

PHYSICS ENROLMENTS IN AUSTRALIAN AND NEW ZEALAND UNIVERSITIES 1997 - 2002

**PHILIP JENNINGS, JOHN DE LAETER
AND GRAEME PUTT**

This is the twelfth of a series of triennial surveys of physics enrolments in Australian and New Zealand Universities. This project began in 1974 with surveys by de Laeter¹ and Watson-Munro² for physics enrolments at Australian Colleges of Advanced Education and Universities respectively in the period 1963 to 1973. The original aim of the surveys was to collect data for planning purposes and to study the effects of Government policy on the physics profession.

In 1975, de Laeter and Watson-Munro³ produced the first of these combined surveys for all Australian tertiary educational institutions covering the period 1965-1975. They repeated the exercise in 1979⁴. Following the retirement of Professor Watson-Munro in 1979, Philip Jennings and John de Laeter combined to continue the surveys at triennial intervals through the eighties^{5,6,7,8}. In 1993 the survey was expanded to include New Zealand universities and Graeme Putt joined the team^{9,10}.

We now have a consistent set of data covering the period 1968 to 2002 for Australian universities and from 1991 to 2002 for New Zealand universities.

Introduction

Originally, the surveys focused on numbers of third and fourth year physics students. These were easier to identify than graduates as some of them do double majors and are difficult to keep track of, while others graduate at mid-year. Although it is easier today to collect the data on physics graduates because it is required by the Federal Government, we have continued to count third and fourth years physics majors for consistency. They also represent a more realistic estimate of the enrolments in physics rather than the output of physics departments.

Beginning with the 1982 survey, we began to collect the total number of postgraduate students in physics. Here again we chose to count the total number of postgraduate students to gain an indication of the size of the postgraduate effort. In earlier surveys^{6,7,8} we also estimated the number of pass, honours and postgraduate graduates each year.

Beginning in 1991, we also began to address gender issues because of the perceived low level of participation by females in physics. Initially there was some difficulty in obtaining this data but we now have sufficient data to draw conclusions and as time goes by, we are able to study trends in participation rates of males and females.

The 1996 and 1999 surveys^{10,11} were undertaken in the midst of considerable upheaval and unprecedented anxiety about the future of physics in Australia and New Zealand due to the severe budget cuts and declining enrolments in Physics in many tertiary educational institutions. The situation has not improved although this new data shows some early signs of a recovery.

*Professor P.J. Jennings is at Murdoch University
jennings@murdoch.edu.au*

*Emeritus Professor J.R. de Laeter is at Curtin University
rdelaeter@cc.curtin.edu.au*

*Dr G.D. Putt is at the University of Auckland
gdp@phy.auckland.ac.nz*

Methods

This survey was conducted in July and August of 2002 at a time when North American and European Universities were reporting renewed student interest in Physics. In addition to collecting data about third year, fourth year (Honours and Diploma) and postgraduate (MSc and PhD) enrolments we asked a set of questions about recent changes in course content and structure and to the administration of the Physics course in the various Universities. We also sought information about changes planned for the near future, changes in the student population and significant problems facing the Departments.

This data was obtained from the Heads of the various physics departments in Australia and New Zealand. We have tried to ensure that the data is consistent and accurate by circulating the tables to Heads for checking. However, there are certain to be minor errors due to the difficulty of uniquely identifying physics majors. We encourage readers to notify us if they detect any errors in the data.

Analysis of Enrolment Data

The third year, fourth year and postgraduate enrolments for the period 1996 - 2002 are presented in Tables 1, 2 and 3. Figures 1, 2 and 3 show the trends in total enrolments at third year, fourth year and postgraduate level over the 35-year period since data collection began in 1968.

The following observations are made:

Third year enrolments

Twenty-six Australian Universities are now offering some sort of Physics degree compared with thirty a decade ago. Six New Zealand Universities offer a degree in Physics, the same as a decade ago.

Australian third year enrolments seem to have stabilised after falling from 711 in 1993 to 468 in 2001. The results for 2002 show early signs of recovery in all States of Australia. This may be partly due to the introduction of new physics-related degrees such as photonics, nanotechnology and medical physics that run alongside the existing physics degrees and utilise their 3rd year units. The New Zealand enrolments have been almost static over the past decade with fluctuations of 15% about a mean of 127 students.

The proportion of female students in third year physics has not

Table 1
Physics Enrolments in Australian
& New Zealand Universities 1997 - 2002
Numbers of Third Year Physics Students

Institution	1997		1998		1999		2000		2001		2002	
	M	F	M	F	M	F	M	F	M	F	M	F
Griffith University	9	4	10	5	13	5	14	2	10	3	13	4
James Cook University	2	2	3	0	4	1	5	0	3	0	5	0
Queensland Uni of Technology	6	5	5	1	10	1	6	2	8	2	13	3
Central Queensland University	14	5	16	5	11	6	11	2	11	5	12	0
University of Queensland	9	4	13	1	9	1	10	4	9	3	9	4
University of Southern Queensland	5	0	2	0	3	1	3	0	3	1	2	4
Total Queensland	45	20	49	12	50	14	44	10	44	14	55	15
65	61	64	59	58	70							
Macquarie University	23	2	14	4	19	5	14	5	16	5	21	6
University of Newcastle	8	1	10	2	16	1	17	3	20	2	26	2
University of New England	9	4	6	2	5	1	2	0	2	0	2	0
University of New South Wales	28	6	30	10	20	10	15	4	11	8	33	4
University of Sydney	24	6	30	8	40	5	25	9	35	7	33	13
Uni of Technology, Sydney	12	4	14	6	16	7	17	5	14	3	11	2
University of Western Sydney	13	1	8	2	14	3	15	3	13	4	12	3
University of Wollongong	13	3	9	3	4	4	10	2	14	2	18	4
Total New South Wales	130	27	121	37	134	36	115	31	125	31	156	340
157	158	170	146	156	190							
Aust Defence Force Academy	9	0	9	0	19	4	22	7	12	1	9	3
Aust National Uni - Faculties	21	6	22	4	15	6	28	7	21	11	36	11
University of Canberra	1	0	2	0	2	0	0	0	0	0	0	0
Total ACT	31	6	33	4	36	10	50	14	33	12	45	14
37	37	46	64	55	59							
University of Ballarat	0	0	0	0	0	0	0	0	0	0	0	0
Deakin University	0	0	0	0	0	0	0	0	0	0	0	0
La Trobe University	11	3	4	3	5	2	4	3	10	6	9	7
Monash University	50	16	44	20	50	6	31	9	31	10	25	13
Royal Melb Inst of Technology	31	7	32	7	18	5	25	5	23	6	24	7
Swinburne University	0	0	0	0	0	0	0	0	0	0	0	0
University of Melbourne	22	11	33	15	31	11	27	11	26	9	34	10
Victoria University	33	12	39	8	28	4	24	4	11	2	21	3
Total Victoria	147	49	152	53	132	28	111	32	101	33	112	40
196	205	160	152	134	152							
University of Tasmania	8	1	8	1	9	2	11	1	7	1	11	3
Flinders University	13	1	14	2	14	4	2	6	8	1	20	7
University of Adelaide	4	3	19	6	16	0	15	1	13	4	21	8
University of South Australia	5	3	3	1	0	0	0	0	2	2	3	1
Total South Australia	22	7	36	9	30	4	17	7	23	7	44	16
29	45	34	24	30	60							
Curtin University of Technology	12	1	15	3	15	1	2	0	7	5	5	6
Murdoch University	6	2	2	4	8	1	2	0	6	2	6	3
University of Western Australia	27	13	26	12	25	14	27	12	29	8	31	11
Total Western Australia	41	11	36	15	48	16	31	12	42	12	42	20
52	51	64	43	54	62							
Northern Territory University	1	0	3	0	2	0	0	0	0	0	0	0
Total Australia	425	121	438	131	441	110	384	107	375	110	465	142
546	569	551	491	485	607							
Massey University	8	4	5	2	5	3	7	3	5	1	2	0
University of Auckland	40	7	26	4	41	8	40	9	45	9	48	7
University of Canterbury	30	8	34	6	37	9	37	9	27	6	24	1
University of Otago	7	1	7	0	7	0	8	2	9	2	11	2
University of Waikato	13	1	11	4	10	1	13	1	15	1	14	2
Victoria University	19	1	18	0	14	3	10	4	13	2	19	0
Total New Zealand	117	22	101	16	114	24	115	28	114	21	118	12
139	117	138	143	135	130							

Table 2
Physics Enrolments in Australian
& New Zealand Universities 1997 - 2002
Numbers of Fourth Year Physics Students

Institution	1997		1998		1999		2000		2001		2002	
	M	F	M	F	M	F	M	F	M	F	M	F
Griffith University	0	1	5	1	5	1	2	2	5	1	4	1
James Cook University	0	0	1	2	0	1	0	1	0	1	0	0
Queensland Uni of Technology	3	1	2	1	1	0	0	1	4	1	2	0
Central Queensland University	7	1	6	1	3	0	2	0	1	0	1	0
University of Queensland	6	1	2	0	9	1	6	3	5	5	7	2
University of Southern Queensland	1	0	0	0	0	0	1	0	2	0	0	0
Total Queensland	17	4	15	4	20	2	12	6	18	7	14	3
21	19	22	18	25	17							
Macquarie University	5	2	3	0	2	1	0	2	2	0	2	1
University of Newcastle	4	0	5	1	1	1	2	0	1	0	4	0
University of New England	0	0	2	0	0	0	0	0	0	0	0	0
University of New South Wales	8	6	13	6	9	7	8	4	7	3	6	4
University of Sydney	9	1	12	4	5	3	10	4	9	5	10	4
Uni of Technology, Sydney	5	1	4	0	1	1	3	1	3	0	2	1
University of Western Sydney	4	1	0	0	0	0	4	0	0	0	2	1
University of Wollongong	5	3	10	1	7	1	4	1	3	0	7	0
Total New South Wales	40	14	49	12	25	14	31	12	25	8	33	11
54	61	39	43	33	44							
Aust Defence Force Academy	1	0	6	0	1	0	2	1	0	0	1	0
Aust National Uni - Faculties	4	2	5	7	9	3	5	4	4	2	8	5
University of Canberra	0	0	0	0	0	0	0	0	0	0	0	0
Total ACT	5	2	11	7	10	3	7	5	4	2	9	5
7	18	13	12	6	14							
La Trobe University	2	0	0	0	3	2	3	1	0	0	1	1
Monash University	8	1	9	2	2	5	4	1	7	1	2	0
Royal Melb Inst of Technology	10	2	8	1	9	0	2	0	6	1	4	0
Swinburne University	0	0	0	0	1	0	1	0	3	0	3	0
University of Melbourne	9	3	10	8	14	10	19	7	11	4	14	4
Victoria University	7	1	2	1	4	0	3	0	3	0	2	2
Total Victoria	36	7	29	12	33	17	32	9	30	6	26	7
43	41	50	41	36	33							
University of Tasmania	4	2	4	2	2	1	3	0	5	1	6	1
Flinders University	5	3	3	1	6	0	3	1	2	2	5	0
University of Adelaide	9	2	7	2	3	1	7	2	7	0	9	3
University of South Australia	4	2	1	2	1	1	0	0	0	0	1	1
Total South Australia	18	7	11	5	10	2	10	3	9	2	15	4
25	16	12	13	11	19							
Curtin University of Technology	5	0	5	1	6	2	6	2	1	0	6	4
Murdoch University	4	2	2	0	2	1	2	0	1	0	1	0
University of Western Australia	16	1	8	4	10	4	9	3	10	3	12	2
Total Western Australia	29	3	15	5	18	7	17	5	12	3	19	6
32	20	25	22	15	25							
Total Australia	149	39	134	47	118	46	102	40	103	29	122	37
188	181	164	142	132	159							
Massey University	1	0	5	1	4	1	1	2	0	0	2	0
University of Auckland	21	2	15	4	9	4	16	3	13	1	16	3
University of Canterbury	8	1	13	5	17	3	14	7	16	8	10	4
University of Otago	17	4	9	2	8	0	13	1	11	4	13	1
University of Waikato	8	0										

Table 3
Physics Enrolments in Australian
& New Zealand Universities 1997 – 2002
Numbers of Postgraduate Physics Students

Institution	1997		1998		1999		2000		2001		2002	
	M	F	M	F	M	F	M	F	M	F	M	F
Griffith University	11	0	10	0	10	0	14	2	11	2	10	3
James Cook University	17	6	16	6	17	6	15	4	14	4	15	3
Queensland Uni of Technology	36	11	34	9	31	8	38	11	34	9	35	6
Central Queensland University	7	0	4	1	2	0	2	0	3	0	1	0
University of Queensland	26	5	21	5	27	5	28	5	27	6	28	7
University of Southern Queensland	1	0	2	0	3	0	4	0	4	0	5	0
Total Queensland	98	22	87	21	90	19	98	22	93	21	94	19
	120		108		109		120		114		113	
Macquarie University	33	10	25	12	19	9	12	4	10	6	13	6
University of Newcastle	15	2	16	1	17	1	12	2	11	2	14	2
University of New England	4	1	5	1	5	0	3	0	2	0	0	0
University of New South Wales	59	18	61	16	51	16	38	19	36	17	38	15
University of Sydney	61	16	58	14	54	10	50	11	45	11	40	12
Uni of Technology, Sydney	19	6	18	4	14	4	9	5	7	7	8	4
University of Western Sydney	9	2	9	3	4	0	4	0	5	0	5	0
University of Wollongong	15	5	15	2	20	1	25	2	23	3	22	4
Total New South Wales	215	54	207	53	184	41	163	43	139	46	140	43
	269		260		225		196		185		183	
Aust Defence Force Academy	11	0	11	0	7	0	5	0	6	1	8	1
Aust National Uni - Faculties	12	2	12	2	14	3	12	2	11	2	13	2
ANU - Res Schi of Phys Sciences	69	20	63	21	43	21	35	20	38	21	39	23
Total ACT	92	22	86	23	64	24	52	22	55	24	60	26
	114		109		88		74		79		86	
La Trobe University	17	6	16	5	18	4	11	4	11	5	7	5
Monash University	38	7	31	9	29	9	15	6	17	6	19	6
Royal Melb Inst of Technology	32	4	35	5	34	6	44	8	35	11	26	10
Swinburne University	1	1	2	2	8	3	14	3	17	3	17	4
University of Melbourne	71	15	59	18	58	21	71	29	71	29	67	29
Victoria University	14	2	12	2	9	3	5	2	4	2	5	2
Total Victoria	173	35	155	41	156	46	160	52	155	56	141	56
	208		196		202		212		211		197	
University of Tasmania	8	0	6	0	6	0	6	0	5	0	6	0
	8		6		6		6		5		6	
Flinders University	12	2	12	2	8	3	7	3	5	3	5	2
University of Adelaide	39	9	41	11	35	11	23	10	27	11	28	9
University of South Australia	12	1	12	1	11	1	2	0	2	0	3	1
Total South Australia	63	12	65	14	54	15	32	13	34	14	36	12
	75		79		69		45		48		48	
Curtin University of Technology	21	4	31	6	36	4	39	6	43	6	45	6
Murdoch University	10	5	9	7	13	11	12	8	11	7	12	8
University of Western Australia	30	3	29	1	32	1	29	5	28	5	29	5
Total Western Australia	61	12	69	14	81	16	80	19	82	18	86	19
	73		83		97		99		100		105	
Northern Territory University	1	0	2	0	1	0	1	0	1	0	1	0
	1		2		1		1		1		1	
Total Australia	711	157	677	166	636	161	582	171	564	179	564	175
	868		843		797		753		743		739	
Massey University	10	2	11	2	14	2	10	3	7	2	4	1
University of Auckland	31	11	26	7	17	7	19	5	26	5	19	4
University of Canterbury	34	3	30	5	33	6	26	9	23	12	26	10
University of Otago	33	9	39	11	42	12	32	9	27	6	22	5
University of Waikato	27	3	20	1	25	1	16	1	13	0	10	1
Victoria University	9	2	15	2	14	2	27	5	28	13	21	12
Total New Zealand	144	30	141	28	145	30	130	32	124	38	102	33
	174		169		175		162		162		135	

physics (3), computational physics (3), astro/space physics (3), nanotechnology (2).

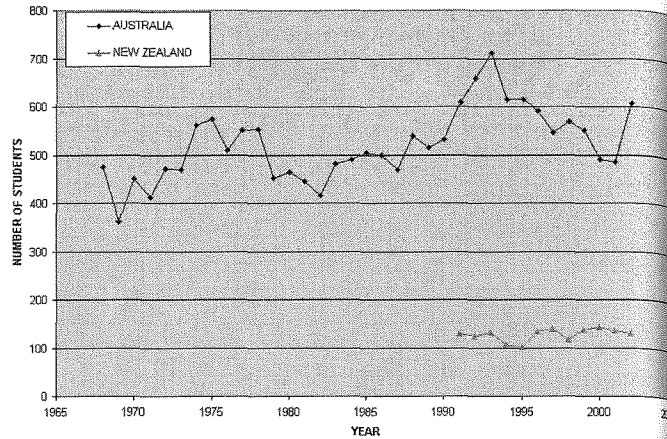
- 4 Australian Universities have terminated their physics courses since 1997.
- 8 Australian Universities have undertaken major reviews and subsequent restructuring of their physics courses over the past five years.
- 4 Australian Universities have introduced joint degrees with physics and engineering.
- Only 4 Australian Universities reported no substantial changes to their offerings over the past five years.

New Zealand

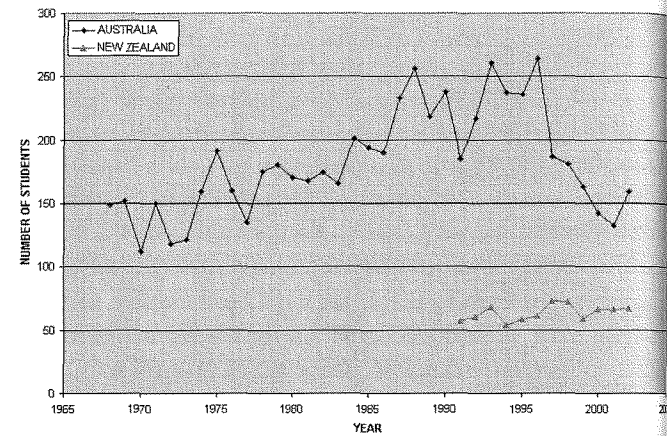
Most initiatives undertaken in NZ seem intended to maximise employment opportunities for graduates that might otherwise steer away from standard BSc degrees majoring in Physics that are perceived as limiting unless they are followed by post-graduate degrees.

Otago has launched a series of 4-year Bachelor of Applied Science degrees that link applied science and technology with business skills. Physics hosts two of these in Electronics and Energy Management and contributes to a third in

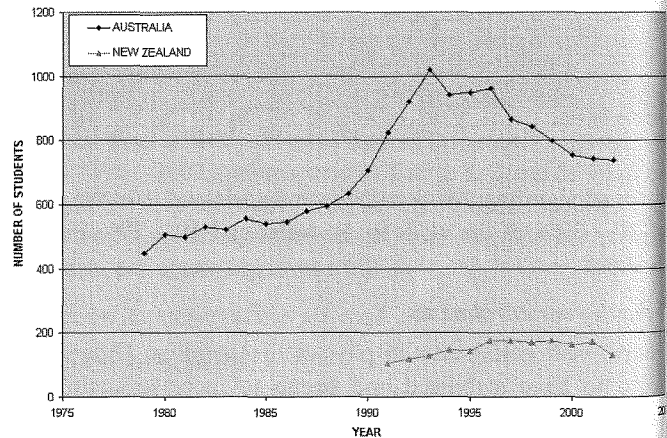
NUMBERS OF THIRD YEAR STUDENTS



NUMBERS OF FOURTH YEAR STUDENTS



NUMBERS OF POSTGRADUATE STUDENTS



Telecommunications.

At Victoria University of Wellington, Physics has amalgamated with Chemistry to produce courses for science degrees that have a strong technology edge to the Physics and Chemistry involved.

At Waikato, Physics contributes strongly to a newly introduced electronic engineering degree, while Massey has steered its undergraduate electronics teaching program in Physics in a similar direction to accommodate the introduction of engineering on its campus. The viability of these new engineering programs depends heavily on cooperative Physics

input. Regrettably the additional teaching demands all of these new initiatives involve have not been matched by staffing needs. Accordingly smaller departments like Waikato have had to steadily shed some of their interesting but less essential courses at senior level in order to survive.

On a different note Canterbury now offers an undergraduate research project to students at the third year level for credit in place of part of the standard papers requirements. It was introduced on trial for US students on one-year exchange programs but is now included as a fixture in their third year course offerings.

Meanwhile Auckland, intent on improving links between physics and the formal mathematical offerings of the Mathematics Department, has introduced alternative papers - analytical techniques in physical sciences - for its physics students, the teaching of which it shares jointly with Mathematics.

Are there any major changes planned in your educational offerings in the next three years?

Australia

14/30 Australian Universities indicated that no major changes were planned.

- 13 Australian Universities have planned major new initiatives for the next three years, including nanotechnology (4), photonics (4), medical physics (1), biophysics (1), computational physics (1), astrophysics (1), environmental physics (1).
- 5 Australian Universities have plans for major restructuring of their physics major in the next three years.

New Zealand

The answer to this question is a resounding NO. It is clear that Physics Departments across NZ are under great stress staff-wise. Initiatives undertaken in the past five years have not been resourced with staff as expected. Indeed several departments have even lost staff through attrition without replacement. Accordingly most departments are struggling to survive with existing commitments let alone opening themselves to new ones.

Otago mentions the possibility of a new Masters degree in medical physics but only in passing.

Have you observed any substantial changes in the Physics student population at your University over the past five years? (eg change in gender balance, change in quantity or quality of students, changing age profile, etc)

Australia

12/30 Australian Universities have not observed any substantial changes in their student population in Physics over the past five years.

18/30 Australian Universities have observed some substantial changes. The most commonly reported changes are:

- more part-time students (4)
- better quality students attracted by new applied physics offerings (4)

- demand for flexible learning packages (4)
- decline in the standard of mathematics preparation (3)
- more female students (2)
- more overseas students (2)
- declining enrolments (2)
- increasing enrolments (2)

New Zealand

While there is an ongoing concern about the declining student ability at entrance level, departments are reluctant to address it by restricting entry to first year courses for fear of being penalized for falling student enrolments. There is genuine concern in most institutions about the general decline in post graduate numbers and the effect this has on recruiting well prepared graduate assistants to assist with junior laboratory staffing and the heavy marking demands of assigned coursework.

Auckland, the populous centre for most of the recent Asian immigration to NZ, reports a steadily increasing proportion of Asian students in its physics classes that has now reached a level exceeding that of its traditional cultural intake. Language difficulties and different cultural approaches to completing laboratory and coursework tasks with this group's infusion pose new challenges in teaching and assessment strategies for academic staff.

Have there been any significant changes to the administration of your Physics degree over the past five years? (eg mergers, closure, etc.)

Australia

15/30 Australian Universities said that there had been no significant changes in the administration of their physics degree over the past five years. The other 15/30 Australian Universities have experienced substantial changes. The most common were mergers with a related discipline and consequent loss of departmental autonomy. The most common mergers were with engineering (5), chemistry (4) and mathematics (3).

New Zealand

Mergers have occurred at Wellington (VUW) and Palmerston North (Massey) of former Physics and Chemistry departments.

- In Massey's case, the former department of Mathematics was also merged with Physics and Chemistry to form the Institute of Fundamental Sciences.
- Both Waikato and Massey have been forced to accommodate demands from fresh engineering initiatives on their campuses that have both modified and reduced their departmental offerings.
- Canterbury which has had a long standing 4-year honours program in Astronomy now runs a standard 3-year BSc program in Astronomy.

What do you consider are the most significant problems facing your Department at this time? (eg declining enrolments, lack of junior staff, etc)

Australia

One Australian University said that there were no significant problems facing their Department. The remaining Universities listed a wide variety of issues of concern. These are listed below in descending order of frequency of response.

- Funding cuts/ funding crisis (12)
- Loss of staff (11)
- Workload explosion for staff (9)
- Declining undergraduate enrolments (9)
- Shortage of postgraduate students (7)
- Skewed age profile of staff/ succession crisis (4)
- Loss of service teaching (3)

New Zealand

The common cry is the lack of junior staff due to a decline in post graduate numbers and the inability to recruit additional staff to undertake the new teaching programs as well as cope with extra, externally funded research contracts departments now seek to support overall funding. The perceived decline in post-graduate numbers is based on this year's sudden drop of about 20% rather than actual longstanding information as the statistics reveal. Nevertheless it highlights the stress permanent staff are under.

In NZ the squeezing effect on academic staffing has not produced the dramatic closedown of departments Australia has experienced. Instead the effect has been spread, somewhat unevenly, across the existing institutions. This might help explain any relative optimism of the majority of Australian surviving departments compared with their NZ counterparts.

Auckland, the largest NZ Physics department, had 26 permanent staff five years ago. Now with overall EFTS numbers essentially unchanged it has 22, a drop not offset by the appointment of temporary staff.

At a time when phrases like the "knowledge economy" and "the knowledge wave" abound in national forums, commitment in the country to "science and technology" as its prime-mover still slumbers as far as Physics is concerned.

Most of the plum rewards available within NZ are still to be found in management, accounting, law and medical specialisation. Physics therefore continues to harvest only a modest numbers of talented students and this is a matter of critical concern to the discipline.

Conclusions

The past five years has been a time of major changes in Physics education in Australia and New Zealand. Most Departments have undergone changes of structure and many have been merged with other similar departments.

At the end of this survey period the third and fourth year enrolments in Australian Universities seem to have stabilised and may even have begun to recover, although they are still well below the levels reached a decade ago. In contrast the corre-

sponding enrolments in New Zealand Universities have remained almost static over this period.

Australian postgraduate numbers in Physics continued to decline from their high point in 1993 and are now down by more than 25% from that peak. In contrast, NZ postgraduate numbers increased through the nineties and have turned down only in the last year.

Many Physics Departments have introduced new allied courses in applied areas such as photonics, medical physics and computational physics in an attempt to make their courses more attractive. Many others are planning to make similar changes in the near future. There is some evidence that these changes have been successful in attracting more high-quality students into physics, at least in the short term.

Many Physics Departments are facing funding crises and workload explosions as a result of the departure of staff who are not being replaced. Many Heads of Department expressed concerns about continuity and succession planning as older staff retire and are not replaced. Most Departments now have highly skewed age profiles with most staff over 50 and in senior positions.

Overall it appears that the funding and enrolments crises that appeared in the mid nineties may have almost run their course and that Physics Departments have successfully restructured in many cases to cope with the new funding arrangements. Considerable staff losses have occurred and further losses seem inevitable but the enrolments picture is encouraging and there are early signs of a recovery. Over the next five years most Physics Departments will have to cope with an increasing workload and declining staff and financial resources but the future does look more promising than it did three years ago.

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