U-notat 6/99

# Departments of Physics at Norwegian Universities

**Expenditure on Research and Development (R&D)**

**Academic staff**

Data from Norwegian R&D Statistics 1997

Commission from the Science and Technology Division at the Research Council of Norway

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Tables

**Introduction**

The following presents tables on R&D expenditure and scientific personnel at units dealing with physics at the four universities of Norway. The included units are [1]:

University of Oslo:
*Department of Physics*
*Institute of Theoretical Astrophysics*

University of Bergen:
*Department of Physics*

Norwegian University of Science and Technology (NTNU)
*Department of Physics*

University of Tromsø
*Department of Physics*

[1] The selection of the units was undertaken in collaboration with the Science and Technology Division at the Research Council of Norway.

**R&D expenditure**

Norwegian R&D statistics for 1997 were completed in February 1999. The figures in this presentation are based on the R&D statistics for the Higher Education Sector (HES). The following tables present data on R&D expenditure within physics at the universities as part of the HES, and data on R&D expenditure within the 5 units dealing with physics.

The first table present R&D expenditure in Norway as a whole and in physics.

Table 1 R&D expenditure in physics in relation to total R&D expenditure in 1995 and 1997. (NOK million).

| Category | 1995 | 1997 | Change in per cent |
|---|---|---|---|
| Total R&D expenditure in Norway | 15 970 | 18 244 | 14 % |
| Industry Sector | 7 341 | 8 572 | 17 % |
| Institute Sector | 4 491 | 4 827 | 7 % |
| Higher Education Sector | 4 139 | 4 846 | 17 % |
| Universities [1] | 3 808 | 4 414 | 16 % |
| *Of which natural sciences* | *1 011* | *1 186* | *17 %* |
| *Of which physics* | *139* | *146* | *5 %* |

*Source: NIFU*

[1] Higher Education Sector, State Colleges not included

Table 1 shows that there has been an increase in total R&D expenditure in Norway (14 per cent in current prices) from 1995 to 1997. This represents 6 per cent increase in fixed prices. In the departments of physics at the four universities in Norway there has been no increase in fixed prices, 5 per cent in current prises. This increase is due to an increase in direct/external funding which occurred mainly in direct current costs. From 1995 to 1997 there has been a decrease in GUF, in real therms.

The R&D in the HES is mainly financed by block grants from the Ministry of Education, Research and Church Affairs - general university funds (GUF). The remaining part is financed from direct/external funding, i.e. business and industry, direct government funding, including funds from the Research Council of Norway, and other sources of funds.

Table 2 Total R&D expenditure, current costs and expenditure on scientific equipment by main source of funding in the HES in 1997. (NOK million).

| Main source of funding | Current costs | Scientific equipment | Total current costs and sc.equipment | Total R&D expenditures |
|---|---|---|---|---|
| GUF | 2 825 | 97 | 2 922 | 3 340 |
| Direct funding | 1 399 | 106 | 1 505 | 1 506 |
| Total | 4 224 | 203 | 4 427 | 4 846 |

*Source: NIFU*

In the national R&D statistics direct government funding is composed of funds from the Research Council of Norway and other public funding. Other external funding is divided into three categories: business/industry, other sources (i.e own funds and funds from private foundations) and abroad.

In this paper current expenditure is defined as labour costs and other current costs. L*abour costs* comprise salaries and associated costs such as bonus payments, holiday pay, contribution to pension funds and other social security payments, payroll taxes etc. *Other current costs* comprise:

- Direct current costs at department level such as non-capital purchases of materials, supplies and minor equipment to support R&D (books, journals, reference materials, travel expenses)
- Indirect current costs, infrastructure/overhead costs such as water, fuel and services, central university administration costs, security, storage, computer services, rents etc.

Capital expenditure is the annual gross expenditure on fixed assets. It is composed of expenditure on

- Land and buildings (not presented in this paper)
- Scientific instruments and equipment (Table 2-7)

From Table 2 we see that 69 per cent of total R&D expenditure was funded from general university funds (GUF), while 66 per cent of current costs and scientific equipment were financed from GUF. It is noticeable that 52 per cent of scientific equipment was funded by direct funding.

The next six tables are concentrated on the 5 units of physics. The tables present data on R&D expenditure in these units.

Table 3 Total R&D expenditure, total current costs and expenditure on scientific equipment by main source of funding in physics in the HES in 1997. (NOK million).

| Main source of funding | Current costs | Scientific equipment | Total current costs and sc.equipment | Total R&D expenditures |
|---|---|---|---|---|
| GUF | 86,2 | 2,5 | 88,7 | 90 |
| Direct funding | 47,7 | 7,5 | 55,2 | 55 |
| Total | 133,9 | 10,0 | 143,9 | 146 |

*Source: NIFU*

Table 3 shows that in physics 75 per cent of the scientific equipment was financed from direct funding in 1997. The share is bigger than in the HES in total. 36 per cent of the current costs were financed from the same source.

Table 4 shows that the University of Oslo had the largest R&D expenditure on current costs and scientific equipment within physics (56 million NOK) in 1997. This represents 39 per

cent of total R&D expenditure in physics at the four universities in total. At the University of Oslo16 per cent of total R&D expenditure in the field of natural sciences was spent in physics, at NTNU the share was 20 per cent and in Bergen only 9 per cent. Despite the fact that a small part of the R&D expenditure in natural sciences was within physics in Bergen, this represents 20 per cent of the activity within physics at the four universities as a whole.

Table 4 R&D expenditure on current costs and scientific equipment in natural sciences and physics and the share of physics at the universities in 1997. (NOK million).

| Institution | Natural sciences | Physics | |
|---|---|---|---|
| | NOK mil. | NOK mil. | Percentage |
| University of Oslo | 354,0 | 56,1 | 16 |
| University of Bergen | 310,4 | 28,3 | 9 |
| Norwegian University of Science and Technology (NTNU) | 210,6 | 43,0 | 20 |
| University of Tromsø | 135,2 | 16,5 | 12 |
| Total | 1010,2 | 143,9 | 14 |

*Source: NIFU*

The next table shows R&D expenditure on current cost and scientific equipment at the five units.

Table 5 R&D expenditure on current costs and scientific equipment at the university departments of physics by main source of funding in 1997 (NOK million).

| Department and institution | GUF NOK | Direct/ external funding NOK | Total NOK | Percentage direct/ external funding |
|---|---|---|---|---|
| Department of Physics, Univ. of Oslo | 29,6 | 20,1 | 49,7 | 40 |
| Institute of Theoretical Astrophysics, Univ. of Oslo | 4,6 | 1,8 | 6,4 | 28 |
| Department of Physics, Univ. of Bergen | 15,9 | 12,4 | 28,3 | 44 |
| Department of Physics, NTNU | 25,7 | 17,3 | 43,0 | 40 |
| Department of Physics, Univ. of Tromsø | 12,9 | 3,6 | 16,5 | 22 |
| Total | 88,7 | 55,2 | 143,9 | 38 |

*Source: NIFU*

The share for physics at the selected units was 38 per cent from direct/external funding on current costs and scientific equipment. Total figures for HES was 34 per cent. The University of Bergen had the highest percentage with 44, while the departments of physics in Oslo and at NTNU had 40 per cent direct/external funding (Table 5).

The two departments in Oslo had a share of almost 40 per cent of both GUF and direct funding of R&D expenditure in physics.

Table 6 shows how GUF is divided between current costs, direct current costs and scientific equipment. Direct current costs comprise books, journals, and reference materials. The rest of current costs are overhead or indirect costs, see page 4.

Table 6 R&D expenditure on current costs, direct current costs and scientific equipment financed by GUF at the university departments of physics in 1997. (NOK million).

| Institution | Current costs | *Of which direct costs* | Scientific equipment | Total |
|---|---|---|---|---|
| Department of Physics, Univ. of Oslo | 28,7 | *2,5* | 0,9 | 29,6 |
| Institute of Theoretical Astrophysics, Univ. of Oslo | 4,5 | *0,5* | 0,1 | 4,6 |
| Department of Physics, Univ. of Bergen | 15,7 | *1,5* | 0,2 | 15,9 |
| Department of Physics, NTNU | 25,0 | *1,1* | 0,7 | 25,7 |
| Department of Physics, Univ. of Tromsø | 12,3 | *2,1* | 0,6 | 12,9 |
| Total | 86,2 | 7,7 | 2,5 | 88,7 |

*Source: NIFU*

The table shows that all the selected units had very low expenditure on scientific equipment financed by GUF. At the four universities current costs within physics represent almost 98 per cent of GUF (capital expenditures excluded).

Table 7 Direct/external funding on R&D at the university departments of physics by source of funds in 1997. (NOK million)

| | Source of funds | | | | |
|---|---|---|---|---|---|
| | | Direct government/ external funding | | | |
| Institution | Business/ industry | Research Council of Norway | Other public funding | Other resources/ abroad/ own funds | Total |
| Department of Physics, Univ. of Oslo | 0,2 | 19,3 | 0,4 | 0,2 | 20,1 |
| Institute of Theoretical Astrophysics, Univ. of Oslo | 0,0 | 1,8 | 0,0 | 0,0 | 1,8 |
| Department of Physics, Univ. of Bergen | 1,3 | 8,9 | 1,8 | 0,4 | 12,4 |
| Department of Physics, NTNU | 3,1 | 12,7 | 0,0 | 1,6 | 17,3 |
| Department of Physics, Univ. of Tromsø | 0,1 | 2,0 | 0,2 | 1,3 | 3,6 |
| Total | 4,6 | 44,7 | 2,4 | 3,5 | 55,2 |

*Source: NIFU*

This table shows how direct funding is distributed on different sources of funds at the selected units. The largest source of funds in 1997 was the Research Council of Norway, with a share of 81 per cent of direct funding on R&D. Business/industry had a share of 8 percent and the other sources even less. For natural sciences as a whole funds from the Research Council of Norway contributed with 54 per cent of total external funding. Other sources and abroad contributed with 19 per cent, and business/industry with 14 per cent.

Table 8 Current expenditure by type of activity at the university departments of physics in 1997. Per cent, rounded off to closest 5.

| Institution | Type of activity: Basic research | Applied research | Experimental development | Total |
|---|---|---|---|---|
| Department of Physics, Univ. of Oslo | 75 | 15 | 10 | 100 |
| Institute of Theoretical Astrophysics, Univ. of Oslo | 95 | 5 | 0 | 100 |
| Department of Physics, Univ. of Bergen | 60 | 25 | 15 | 100 |
| Department of Physics, NTNU | 90 | 10 | 0 | 100 |
| Department of Physics, Univ. of Tromsø | 50 | 40 | 10 | 100 |

*Source: NIFU*

Table 8 shows the distribution of current costs by type of activity at the departments of physiscs. The institute of Theoretical Astrophysics at University of Oslo had the highest component of basic research with 95 per cent. The Department of Physics at NTNU also had a high component of basic research with 90 per cent.

In the Frascati Manual[2] the three types of activities are defined as follows:

- Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.
- Applied research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or object.
- Experimental development is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems or services; or to improving substantially those already produced or installed.

[2] The international guidelines for compiling R&D statistics are issued by OECD in the "Frascati Manual" (*The measurement of Scientific and Technological Activities. Proposed Standard Practice for Surveys of Research and Development.* Frascati Manual 1993, OECD 1994).

**R&D personnel**

The next three tables present figures on academic staff at the five selected units of physics. In 1997 researchers approximately spent 60 per cent of their time performing R&D activities, while technicians and other supporting personnel spent 40 per cent.

Table 9 below shows data for head counting of R&D personnel in 1995 and 1997 as a total, within natural sciences and within physics. (Notice that the number of persons refer to a given date, October 1 1997).

Table 9 Academic staff per 1. October at the departments of physics in relation to total academic staff in Norway and in HES in 1995 and 1997.

| Category | 1995 | 1997 | Change in per cent |
|---|---|---|---|
| Total academic staff in Norway | 26 715 | 30 280 | 13,3 |
| Institute Sector | 6 048 | 6 118 | 1,2 |
| Higher Education Sector | 12 652 | 13 785 | 9,0 |
| The four universities | 7 598 | 8 157 | 7,4 |
| *Of which natural sciences* | *1 962* | *1 972* | *0,5* |
| *Of which in physics* | *333* | *293* | *-12,0* |

*Source: NIFU*

Total academic staff in Norway has increased by 13 per cent from 1995 to 1997. In the Higher Education Sector the increase was 9 per cent. The table shows that there is almost no increase in natural sciences within the four universities, and that physics has decreased by 12 per cent. In 1995 there were 333 persons (headcounts per 1. October) in physics. In 1997 there were 293. The decrease has mainly occurred among the externally paid researchers and the externally paid recruitment personnel.

Table 10 below shows the professional rank of the academic staff in physics in 1997. Of total academic staff 163 persons, or 56 per cent, had tenured positions and 34 per cent of the staff were fellowships holders (recruitment personnel).

43 per cent of the total academic staff in the selected units in physics was at the University of Oslo. 30 per cent was at NTNU, and NTNU had the majority of the externally paid researchers (contract researchers). More than 50 per cent of the recruitment personnel was connected to the University of Oslo.

Table 10 Academic staff per 1. October at the university departments of physics by institution and professional rank in 1997.

| Department and institution | Profes-sor | Associ-ate profes-sor | Other tenured posi-tions | Total tenured person-nel | Post. doc | Other research-ers | Recruit-ment personnel | Total |
|---|---|---|---|---|---|---|---|---|
| Department of Physics, Univ. of Oslo | 37 | 17 | 1 | 55 | 5 | 4 | 46 | 110 |
| Institute of Theoretical Astrophysics, Univ. of Oslo | 9 | 1 | 0 | 10 | 1 | 2 | 4 | 17 |
| Department of Physics, Univ. of Bergen | 18 | 13 | 4 | 35 | 2 | 3 | 11 | 51 |
| Department of Physics, NTNU | 29 | 15 | 0 | 44 | 7 | 6 | 30 | 87 |
| Department of Physics, Univ. of Tromsø | 8 | 9 | 2 | 19 | 0 | 1 | 8 | 28 |
| Physics at the universities in 1997 | 101 | 55 | 7 | 163 | 15 | 16 | 99 | 293 |
| Physics at the universities in 1995 | 104 | 55 | 9 | 168 | 16 | 26 | 123 | 333 |

*Source: NIFU/Research Personnel Register*

Physics is dominated by men. In 1997 there was only one female professor and seven associate professors at the departments in question. Women represented 26 per cent of the recruitment personnel in physics, while in the natural sciences as a whole the share was 33 per cent. Almost half of the 26 fellowships held by women was financed by the Research Council of Norway and 9 from general university funds (GUF).

The last table, Table 11, shows the number of full-time equivalent R&D personnel within physics.

Table 11 Total personnel involved in R&D at the university departments of physics. Full time equivalent (FTE) in 1997.

| Institution | Research-ers | Technicians and other supporting staff | Total | Ratio of technicians and other supporting staff/researchers |
|---|---|---|---|---|
| Department of Physics, Univ. of Oslo | 100 | 46 | 146 | 0,46 |
| Institute of Theoretical Astrophysics, Univ. of Oslo | 16 | 5 | 21 | 0,31 |
| Department of Physics, Univ. of Bergen | 52 | 33 | 85 | 0,63 |
| Department of Physics, NTNU | 84 | 38 | 122 | 0,45 |
| Department of Physics, Univ. of Tromsø | 26 | 23 | 49 | 0,88 |
| Total person-years (FTE) | 278 | 145 | 423 | 0,52 |
| Total R&D-person-years (FTE) | 162 | 60 | 222 | 0,37 |

*Source: NIFU/R&D statistics*