Terje Bruen Olsen

Physical sciences in Norway. A bibliometric analysis

- Publication and Citations within Physical Sciences in Norway
- Journal publishing at the Department of Physics, Univ. of Oslo

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Preface

This report presents a bibliometric analysis of Norwegian research in *Physical sciences*. The report has two sections.

The first section provides a picture of the overall publication activity and the 'visibility'of Norwegian research in a set of scientific fields considered relevant to *Physical sciences* compared to other countries. This section is a result of a project commissioned by the Research Council of Norway, Science and Technology Division, as a contribution to the national evaluation exercise of Norwegian physics.

In the second section we present the results of a more detailed bibliometric analysis of a selected institute, the Department of Physics at the University of Oslo. This is a preliminary study initiated by NIFU itself.

The report is written by Terje Bruen Olsen. Egil Kallerud has commented on earlier drafts.

Oslo, April 2000

Petter Aasen
Director

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Publication and Citations within Physical Sciences in Norway

A comparison between Norway and other countries, based on the National Science Indicators on Diskette (NSIOD)

1 Introduction

Bibliometric R&D indicators measure 1) the extent of publishing in international scientific journals, and 2) the extent to which these papers have been referred to or *cited* in other papers in the same journals. In the following we will present tables and figures with publication and citation statistics in three fields of science considered by the *Research Council of Norway* to be relevant for the *physical sciences*, comparing Norway to a selection of other countries. The three fields are *Physics*, *Astrophysics* and *Materials Science*.

2 Data source

The *National Science Indicators On Diskette (NSIOD)* is a database with aggregated publication and citation statistics which covers about 170 countries, i.e. almost the whole world, throughout the period 1981-98. Statistics are also available for the geopolitical regions Asia Pacific, the European Union and Latin America. In the standard version of NSIOD that has been applied for the present analysis the papers are classified in 24 fields of science. Most of these belong to the natural sciences and technology. However, a few of the social sciences are also included. NSIOD is published by the *Institute for Scientific Information (ISI)*, in Philadelphia, USA, a commercial enterprise which also publishes the *Science Citation Index (SCI*), the *Social Science Citation Index (SSCI)*, and the *Arts & Humanities Citation Index (AHCI)*, as well as several other bibliometric products on scientific publishing.

All the fields of science in the NSIOD standard database are listed alphabetically below:

- Agricultural Sciences
- Astrophysics
- Biology & Biochemistry
- Chemistry
- Clinical Medicine
- Computer Science
- Ecology/Environment
- Economics & Business
- Education
- Engineering
- Geosciences
- Immunology
- Law
- Materials Science
- Mathematics
- Microbiology
- Molecular Biology & Genetics
- Multidisciplinary
- Neuroscience
- Pharmacology
- Physics
- Plant & Animal Science
- Psychology/Psychiatry
- Social Sciences, general

A field of science is defined by the journals that are classified under the field. Each journal is generally classified under *one* field.[1] All papers in a journal are regarded as belonging to that journal's field of science.[2]

In the database that is the basis for the present analysis, it is not possible to split the fields of sciences into more narrow categories.[3] The data are aggregated at a national level enabling a comparison of countries for different fields of science. Using NSIOD it is not possible to break down national data, neither for individuals nor institutions/institutes.[4]

The number of journal papers can be considered as an indicator of scientific *production*. The number of citations can be seen to be an expression of the extent to which the publication has been *recognised* by, or made *visible* to, colleagues in science. There is general agreement among bibliometricians that extreme care should be given not to interpret publication and citation frequencies as measures of research *quality*. On the other hand, bibliometric data can be useful as background data in evaluations, e.g., of a field of science or a research unit.

In the following we will present – by tables and figures – a survey of the extent of Norwegian publishing within a selection of three fields considered by the Research Council of Norway to be relevant for the on-going evaluation of Norwegian physical sciences, and make comparisons with publishing activities in a selection of other countries. We also present data on citation indicators such as *Citation impact* and *Relative citation impact*, see p. 11. The selected fields are *Physics, Astrophysics* and *Materials Science*. The borderlines between the fields are not clear-cut, however, neither in epistemological nor operational terms. For example, a few journals are included in more than one category. In general terms, *Physics* includes journals of a broad, general nature from all areas of physics. The category also includes condensed matter physics, optics, acoustics, and journals dealing with applied physics. The *Astrophysics* category includes astronomy in addition to astrophysics and covers journals that focus on celestial bodies. The *Materials Science* category contains journals concerned with the study of materials applied to science and technology, and covers a broad scope of materials (paper & wood, textiles, ceramics, composites etc.) as well as construction and building technology.

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1 A few journals have, however, been classified under 2 – or, exceptionally – 3 fields, see Annex 3.

2 There are exceptions here also, see the introduction to Annex 4.

3 We have used the standard version of NSIOD. There is also a "DeLuxe" version with more narrowly defined subfields – 104 categories in all. NIFU has, however, not bought the "DeLuxe" version. In Annex 3 we show the relationship between the two field classification systems.

4 NIFU has access to another ISI-database where this is possible, but for Norwegian papers only. The National Citation Report (NCR) for Norway encompasses all papers in ISI-indexed journals with "Norway" in the authors' address field of the base. Provided further development of the database is undertaken, the NCR makes possible in-depth bibliometric analyses. Norwegian researchers' publication patterns can be analysed at an institutional, institute and personal level. In addition, these disaggregated data contain information about the journals in which the papers are published and about co-authorship, i.e. who publishes with whom. – Actually, NIFU has undertaken a pilot case study based on the NCR data, of the publishing of the Department of Physics, University of Oslo; see the second section of this report.

Annex 4 presents a complete list of the journals included in the three field categories, from which the papers in the present analysis have been counted.

The journal-based field classification provides statistics that may differ from statistics with a different classification base. Ideally, one would prefer to identify the subjects by classifying the single papers, not only the journals. A study of microbiology[5] reveals that even if the journals included in NSIOD cover almost all papers published by Norwegian microbiologists, only about 40 per cent of the papers were published in journals classified as *Microbiology*. Most papers were published in journals classified in *other* NSIOD fields, for example, *Clinical Medicine* and *Plant & Animal Science*. An unpublished pilot case study of the Department of Physics, University of Oslo, has a similar conclusion. Between a one third and a fourth of the papers of the tenured staff were published in journals attributed to *other* fields than *Physics*, *Astrophysics* and *Materials Science*.

In general, there are many precautions to be taken in interpreting bibliometric statistics properly; some general warnings against misinterpretations are presented in Annex 2.

In the present study of the physical sciences one should be careful not to use the aggregate NSIOD statistics as a tool to assess the productivity and visibility of individual Norwegian physicists or research groups. There are at least two reasons for this.

Firstly, the journal-based approach provides basic data that are different from data retrieved from the authors' publication list. Scientists tend to publish in a broad spectre of journals, not only in the core journals of their own main discipline. Multi- and transdisciplinary co-operation often occurs, and this is reflected in the publishing behaviour. As the examples above show, the bulk of papers written by the scientists in a particular field is published in journals that are mainly associated with *other* fields.

Secondly, the publication output is, of course, a function of the number of active scientists in the relevant fields. In the present analysis we actually find that Norway has low output in terms of papers in the physical sciences using the NSIOD data. The data do not tell, however, the productivity in terms of number of papers *per person*, or *per man-year* in Norway compared to other countries. To do this, we would need to know the magnitude of the physicist "population" of the countries. These input data are not easily available, and have not been considered in the present analysis. But assuming that Norway has a small number of physicists compared to other countries, the average productivity in terms of papers per person or papers per unit money may be just as high for Norway as for several of the other countries for which comparison is made. From bibliometric data we simply cannot tell whether this is the case or not. So, one should be careful not to draw conclusions from aggregate bibliometric data on a national level to a group or individual level.

[5] Aksnes D.W., Olsen T.B., Seglen P.O: *Inadequacy of a journal-based field delineation. Incomplete recovery of Norwegian microbiology articles in ISI's Microbiology field*, proceedings paper at the 7th conference of the International Society for Scientometrics and Informetrics, Colima, Mexico, July 1999.

In the following, we present tables and figures on publications and citations.[6] In general, they speak for themselves. Some explanations and comments, however, are presented in the following text sections.

3 The total period 1981-98

During the period 1981-98 more than 10 million papers were published in the journals included in the database. Of these, about 58 000 had one or more authors with a Norwegian address. These "Norwegian" papers represent 0.6 per cent of all papers in the world, Table 1 lists a selection of countries to which Norway will be compared in this report. These 22 countries cover around 90 per cent of all published papers in the world.

Table 1. Papers and citations for selected countries, 1981-1998. All fields of science.

Country	Number of papers	Percentage of world total	Cited papers	% cited papers	Number of citations	Citation impact	Relative citation impact
US	3 829 448	38.1	3 034 238	79.2	56 267 471	14.69	1.44
UK	894 872	8.9	698 065	78.0	10 594 716	11.84	1.16
Japan	803 805	8.0	595 738	74.1	6 692 577	8.33	0.82
Germany	789 511	7.9	570 972	72.3	7 329 410	9.28	0.91
France	574 635	5.7	420 131	73.1	5 414 332	9.42	0.92
Canada	491 189	4.9	385 380	78.5	5 312 514	10.82	1.06
Italy	316 537	3.2	233 577	73.8	2 632 270	8.32	0.81
Australia	250 766	2.5	193 306	77.1	2 419 618	9.65	0.94
Netherlands	223 212	2.2	177 823	79.7	2 636 484	11.81	1.16
Sweden	184 624	1.8	149 362	80.9	2 410 666	13.06	1.28
Spain	179 462	1.8	123 725	68.9	1 039 414	5.79	0.57
Switzerland	159 343	1.6	123 244	77.4	2 326 876	14.60	1.43
Belgium	110 053	1.1	82 524	75.0	1 108 239	10.07	0.99
Denmark	91 454	0.9	73 970	80.9	1 120 305	12.25	1.20
Finland	77 151	0.8	59 666	77.3	752 945	9.76	0.95
Austria	69 972	0.7	49 378	70.6	569 923	8.15	0.80
Norway	**58 321**	**0.6**	**45 367**	**77.8**	**544 167**	**9.33**	**0.91**
New Zealand	51 510	0.5	39 536	76.8	422 982	8.21	0.80
Greece	39 535	0.4	26 321	66.6	194 737	4.93	0.48
Ireland	25 562	0.3	17 788	69.6	179 900	7.04	0.69
Portugal	16 906	0.2	11 348	67.1	90 612	5.36	0.52
Iceland	2 696	0.0	2 042	75.7	26 634	9.88	0.97
World total *)	10 044 850	100.0	7 324 416	72.9	102 639 440	10.22	1.00

Source: NIFU Data: National Science Indicators/Institute for Scientific Information

*) I.e. the about 170 countries included in the database. The number of papers and citations for the countries will sum up to more than the world total and the percentages to more than 100 because of co-authorships across the countries.

Table 2 shows Norwegian papers within all fields of science in the database. *Clinical Medicine* is by far the greatest field by number of papers and covers alone 32 per cent of all the Norwegian papers. The selected physical sciences (boldface) represent 8.4 per cent. Figure 1 illustrates the relative size of these three fields.

[6] Annex 1 gives a list of all tables and figures in this paper.

In Table 3 we look more closely at selected fields in the physical sciences. The three fields are presented in separate tables. This is the sub-number system of the tables, which also applies in the figures:

1. Physics
2. Astrophysics
3. Materials Science

Table 2. Norwegian papers by field of science, 1981-1998

Field of Science	Number of Norwegian papers	Percentage Norwegian papers of all papers in the field	The field's percentage of all Norwegian papers	The field's percentage of all papers in the world
Agricultural Sciences	1 232	0.45	2.11	2.76
Astrophysics	**484**	**0.42**	**0.83**	**1.14**
Biology & Biochemistry	4 757	0.55	8.16	8.68
Chemistry	5 430	0.39	9.31	13.97
Clinical Medicine	18 654	0.80	31.99	23.19
Computer Science	365	0.33	0.63	1.09
Ecology/Environment	2 280	1.05	3.91	2.16
Economics & Business	780	0.54	1.34	1.43
Education	100	0.22	0.17	0.46
Engineering	2 531	0.37	4.34	6.74
Geosciences	3 536	1.36	6.06	2.58
Immunology	1 780	1.07	3.05	1.65
Law	13	0.04	0.02	0.33
Materials Science	**934**	**0.29**	**1.60**	**3.25**
Mathematics	812	0.48	1.39	1.69
Microbiology	1 436	0.59	2.46	2.41
Molecular Biology & Genetics	1 409	0.53	2.42	2.65
Multdisciplinary	661	0.37	1.13	1.77
Neuroscience	2 241	0.60	3.84	3.69
Pharmacology	1 559	0.59	2.67	2.62
Physics	**3 479**	**0.30**	**5.97**	**11.42**
Plant & Animal Science	6 123	0.86	10.50	7.11
Psychology/Psychiatry	1 612	0.54	2.76	2.95
Social Sciences, general	2 190	0.61	3.76	3.59
Total *)	58 321	0.58	..	..

Source: NIFU Data: National Science Indicators/Institute for Scientific Information

*) The number of papers sums up to more than the total and the precentages to more than 100 because some of the journals are classified under more than one field.

In Table 3 national data are presented using the following indicators:

- All papers in the field in absolute figures
- All papers in the field as a percentage of all papers in the country
- *Relative publication index*, defined as the field's percentage of the total number of papers in the country, divided by the field's percentage of the total number of papers of all countries in the database
- Cited papers in absolute figures
- Cited papers as percentage of all papers
- All citations in absolute figures
- *Citation impact*, which is the number of citations divided by the number of papers.

- *Relative citation impact*, which shows the relation between the field's citation impact in individual countries and the citation impact for the field worldwide when all countries are included (the impact base in the table). The relative citation impact for a field in a particular country thus has the value of 1 if the country's papers are cited to the same extent as all papers worldwide in the field.
- *Impact base*, which is the average number of citations per paper (citation impact) for all the papers worldwide in the field.

In Table 3 the countries are ranked according to the number of papers. As can be seen, Norway ranks as number 18 in the total of 22 countries in all the three fields. In the field of *Physics* about 3 500 papers with Norwegian author addresses have been published from 1981 through 1998. This is only slightly more than the *half* of the Finnish production. Denmark had more than 2.5 times as many papers as Norway and Sweden more than 4 times as many. The situation in *Astrophysics* is more or less the same. Denmark and Finland had about twice, and Sweden more than three time as many as many papers as Norway in this field. In *Materials Science* Norway is very similar to Denmark, but Sweden is far ahead and Finland had more than twice as many papers.

The number of papers of a country is, of course, related to its size. Figure 2 shows article production per million inhabitants. To give an idea of the development of the field, data for three years (1981, 1990 and 1998) have been included. Compared to other countries, Norway scores low on this indicator in all the three physical fields. In *Astrophysics*, Norway ranks similarly to France, Germany and the US.

In Figure 3, the country's papers within a field is displayed as a percentage of all national papers. This gives an impression of the field profiles of the countries. For Norway, the share of all the three fields is smaller than for any of the other countries except Iceland, and – in *Materials Science* – Denmark. In consequence, it appears that the physical fields of science do not weight heavily in the total scientific papers production of Norway.

This also follows from Figure 4 in which the Nordic countries are in focus. Figure 4 shows the relative publication index for the selected three physical sciences. A relative publication index value of 1 means that the field's percentage of the total number of papers in the country corresponds to the field's percentage of the world total. As shown in the figure, Norway has about half that which may be "expected" in *Physics* and *Materials Science*, and about three-quarters that for *Astrophysics*.

Looking at the relative citation impact (Figure 5), we find that Norway ranks lowest of the Nordic countries in all the three fields under consideration, in *Physics* even lowest of *all* the selected countries. In *Astrophysics* only Finland ranks lower. In *Materials Science*, Norway is comparable to Germany but ranked above Finland. In all the three fields the relative citation index for Norway has values considerably below 1, which means that Norwegian papers are cited less frequently than the world average.

Table 3.1. Papers and citations within Physics for selected countries, 1981-1998

Country	Number of papers	% of all papers in the country	Relative publica-tion index	Cited papers	% cited papers	Number of citations	Citation impact	Relative citation impact	Impact base
US	341 748	8.9	0.78	280 797	82.2	4 794 712	14.03	1.60	8.75
Japan	135 319	16.8	1.47	100 763	74.5	1 036 325	7.66	0.88	8.75
Germany	116 078	14.7	1.29	92 025	79.3	1 208 547	10.41	1.19	8.75
France	88 895	15.5	1.35	67 849	76.3	864 846	9.73	1.11	8.75
UK	75 622	8.5	0.74	59 856	79.2	755 663	9.99	1.14	8.75
Italy	45 535	14.4	1.26	33 987	74.6	370 757	8.14	0.93	8.75
Canada	35 572	7.2	0.63	28 505	80.1	330 113	9.28	1.06	8.75
Switzerland	26 628	16.7	1.46	21 390	80.3	398 527	14.97	1.71	8.75
Netherlands	21 685	9.7	0.85	17 662	81.5	248 317	11.45	1.31	8.75
Spain	20 830	11.6	1.02	15 440	74.1	132 365	6.35	0.73	8.75
Australia	16 237	6.5	0.57	12 539	77.2	123 563	7.61	0.87	8.75
Sweden	15 072	8.2	0.71	11 917	79.1	150 941	10.01	1.14	8.75
Belgium	11 911	10.8	0.95	9 296	78.1	104 754	8.79	1.00	8.75
Denmark	9 261	10.1	0.89	7 652	82.6	126 701	13.68	1.56	8.75
Austria	8 320	11.9	1.04	6 319	76.0	70 385	8.46	0.97	8.75
Finland	6 005	7.8	0.68	4 715	78.5	61 788	10.29	1.18	8.75
Greece	5 757	14.6	1.27	4 198	72.9	37 042	6.43	0.73	8.75
Norway	**3 479**	**6.0**	**0.52**	**2 718**	**78.1**	**26 314**	**7.56**	**0.86**	**8.75**
Portugal	2 845	16.8	1.47	1 942	68.3	15 757	5.54	0.63	8.75
Ireland	2 150	8.4	0.74	1 635	76.1	16 285	7.57	0.87	8.75
New Zealand	1 924	3.7	0.33	1 516	78.8	19 281	10.02	1.15	8.75
Iceland	122	4.5	0.40	91	74.6	969	7.94	0.91	8.75

Source: NIFU Data: National Science Indicators/Institute for Scientific Information

Table 3.2. Papers and citations within Astrophysics for selected countries, 1981-1998

Country	Number of papers	% of all papers in the country	Relative publica-tion index	Cited papers	% cited papers	Number of citations	Citation impact	Relative citation impact	Impact base
US	54 897	1.4	1.26	49 780	90.7	1 078 024	19.64	1.37	14.32
UK	13 971	1.6	1.37	12 137	86.9	227 514	16.28	1.14	14.32
Germany	12 794	1.6	1.43	11 069	86.5	179 649	14.04	0.98	14.32
France	8 858	1.5	1.36	7 514	84.8	115 541	13.04	0.91	14.32
Italy	7 473	2.4	2.08	5 982	80.1	83 314	11.15	0.78	14.32
Canada	5 972	1.2	1.07	5 268	88.2	94 631	15.85	1.11	14.32
Japan	5 500	0.7	0.60	4 599	83.6	61 681	11.21	0.78	14.32
Netherlands	4 333	1.9	1.71	3 882	89.6	76 491	17.65	1.23	14.32
Australia	3 966	1.6	1.39	3 386	85.4	60 728	15.31	1.07	14.32
Spain	3 406	1.9	1.67	2 692	79.0	29 765	8.74	0.61	14.32
Sweden	1 592	0.9	0.76	1 384	86.9	22 119	13.89	0.97	14.32
Switzerland	1 434	0.9	0.79	1 256	87.6	27 436	19.13	1.34	14.32
Belgium	1 246	1.1	1.00	1 017	81.6	12 219	9.81	0.69	14.32
Denmark	1 092	1.2	1.05	924	84.6	14 501	13.28	0.93	14.32
Greece	993	2.5	2.21	695	70.0	5 022	5.06	0.35	14.32
Finland	915	1.2	1.04	756	82.6	8 121	8.88	0.62	14.32
Austria	659	0.9	0.83	512	77.7	4 461	6.77	0.47	14.32
Norway	**484**	**0.8**	**0.73**	**401**	**82.9**	**4 889**	**10.10**	**0.71**	**14.32**
New Zealand	374	0.7	0.64	307	82.1	3 149	8.42	0.59	14.32
Ireland	240	0.9	0.83	188	78.3	2 688	11.20	0.78	14.32
Portugal	129	0.8	0.67	93	72.1	745	5.78	0.40	14.32
Iceland	20	0.7	0.65	19	95.0	286	14.30	1.00	14.32

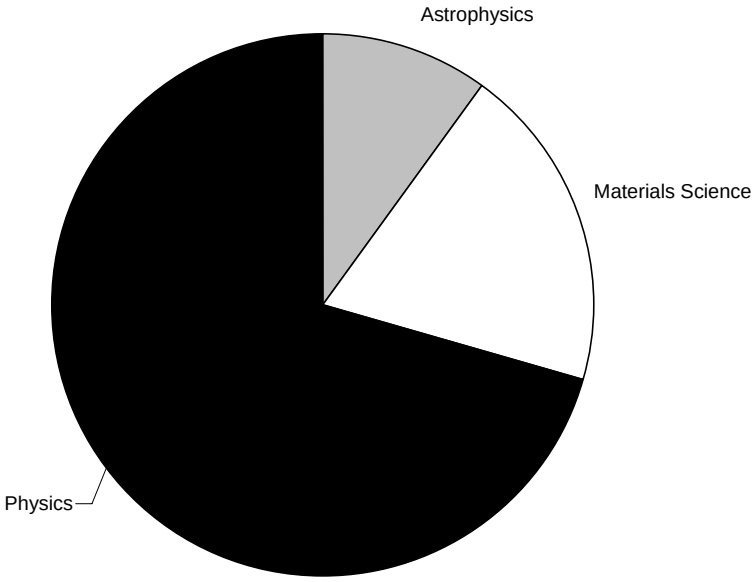
Source: NIFU Data: National Science Indicators/Institute for Scientific Information

Table 3.3. Papers and citations within Materials Science for selected countries, 1981-1998

Country	Number of papers	% of all papers in the country	Relative publica-tion index	Cited papers	% cited papers	Number of citations	Citation impact	Relative citation impact	Impact base
US	93 961	2.5	0.76	67 945	72.3	715 041	7.61	1.61	4.73
Japan	44 264	5.5	1.70	28 052	63.4	193 259	4.37	0.92	4.73
Germany	31 414	4.0	1.23	18 165	57.8	127 729	4.07	0.86	4.73
UK	22 991	2.6	0.79	16 209	70.5	126 172	5.49	1.16	4.73
France	16 567	2.9	0.89	10 812	65.3	83 697	5.05	1.07	4.73
Canada	12 622	2.6	0.79	8 445	66.9	63 708	5.05	1.07	4.73
Italy	5 831	1.8	0.57	3 949	67.7	26 036	4.47	0.95	4.73
Sweden	5 176	2.8	0.86	3 345	64.6	25 642	4.95	1.05	4.73
Australia	5 120	2.0	0.63	3 496	68.3	25 682	5.02	1.06	4.73
Spain	4 604	2.6	0.79	3 129	68.0	18 249	3.96	0.84	4.73
Netherlands	3 730	1.7	0.51	2 722	73.0	22 909	6.14	1.30	4.73
Switzerland	3 257	2.0	0.63	2 193	67.3	19 762	6.07	1.28	4.73
Belgium	2 242	2.0	0.63	1 417	63.2	9 364	4.18	0.88	4.73
Finland	2 206	2.9	0.88	1 314	59.6	7 648	3.47	0.73	4.73
Austria	1 811	2.6	0.80	1 163	64.2	7 548	4.17	0.88	4.73
Greece	1 122	2.8	0.87	694	61.9	3 341	2.98	0.63	4.73
Denmark	1 047	1.1	0.35	723	69.1	6 314	6.03	1.27	4.73
Norway	**934**	**1.6**	**0.49**	**629**	**67.3**	**3 845**	**4.12**	**0.87**	**4.73**
Portugal	818	4.8	1.49	465	56.9	2 089	2.55	0.54	4.73
New Zealand	713	1.4	0.43	454	63.7	2 337	3.28	0.69	4.73
Ireland	543	2.1	0.65	319	58.8	1 884	3.47	0.73	4.73
Iceland	9	0.3	0.10	5	55.6	7	0.78	0.16	4.73

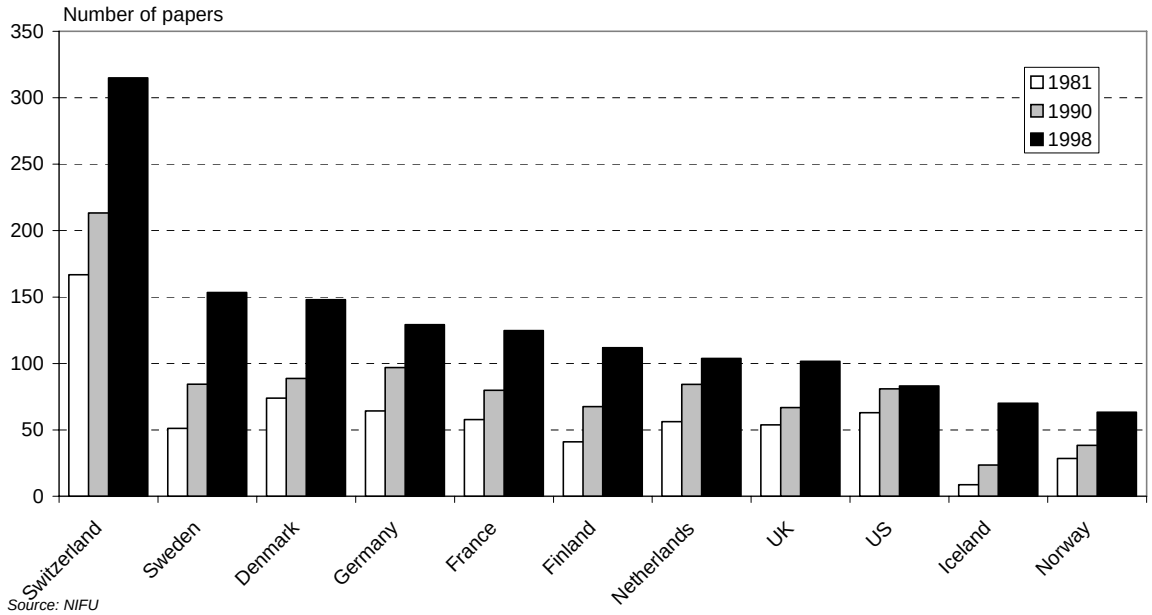
Source: NIFU Data: National Science Indicators/Institute for Scientific Information

Fig. 1 Physics, Astrophysics and Materials Science - share of papers 1994-98



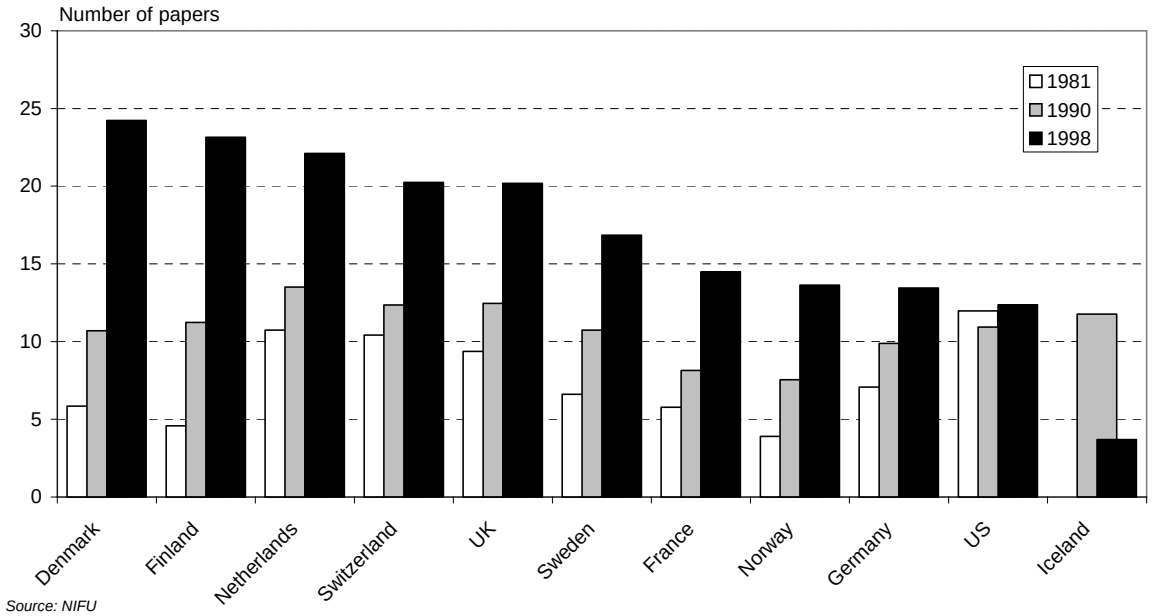
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 2.1 Papers per mil. inhabitants within Physics in selected countries 1981, 1990 and 1998



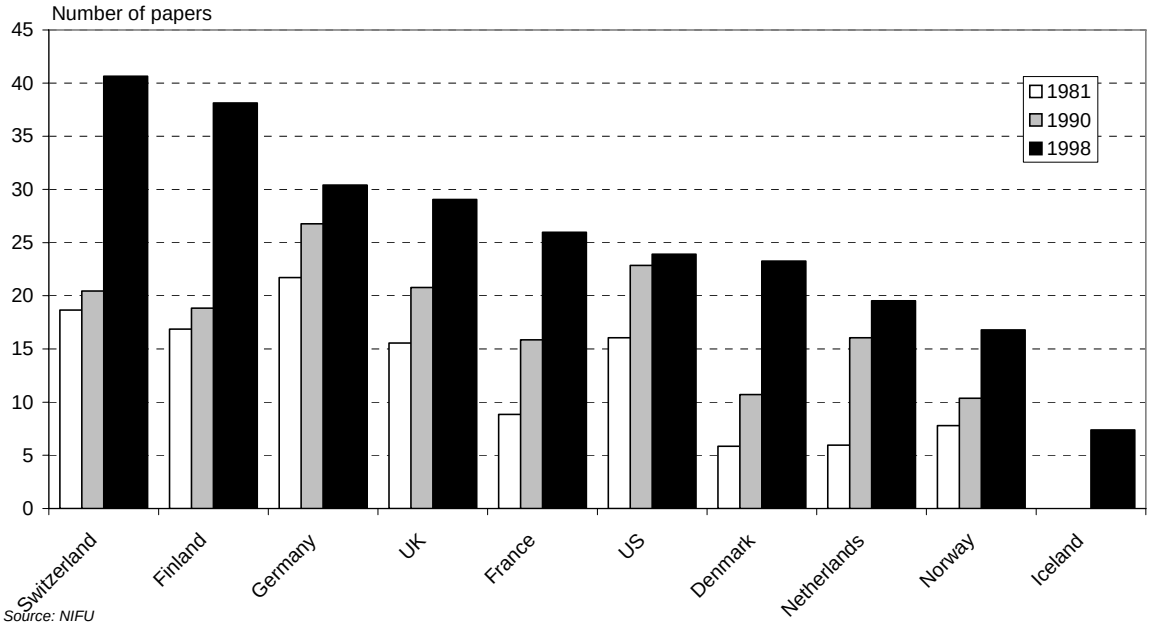
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 2.2 Papers per mil. inhabitants within Astrophysics in selected countries 1981, 1990 and 1998



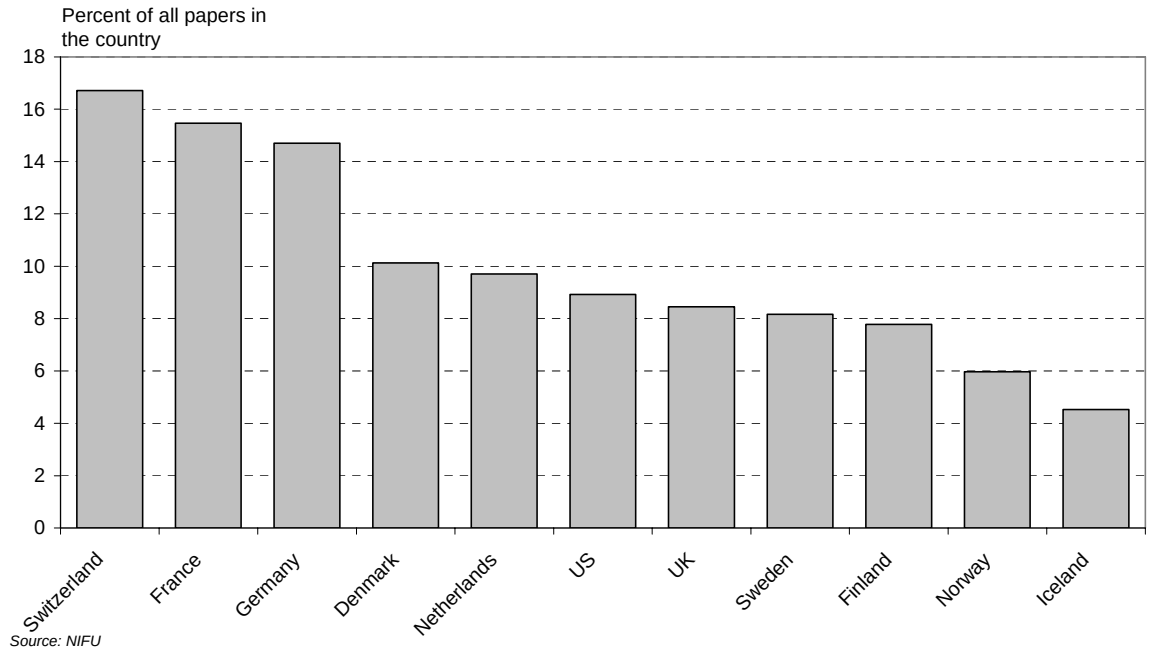
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 2.3 Papers per mil. inhabitants within Materials Science in selected countries 1981, 1990 and 1998



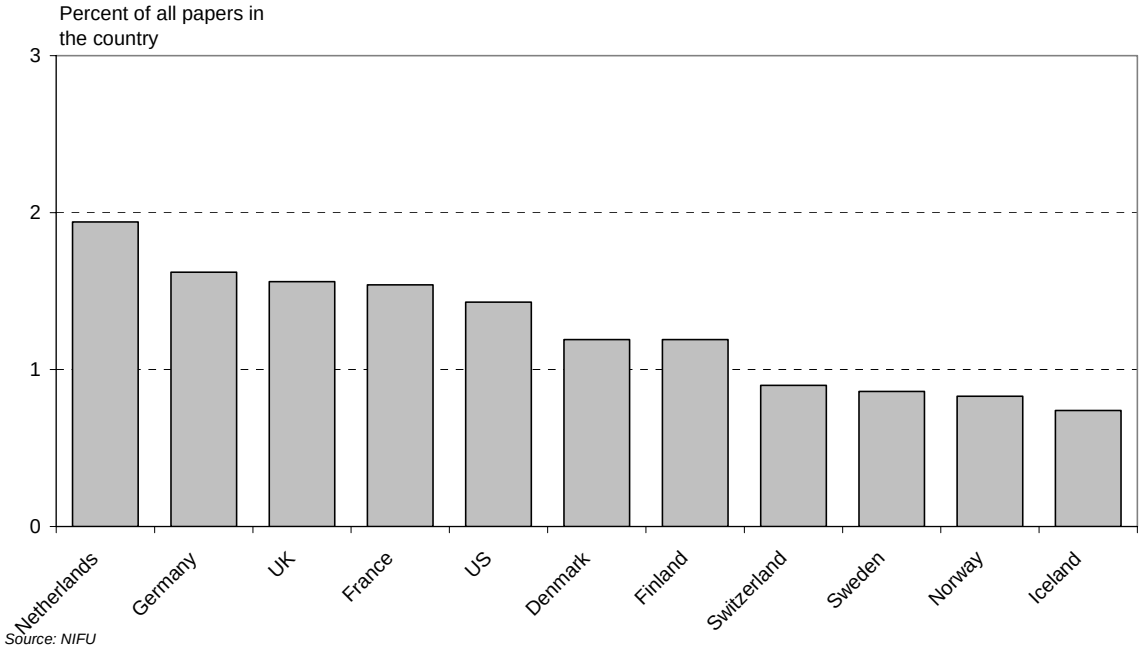
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 3.1 Papers within Physics as a percentage of all the country's papers, 1981-98



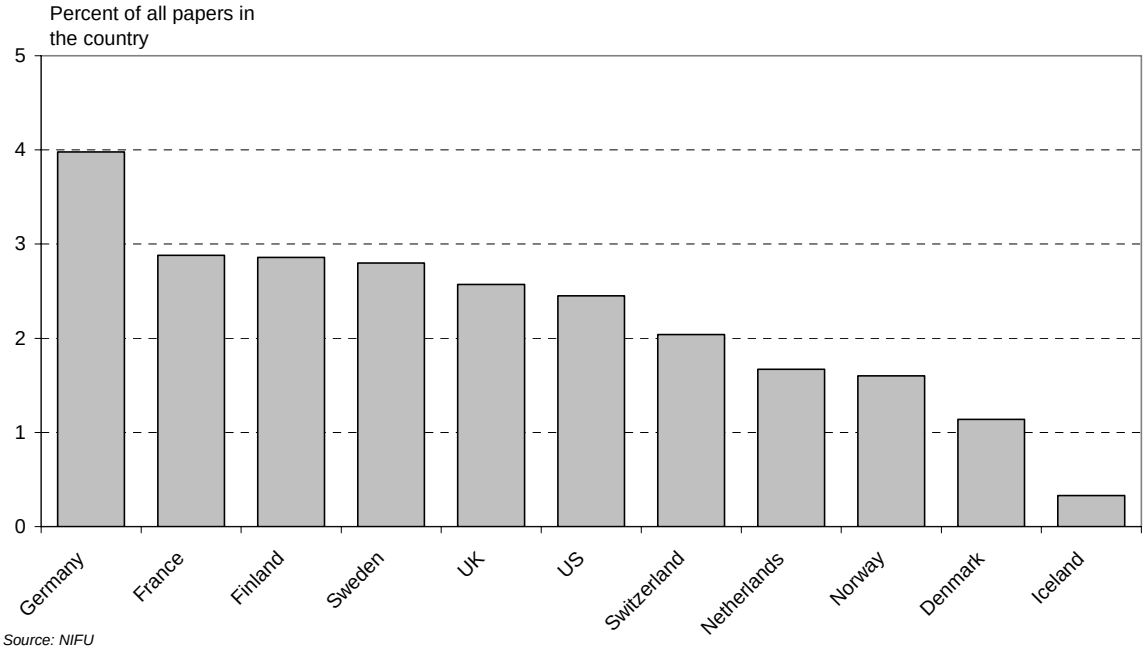
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 3.2 Papers within Astrophysics as a percentage of all the country's papers, 1981-98



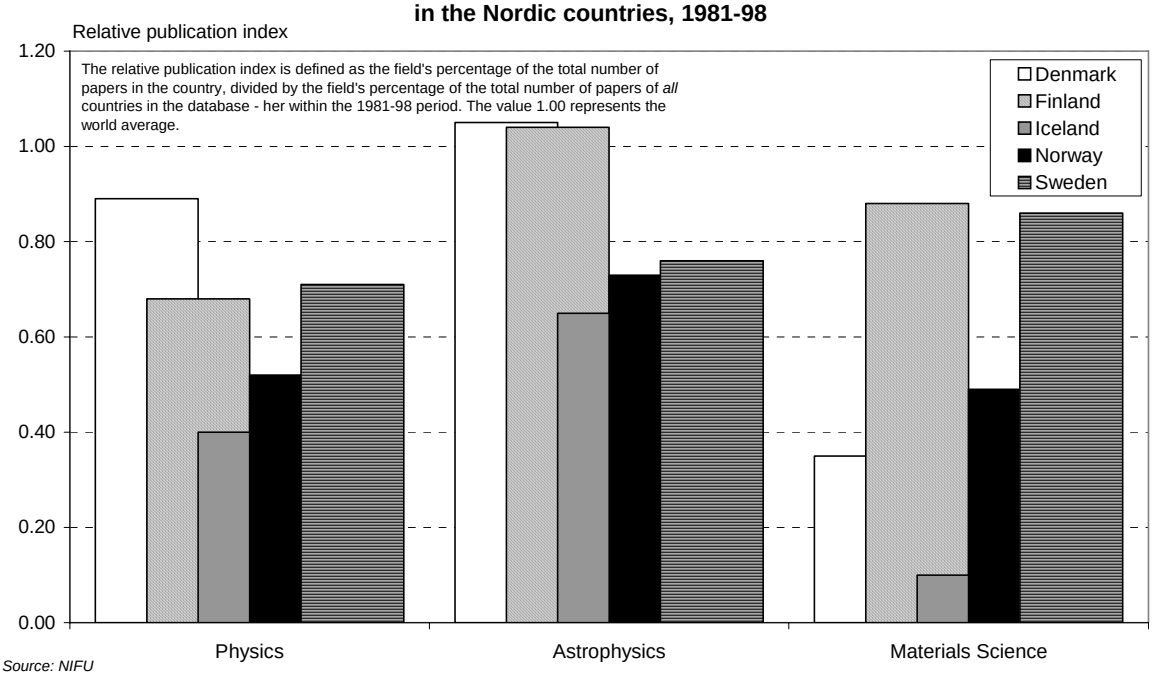
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 3.3 Papers within Materials Science as a percentage of all the country's papers, 1981-98



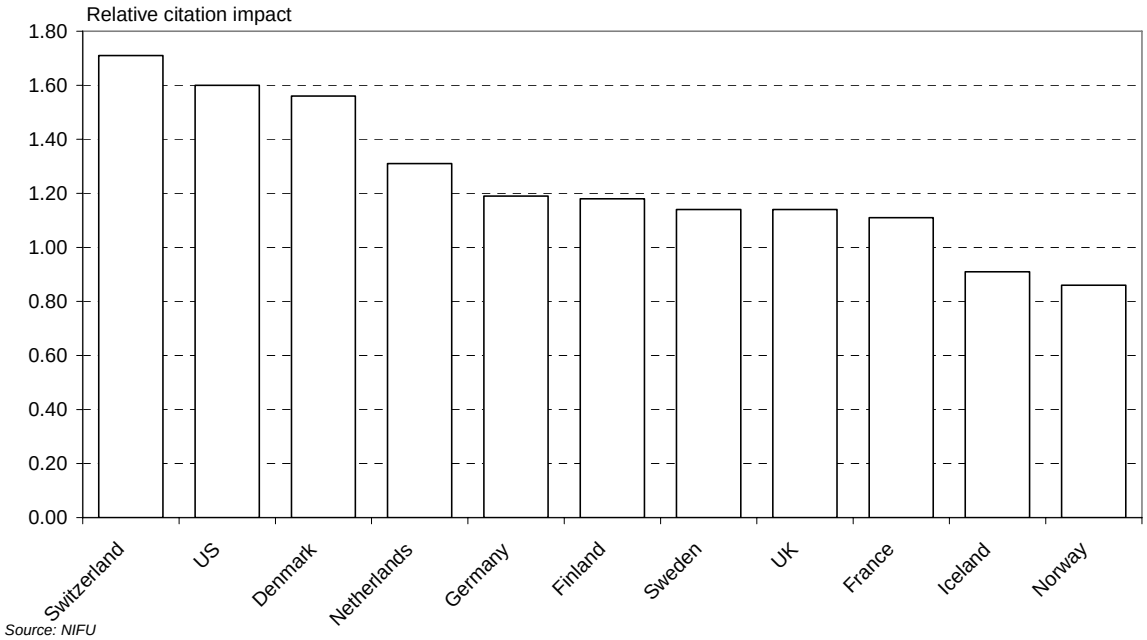
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 4. Relative publication index within Physics, Astrophysics and Materials Science in the Nordic countries, 1981-98



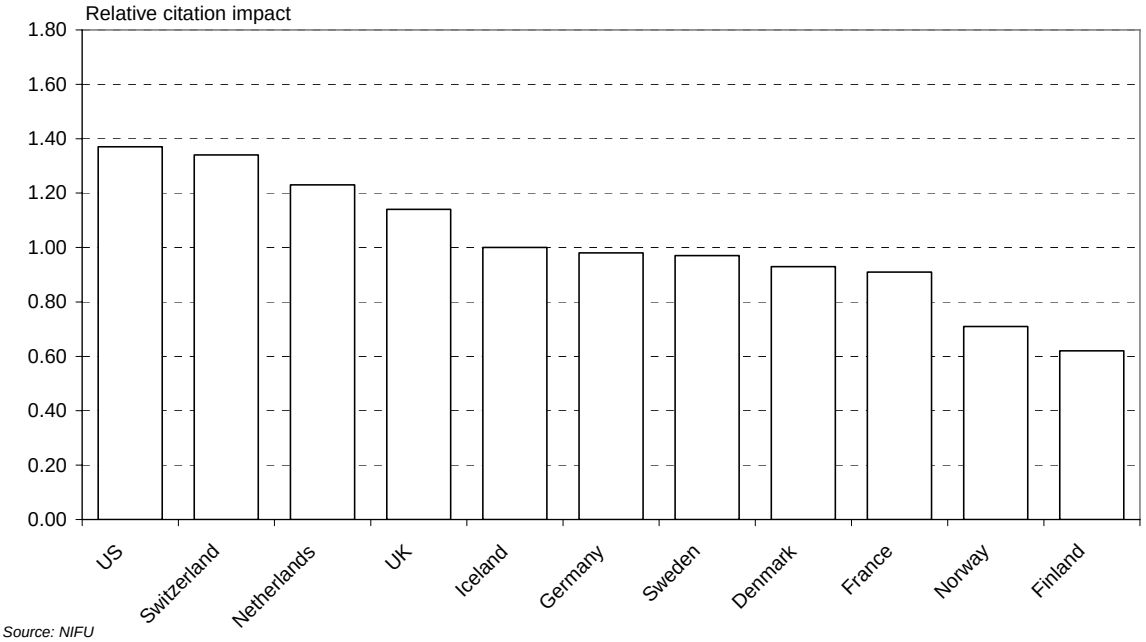
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 5.1. Relative citation impact within Physics in selected countries, 1981-98



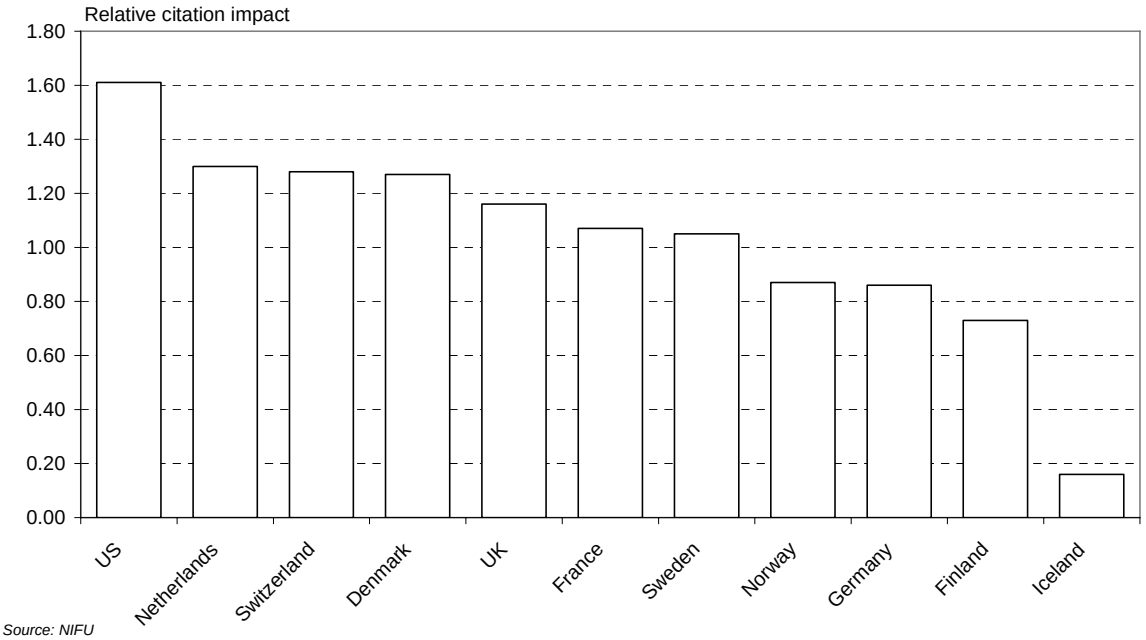
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 5.2. Relative citation impact within Astrophysics in selected countries, 1981-98



Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 5.3. Relative citation impact within Materials Science in selected countries, 1981-98



Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

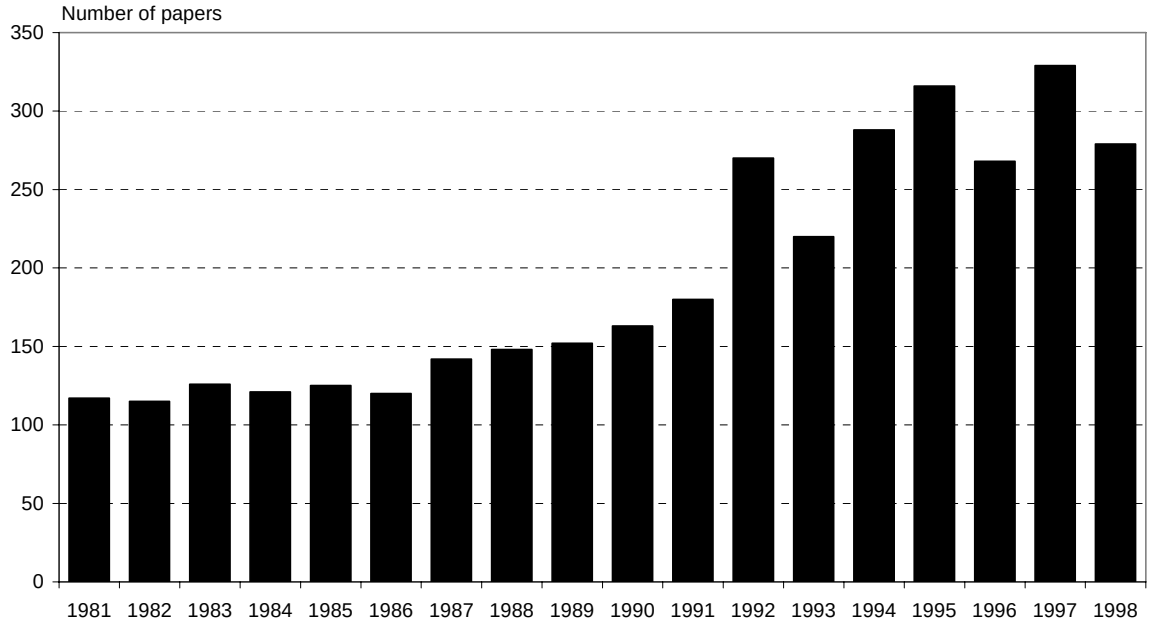
4 Time trends

Figures 6 and 7 show the development for Norway during the 18-year period 1981-98 of the number of papers within the three selected fields of science. As can be seen, there has been an increase in all the three fields through the period. One should be aware, however, that this is mainly an effect of the database construction. There has been a general increase of the number of papers in the total database because of ISI's inclusion of more journals in the course of the period.

In Figure 8 the development in the relative citation impact during the period is shown for the Nordic countries. The trend differs between the three fields. In *Physics*, the trend for Norway was declining until about 1990, after which the relative citation impact started to increase. By the end of the period the impact value remains slightly above 1. This is about the same level as Sweden, but behind Denmark and Finland. In *Astrophysics*, Norway falls behind Denmark and Sweden but is on a par with Finland by the end of the period. The *Materials Science* demonstrates a variable trend for Norway. By the end of the period, however, the Norwegian score is at the level of Sweden and Finland, but below Denmark.

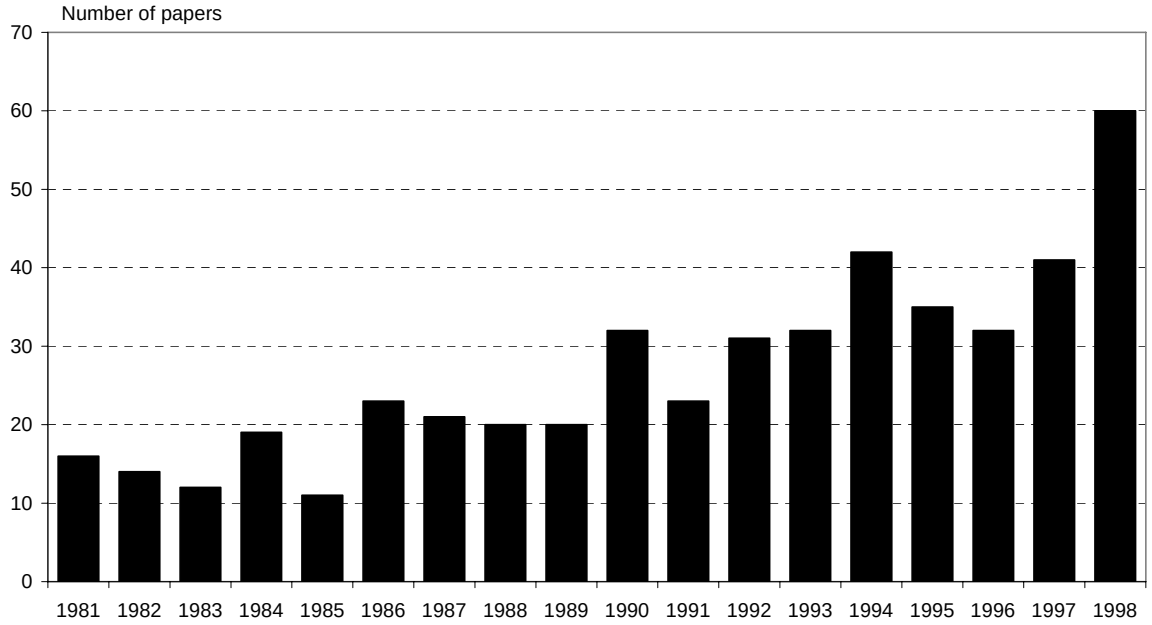
The number of papers in the *Astrophysics* and *Materials Science* is relatively low, so one should interpret the statistics with caution. Low figures accounts for the fact that Iceland has been excluded from the *Astrophysics* and *Materials Science* data.

Fig. 6.1 Norwegian papers within Physics, 1981-98



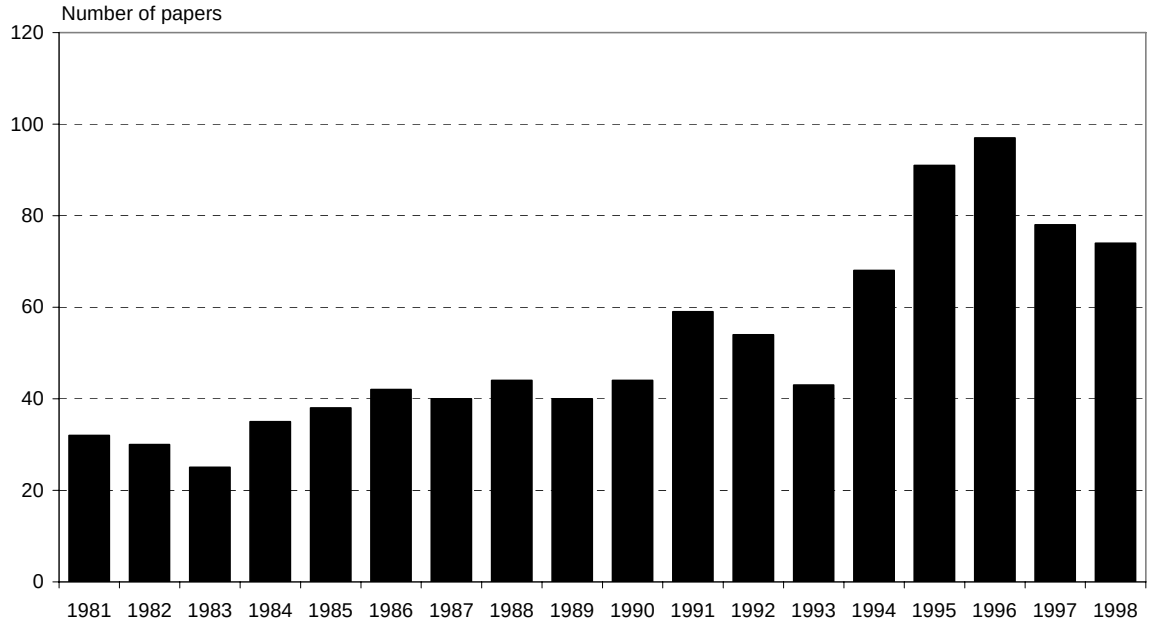
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 6.2 Norwegian papers within Astrophysics, 1981-98



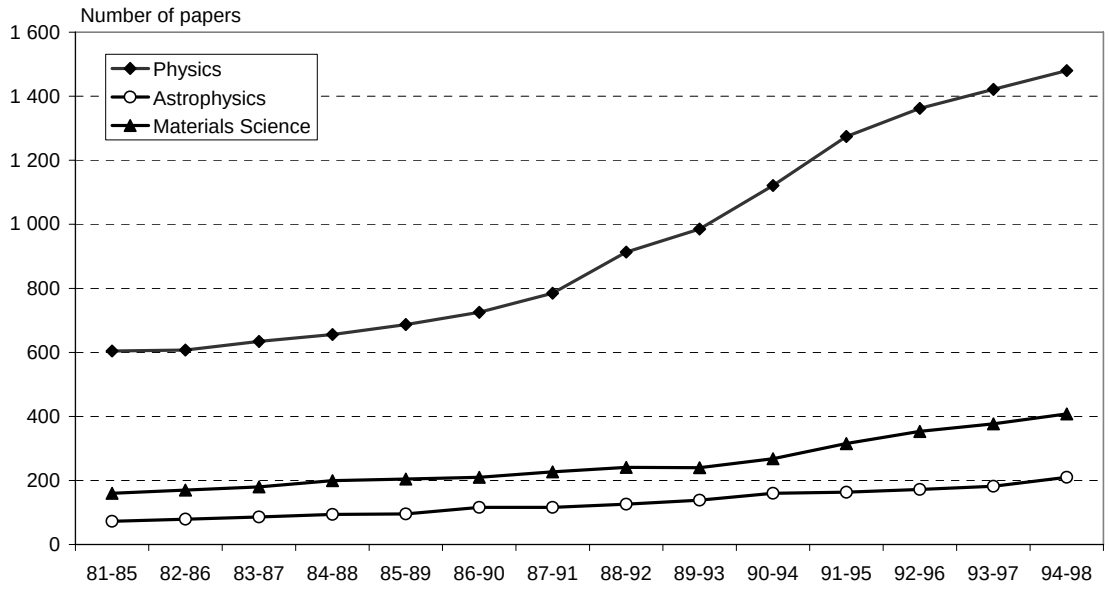
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 6.3 Norwegian papers within Materials Science, 1981-98



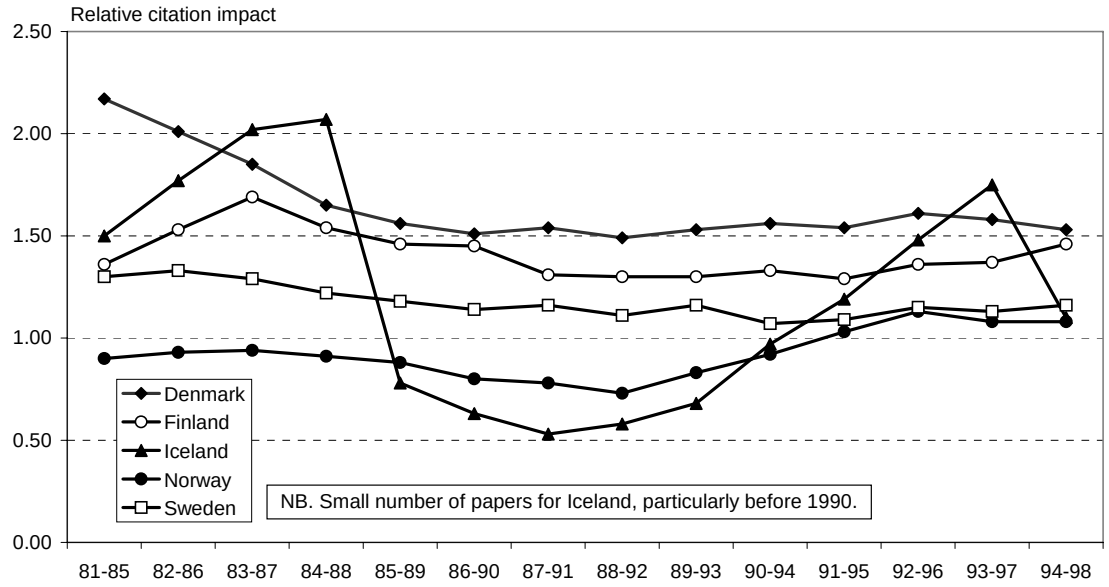
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 7 Norwegian papers in Physics, Astrophysics and Materials Science, 1981-98. Accumulated figures for overlapping 5-year periods.



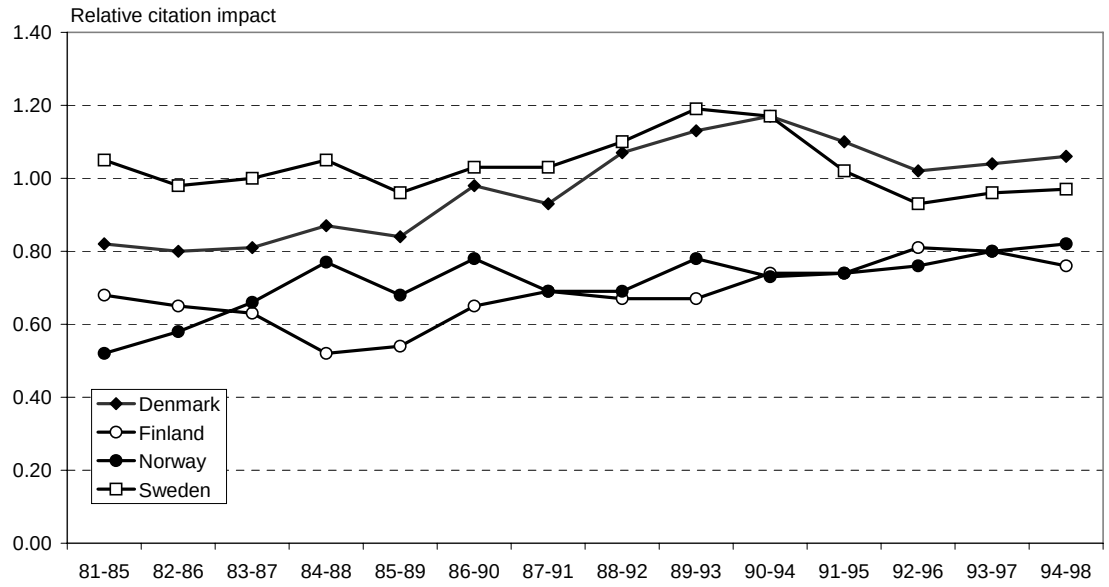
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 8.1. Relative citation impact within Physics for the Nordic countries, 1981-98. Average figures for overlapping 5-year periods.



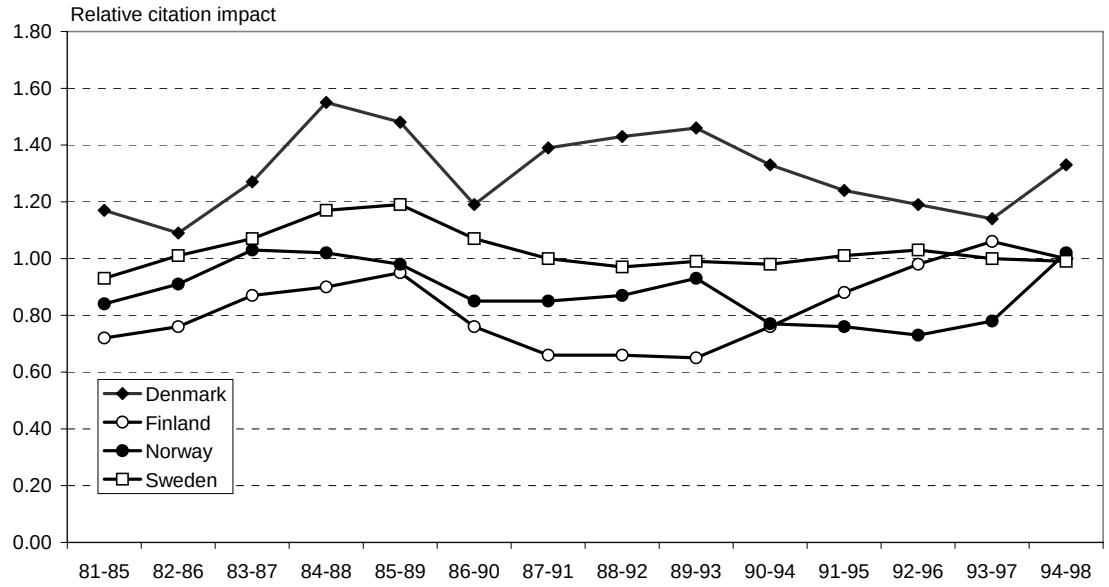
Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 8.2. Relative citation impact within Astrophysics for the Nordic countries, 1981-98. Average figures for overlapping 5-year periods.



Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Fig. 8.3. Relative citation impact within Materials Science for the Nordic countries, 1981-98. Average figures for overlapping 5-year periods.



Source: NIFU
Data: National Science Indicators/Institute for Scientific Information

Annex 1 List of tables and figures

Annex 2 A note of caution

Care should be taken when interpreting bibliometric indicators.

In the bibliometric literature the strength and weakness of such indicators are frequently discussed. Here are some of the issues – not at all a complete list! – of which one should be aware when interpreting the statistics and data presented in this analysis.

- The ISI databases are produced in the US. Those journals to be indexed are determined by ISI, which claims to cover the leading journals in the world within the different fields of science. The journal list is available and how representative the selected journals are may be personally assessed. Annex 4 lists the journals of the relevant fields in the present analysis.
- Some critics contend that the selection of journals is skewed because of the language; journals published in English are over-represented in the database compared to journals in other languages. Against this it is argued that as international orientation is a criterion for a journal to be included in the database, it should be expected that many journals are published in English.
- According to another argument those journals that are selected reflect in essence fields of science that are more or less firmly established. It takes time for journals in upcoming or recently established fields to be included because, among other things, that the database require time series.
- International journal publishing is not equally relevant for all fields of science. In the humanities and most of the social sciences, for example, research results are published primarily in other publication types than international scientific journals. In many sub-fields, monographs, locally oriented journals, report series, etc., may be more appropriate and important media for presenting the research results than international journals.
- Even within the natural and technological sciences there are variations in the degree to which the most relevant journals have been included in the database. Physics, chemistry and biomedicine are fields in which most of the publishing is concentrated within a relatively well defined set of dominant and leading journals – and which also receive most citations. All these journals are included in the ISI databases. In biology and geosciences, on the other hand, a greater proportion of the papers are more often published in national or locally oriented journals, which to a lesser extent – and in a more casual and unsystematic way – are covered by the databases. In technology, humanities, and most of the social sciences journal publishing seems to be less crucial than in the natural sciences.
- As for citation counts, it is not generally agreed what the figures actually express. There may be different motives for citing, and citing behaviour may vary considerably between the various fields and segments of the scientists' community. Citation counts, therefore, are not necessarily numerical expressions for the quality of the scientific literature, but more likely for its impact or usefulness in one sense or another.
- The inclination to cite fellow scientist from one's own country varies from country to country, and seems most pronounced among the US scientists. This affects the relative citation indexes also for other countries.
- In addition, one should be aware of different technical and methodological problems of measuring – like printing and spelling errors, synonyms (which may result in double-counting), or homonyms (the problems concerning different authors with identical names), etc.

Annex 3 Fields and journals in NSIOD

All journals have been classified according to field categories corresponding to the categories of *Current Contents*. *Current Contents* is a database displaying the tables of contents from scholarly journals and provides bibliographic data for journal articles, etc. *Current Contents* is published weekly in seven editions. Each edition covers related fields of science. In this annex the correspondence between the *NSIOD* standard version codes and the *Current Contents* categories is displayed. The codes in the DeLuxe version of *NSIOD* are identical to the *Current Contents* categories.

Within the one and same *Current Contents* Product Code (or edition) a journal can be counted only once. However, a journal may occasionally have been included in two ore more product codes, e.g. both in *Life Sciences* and *Agriculture, Biology & Environmental Sciences*, if the journal has been found relevant to both products. In this case the journal has been included in the *NSIOD* data more than once, which results in double or triple counting.

A different sort of double counting arises from the fact that many articles have authors from more than one country. In these cases the article has been counted once for each country represented among the authors.

Classification of fields of science (NSIOD 1998)

National Science Indicators (NSIOD):		*Current Contents:*		
Code	*Description*	*Code*	*Edition*	*Description*
AGD	Agricultural Sciences	CMA	A	Agricultural Chemistry
AGD	Agricultural Sciences	A/A	A	Agriculture/Agronomy
AGD	Agricultural Sciences	F	A	Food Science/Nutrition
ASD	Astrophysics	SP	S	Space Science
BID	Biology & Biochemistry	BIL	P	Biochemistry & Biophysics
BID	Biology & Biochemistry	BIO	A	Biology
BID	Biology & Biochemistry	BTC	A	Biotechnology & Applied Microbiology
BID	Biology & Biochemistry	END	P	Endocrinology, Nutrition & Metabolism
BID	Biology & Biochemistry	EXP	P	Experimental Biology
BID	Biology & Biochemistry	PSL	P	Physiology
CHD	Chemistry	CME	T	Chemical Engineering
CHD	Chemistry	CMP	S	Chemistry
CHD	Chemistry	CML	P	Chemistry & Analysis
CHD	Chemistry	INC	S	Inorganic & Nuclear Chemistry
CHD	Chemistry	ORG	S	Organic Chemistry/Polymer Science
CHD	Chemistry	PHC	S	Physical Chemistry/Chemical Physics
CHD	Chemistry	SIA	S	Spectroscopy/Instrumentation/Analytical Scien
CLD	Clinical Medicine	AIC	C	Anesthesia & Intensive Care
CLD	Clinical Medicine	CVS	P	Cardiovascular & Hematology Research
CLD	Clinical Medicine	CAR	C	Cardiovascular & Respiratory Systems
CLD	Clinical Medicine	INF	C	Clinical Immunology & Infectious Disease
CLD	Clinical Medicine	PSY	C	Clinical Psychology & Psychiatry
CLD	Clinical Medicine	DEN	C	Dentistry/Oral Surgery & Medicine
CLD	Clinical Medicine	DER	C	Dermatology
CLD	Clinical Medicine	NUT	C	Endocrinology, Metabolism & Nutrition
CLD	Clinical Medicine	SOC	C	Environmental Medicine & Public Health
CLD	Clinical Medicine	GAS	C	Gastroenterology & Hepatology
CLD	Clinical Medicine	GNC	C	General & Internal Medicine
CLD	Clinical Medicine	HLT	C	Health Care Sciences & Services
CLD	Clinical Medicine	HEM	C	Hematology
CLD	Clinical Medicine	DGX	P	Medical Research, Diagnosis & Treatment
CLD	Clinical Medicine	MGN	P	Medical Research, General Topics
CLD	Clinical Medicine	OGS	P	Medical Research, Organs & Systems
CLD	Clinical Medicine	NEU	C	Neurology
CLD	Clinical Medicine	CGX	P	Oncogenesis & Cancer Research
CLD	Clinical Medicine	ONC	C	Oncology
CLD	Clinical Medicine	OPH	C	Ophthalmology
CLD	Clinical Medicine	ORT	C	Orthopedics & Sports Medicine
CLD	Clinical Medicine	OTO	C	Otolaryngology
CLD	Clinical Medicine	PED	C	Pediatrics
CLD	Clinical Medicine	PMC	C	Pharmacology/Toxicology
CLD	Clinical Medicine	RAD	C	Radiology, Nuclear Medicine & Imaging
CLD	Clinical Medicine	REP	C	Reproductive Medicine
CLD	Clinical Medicine	MED	C	Research/Laboratory Medicine & Medical Tech
CLD	Clinical Medicine	RHU	C	Rheumatology
CLD	Clinical Medicine	SUR	C	Surgery
CLD	Clinical Medicine	URO	C	Urology & Nephrology
CSD	Computer Science	CSE	T	Computer Science & Engineering
CSD	Computer Science	IST	T	Information Technology & Communications Sys
ECD	Economics & Business	ECO	B	Economics
ECD	Economics & Business	MGT	B	Management
EDD	Education	EDU	B	Education
EGD	Engineering	AER	T	Aerospace Engineering
EGD	Engineering	ARA	T	AI, Robotics & Automatic Control
EGD	Engineering	CIV	T	Civil Engineering
EGD	Engineering	EL	T	Electrical & Electronics Engineering
EGD	Engineering	GNE	T	Engineering Management/General
EGD	Engineering	EMA	T	Engineering Mathematics
EGD	Engineering	EEE	T	Environmental Engineering/Energy
EGD	Engineering	I/M	T	Instrumentation/Measurement
EGD	Engineering	MEC	T	Mechanical Engineering
EGD	Engineering	NCL	T	Nuclear Engineering

Classification of fields of science (NSIOD 1998), continued

National Science Indicators (NSIOD):		*Current Contents:*		
Code	*Description*	*Code*	*Edition*	*Description*
EVD	Ecology/Environment	ENV	A	Environment/Ecology
GED	Geosciences	EAR	S	Earth Sciences
GED	Geosciences	GPM	T	Geological, Petroleum & Mining Engineering
IMD	Immunology	IMM	P	Immunology
LAD	Law	LAW	B	Law
MBD	Molecular Biology & Genetic	CEL	P	Cell & Developmental Biology
MBD	Molecular Biology & Genetic	MBG	P	Molecular Biology & Genetics
MCD	Microbiology	MCB	P	Microbiology
MSD	Materials Science	MTR	T	Materials Science & Engineering
MSD	Materials Science	MET	T	Metallurgy
MTD	Mathematics	MTH	S	Mathematics
NED	Neuroscience	BEH	P	Neurosciences & Behavior
OTH	Multidisciplinary	MUL	P, S, T	Multidisciplinary
PHD	Physics	APP	S	Applied Physics/Condensed Matter/Materials S
PHD	Physics	O/A	T	Optics & Acoustics
PHD	Physics	PHS	S	Physics
PLD	Plant & Animal Science	AN	P	Animal & Plant Sciences
PLD	Plant & Animal Science	AS	A	Animal Sciences
PLD	Plant & Animal Science	AQU	A	Aquatic Sciences
PLD	Plant & Animal Science	ENT	A	Entomology/Pest Control
PLD	Plant & Animal Science	PL	A	Plant Sciences
PLD	Plant & Animal Science	VET	A	Veterinary Medicine/Animal Health
PMD	Pharmacology	PHM	P	Pharmacology & Toxicology
PSD	Psychology/Psychiatry	PSI	B	Psychiatry
PSD	Psychology/Psychiatry	PSO	B	Psychology
SSD	Social Sciences, general	COM	B	Communication
SSD	Social Sciences, general	GEO	B	Environmental Studies, Geography & Developm
SSD	Social Sciences, general	LIB	B	Library & Information Sciences
SSD	Social Sciences, general	POL	B	Political Science & Public Administration
SSD	Social Sciences, general	PUB	B	Public Health & Health Care Science
SSD	Social Sciences, general	REH	B	Rehabilitation
SSD	Social Sciences, general	S/I	B	Social Work & Social Policy
SSD	Social Sciences, general	S/A	B	Sociology & Anthropology
		ARC	Y	Archaeology
	Art and Humanities	ART	Y	Art & Literature
	categories are not	CLS	Y	Classical Studies
	included in the	GEN	Y	General
	NSIOD standard version	HIS	Y	History
		LIP	Y	Language & Linguistics
		LIT	Y	Literature
		PER	Y	Permforming Arts
		PHL	Y	Philosophy
		REL	Y	Religion & Theology

Current Contents editions:
A = Agriculture, Biology and Environmental Sciences
B = Social and Behavioral Sciences
C = Clinical Medicine
P = Life Sciences
S = Physical, Chemical and Earth Sciences
T = Engineering, Computing and Technology
Y = Arts and Humanities

Annex 4 Journals in physical sciences in NSIOD

This is a list of the scientific journals of the three fields in the NSIOD 1998 standard version considered relevant for the physical sciences. The NSIOD data, in addition, include relevant papers appearing in the multidisciplinary journals NATURE, SCIENCE, and PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA.

Physics (280 journals)

ACOUSTICAL PHYSICS
ACTA MATERIALIA
ACTA PHYSICA HUNGARICA NEW SERIES-HEAVY ION PHYSICS
ACTA PHYSICA POLONICA A
ACTA PHYSICA POLONICA B
ACTA PHYSICA SINICA-OVERSEAS EDITION
ACTA PHYSICA SLOVACA
ACUSTICA
ADVANCES IN PHYSICS
AMERICAN CERAMIC SOCIETY BULLETIN
AMERICAN JOURNAL OF PHYSICS
ANNALEN DER PHYSIK
ANNALES DE CHIMIE-SCIENCE DES MATERIAUX
ANNALES DE L INSTITUT HENRI POINCARE-PHYSIQUE THEORIQUE
ANNALES DE PHYSIQUE
ANNALS OF PHYSICS
ANNUAL REVIEW OF MATERIALS SCIENCE
ANNUAL REVIEW OF NUCLEAR AND PARTICLE SCIENCE
APPLIED ACOUSTICS
APPLIED OPTICS
APPLIED PHYSICS A-MATERIALS SCIENCE & PROCESSING
APPLIED PHYSICS B-LASERS AND OPTICS
APPLIED PHYSICS LETTERS
APPLIED SUPERCONDUCTIVITY
APPLIED SURFACE SCIENCE
ATOMIC DATA AND NUCLEAR DATA TABLES
AUSTRALIAN JOURNAL OF PHYSICS
BRAZILIAN JOURNAL OF PHYSICS
CANADIAN JOURNAL OF PHYSICS
CERAMICS INTERNATIONAL
CHAOS
CHEMICAL VAPOR DEPOSITION
CHEMISTRY OF MATERIALS
CHINESE JOURNAL OF PHYSICS
CHINESE PHYSICS LETTERS
CLASSICAL AND QUANTUM GRAVITY
COMMUNICATIONS IN MATHEMATICAL PHYSICS
COMMUNICATIONS IN THEORETICAL PHYSICS
COMPOSITE INTERFACES
COMPUTATIONAL MATERIALS SCIENCE
COMPUTER PHYSICS COMMUNICATIONS
COMPUTERS IN PHYSICS
CONTEMPORARY PHYSICS
CONTRIBUTIONS TO PLASMA PHYSICS
CRITICAL REVIEWS IN SOLID STATE AND MATERIALS SCIENCES
CRYOGENICS
CURRENT OPINION IN SOLID STATE & MATERIALS SCIENCE
CZECHOSLOVAK JOURNAL OF PHYSICS
DIAMOND AND RELATED MATERIALS
DIAMOND FILMS AND TECHNOLOGY
EARTH OBSERVATION AND REMOTE SENSING
EUROPEAN JOURNAL OF MECHANICS B-FLUIDS
EUROPEAN PHYSICAL JOURNAL A
EUROPEAN PHYSICAL JOURNAL B
EUROPEAN PHYSICAL JOURNAL C
EUROPEAN PHYSICAL JOURNAL D
EUROPEAN PHYSICAL JOURNAL-APPLIED PHYSICS
EUROPHYSICS LETTERS
FERROELECTRICS
FERROELECTRICS LETTERS SECTION
FEW-BODY SYSTEMS
FIBER AND INTEGRATED OPTICS
FIZIKA METALLOV I METALLOVEDENIE
FORTSCHRITTE DER PHYSIK-PROGRESS OF PHYSICS
FOUNDATIONS OF PHYSICS
FOUNDATIONS OF PHYSICS LETTERS
GENERAL RELATIVITY AND GRAVITATION
HELVETICA PHYSICA ACTA
HIGH ENERGY PHYSICS & NUCLEAR PHYSICS-ENGLISH EDITION
HIGH ENERGY PHYSICS AND NUCLEAR PHYSICS-CHINESE EDITION
HIGH PRESSURE RESEARCH
HIGH TEMPERATURE
HYPERFINE INTERACTIONS
IEE PROCEEDINGS-OPTOELECTRONICS
IEEE JOURNAL OF QUANTUM ELECTRONICS
IEEE PHOTONICS TECHNOLOGY LETTERS
IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY
IEEE TRANSACTIONS ON MAGNETICS
IEEE TRANSACTIONS ON NUCLEAR SCIENCE
IEEE TRANSACTIONS ON PLASMA SCIENCE
IEEE TRANSACTIONS ON ULTRASONICS FERROELECTRICS AND FREQUENCY CONTROL
IMAGING SCIENCE JOURNAL
INDIAN JOURNAL OF PURE & APPLIED PHYSICS
INFRARED PHYSICS & TECHNOLOGY
INORGANIC MATERIALS
INTERMETALLICS
INTERNATIONAL JOURNAL OF IMAGING SYSTEMS AND TECHNOLOGY
INTERNATIONAL JOURNAL OF MODERN PHYSICS A
INTERNATIONAL JOURNAL OF MODERN PHYSICS B
INTERNATIONAL JOURNAL OF MODERN PHYSICS C
INTERNATIONAL JOURNAL OF MODERN PHYSICS E-NUCLEAR PHYSICS
INTERNATIONAL JOURNAL OF THEORETICAL PHYSICS
INVERSE PROBLEMS
ISPRS JOURNAL OF PHOTOGRAMMETRY AND REMOTE SENSING
IZVESTIYA AKADEMII NAUK SERIYA FIZICHESKAYA
JAPANESE JOURNAL OF APPLIED PHYSICS PART 1-REGULAR PAPERS SHORT NOTES & REVIEW PAPERS
JAPANESE JOURNAL OF APPLIED PHYSICS PART 2-LETTERS
JETP LETTERS
JOURNAL DE PHYSIQUE IV
JOURNAL OF ADHESION
JOURNAL OF ALLOYS AND COMPOUNDS
JOURNAL OF APPLIED PHYSICS
JOURNAL OF COMPUTATIONAL ACOUSTICS
JOURNAL OF COMPUTATIONAL PHYSICS
JOURNAL OF ELECTRONIC IMAGING

JOURNAL OF ELECTRONIC MATERIALS
JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS
JOURNAL OF FLUID MECHANICS
JOURNAL OF HIGH ENERGY PHYSICS
JOURNAL OF IMAGING SCIENCE AND TECHNOLOGY
JOURNAL OF INFORMATION RECORDING
JOURNAL OF INFRARED AND MILLIMETER WAVES
JOURNAL OF LASER APPLICATIONS
JOURNAL OF LIGHTWAVE TECHNOLOGY
JOURNAL OF LOW TEMPERATURE PHYSICS
JOURNAL OF LUMINESCENCE
JOURNAL OF MAGNETISM AND MAGNETIC MATERIALS
JOURNAL OF MATERIALS CHEMISTRY
JOURNAL OF MATERIALS RESEARCH
JOURNAL OF MATERIALS SCIENCE
JOURNAL OF MATERIALS SCIENCE LETTERS
JOURNAL OF MATERIALS SCIENCE-MATERIALS IN ELECTRONICS
JOURNAL OF MATHEMATICAL PHYSICS
JOURNAL OF MODERN OPTICS
JOURNAL OF NON-CRYSTALLINE SOLIDS
JOURNAL OF NON-EQUILIBRIUM THERMODYNAMICS
JOURNAL OF NON-NEWTONIAN FLUID MECHANICS
JOURNAL OF NONLINEAR OPTICAL PHYSICS & MATERIALS
JOURNAL OF NUCLEAR MATERIALS
JOURNAL OF OPTICAL TECHNOLOGY
JOURNAL OF OPTICS-NOUVELLE REVUE D OPTIQUE
JOURNAL OF PHASE EQUILIBRIA
JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL
JOURNAL OF PHYSICS AND CHEMISTRY OF SOLIDS
JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS
JOURNAL OF PHYSICS D-APPLIED PHYSICS
JOURNAL OF PHYSICS G-NUCLEAR AND PARTICLE PHYSICS
JOURNAL OF PHYSICS-CONDENSED MATTER
JOURNAL OF PLASMA PHYSICS
JOURNAL OF POROUS MATERIALS
JOURNAL OF RHEOLOGY
JOURNAL OF SOUND AND VIBRATION
JOURNAL OF STATISTICAL PHYSICS
JOURNAL OF SUPERCONDUCTIVITY
JOURNAL OF SYNCHROTRON RADIATION
JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA
JOURNAL OF THE AMERICAN CERAMIC SOCIETY
JOURNAL OF THE AUDIO ENGINEERING SOCIETY
JOURNAL OF THE CERAMIC SOCIETY OF JAPAN
JOURNAL OF THE EUROPEAN CERAMIC SOCIETY
JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY
JOURNAL OF THE KOREAN PHYSICAL SOCIETY
JOURNAL OF THE OPTICAL SOCIETY OF AMERICA A-OPTICS IMAGE SCIENCE AND VISION
JOURNAL OF THE OPTICAL SOCIETY OF AMERICA B-OPTICAL PHYSICS
JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN
JOURNAL OF VACUUM SCIENCE & TECHNOLOGY A-VACUUM SURFACES AND FILMS
JOURNAL OF VACUUM SCIENCE & TECHNOLOGY B
LASER AND PARTICLE BEAMS
LASER FOCUS WORLD
LASER PHYSICS
LETTERS IN MATHEMATICAL PHYSICS
LOW TEMPERATURE PHYSICS
MATERIALS CHEMISTRY AND PHYSICS
MATERIALS LETTERS
MATERIALS RESEARCH BULLETIN
MATERIALS RESEARCH INNOVATIONS
MATERIALS SCIENCE & ENGINEERING R-REPORTS
MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIALS PROPERTIES MICROSTRUCTURE AND PROCESSING
MATERIALS SCIENCE AND ENGINEERING B-SOLID STATE MATERIALS FOR ADVANCED TECHNOLOGY
METALLURGICAL AND MATERIALS TRANSACTIONS A-PHYSICAL METALLURGY AND MATERIALS SCIENCE
MICROPOROUS AND MESOPOROUS MATERIALS
MICROSCALE THERMOPHYSICAL ENGINEERING
MICROWAVE AND OPTICAL TECHNOLOGY LETTERS
MODELLING AND SIMULATION IN MATERIALS SCIENCE AND ENGINEERING
MODERN PHYSICS LETTERS A
MODERN PHYSICS LETTERS B
MRS BULLETIN
NANOSTRUCTURED MATERIALS
NANOTECHNOLOGY
NOISE CONTROL ENGINEERING JOURNAL
NUCLEAR FUSION
NUCLEAR PHYSICS A
NUCLEAR PHYSICS B
NUCLEAR PHYSICS B-PROCEEDINGS SUPPLEMENTS
NUOVO CIMENTO DELLA SOCIETA ITALIANA DI FISICA A-NUCLEI PARTICLES AND FIELDS
NUOVO CIMENTO DELLA SOCIETA ITALIANA DI FISICA B-GENERAL PHYSICS RELATIVITY ASTRONOMY AND MATHEMATICAL PHYSICS AND METHODS
NUOVO CIMENTO DELLA SOCIETA ITALIANA DI FISICA D-CONDENSED MATTER ATOMIC MOLECULAR AND CHEMICAL PHYSICS FLUIDS PLASMAS BIOPHYSICS
OPTICA APPLICATA
OPTICAL AND QUANTUM ELECTRONICS
OPTICAL ENGINEERING
OPTICAL FIBER TECHNOLOGY
OPTICAL MATERIALS
OPTICAL REVIEW
OPTICS AND LASER TECHNOLOGY
OPTICS AND LASERS IN ENGINEERING
OPTICS COMMUNICATIONS
OPTICS EXPRESS
OPTICS LETTERS
OPTIK
PARTICLE ACCELERATORS
PHASE TRANSITIONS
PHILOSOPHICAL MAGAZINE A-PHYSICS OF CONDENSED MATTER STRUCTURE DEFECTS AND MECHANICAL PROPERTIES
PHILOSOPHICAL MAGAZINE B-PHYSICS OF CONDENSED MATTER STATISTICAL MECHANICS ELECTRONIC OPTICAL AND MAGNETIC PROPERTIES
PHILOSOPHICAL MAGAZINE LETTERS
PHOTOGRAMMETRIC ENGINEERING AND REMOTE SENSING
PHOTONICS SPECTRA
PHYSICA A
PHYSICA B
PHYSICA C
PHYSICA D
PHYSICA SCRIPTA
PHYSICA STATUS SOLIDI A-APPLIED RESEARCH
PHYSICA STATUS SOLIDI B-BASIC RESEARCH
PHYSICAL REVIEW A
PHYSICAL REVIEW B-CONDENSED MATTER
PHYSICAL REVIEW C-NUCLEAR PHYSICS
PHYSICAL REVIEW D
PHYSICAL REVIEW E
PHYSICAL REVIEW LETTERS
PHYSICS AND CHEMISTRY OF GLASSES
PHYSICS ESSAYS
PHYSICS LETTERS A
PHYSICS LETTERS B
PHYSICS OF ATOMIC NUCLEI
PHYSICS OF FLUIDS
PHYSICS OF LOW-DIMENSIONAL STRUCTURES
PHYSICS OF PARTICLES AND NUCLEI
PHYSICS OF PLASMAS
PHYSICS OF THE SOLID STATE
PHYSICS REPORTS-REVIEW SECTION OF PHYSICS LETTERS
PHYSICS TODAY
PHYSICS WORLD
PLASMA PHYSICS AND CONTROLLED FUSION
PLASMA PHYSICS REPORTS
PLASMA SOURCES SCIENCE & TECHNOLOGY
POWDER DIFFRACTION
PRAMANA-JOURNAL OF PHYSICS
PROGRESS IN CRYSTAL GROWTH AND CHARACTERIZATION OF MATERIALS
PROGRESS IN MATERIALS SCIENCE
PROGRESS IN SURFACE SCIENCE
PROGRESS OF THEORETICAL PHYSICS
PROGRESS OF THEORETICAL PHYSICS SUPPLEMENT
PURE AND APPLIED OPTICS
QUANTUM AND SEMICLASSICAL OPTICS
QUANTUM ELECTRONICS
RADIATION EFFECTS AND DEFECTS IN SOLIDS
RADIATION MEASUREMENTS
RADIATION PHYSICS AND CHEMISTRY
REPORTS ON PROGRESS IN PHYSICS
REVIEWS IN MATHEMATICAL PHYSICS
REVIEWS OF MODERN PHYSICS
REVISTA MEXICANA DE FISICA
RHEOLOGICA ACTA
RIVISTA DEL NUOVO CIMENTO
RUSSIAN JOURNAL OF MATHEMATICAL PHYSICS
SCRIPTA MATERIALIA
SEMICONDUCTOR SCIENCE AND TECHNOLOGY
SEMICONDUCTORS
SOLAR ENERGY MATERIALS AND SOLAR CELLS
SOLID STATE COMMUNICATIONS
SOLID STATE IONICS
SOLID-STATE ELECTRONICS
STUDIES IN HISTORY AND PHILOSOPHY OF MODERN PHYSICS
SUPERCONDUCTOR SCIENCE & TECHNOLOGY
SUPERLATTICES AND MICROSTRUCTURES
SURFACE REVIEW AND LETTERS
SYNTHETIC METALS
TECHNICAL PHYSICS
TECHNICAL PHYSICS LETTERS
THEORETICAL AND COMPUTATIONAL FLUID DYNAMICS
THEORETICAL AND MATHEMATICAL PHYSICS
THIN SOLID FILMS
ULTRASONIC IMAGING
ULTRASONICS
USPEKHI FIZICHESKIKH NAUK
VACUUM
WAVE MOTION
WAVES IN RANDOM MEDIA
ZEITSCHRIFT FUR METALLKUNDE
ZHURNAL NAUCHNOI I PRIKLADNOI FOTOGRAFII

Astrophysics (36 journals)

ACTA ASTRONOMICA
ANNALES GEOPHYSICAE-ATMOSPHERES HYDROSPHERES AND SPACE SCIENCES
ANNUAL REVIEW OF ASTRONOMY AND ASTROPHYSICS
ASTRONOMICAL JOURNAL
ASTRONOMISCHE NACHRICHTEN
ASTRONOMY & ASTROPHYSICS SUPPLEMENT SERIES
ASTRONOMY & GEOPHYSICS
ASTRONOMY AND ASTROPHYSICS
ASTRONOMY AND ASTROPHYSICS REVIEW
ASTRONOMY LETTERS-A JOURNAL OF ASTRONOMY AND SPACE ASTROPHYSICS
ASTRONOMY REPORTS
ASTROPARTICLE PHYSICS
ASTROPHYSICAL JOURNAL
ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES
ASTROPHYSICAL LETTERS & COMMUNICATIONS
ASTROPHYSICS AND SPACE SCIENCE
CELESTIAL MECHANICS & DYNAMICAL ASTRONOMY
EARTH MOON AND PLANETS
EXPERIMENTAL ASTRONOMY
GEOPHYSICAL AND ASTROPHYSICAL FLUID DYNAMICS
ICARUS
INTERNATIONAL JOURNAL OF MODERN PHYSICS D
JOURNAL OF ASTROPHYSICS AND ASTRONOMY
JOURNAL OF GEOPHYSICAL RESEARCH-PLANETS
JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY
NEW ASTRONOMY
NUOVO CIMENTO DELLA SOCIETA ITALIANA DI FISICA C-GEOPHYSICS AND SPACE PHYSICS
OBSERVATORY
PLANETARY AND SPACE SCIENCE
PUBLICATIONS ASTRONOMICAL SOCIETY OF AUSTRALIA
PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF JAPAN
PUBLICATIONS OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC
REVISTA MEXICANA DE ASTRONOMIA Y ASTROFISICA
SOLAR PHYSICS
SPACE SCIENCE REVIEW

Materials Science (182 journals)

ACI MATERIALS JOURNAL
ACTA MATERIALIA
ADVANCED CEMENT BASED MATERIALS
ADVANCED COMPOSITE MATERIALS
ADVANCED MATERIALS
ADVANCED MATERIALS & PROCESSES
ADVANCED MATERIALS FOR OPTICS AND ELECTRONICS
ADVANCES IN CEMENT RESEARCH
AMERICAN CERAMIC SOCIETY BULLETIN
APPITA JOURNAL
APPLIED SURFACE SCIENCE
ARCHIVES OF METALLURGY
BOLETIN DE LA SOCIEDAD ESPANOLA DE CERAMICA Y VIDRIO
BRITISH CERAMIC TRANSACTIONS
BULLETIN OF MATERIALS SCIENCE
CANADIAN CERAMICS
CANADIAN METALLURGICAL QUARTERLY
CELLULAR POLYMERS
CELLULOSE CHEMISTRY AND TECHNOLOGY
CEMENT AND CONCRETE RESEARCH
CERAMICS INTERNATIONAL
CERAMICS-SILIKATY
CHEMICAL VAPOR DEPOSITION
CHEMISTRY OF MATERIALS
COMPOSITE INTERFACES
COMPOSITE STRUCTURES
COMPOSITES PART A-APPLIED SCIENCE AND MANUFACTURING
COMPOSITES PART B-ENGINEERING
COMPOSITES SCIENCE AND TECHNOLOGY
CORROSION
CORROSION SCIENCE
CURRENT OPINION IN SOLID STATE & MATERIALS SCIENCE
DIAMOND AND RELATED MATERIALS
DIAMOND FILMS AND TECHNOLOGY
DIE CASTING ENGINEER
FATIGUE & FRACTURE OF ENGINEERING MATERIALS & STRUCTURES
FIZIKA METALLOV I METALLOVEDENIE
GLASS TECHNOLOGY
GLASTECHNISCHE BERICHTE-GLASS SCIENCE AND TECHNOLOGY
HEAT TREATMENT OF METALS
HIGH TEMPERATURE MATERIALS AND PROCESSES
HOLZ ALS ROH-UND WERKSTOFF
HYDROMETALLURGY
IEEE TRANSACTIONS ON COMPONENTS PACKAGING AND MANUFACTURING TECHNOLOGY PART A
IEEE TRANSACTIONS ON COMPONENTS PACKAGING AND MANUFACTURING TECHNOLOGY PART B-ADVANCED PACKAGING
INDUSTRIAL DIAMOND REVIEW
INTERMETALLICS
INTERNATIONAL JOURNAL OF ADHESION AND ADHESIVES
INTERNATIONAL JOURNAL OF FATIGUE
INTERNATIONAL JOURNAL OF NON-EQUILIBRIUM PROCESSING
INTERNATIONAL JOURNAL OF POWDER METALLURGY
INTERNATIONAL MATERIALS REVIEWS
INTERNATIONAL POLYMER PROCESSING
IRONMAKING & STEELMAKING
ISIJ INTERNATIONAL
JOM-JOURNAL OF THE MINERALS METALS & MATERIALS SOCIETY
JOURNAL OF ADHESION
JOURNAL OF ADHESION SCIENCE AND TECHNOLOGY
JOURNAL OF ADVANCED MATERIALS
JOURNAL OF APPLIED POLYMER SCIENCE
JOURNAL OF COATINGS TECHNOLOGY
JOURNAL OF COMPOSITE MATERIALS
JOURNAL OF COMPOSITES TECHNOLOGY & RESEARCH
JOURNAL OF ELASTOMERS AND PLASTICS
JOURNAL OF ENGINEERING MATERIALS AND TECHNOLOGY-TRANSACTIONS OF THE ASME
JOURNAL OF FIRE SCIENCES
JOURNAL OF INTELLIGENT MATERIAL SYSTEMS AND STRUCTURES
JOURNAL OF MATERIALS CHEMISTRY
JOURNAL OF MATERIALS ENGINEERING AND PERFORMANCE
JOURNAL OF MATERIALS PROCESSING TECHNOLOGY
JOURNAL OF MATERIALS RESEARCH
JOURNAL OF MATERIALS SCIENCE
JOURNAL OF MATERIALS SCIENCE & TECHNOLOGY
JOURNAL OF MATERIALS SCIENCE LETTERS
JOURNAL OF MATERIALS SCIENCE-MATERIALS IN ELECTRONICS
JOURNAL OF MATERIALS SCIENCE-MATERIALS IN MEDICINE
JOURNAL OF NONDESTRUCTIVE EVALUATION
JOURNAL OF POLYMER ENGINEERING
JOURNAL OF PULP AND PAPER SCIENCE
JOURNAL OF REINFORCED PLASTICS AND COMPOSITES
JOURNAL OF SOL-GEL SCIENCE AND TECHNOLOGY
JOURNAL OF TESTING AND EVALUATION
JOURNAL OF THE AMERICAN CERAMIC SOCIETY
JOURNAL OF THE AMERICAN LEATHER CHEMISTS ASSOCIATION
JOURNAL OF THE CERAMIC SOCIETY OF JAPAN
JOURNAL OF THE ELECTROCHEMICAL SOCIETY
JOURNAL OF THE EUROPEAN CERAMIC SOCIETY
JOURNAL OF THE JAPAN INSTITUTE OF METALS
JOURNAL OF THE SOCIETY OF LEATHER TECHNOLOGISTS AND CHEMISTS
JOURNAL OF THE TEXTILE INSTITUTE
JOURNAL OF THERMAL SPRAY TECHNOLOGY
JOURNAL OF THERMOPLASTIC COMPOSITE MATERIALS
JOURNAL OF VACUUM SCIENCE & TECHNOLOGY A-VACUUM SURFACES AND FILMS
JOURNAL OF VACUUM SCIENCE & TECHNOLOGY B
JOURNAL OF WOOD CHEMISTRY AND TECHNOLOGY
JOURNAL OF WOOD SCIENCE
KAUTSCHUK GUMMI KUNSTSTOFFE
KOVOVE MATERIALY-METALLIC MATERIALS
KUNSTSTOFFE-PLAST EUROPE
MAGAZINE OF CONCRETE RESEARCH
MATERIALS AND CORROSION-WERKSTOFFE UND KORROSION
MATERIALS AND STRUCTURES
MATERIALS AT HIGH TEMPERATURES
MATERIALS CHARACTERIZATION
MATERIALS CHEMISTRY AND PHYSICS
MATERIALS EVALUATION
MATERIALS LETTERS
MATERIALS PERFORMANCE
MATERIALS RESEARCH BULLETIN
MATERIALS RESEARCH INNOVATIONS
MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIALS PROPERTIES MICROSTRUCTURE AND PROCESSING
MATERIALS SCIENCE AND ENGINEERING B-SOLID STATE MATERIALS FOR ADVANCED TECHNOLOGY
MATERIALS SCIENCE AND TECHNOLOGY
MATERIALS TRANSACTIONS JIM
MATERIALWISSENSCHAFT UND WERKSTOFFTECHNIK
MECHANICS OF COHESIVE-FRICTIONAL MATERIALS
MECHANICS OF COMPOSITE MATERIALS
MECHANICS OF COMPOSITE MATERIALS AND STRUCTURES
MECHANICS OF MATERIALS
METAL SCIENCE AND HEAT TREATMENT

METALL
METALLURGICAL AND MATERIALS TRANSACTIONS A-PHYSICAL METALLURGY AND MATERIALS SCIENCE
METALLURGICAL AND MATERIALS TRANSACTIONS B-PROCESS METALLURGY AND MATERIALS PROCESSING SCIENCE
METALLURGIST
MODELLING AND SIMULATION IN MATERIALS SCIENCE AND ENGINEERING
MOKUZAI GAKKAISHI
MRS BULLETIN
NANOSTRUCTURED MATERIALS
NANOTECHNOLOGY
NDT & E INTERNATIONAL
NORDIC PULP & PAPER RESEARCH JOURNAL
OPTICAL MATERIALS
OXIDATION OF METALS
PAPERI JA PUU-PAPER AND TIMBER
PAPIER
PHYSICS AND CHEMISTRY OF GLASSES
PLASTICS ENGINEERING
PLASTICS RUBBER AND COMPOSITES PROCESSING AND APPLICATIONS
PLATING AND SURFACE FINISHING
POLYMER COMPOSITES
POLYMER ENGINEERING AND SCIENCE
POLYMER GELS AND NETWORKS
POLYMER TESTING
POLYMER-PLASTICS TECHNOLOGY AND ENGINEERING
POWDER METALLURGY
POWDER METALLURGY AND METAL CERAMICS
PRAKTISCHE METALLOGRAPHIE-PRACTICAL METALLOGRAPHY
PROGRESS IN MATERIALS SCIENCE
PROGRESS IN ORGANIC COATINGS
PROTECTION OF METALS
PULP & PAPER-CANADA
RESEARCH IN NONDESTRUCTIVE EVALUATION
REVISTA DE METALURGIA
REVUE DE METALLURGIE-CAHIERS D INFORMATIONS TECHNIQUES
RUBBER CHEMISTRY AND TECHNOLOGY
RUSSIAN JOURNAL OF NONDESTRUCTIVE TESTING
RUSSIAN METALLURGY
SAMPE JOURNAL
SCANDINAVIAN JOURNAL OF METALLURGY
SCIENCE AND TECHNOLOGY OF WELDING AND JOINING
SCRIPTA MATERIALIA
SOLAR ENERGY MATERIALS AND SOLAR CELLS
STAHL UND EISEN
STEEL IN TRANSLATION
STEEL RESEARCH
SURFACE & COATINGS TECHNOLOGY
SVENSK PAPPERSTIDNING-NORDISK CELLULOSA
TAPPI JOURNAL
TETSU TO HAGANE-JOURNAL OF THE IRON AND STEEL INSTITUTE OF JAPAN
TEXTILE CHEMIST AND COLORIST
TEXTILE RESEARCH JOURNAL
THIN SOLID FILMS
TRANSACTIONS OF THE INDIAN INSTITUTE OF METALS
TRANSACTIONS OF THE INSTITUTE OF METAL FINISHING
VACUUM
VIDE-SCIENCE TECHNIQUE ET APPLICATIONS
WEAR
WELDING JOURNAL
WOOD AND FIBER SCIENCE
WOOD SCIENCE AND TECHNOLOGY
ZEITSCHRIFT FUR METALLKUNDE
ZKG INTERNATIONAL

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A preliminary study

1 Introduction

If we wish to compare the volume of material by Norwegian scientists in journals with that of scientists from other countries scientist, *National Science Indicators On Diskette* (NSIOD)[1] is a useful data source. The NSIOD contains aggregate publication and citation counts for almost all the countries in the world. The field classification in the NSIOD is *journal based*. This means that each particular paper has not been classified as such, but has been subsumed under the field category to which the journal in which the paper is published has been attributed.[2] Because the NSIOD data are aggregated at the field and national levels, they are not suitable for detailed analyses.

NIFU possesses, however, a database containing the basic data for all *Norwegian* papers in the ISI-indexed journals. The definition of a Norwegian paper is a paper that has at least one author's address in Norway as registered in the country field of the database. This database makes possible detailed analyses of Norwegian journal publishing. However, since only Norwegian papers are available, comparisons with other countries cannot be made.

In this paper we present the results of a study of one specific Norwegian physical science department. The study has been made as a supplement to the overall bibliometric study of Norwegian physics where Norway is compared to other countries.[3] We chose to look at the *Department of Physics at the University of Oslo*, which is the largest department in the field in Norway. We wanted to assess the amount of journal publishing in this particular department and relate it to the total Norwegian journal publishing in physics. Moreover, we wanted to study the extent to which the journal-based field classification corresponds to the set of journals in which the department's scientists actually publish, and calculate the share of papers published in "non-physical" journals as classified by ISI. We also wanted to look at the intra-departmental variation among the staff members concerning the number

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1 *NSIOD* is published by *Institute for Scientific Information (ISI)*, Philadelphia, USA. *ISI* is a business company which also publishes *Science Citation Index (SCI)*, *Social Science Citation Index (SSCI)*, and *Arts & Humanities Citation Index (AHCI)*, as well as several other bibliometric products.

2 A few journals – and, consequently, the papers – have been included in two or more fields.

3 See the first section of this report.

of papers, the variation in citation figures, which journals are most frequently represented, and the extent of co-publishing with foreign scientists.

We should emphasize that this is a preliminary study. The basis is the NSIOD, which includes a selected set of international scientific journals which, according to ISI, represents ”an elite body of internationally influential research publications”. The number of journals totals 6328, covering science, technology, medicine, and social sciences. Of these, 280 have been classified as *Physics*, 36 as *Astrophysics* and 182 as *Materials science*. The Research Council of Norway has identified these three fields as relevant for the 1999/2000 evaluation of Norwegian physics. In this paper the three categories are collectively denoted *Physical Sciences*. Our assumption is that the journal set defined by these three fields more or less covers all the core international journals in the fields, and that the data base therefore captures most of the papers in what may be described as the international stock of publications in the *Physical Sciences*.

In the following we will describe our method for selecting scientists and papers, and then present the results of our analysis. Even though we will assume that our study presents a fairly correct description of the international publishing at the Department of Physics at the University of Oslo, it must be pointed out that the quality of the data has not been properly tested to be applied for evaluative purposes. This applies in particular when evaluating individual scientists. Before using this sort of material for evaluation purposes, the individual scientist should be given the opportunity to check and, in case of errors and omissions, correct and supplement his or her publication record.

In the present study we have looked at trends only to a limited extent. Rather, an overall picture of the total 1981-98 period is displayed. However, the data also permits trend studies, but this has not been done at this stage.

2 Which persons are included?

In the study we include all the 58 persons who – according the NIFU database on the Norwegian research personnel – were either *tenure* holders or had *senior scientist* status at the Department of Physics as of Oct. 1, 1997. Research fellows and other research recruits have been excluded, as has non-scientific staff. Among the 58 we find a few persons who have left the department after Oct. 1, 1997, due to retirement or for other reasons. On the other hand, persons whose affiliation with the department dates later than Oct. 1, 1997 are not included. A standardised name list was constructed for the 58 selected persons, in which different name spelling alternatives were set up to make the data capture from the bibliometric data base as accurate as possible. The standard name format in this database consists of the family name in full and initials for the first name(s). Despite this name ”calibration” there is a risk that, on the one hand, some of the relevant papers have been ignored because valid name spelling variants have not been recognized (synonyms), and, on the other hand, papers are mistakenly included because of name identity of different

persons (homonyms). Nevertheless, we assess the ”hit percentage” of our identification procedure to be fairly high.

3 Characteristics of the personnel

Among the 58 persons we find 37 ”full” professors, 18 associate professors, and 3 senior scientists. There are 55 men and only 3 women. The average age on Oct. 1, 1997, was 54 (excluding the senior scientists). As many as 69 per cent of the tenured staff were 50 years or more, 87 per cent 40 years or more.

Table 1 Tenured staff and senior scientists at the Department of Physics, Univ. of Oslo, 1997, by age groups

Age group	Number	Percentage
30 - 39	7	12
40 - 49	10	17
50 - 59	20	34
60 or more	21	36
Total	58	100

Source: Research Personnel Register/NIFU

Most of persons had been departmental staff members during the majority of their occupational career, starting out as a research fellow, assistant or doctoral student, and, eventually ending up as professor. Looking at the 58 persons registered in 1997, we find as many as 51 were already associated to the department in 1991, and 37 back in 1977. Therefore, it seems to have been low personnel mobility at the department through the years, both in relation to other universities and to research institutes outside the universities.

4 Data base queries

In the bibliometrical database we queried all the papers[4] of which the 58 persons, with the different name spelling alternatives, were identified as (co)authors.

As a result 1023 papers were identified, which we assume – with a reasonable accuracy – cover the bulk of paper publishing during the 1981-98 period of the 58 persons holding tenures or senior positions at the Department of Physics at the University of Oslo. This amount of papers was the basis for the later analysis. It should be recognized that the 1023 papers also include papers published before the author was employed at the department.

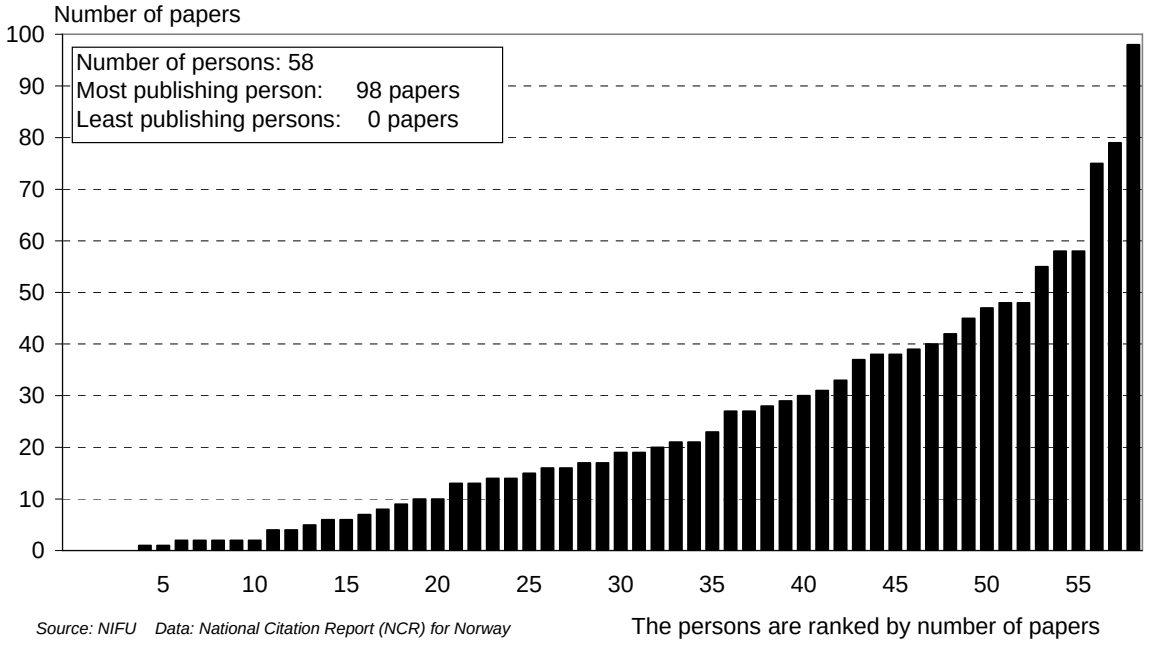
One might prefer to restrict the data to comprise only those persons actually employed at the Department of Physics at any time, and their publications during the employment period. One might also want to distinguish the publishing during a person’s recruitment

[4] Only NSIOD papers were included, and only the paper categories *article*s, *proceedings papers*, *reviews* and *notes*. Other categories like *abstract*s, *book reviews*, *letters* etc. were excluded.

period from his or her publication activity as a tenured professor. Such distinctions would make possible a more exact description of the development of the department's publishing activities. In this preliminary study, however, we have not made these distinctions.

5 Skewed allocation in paper production

Figure 1. Number of journal papers of the tenured staff and senior scientists at the Department fo Physics, Univ. of Oslo, 1981-98



In total, 55 of the 58 persons were (co)authors of the 1023 papers; i.e. 3 persons were not represented at all. Of those who were represented, the average number of papers per person was 25 for the period 1981-98. However, the distribution is extremely skewed. The reasons for this are partly that some persons have been active authors for only a part of the 18-year period, and partly the considerable variation in productivity. The most productive author published 98 papers, and the second published 79 papers. Only 6 persons have more than 50 papers; 27 had 20 or more papers.

Ideally we should take the time dimension into consideration, i.e. calculate the average number of papers within narrower time windows (see 1.4), i.e. controlling for employment periods.

6 Citations

When we consider the extent to which the papers have been referred to or cited in succeeding papers in the database, we find the distribution to be extremely skewed. Excluding the papers published in 1997 and 1998, i.e. papers which had not had much chance to be cited at all by the end of 1998, 877 papers remain. At the one extreme, two of these received more than 100 citations; at the other, 93 papers received no citations at all.

Skewed distributions like this are common in all fields of science. The question whether the skewness in the present sample is extraordinarily strong can only be answered by comparative studies.

The cumulative citation figures presented here reflect the total number of citations throughout the whole period. This means that papers published early in the period have a larger number of succeeding years in which to be cited, compared to papers published later in the period. Even when we exclude the two last years of the period, skewness occurs in the figures. Therefore, development over time should ideally be described by citation figures limited to time windows of a fixed number of years (for example 5-year periods).

Table 2. Accumulated number of citations 1981-98 to journal papers published 1991-96 by tenured staff or senior scientists at the Department of Physics, Univ. of Oslo

Number of citations	Number of papers	Percentage
None	93	11
1	78	9
2	88	10
3	63	7
4	56	6
5	49	6
6	51	6
7	36	4
8	44	5
9	38	4
10	43	5
11-20	127	14
21-30	52	6
31-40	25	3
41-50	12	1
More than 50	22	3
Total	877	100

Source: NIFU Data: National Citation Report (NCR) for Norway

7 In which journals were the papers published?

The 1023 papers were published in 195 different journals. Journals with 10 papers or more cover 619 papers or 61 per cent of the total. These are – in the database writing style:

Journal	Number of papers 1981-98
NUCLEAR PHYSICS A	79
PHYSICA SCRIPTA	78
PHYSICS LETTERS B	54
JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS	44
PHYSICAL REVIEW LETTERS	42
PHYSICAL REVIEW B-CONDENSED MATTER	29
RADIATION RESEARCH	24
NUCLEAR PHYSICS B	20
PHYSICAL REVIEW A	20
PHYSICAL REVIEW E	20
GEOPHYSICAL RESEARCH LETTERS	16
JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS	16
ZEITSCHRIFT FUR PHYSIK C-PARTICLES AND FIELDS	16
JOURNAL OF APPLIED PHYSICS	15
WAVE MOTION	15
PHYSICA A	14
PHYSICAL REVIEW C-NUCLEAR PHYSICS	14
ACTA PHYSICA POLONICA B	13
ANTICANCER RESEARCH	13
BRITISH JOURNAL OF CANCER	12
JOURNAL OF CHEMICAL PHYSICS	12
PHYSICAL REVIEW D	12
PHYSICA C	11
ACTA CRYSTALLOGRAPHICA SECTION A	10
EUROPHYSICS LETTERS	10
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT	10

Note that two cancer research journals are listed; this is explained by the previous career of one of the most published persons (see 1.8).

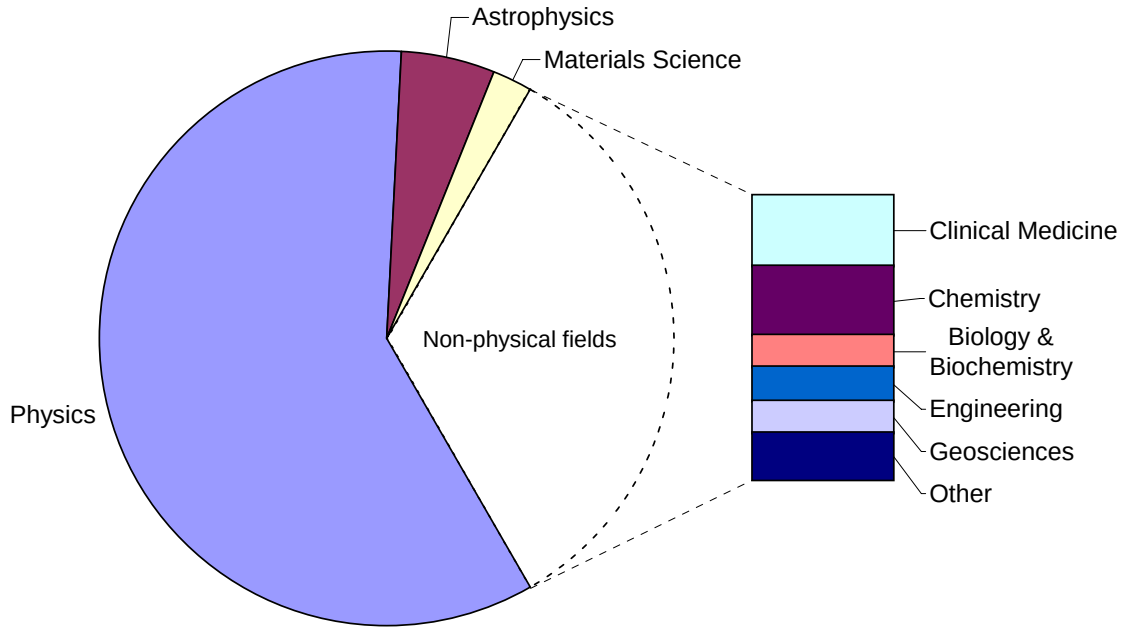
8 In which fields of science were the papers published?

Commencing with the journal-based field classification, we find, not surprisingly, that most of the papers were published in journals classified as *Physical sciences*, hereby 646 in *Physics*, 59 in *Astrophysics*, and 22 in *Materials science*. Of these, 18 have been double-counted in *Physics* and *Materials science*. Thus, altogether 709, or 69 per cent of the total of 1023 papers, have been published within *Physical sciences* of which 646, or 63 per cent, in the core category of *Physics*.

Consequently, less than a third (31 per cent) of the papers produced by the tenured staff at the Department of Physics in 1997 were published in journals classified as fields *other* than Physical sciences. The number of these papers amounts to 314, excluding 11 papers, which, because of double-classification, also were included within the Physical sciences. Of these ”non physical” papers, 92 were classified as *Clinical medicine* and 88 as *Chemistry*. The large number for *Clinical medicine* can be explained by the previous career as a cancer researcher for one of the staff members. Excluding the production of this single person, the percentage of ”non-physical” papers is reduced from 31 per cent to 23 per cent.

It may be argued that one should only include those papers which have been published during the period of the person’s ”attachment” to the department, and not include published papers in previous positions at other institutions. To single out ”relevant” papers according to this criterion would require more data processing time than has been available for this study.

Figure 2. Journal papers of the tenured staff and senior scientists at the Department fo Physics, Univ. of Oslo, 1981-98, by field of science



Source: NIFU Data: National Citation Report (NCR) for Norway

Table 3. Journal papers 1981-98 by tenured staff and senior scientist at the Department of Physics, Univ. of Oslo, by field of science[*)]

Field of science	Antall
Physical sciences, hereby:	*709*
Physics	646
Astrophysics	59
Material Science	22
Other sciences, hereby:	*314*
Clinical Medicine	92
Chemistry	88
Engineering	44
Biology & Biochemistry	41
Geosciences	40
Multidisciplinary	27
Molecular Biology & Genetics	10
Plant & Animal Science	7
Ecology/Environment	6
Pharmacology	5
Immunology	3
Microbiology	2
Total	1 023

Source: NIFU Data: National Citation Report (NCR) for Norway

[*)] Adding the fields of science gives a somewhat higher figure than the real total because some journals are attributed to more than one field of science.

9 The Department of Physics at the University of Oslo as a part of the total Norwegian physical research

Table 4. Norwegian journal papers in Physical sciences 1981-98. Total, and hereby at Department of Physics, Univ. of Oslo.

Field of science	Total	Hereby Dept. of Physics	Percentage Dept. of Physics
Physics	3 479	646	19
Astrophysics	484	59	12
Materials science	934	22	2
Total [1)]	4 597	709	15

Source: The Research Personnel Register/NIFU

[1)] Adding the fields of science gives a somewhat higher figure than the real total because some journals are attributed to more than one field of science.

Compared to the total Norwegian publishing production in the three field categories considered as *Physical sciences* in the NSIOD database, the proportion of papers of the selected staff members of the Department of Physics amounts to 15 per cent. If we consider the core category of *Physics* exclusively, the percentage amounts to 19 per cent, that is, about one fifth of all Norwegian papers in the category.

10 Co-authorship with other countries

For 494 – or 48 per cent – of the 1023 papers, only *Norwegian* addresses were registered. For 329 papers, *one* foreign country was included among the authors' addresses. In the remaining 200 papers, the Department of Physics' staff members co-operated with scientists in 2 or more countries. In one paper, as many as 11 countries (Norway included) were represented.

Table 5 International co-authorships of journal papers authored by tenured staff and senior scientists at the Department of Physics at the University of Oslo 1981-98

Number cooperating of countries	Number of papers	Percentage
10	1	0
9	1	0
8	1	0
7	7	1
6	9	1
5	11	1
4	18	2
3	54	5
2	98	10
1	329	32
Norwegian addresses only	494	48
Total	1 023	100

Source: NIFU Data: National Citation Report (NCR) for Norway

USA is the country most frequently represented – in 181 papers of the total of 1023. Denmark follows with 115 and Sweden with 96 papers. Altogether are 35 countries represented among the authors of the 1023 papers, excluding Norway. The following countries occur 10 times or more:

Country	Number of papers 1981-98
USA	181
Danmark	115
Sverige	96
Tyskland	63
Russland/USSR	62
Storbritannia	60
Frankrike	54
Italia	52
Canada	46
Sveits	39
Polen	31
Finland	24
Japan	23
Nederland	15
Spania	13
Israel	13

11 Some methodological points

In interpreting the data one should be aware of some crucial points.

The study includes tenured staff employed at the Department of Physics at the University of Oslo as of Oct. 1, 1997. Senior scientists associated with the department on the same date are also included. That is, the data even includes persons who have resigned or retired later than Oct. 1, 1997. On the other hand, persons who were employed later than this date are not included.

The analysis concerns publishing in *journals*, not other types of publications. The papers selected for the analysis corresponds to the journal set in NSIOD. That is, *articles*, *proceedings papers* and *reviews* are included, but not other journal items, like *editorials*, *letters* etc.

The analysis includes papers published through the period 1981-98. Papers published in 1999 or *before* 1981 are not included. The analysis covers *all* the papers in the database published by the selected authors during the 1981-98 period, and even includes papers published during employment *outside* the Department of Physics.

In the data processing these assumptions have been made:

- The data of the Research Personnel Register are correct, i.e., all relevant persons are included with correct name spelling.
- The spelling of the persons' last names is identical in the Research Personnel Register and the publication database.
- Norwegian scientists have a Norwegian address in the publication database.
- The papers recovered in the database encompass all the international journal publishing of the selected 58 persons.

Some reservations:

- We *may* have "lost" some relevant name spelling variants.
- We *may*, unwittingly, have removed some false homonyms.
- We *may*, unwittingly, have kept some real homonyms.

A data base characteristic:

- For a paper, only the first 16 authors and the first 15 authors' adresses have been recorded in the database. This may have lead to a minor underestimation of the number of papers.