which have appeared on a world-wide scale in recent years. Moreover, one cannot help wondering whether they do not also reflect the ever-increasing demand by students to have everything handed to them on a plate: self-discipline and "freedom" being apparently regarded as mutually exclusive.

ENROLMENTS AND EXAMINATION RESULTS

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

STAFF

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

* Promoted to Senior Lecturer as from 1.1.1975.

AWARDS AND HONOURS

Dr Melrose was awarded the Pawsey Medal for 1974 by the Australian Academy of Science. This is "awarded to a scientist not over the age of 35 years for distinguished research in physics...".

Dr Buchdahl was elected a Fellow of the Optical Society of America "in recognition of his distinguished service in the advancement of optics".

OTHER ACTIVITIES

Dr Melrose spent February at the CSIRO Division of Radiophysics. He gave a lecture at the May meeting of the Astronomical Society of Australia.

Professor Buchdahl spent three weeks in the People's Republic of China as a member of an official scientific delegation sponsored jointly by the Academy of Science and the A.N.U.

VISITOR

Professor Peter Rastall, Professor of Physics in the University of British Columbia continued his studies on the theory of spinors and left the Department in March.

RESEARCH

M. Andrews

The effect of singularities of the potential on bound and scattering states of quantum particles in one dimension was investigated. For a class of singular potentials it has been possible to separate those singularities which allow the passage of particles from those which are inpenetrable. Some mathematical technicalities remain to be dealt with.

Exactly soluble models of the interaction between pairs of atoms are being used to investigate the validity of an approximation used by Brueckner in the calculation of the broadening of spectral lines.

H. A. Buchdahl

The manuscript of a book entitled "Twenty Lectures on Thermodynamics" briefly mentioned in last year's report, was accepted for publication by Pergamon Press Australia. A great deal of time was spent in minor revision and proof reading.

To have a Hamiltonian aberration theory of optical systems without symmetries requires in the first place that one or other of the characteristic functions of a quite general refracting surface be at hand. A tractable method was derived for obtaining the angle characteristic of such a surface. This work was accepted for publication in OPTIK.

It appears that the power series for the point characteristic of a spherical refracting surface for arbitrary values of all six arguments (up to a reasonable degree) is nowhere to be found. All terms of the series of degree < 8 have been obtained, and this work also will appear in OPTIK.

Some incidental work was done in the context of a research project of Dr P. Stiles, Research School of Chemistry. This is incorporated in a manuscript he has prepared. The main problem is to obtain an explicit expansion of spheroidal in terms of spherical harmonics.

Other work in optics, tensor calculus and thermodynamics has not yet reached the stage of finished manuscripts and will be reported on in due course.

Dr D.B. Melrose

A suggestion that whistler waves might be important in producing radio emission from the solar corona was shown to be unacceptable; a paper is to be published in the *Australian Journal of Physics*.

There is no adequate theory for type V solar radio bursts. An idea on why some electron streams should generate type V bursts while others generate U-bursts was explored; a paper is to be published in the *Proceedings of the Astronomical Society of Australia.*

The effects of the resonant interaction between fast particles and waves in a collisionless plasma may be described using a pair of quasi-linear equations. It was shown that these equations may be applied also to the case of fast particles interacting with waves in a collision-dominated plasma. A paper has been submitted to *Astrophysics and Space Science.*

Most of the time spent on research was in preparation of a book on plasma astrophysics. Five of a proposed nine chapters were written.

PUBLICATIONS

ANDREWS, M. (with MEIER, P.[1] and SANDEMAN, R.J.[2])
'The static polarizability of argon ions'. J. Phys. B: Atom. Molec. Phys., 7, L339-341, 1974.

BUCHDAHL, H.A.
'Static sources in the Brans-Dicke theory'. General Relativity and Gravitation, 4 (1973), 319-326.
'Remark on the solution of the harmonic oscillator equation'. Amer. J. Phys., 42 (1974), 47-50.
'Remark on the factor 1/n! in the partition function. Amer. J. Phys. 42 (1974), 57-53.
'On a calculus which reflects SO(3,2) ≈ Sp(2,R)'. Tensor N.S., 27 (1973), 329-336.
'Chromatic aberration theory of systems without symmetries'. Optik, 40 (1974), 460-468.
'Remark on the Theorem of Carathéodory. Proc. Camb. Phil. Soc., 76 (1974).

MELROSE, D.B.
'Mode Coupling in the Solar Corona. I. Coupling Near the Plasma Level'. Australian Journal of Physics, 27 (1974), 31-42.
'Mode Coupling in the Solar Corona. II. Oblique Incidence'. Australian Journal of Physics, 27 (1974), 43-52.
'The Mechanism Responsible for "Shadow" Type III Bursts. I. Absorption Due to Langmuir Turbulence'. Australian Journal of Physics, 27 (1974), 259-269.
'The Mechanism Responsible for "Shadow" Type III Bursts. II. Absorption Due to Ion Sound Turbulence'. Australian Journal of Physics, 27, (1974), 271-277.
'Effects of an Ambient Medium on the Emission Absorption and Scattering of Waves by Atoms and Molecules', Astrophysics and Space Science, 29 (1974), 211-219.
'Gyromagnetic Absorption at the Fundamental'. Australian Journal of Physics'. 27 (1974), 279-283.
'Comments on "Neutralization and Stabilization of Particle Streams in the Corona and Type III Radio Bursts" by Dean F. Smith'. Solar Physics, 34 (1974), 421-425.

'On Predicted Preferential Backward Emission at the Second Harmonic of the Plasma Frequency in Solar Radio Bursts'. Astrophysical Letters, 15 (1973), 55-57.
'On the Propagation of the Electron Streams Generating Type III Bursts'. Solar Physics, 37 (1974), 353-365.
'A Relationship between the Brightness Temperatures for Type III Bursts'. Solar Physics, 35 (1974), 441-450.
'A Relativistic Quantum Theory for Processes in Collisionless Plasmas'. Plasma Physics, 16 (1974), 845-864.

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	Distinction	Credit	Pass	Fail
BO1	7	6	1	2*	6	1	1	2	0	2*
CO1	11	11	0	3	11	1	1	3	3	3
CO2	4	4	0	0	4	2	1	1	0	0
CO3	3	3	0	0	3	2	0	1	0	0
CO5	5	5	0	1	5	1	1	2	0	1

*Both absent from examination

	Enrolled	Sitting	Result
Final Honours	1	1	H1