

## Citation Analysis of Doctoral Theses in Physics Submitted to North Bengal University in West Bengal: An In-Depth Study

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### Abstract

This study evaluates Ph.D. theses in physics, submitted to the North Bengal University Darjeeling, West Bengal during 1987 to 2007. This study aims to determine the year wise distribution of theses, the guideship pattern, to determine the most productive guides and average number of citations per theses. The study also investigate the citation distribution to show which format is cited most in each subject of science, to identify the characteristics of the cited references in terms of format, source of information, and to view the chronological distribution of cited literature, which will show the time during which literature in the particular subjects remains active. The study presents the trends in authorship pattern and collaborative research in physics. Journals and Books/ monographs were the two formats that were most frequently cited in Physics (81.76% and 8.34%). The ratio between single and multi-authored papers is approximately 1:3. The degree of collaboration in physics is 0.774. The study indicates that maximum references were used during the year of 1980-1989. Journals published in India, USA, United Kingdom and the Netherlands are popular among the University science researchers. The most frequently cited journal titles were *The Physics Letter*, *Physics Review A*, *Mol. Cryst. Liq. Crystal*.

**Keywords:** Citation analysis; Physics; Productivity of guides; Authorship collaboration; Authorship pattern; Core journals; University of North Bengal.

### Introduction

Citation refers to the list of references to other works in a published work. "Referring" means mentioning in the proper context and giving an explicit bibliographical statement in a list of references. Older articles are then cited by or will receive a citation from the newer one.[1] Citations acknowledge the existence of related literature. They help to communicate special knowledge.[2] Merton (2000) observes that citations provide peer recognition that is central scholarly system of science and other fields.[3] Typically, citation shows that a relationship exists between the work of an

author and the previous works done in that field. Isaac Newton referred to this relationship when he said, "If I have seen further, it is by standing on the shoulders of giants".[4] Authors contribute to existing knowledge and demonstrate that they are current with activity in their fields.[5] Citation analysis looks at citation practices.[2] Citation analysis helps to determine the competitive position of authors and can help to identify useful journals.[5] Citation analysis may be viewed as a collaborative effort that can promote the quality of scholarly research.[1] Citation analysis is also a way to understand users. Studying references cited by faculty publication show the sources most commonly used and valued locally.[6]

Meho (2007) has observed that citation analysis is actually a branch of information science in which researchers study the way articles in a scholarly field are accessed and referenced.[7] Citation analysis was developed to identify core articles, authors, or journals in a field. Citation analysis has been used beyond information science for scholarly analysis and

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evaluation. Johnson (2000) point out that citation studies reveal much about scholarly communication and can guide collection development in academic libraries.[8] Garfield (1983) noted that citation analysis is used to study the journals as well as the people and work of science.[9] Citation analysis of different subjects are based on a literary model of scientific process.[10] Based on this model, citation analysis has been carried out in a variety of ways.[11] Garfield (2004) observed that scientific work is represented by the papers published to report it, and the relationships between works are represented by references.[10] Smith (1981) suggested that citation analysis of theses and dissertations can have implications for both collection development and user services. She cautions librarian that citation does not imply quality or importance.[12] It is a controversial methodology because it does not represent all the possible needs or uses for information.[13] Though valid criticism of citation analysis exists, several authors have shown that citations correlate with other methods of collection analysis, including impact factors, circulation statistics, in-house use, and user surveys.[14,15,16]

Today, bibliometrics and scientometrics make extensive use of citations to assess quality and trace patterns of scholarly communication.[17] A number of researchers have used citation analysis to look at the subject focus of postgraduate students and determine their journal needs.[18,19] It is against this background that this study does citation analysis of doctoral theses (1987-2007) in Physics submitted to North Bengal University in West Bengal.

## Objectives

The investigation aims at establishing the following objectives:

1. To study the year wise break up of theses in various discipline of sciences submitted to North Bengal University during 1987-2007.

2. To study the guideship pattern in sciences
3. To study the productivity of guides in the selected discipline
4. An analysis of the recorded citations to determine the average number of citations in selected disciplines of sciences.
5. To study the rate of collaborative research by analyzing the authorship pattern of the citations.
6. To study the pattern of contributing authors in the various discipline of sciences.
7. To determine the use of different types of documents like books, periodicals, journals articles, conference proceedings, reports, online, etc.
8. To observe the chronological distribution of citations to determine the productive years of used publications.
9. To study the country wise distribution of cited journals to find out the country of origin of the published journals
10. To compile a rank list of core journals in the various selected disciplines of sciences.

## Methodology

The research design adopted was a descriptive study. The information about these theses has been obtained from the Library and 50 theses belonged to Physics from the year 1987 to 2007 were used in the data collection. Their bibliographic information was keyed into Microsoft Access. The collection of the citation data in this research was carried out Re-prospective Conversion Methods and a total of 8182 citations were collected to study the following:

### *Year Wise Distribution of Theses*

Table 1 shows the year wise break up of theses in Physics.

**Table 1**

SI No	Year	No of Theses
1.	2007	1
2.	2006	2
3.	2005	2
4.	2004	0
5.	2003	1
6.	2002	5
7.	2001	0
8.	2000	3
9.	1999	3
10.	1998	2
11.	1997	2
12.	1996	2
13.	1995	4
14.	1994	0
15.	1993	5
16.	1992	0
17.	1991	4
18.	1990	6
19.	1989	2
20.	1988	2
21.	1987	4
	<b>Total</b>	<b>50</b>

Table 1 shows the year wise break up of theses in physics submitted to the respective department of North Bengal University from 1987-2007. In all of total 50 theses have been submitted in the selected subject. Year wise analysis of theses reveals that the maximum contribution was made during 1990, with 6 theses followed by the year 1993, 2002 (five theses). It is interesting to note that not even a single Ph D was awarded in 2004, 2001, 1994 and 1992.

*Guideship Pattern*

Table 2 reflects the Guideship pattern of physics theses as below.

The Table shows the Guideship pattern in Physics. The table reveals that 94% scholars have a Single guide while 6% scholars have a double guide.

**Table 2**

Number of Guides	No of Theses	Percent
1	47	94.0
2	3	6.0
<b>Total</b>	<b>50</b>	<b>100</b>

Guideship Pattern in Physics

**Table 3**

SI No	Name of Guide	No of Theses	Rank
1	N Chaudhuri	10	1
2	S Acharyya	7	2
3	Pradip Kumar Mandal	4	3
4	S Mukherjee	4	3
5	Shukla Paul	4	3
6	D Das Gupta	4	4
7	Ranjit Paul	3	4
8	Biswanath Bhattacharyya	2	5
9	MM Banerjee	2	5
10	N Kar	2	5
11	S K Ghosal	2	5
12	S N Sen	2	5
13	B Banerjee	2	5
14	Paritosh Biswas	1	6
15	P Ghosh	1	6
16	Krishna Pranab Chanda	1	6
17	B Das	1	6
18	Malay Kumar Das	1	6

*Productivity of Guides*

Table 3 shows the most productive guides in the creation of PhD theses.

Dr. N Chaudhuri, has guided highest number of PhDs in physics, with 10, followed by Dr. S Acharyya, who has guided 7 scholars. The third place is occupied by Dr. Pradip Kumar Mandal, Dr. S Mukherjee, D Das Gupta and Dr. Shula Paul respectively who have guided 4 scholars in each and so on.

*Average Number of Citation per Theses*

The table represents the average number of citations per theses in physics. In total of 8182 citations were analyzed out of 50 theses with around 163.64 average citations.

*Form Dispersion of Citations*

The citations were classified into various bibliographic forms such as Journals, Books, Conference Proceedings, Ph.D Dissertations, and Reports etc.

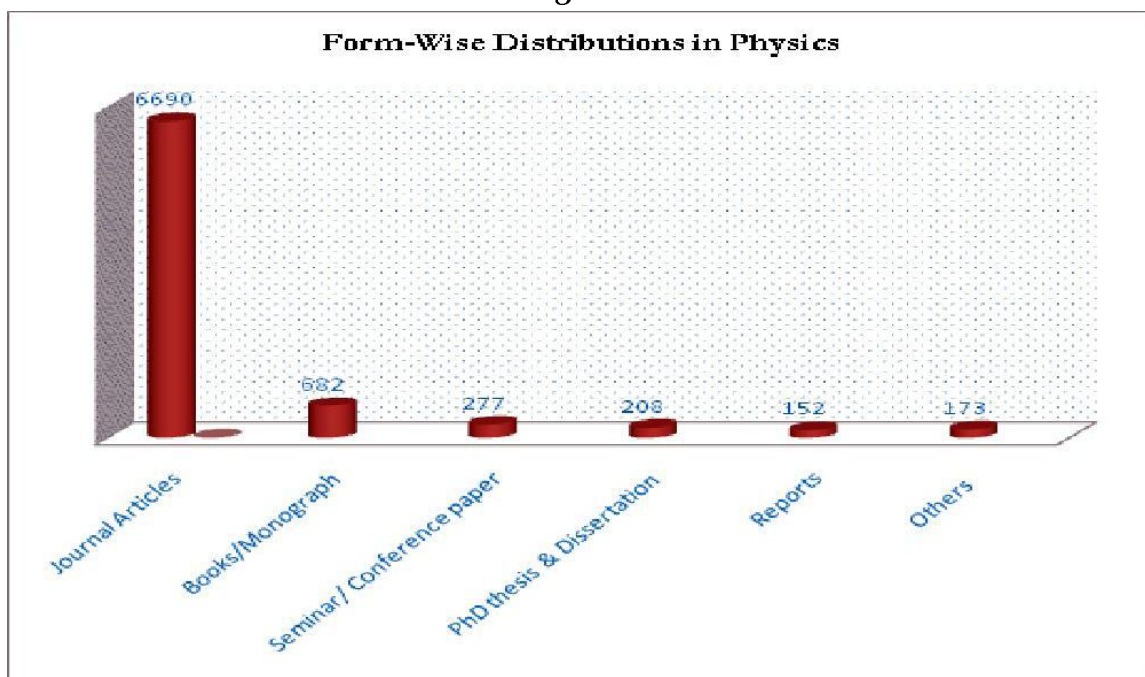
Table 5 and Figure 1 represent the form

**Table 4: Average No. of citations**

No. of theses	Total citations	Average
<b>50</b>	<b>8182</b>	<b>163.64</b>

**Table 5: Form-Wise Distribution**

Sl. No.	Forms of Document cited	No. of citation	Percentage	Cumulative no. of citation	Cumulative percentage	Rank
1	Journal Articles	6690	81.76	6690	81.76	1
2	Books/Monograph	682	8.34	7372	90.1	2
3	Seminar/ Conference paper	277	3.39	7649	93.49	3
4	PhD thesis & Dissertation	208	2.54	7857	96.03	4
5	Reports	152	1.86	8009	97.89	5
6	Others: includes manual, URLS, Lecture notes, Unpublished etc.	173	2.11	8182	100	6
	<b>Total</b>	<b>8182</b>	<b>100</b>	<b>8182</b>		

**Figure 1**

dispersion in physics. The total number of citations in the discipline is 8182. It is evident from the analysis that a large portion of the documents used include Journal articles 6690 (81.76%) Monographs/ Books 682 (8.31%), Seminar/ Conference paper 277 (3.39%), Ph. D theses/ Dissertations 208 (2.54%), Reports 152 (1.86%), and others 173 (2.11%).

Journal articles are the most important form of publication cited, followed by books, Seminar/ Conferences paper, Ph.D theses/ Dissertations and Reports.

#### *Author Dispersions of the Citations*

The authorship pattern reflects the nature of productivity of writers associated with Physics discipline. Whether the preference is

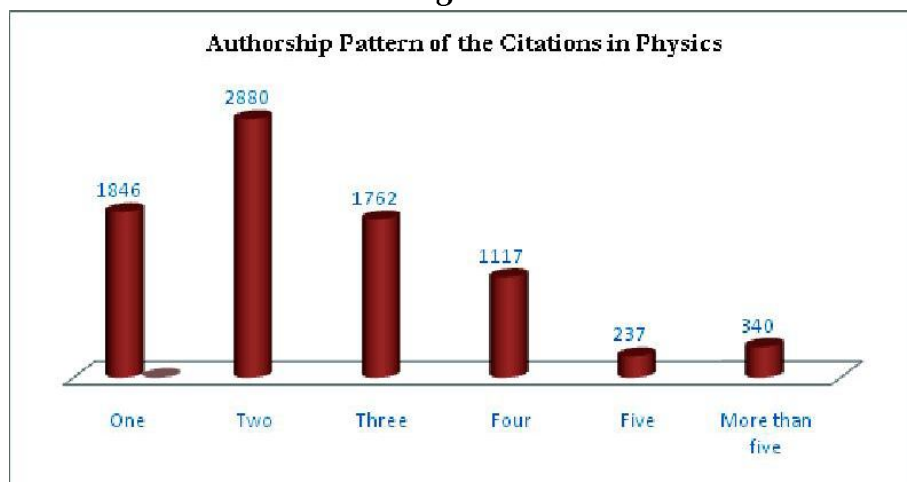
of solo works or collaborative works are appreciated. The trend of authorship pattern can be gauged by analyzing the author dispersion relating to works of single authors and multiple authors.

Table 6 and Figure 2 present the authorship pattern in the field of physics. Two - authored papers comprised the highest percentage (35.21%) of total 8182 papers/ citations. Single authored papers constituted 22.56% of the cited papers. Three authored papers accounted for 21.53%, four authored papers counted for 13.65%, five authored counted for 2.90% and the rest i.e., 4.15% were by six or more authors. Thus, multi-authored papers far outnumbered single- authored papers, accounting for

**Table 6: Authorship Pattern of Journal Citations**

Sl. No.	No. of Authors	No. of Citations	Percentage
1	One	1846	22.56
2	Two	2880	35.21
3	Three	1762	21.53
4	Four	1117	13.65
5	Five	237	2.90
6	More than five	340	4.15
	<b>Total</b>	<b>8182</b>	<b>100</b>

**Figure 2**



77.44% of the total cited papers.

This clearly indicates that the predominance of multi-authored papers (77.44%) over single-authored papers (22.56%). The ratio between single and multi-authored papers is approximately 1:3. The high incidence of multiple authorship is a characteristic of the science.

#### *Degree of Author Collaboration*

The extent of collaboration in research can be measured with the help of multi - authored papers. To determine the degree of collaboration in quantitative terms, the formula given by Subramanayam has been used. The formula is as:

Where C= Degree of Collaboration in a discipline

$$C = \frac{Nm}{Nm + Ns}$$

Nm = Number of Multi authored papers

Ns = Number of single authored papers

The degree of collaboration is 0.776 as a whole. This clearly indicates the trend towards

$$C = \frac{6336}{6336+1846} = 0.774$$

collaborative research.. This reflects the degree of prevalence of multiple authored publications in physics, which reflects higher level of collaboration. This supports the observation of Price (1963) that team research is a common trend in scientific activity

#### *Chronological Analysis/Time Dispersion*

The term time dispersion expresses the year of publication of the documents in use. The documents when treated into blocks of decades reveal the most productive decade and the obsolescence rate of literature. With the explosion of literature and multi dimensional growth of the universe of knowledge has simultaneously stimulated the use and obsolescence of published materials. The faster the rate of recent publications higher is the obsolescence rate. It also differs from discipline

**Table 7**

Author	Publications	Percentage
Single	1846	22.56
Multiple	6336	77.44

**Table 8: Chronological Distribution of Citation**

Sl. No.	Year	No. of citation	Percentage	Cumulative frequency
1	2000-2007	376	2.60	4.60
2	1990-1999	1501	18.34	22.94
3	1980-1989	2695	33.93	55.88
4	1970-1979	2462	31.09	85.95
5	1960-1969	665	8.13	94.08
6	1950-1959	265	3.24	97.32
7	Before 1950s	218	2.67	99.99
	<b>Total</b>	<b>8182</b>	<b>100</b>	

to discipline. Thus it becomes essential to study the citations to determine the documents utility depending upon the time factor.

Table 6 examines the time dispersion of citations in physics. A total number of citations were analyzed for determining the age of utility of the publications were 8182. The study covers the time span under the year blocks in decades. The analysis reveals that the years 1980-1989 (32.94%) is the most productive decade followed by 1970-1979 (30.09%) is at second position, 1990-1999 (18.34%), 1960-1969 (8.13%), 2000-2007 (4.59%) and before 1950s with (2.67%).

#### *Country Wise Dispersion of Cited Journals*

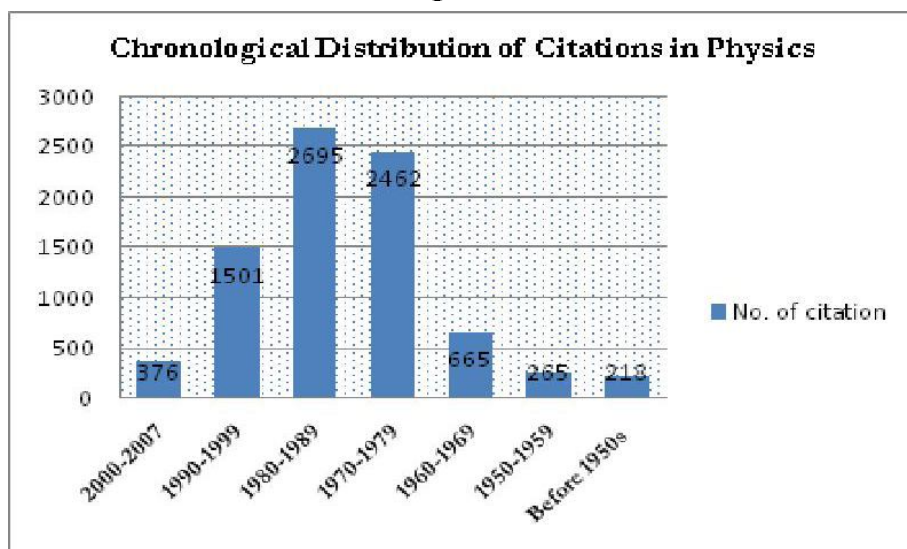
Research work cover published literature

from any part of the world. The relevance and importance of the maximum used material can be related to the country producing the largest usable literature. The citation study of the research dissertations can lead to understand the country wise use pattern of researchers in physics.

The Journals are analyzed according to their country of origin and the result of the most productive countries is shown in the Table 9. It has been observed from the analysis that India is the leading country with 28.48% of the total journals cited. USA has a contribution with 20.21 % of journals and UK with 7.50%. It can be inferred from the analysis that, *India*, *USA* and *UK* are the prominent countries of Physics journals that have been cited by the research scholars of the respective departments.

#### *Ranked List of Core Journals*

Journals are very useful for researchers for the scientific communication but their increasing cost puts the librarian to study the quality, usefulness and suitability to a particular group of users. Core journals ranking studies are usually made to help in the selection of journals and in assessing the importance of one or more journals in a particular subject field. Frequency of citations or use of a journal is governed by many factors

**Figure 3**

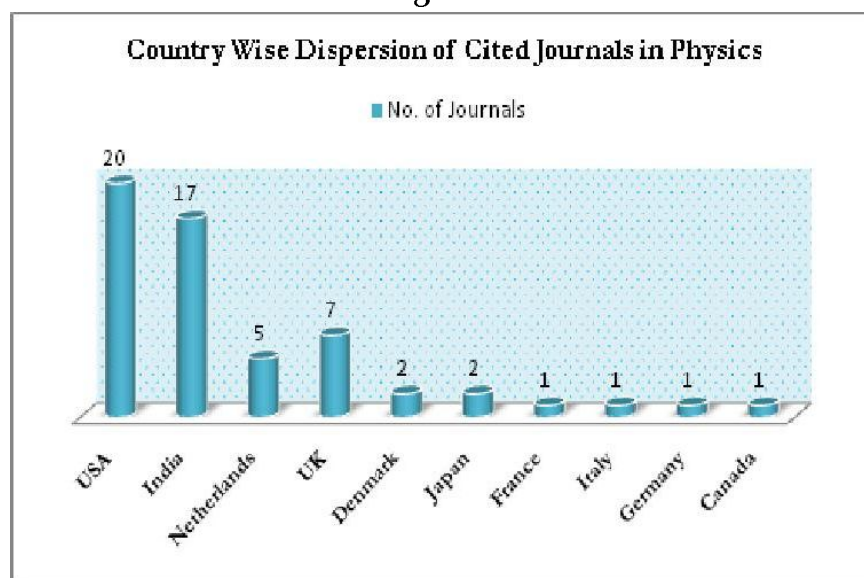


**Table 9 Journals having 30 or more than 30 Citation Each**

Sl. No.	Country	No. of Journals	No of Citations	Percentage	Rank
1	USA	20	1905	28.48	1
2	India	17	964	14.40	2
3	Netherlands	5	791	11.82	3
4	UK	7	426	6.37	4
5	Denmark	2	198	2.96	5
6	Japan	2	73	1.09	6
7	France	1	75	1.12	7
8	Italy	1	69	1.04	8
9	Germany	1	65	0.98	9
10	Canada	1	40	0.59	10
11	Others	337	2084	31.15	11
	<b>Total</b>	<b>395</b>	<b>6690</b>	<b>100</b>	

Country wise dispersion of cited journals

**Figure-4**



such as availability, language and country of publication, size and frequency of publication, coverage in secondary journals, reprint dissemination, reputation of the authors and so on. Therefore, the present study is to judge the variable and productive journals, cited in Physics.

In the collected data all the 6690 articles have been published in 395 journals which have been ranked up to 48 positions. These are journals in which the frequency of occurrence is 409 to 30. The journals with less than 30 citations have not been considered. The calculation was made with the application of Bradford Law; which resulted that in the first

zone 13 journals contained 2244 articles, in the second zone 40 journals contained 2237 articles and remaining 342 journals contained 2209 articles in the third zone.

In other words, we can say that first 13 journals have covered 1/3 of the total articles, next 40 journals have covered 1/3 articles and 342 journals also covered yet another 1/3 articles. Thus the first 13 journals are regarded as core journals in the field.

The ranked list of most productive journals as appeared in the source theses is presented in table 8. It is clearly evident from analysis that *The Physics Letter* tops the list with highest

**Table 10: Ranked List of Cited Journals in Physics**

SI No	Journals	No of Citations	%	Accum. Citations (%)	Rank
1	Physics Letter	409	6.12	6.12	1
2	Physical Review. A	309	4.62	10.75	2
3	Mol. Cryst. Liq. Crystal	201	2.86	13.6	3
4	Physical Rev. Letter	178	2.67	16.27	4
5	Indian Journal of Pure and Applied Physics	157	2.35	18.62	5
6	Journal of Applied Physics	153	2.29	20.91	6
7	Physics Review. B	143	2.14	23.05	7
8	Astrophysical Journal	134	2.10	25.15	8
9	Acta Crystallogr.	119	1.78	26.93	9
10	Journal of Chemical Physics	118	1.76	28.69	10
11	Journal of Crystal Growth	113	1.69	30.38	11
12	Liq. Cryst.	107	1.60	31.98	12
13	Current Science	103	1.55	33.53	13
14	Journal of Non Crystal Solids	97	1.46	34.99	14
15	Physics C	89	1.34	36.33	15
16	Nature	88	1.33	37.66	16
17	J. Sound and Vibration	83	1.25	38.91	17
18	Sound and Vibration	81	1.22	40.13	18
19	Int. J. Non-Linear Math. Physics	79	1.19	41.32	19
20	Indian Journal of Pure and Applied Math	77	1.15	42.47	20
21	Astronomy and Astrophysics	75	1.13	43.6	21
22	Appl. Phys. Letter	74	1.10	44.7	22
23	J. Fluid Mech	72	1.07	45.77	23
24	Z. Phys.	69	1.03	46.8	24
25	Bulletin of Material Sciences	69	1.03	47.83	24
26	Z. Naturforsch	65	0.97	48.8	25
27	Proceedings of the Indian academy of Science	65	0.97	49.77	25
28	Physics	63	0.94	50.71	26
29	Physics News	62	0.93	51.64	27
30	Pramana ( A Journal of Physics)	58	0.87	52.51	28
31	Journal of Astrophysics and Astronomy	56	0.84	53.35	29
32	Physics Today	55	0.82	54.17	30
33	Science	53	0.79	54.96	31



Sl No	Journals	No of Citations	%	Accum. Citations (%)	Rank
34	Physics Fluids -A	51	0.74	55.7	32
35	Indian Journal of Physics	49	0.64	56.34	33
36	Physics Fluids – B	47	0.71	57.05	34
37	Solid State Science	47	0.71	57.76	34
38	Proceedings of the IEEE	45	0.67	58.43	35
39	Advances in Physics	43	0.64	59.07	36
40	Bulletin of the Astronomical Society of India	42	0.63	59.7	37
41	Journal of the physical society of Japan	41	0.61	60.31	38
42	Asian Journal physics	41	0.61	60.92	38
43	Canadian Journal of Physics	40	0.59	61.51	39
44	Rev. Mod. Physics	39	0.58	62.09	40
45	Journal of Fluids and Structure	39	0.58	62.67	40
46	Bulletin Calcutta mathematical Society	39	0.58	63.25	40
47	Indian Journal of Physics-B	38	0.57	63.82	41
48	Bulletin of Astronomical Society of India	37	0.55	64.37	42
49	Physical Review –C	35	0.52	64.89	43
50	Journal of Aeronautical Society of India	34	0.51	65.4	44
51	Indian Journal of Chemistry	34	0.51	65.91	44
52	Reviews of Modern Physics	33	0.50	66.41	45
53	Annals of mathematical physics	33	0.50	66.91	45
54	Journal of the society of material Science	32	0.49	67.4	46
55	Journal of Indian Chemical Society	32	0.49	67.89	46
56	Transactions of the American Nuclear Society	31	0.48	68.37	47
57	MNRS	30	0.47	68.84	48
58	Other less than 30 citations	2084	31.16	100	49
	<b>Total</b>	<b>6690</b>	<b>100</b>		

contribution of 409 (6.12%) citations.

*Physics Review A*, is in the second position by accounting 309 (4.62%) citations. While *Mol. Cryst.Liq. Crystal* occupies the third position with 201 (2.86%) citations and so on. It is important to note that *Indian Journal of Pure and Applied Physics* occupies fifth position with 157 (2.34%) of citations.

It is interesting to note that high status of multi-disciplinary journals like *Nature and Science etc.* are also in the ranked list of physics journals literature.

### Conclusion

The results provide useful insight into the information base of University scientific production in this subject. The number of the production of Ph.D theses is discussed, along with their Guideship pattern and the most productive guides and also the sources of information used by the University researchers defending Ph.D theses in physics. The study indicates that maximum references were used during the year of 1980-1989. According to the distribution by document type most of the publications cited are articles in journals; the number of references to other kinds of documents such as books, conference proceedings, reports, and other articles is small; and references of Internet documents are rare. The high percentage of citations of journal articles confirms the important role played by scientific journals in the dissemination of science in North Bengal. The study reveals that journals are the most intensely cited by physics Ph.D thesis authors which reflect the use of information contained primarily in periodicals. Moreover, a large share of the information is found in a short number of journals, essentially those with greatest impact in this field. Nonetheless, as the act of citing a journal title in dissertations represents implicit use of the library resources, the list of core journal titles that get cited most frequently can be used for collection management purposes.

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