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THE AUSTRALIAN NATIONAL UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF THEORETICAL PHYSICS

ANNUAL REPORT 1965

Academic Staff:

>   Professor H. A. Buchdahl, D.Sc.(Lond.), D.Sc.(Tas.),
>   A.R.C.S.
>
> *Dr. L. J. Tassie, M.Sc., Ph.D. (Melb.)
>
>   Dr. M. Andrews, B.Sc. (Q'land), Ph.D. (Birm.) . ;
>
> +H. Cohen, B.Sc.(Syd.)

>   * On leave 1965
>   + Temporary Lecturer 1965.

Dr. Tassie spent his study leave in the U.S.A., mostly at the University of Indiana as Visiting Associate Professor, and for a time at the Argonne National Laboratory.

Dr. Andrews took up his duties as lecturer at the beginning of the year.

Teaching:

Student enrolments and examinations are set out in the following table:-

	Enrolled	Examined	Passed
Theor. Phys. III	9	8(1W)	4 (1HD,1D,2Cr.)
Theor. Phys. IV	1	1	1 (HI)
Ph.D.	3	-	-

Some of the fourth year lectures were also attended by people from the I.A.S.

Research:

This account excludes Dr. Tassie's work abroad, in the course of which he wrote and published a number of papers.

An investigation was begun of the non-relativistic scattering of particles by two-particle systems, making use of the recent developments due to Fadeev (Andrews).

A new calculus ("rotor calculus") was developed which is analogous to the spinor calculus of Infeld and v n der Waerden, and which exploits the isomorphism between the Lorentz group and the group of complex three-dimensional rotations. Two long manuscripts were prepared. (Buchdahl)

Few, if any, static spherically symmetric solutions of the general relativistic field equations are known such that (1) it can be exhibited in elementary closed form; (2) the density of matter vanishes at the boundary; (3) its physical realizability is not excluded (for instance by the velocity of sound exceeding that of light, etc.); (4) the equation of state of the matter can be exhibited

in simple closed form. One such solution was obtained by using non-canonical coordinates. (Buchdahl)

It was shown that from the anti-commutator of two σ-symbols as given by Infeld and van der Waerden the full defining relation for these symbols can be deduced algebraically. A paper on this was published. (Buchdahl)

It is possible to obtain very general inequalities governing static massive spheres in general relativity. This problem (first studied in 1959) is being reinvestigated with the intention of substantially strengthening previous results, the possibility of doing so being suggested by some results obtained recently by Bondi. (Buchdahl)

In optics, much progress was made in generalizing the method of quasi-invariants. Previously all aberration coefficients in principle related arbitrary rays to a "base-ray" along the axis of the system. The base-ray can now be any meridional ray. This extension is likely to be of importance in the study of wide-angle systems. (Sands [Ph.D. student])

An investigation was carried out regarding the "incompressible sphere" in general relativity, defined as a static spherically symmetric distribution of matter in which the velocities of sound and light are everywhere equal. Apart from the underlying theory, numerical integrations were done on the IBM 1620 computer. (Buchdahl and Land [Honours student])

A good deal of time-consuming labour went into reading and correcting the proofs of the book "Concepts of Classical Thermodynamics" which is being published by the Cambridge University Press as one of the "Monographs in Physics". (Buchdahl)

Other Activities:

Professor Buchdahl attended the triennial meeting on Relativistic Theories of Gravitation held in London in July, at which time he also visited the Cambridge University Press and the Department of Technical Optics at the Imperial College. The costs of the journey were borne partly by the University and partly by the Committee on General Relativity and Gravitation. Professor Buchdahl also attended the meeting of the Australian Mathematical Society held in Hobart in May.

Publications:

Buchdahl, H. A.

'Optical Aberration Coefficients. XII. Remarks on Aberrations of any Order.' Jour. Opt. Soc. America, 55, 641, 1965.

Buchdahl, H. A.

'Remark on the defining relation of the σ-symbols.' Journal of the Australian Mathematical Society. 5, 393, 1965.

Buchdahl, H. A., Tassie, L. J.

'Gauge-Independent Theory of Symmetry. II.' Australian Journal of Physics, 18, 109, 1965.

Reiner, A. S., and Tassie, L. J.

'Electron Scattering by Deformed Nuclei.' Nuovo Cimento, 37, 1524, 1965.

Publications (Cont'd.)

Tassie, L. J.

   'Dirac Magnetic Monopoles and Superconductivity.'
   Nuovo Cimento, 38, 1935, 1965.

Tassie, L. J.

   'Dirac Magnetic Monopoles and Superconductivity.'
   Bulletin of the American Physical Society, 10, 532, 1965.