Research Publication Output in 'Nuclear Physics': A Scientometric Analysis

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Abstract

This study analyses the research output performance of nuclear physics. The study period is selected as 1999 to 2013. These Data's were collected mainly from Scopus database during the period 1999-2013. Based on the string, totally 21034 records were downloaded and analysed by MS office Excel 2007 as per objective of the study. It is noted that out of 21,034 research papers envisaged in the study, triple and four authors contributed papers occupying first and second in the order, it is calculated 4080 (19.40%) and 3839 (18.24%) respectively. Double authors contributing to the research occupies the third rank with 3450 (16.40%) and five authors occupy the fourth rank at 3051 (14.50%) followed by six authors and seven authors placed fifth and six ranks with 2109 (10.02%), 1406 (6.69%) respectively.

Keywords

Scintometric Analysis; Nuclear Physics;.Research Output; Growth Of Literature

Electronic access

The journal is available at www.jalis.in

Journal of Advances in Library and Information Science
ISSN: 2277-2219 Vol. 5. No.2. 2016. Pp124-131

INTRODUCTION

The terms bibliometrics and scientometric were almost simultaneously introduced by Pritchard and by Nalimov and Mulchenko in 1969. While Pritchard explained the term bibliometrics as "the application of mathematical and statistical methods to books and other media of communication".The term 'Scientometrics', often used synonymously as 'Bibliometrics', which originated in Russia, is quantitative methods of application in measuring science. The measurement involves counting artifacts to the production and use of information, and arriving conclusions from the counts. Nalimov and Mulchenko defined scientometrics as "the application of those quantitative methods which are dealing with the analysis of science viewed as an information process". According to these interpretations the speciality scientometric is restricted to the measurement of science communication, whereas bibliometrics is designed to deal with more general information processes. The terms like 'Librametrics', 'Bibliometrics', 'Informetrics' and 'Scientometrics' have been used synonymously in order to study the growth of literature in a discipline and other aspects of literature quantitatively. Scientometrics analyses, the quantitative aspects of science, the quantitative of the Science of Science, of Scientific Communication Studies and of Science Policy Studies. Scientometrics and Informetrics are bound through their mutual interest in scientific literature. Their statistical and mathematical orientation does not preclude analysis by qualitative methods.

REVIEW OF LITERATRURE

Karpagam et al. (2011) have analyzed the growth pattern of Nanoscience and Nanotechnology literature in India during 1990 - 2009 (20 years). The Scopus international multidisciplinary bibliographical database has been used to identify the Indian contributions on the field of nanoscience and nanotechnology. The study measures the performance based on several parameters, country annual growth rate, authorship pattern, collaborative index, collaborative coefficient, modified collaborative coefficient and subject profile. Further the study examines national publication output and impact in terms of average citations per paper, international collaboration output and share, contribution and impact of Indian Institutions and impact of Indian journals.

Granda - Orive et al., (2011) compared the production, impact and co-authorship of publications by Spanish authors on smoking and tobacco between two time periods (1998/2002 versus 2003/2007) using Science Citation Index. Spanish scientific production and co-authorship of documents on smoking and tobacco have increased from one period to the next. The documents from the earlier period receive more citations.Tsay (2011) conducted a bibliometric analysis and comparison of JASIST, IPM and JOD publications for volumes published from 1998 to 2008. The following conclusions may be drawn from this study JASIST published more than twice of articles of IPM and JOD, both published approximately the same number of articles. Interestingly, JOD published more book reviews (54%) than journal articles. Sangam (2012) has tried in his study to investigate the pattern of authorship and Collaborative studies in the field of demography. The data was made available from the population index for the time span 1988 -1999. It is found that the growth in the proportion of collaborated publication shows decreasing value. The computed value of CI and DC show a consistent trend, reflecting the growing collaboration.Gupta, B.M and Adarsh Bala, (2013) analysed the research output of India in Alzheimer's diseases research during 202-2011. The study revealed that India ranks at 16 th Position (with 900 papers) among top 20 top countries with global publication share of 1.33 per cent (rising form 0.39 per cent in 2002 to 2.36 percent 2011) and an annual average publication growth rate of 31.90 percent during 2002-2011.

Mishra A.K and Balhara Y.P.S (2013) conducted a study on statistical methodology for the scientometric study of the growth of medical sciences in India. The result indicates differential growth trajectory in many sub-disciplines of medical sciences. The Specialities such as epidemiology, obstetrics and gynaecology, geriatrics and psychiatry and mental health need to be pursued more seriously. Ganna P.S. et al., (2013) estimated the availability of Literature on PubMed-Medline by Indian orthodontists from 1999-2011 by using bibliometrics analysis. The Study indicates that out of total of 242 articles, 189 got Published in international journals and 53 in Indian journals. 50(20.6 per cent) were published in journals of clinical orthodontics followed by 37(15.2 per cent) in American journal of orthodontics and dentofacial orthopaedics. Bhutani G, Karlra S, verma P and Kaushal J .(2014) made a Bibliometric analysis of the Journal of Medical Nutraceuticals Publications of the year 2012-2013 of JMNN.The study revealed that a total of four main issues were published in JMNN in the year 2012-2013, including a total of 46 publications. The review articles were maximally. All the sub 0specialities were well covered, the largest being diabetes and endocrinology. Minas H, wright A. Zhao M and Kakuma, R (2014) analysed the international journal of mental health system. Articles with three to five authors constitute the dominant authorship patter, and author's affiliations are varied. IJMHS to be well positioned in the four categories in which it is listed, including comparisons with well-established BMC journals that have similar scientific interest. Geographic authorship patterns show contributions from a large number of countries including many low and middle income countries.Yayci E, Guler O.T, Atacag T and Cetin A, (2014) investigated bibliometric analysis of publication on polycystic ovary syndrome and turkey's scientific contribution Web of Science based search on the field of "Polycystic Overay Syndrome" through the database of Science Citation Index Expanded from 1980 to the date of the study (June 20th 2012), the study also revealed 8891 English Scientific documents. Among these. 2836(31.9 per cent), Turkey (5.34 per cent) Turkey has a prominent Place with respect to its contribution to the scientific repertory on the field. This contribution has been steadily increasing during the last decade.

STATEMENT OF PROBLEM

The present study aims at analyzing the research output performance of global scientist in the field of nuclear physics research. Its output in nuclear physics research has received the attention of various researchers, policy makers, and planners. Many of the publications have revealed the issue of Nuclear Physics research and its consequence on maintaining the information technology. Due to sprinkled publications, the findings of this research have not been visible to the policy makers. In order to overcome this problem, this study attempts to convert the publications into inclusive database. This would be a major work towards consolidating the research output process on one side and facilitating the visibility of the publications on the other. This database (Scopus data base) covers information relating to the titles, authors, author affiliation, methodology adopted and the continent and country coverage of the comprehensive publications during the study periods of fifteen years (1999 to 2013). With respect to the above mentioned problem, this research attempts to analyze the research outputs on

Nuclear Physics . This research aims at assemble data from different countries and even continents.

OBJECTIVES OF THE STUDY

The major objectives are framed with the unique principle of the present study as mentioned below:

1. To identify the source-wise distribution of Nuclear Physics research output of the study from 1999 to 2013.
2. To identify the Prolific Authors According to highest research productivity
3. To analyzes the Authorship Pattern of publication on Nuclear physics

METHODOLOGY

The present study attempts to analyse the research output performance in the field of Nuclear Physics. It aims to identify the distribution of Nuclear Physics research outputs both at national and international levels on the basis of research papers contributed by the researchers in respective discipline in Nuclear Physics research. The study will also examine the author's productivity and degree of collaboration in Nuclear Physics research outputs. The necessary data was collected from the Science Citation Index (SCI) and Social Science Citation Index (SSCI) and Arts & Humanities Citation Index (ACHI) which is available via the Scopus Data base and Web of Science (WoS). The study period is selected as 1999 to 2013. These Data's were collected mainly from Scopus database during the period 1999-2013. Based on the string, totally 21034 records were downloaded and analysed by MS office Excel 2007 as per objective of the study. A total of 21034 records were downloaded and analyzed by using the Histcite software application as per the objectives of the study.

DATA ANANLYSIS

Research output on Nuclear physics

Table 1: Source wise distribution of Nuclear physics Research output

S.No	Source	Records	%
1	Article	18056	85.65
2	Abstract	1641	7.90
3	Review	1161	5.62
4	Editorial Materials	116	0.55
5	Letter	15	0.07
6	Correction	10	0.05
7	Book Review	09	0.04
8	News Items	09	0.04
9	Reprint	06	0.03
10	Bibliography	04	0.02
11	Proceeding paper	04	0.02
12	Software Review	01	0.00
13	Meeting Abstract	01	0.00
	Total	**21034**	**100.00**

The above table 1 shows the Source wise distribution of Nuclear physics Research output indexed in Scopus Database during the study period of 1999-2013. The productivity of scientists on Nuclear Physics spreads over a variety (Thirteen types) of publication such as Article, abstract, review, editorial materials, Letter ,correction , book review ,news items , reprint ,bibliography ,proceeding paper, software review and meeting abstract. It is clear from the analysis that the share of articles is the most prominent bibliographic form of publication and it occupies 85.65% (18056) of total publications. Abstract with 7.90% (1641) contributions, Review 5.62% (1161),Editorialmaterials0.55%(116),letter0.07%(15), Correction 0.05%(10), Book review 0.04% (09),News Items0.0%4(09), Reprint 0.03% (06), Bibliography 0.02% (04), proceeding Paper 0.02% (04), and followed by remaining bibliographic forms. Remaining document types such as software review and meeting abstracts scored the low numbers of output (below one percentage of output) for communication among the Nuclear physics scientists.

PROLIFIC AUTHORS

In this analytical period, 58794 researchers have produced 21034 literature contributions scattered over 90 journals. In accordance to this the researcher has ranked according to their highest publications in the field of Nuclear physics till the 16^{th} rank for the top 100 published authors. The first 100 authors are identified as the highest contributors to Nuclear physics research. Table 4.6 reveals the first hundred prolific authors total local citation scores and its t-value; total global citation scores and its t-value; total citation rank.

Table 2: Prolific Authors According to highest research productivity

S.No	Author Name	Rec.	Rank	%	TLCS	TLCS/t	TGCS	TGCS/t	TLCR
1	Braunn B. Colin J. Courtois C.	33	1	0.2	16	1.37	1324	118.95	20
2	Campbell G.K.	33	1	0.2	3	0.25	815	72.03	2
3	Blundell C.D.	33	1	0.2	21	1.65	209	18.55	25
4	Almond A.	31	2	0.1	9	0.68	547	46.25	9
5	Pywell R.E.	31	2	0.1	5	0.43	444	39.68	13
6	Sawatzky B.D.	29	3	0.1	9	0.79	564	52.36	6
7	Ives J.	29	3	0.1	7	0.57	918	81.35	8
8	Kolb N.R.	28	4	0.1	13	0.99	707	60.76	12
9	Igarashi R.	28	4	0.1	24	1.67	1155	90.3	10
10	Wurtz W.A.	28	4	0.1	11	0.98	739	66.64	13
11	Alvarez-Romero J.T.	27	5	0.1	31	2.2	785	60.9	30
12	Naik A.	27	5	0.1	10	0.81	592	52.3	10
13	Buu O.	26	6	0.1	17	1.35	527	42.74	14
14	Jones R.M.	26	6	0.1	17	1.23	749	61.34	7
15	Sawatzky B.D.	26	6	0.1	19	1.45	885	72.93	9
16	Ives J.	25	7	0.1	16	1.18	669	60.56	13
17	Khan V.F.,	24	8	0.1	52	3.86	989	77.5	71
18	Dinardo M.	24	8	0.1	3	0.25	636	55.62	10
19	Guillemin T.	24	8	0.1	18	1.38	531	44.13	20
20	Sadhankar R.	24	8	0.1	7	0.57	546	48.03	4
21	LaHaye M.D.	24	8	0.1	2	0.14	546	46.21	2
22	Armour A.D.	24	8	0.1	6	0.49	626	56.57	3
23	Clerk A.A.	24	8	0.1	0	0	0	0	0
24	Blencowe M.P.	23	9	0.1	13	0.99	384	32.77	7
25	Schwab K.C.	23	9	0.1	2	0.18	396	34.7	6
26	Levi B.G.	22	10	0.1	29	2.27	871	70.95	19
27	Blundell C.D.	22	10	0.1	13	1.05	791	71.63	30
28	Reed M.A.C.	22	10	0.1	10	0.78	502	44.71	11
29	Overduin M.	22	10	0.1	16	1.24	507	43.2	19
30	Almond A.	22	10	0.1	10	0.73	567	46.8	8
31	Tuchetti S.	22	10	0.1	6	0.49	443	38.36	8
32	Uddin M.S.	21	11	0.1	10	0.72	466	37.73	8
33	Baba M.	21	11	0.1	6	0.47	473	41.09	9
34	Hagiwara M.	21	11	0.1	2	0.18	531	48.33	16
35	Tarkanyi F.	21	11	0.1	5	0.43	501	44.54	7
36	Ditroi F.	21	11	0.1	25	2	520	42.51	8
37	Takacs S.	21	11	0.1	7	0.53	682	59.45	4
38	Hermanne A.	21	11	0.1	10	0.79	524	47.6	8
39	Jung I.	21	11	0.1	5	0.43	639	58.14	14
40	Krawczynski H.	20	12	0.1	4	0.33	653	57.42	6

Among the 58794 authors, "Braunn B", "Campbell G.K", "Blundell C.D" has published the highest number of literature have been 33 literature (0.2%). Braunna B literature output has been scattered in 20 cited references with scored 16 TLCS with t-value 1.37 and 1324 TGCS with t-value 118.95, similar to the Cambell C.D, literature references cited scored 2 TLCR with 3 TLCS with t-value 0.25 and 815 TGCS with t- value 72.03, Blundell C.D, literature reference cited scored 21 TLCS , t-value 1.65 and 209 TGCS with t-value 18.55 respectively. Followed by the Almond A, Pywell R.E, has published 31 literatures been published in identifying top 100 authors they have got second rank. Almond A, has published 33 literatures with (0.1%) with 9 TLCR, 9 TLCS with 0.68 t-value, 547 TGCS with 46.25 t-values. Pywell R.E, has published 33 literatures (0.1%) with 13 TLCR and scored 5 TLCS with 0.43 t-value, 444 TGCS with 39.68 t-values. Sawatzky B.D, Ives J, has stand in third rank with 29 literature of research output in the field of Nuclear physics

AUTHORSHIP PATTERN

The objective of the study of authorship pattern is to bring out the research pattern in a discipline. The extent of research contribution by the researchers is explained in the analysis of authorship pattern. Hence it is considered to be an important aspect in Bibliometric analysis. It aims at analyzing the performance of scientists in contributing research output either individually or collectively. Many studies have analyzed the characteristics of the subject literature and have focused their attention on the quality and rate at which authors published in their fields. It has received adequate attention in the present research. In identifying the individual research performance in any area of science, it is essential to analyze the author productivity. The author productivity is determined based on the scientists in a field. Generally, research activity carried out by a scientist or a group of scientists, depends on the nature and aim of research. It also depends on the ability and efficiency of scientists. This is based on their skills and talents. The analysis of author productivity examines the prevailing trend in understanding the research process in any discipline of science.

A significant note of the study is that the majority of the articles are contributed by multiple authors. Especially triple authors' contribution is highest among the other collaborative productivity. It indicates that the single authored work is less than that of the multiple authored contributions.

Table 3Authorship Pattern of publication on Nuclear physics

S. No	Authorship pattern	Public-ations	%	No. of Authors	%
1.	Single Author	1263	6.0	1263	1.40
2	Double Authors	3450	16.40	6900	7.70
3	Three Authors	4080	19.40	12240	13.62
4	Four Authors	3835	18.24	15356	17.09
5	Five Authors	3051	14.50	15255	17.00
6	Six Authors	2109	10.02	12654	14.08
7	Seven Authors	1406	6.69	9842	10.96
8	Eight Authors	835	3.97	6680	7.43
9	Nine Authors	421	2.00	3789	4.21
10	Ten Authors	585	2.78	5850	6.51
	Total	**21034**	**100.00**	**89824**	**100.00**

Table 4.8 indicates authorship pattern in the field of Nuclear physics research. Here the authors are classified according to the number of research contribution. In this aspect single author has contributed (6.0%) papers in this study. It is noted that out of 21,034 research papers envisaged in the study, triple and four authors contributed papers occupying first and second in the order, it is calculated 4080 (19.40%) and 3839 (18.24%) respectively. Double authors contributing to the research occupies the third rank with 3450 (16.40%) and five authors occupy the fourth rank at 3051 (14.50%) followed by six authors and seven authors placed fifth and six ranks with 2109 (10.02%), 1406 (6.69%) respectively. Single authors contributed papers got seventh rank with 1263 (6.0%) and remaining eight authors 835 (3.97%), nine authors 421 (2.0%) and ten and above authors 585 (2.78%) contributed papers placed eighth, ninth and tenth rank respectively.

It is seen from the above analysis that collaborative authors' productivity is more than the single author contribution. Single author productivity is only 6.0 percent on the whole were as multi author's productivity is at 94 percent.

YEAR WISE AUTHORSHIP PATTERN ON NUCLEAR PHYSICS RESEARCH OUTPUT

Table 4.9 indicates year wise authorship pattern in the field of nuclear physics research. Here the authors are classified according to the number of research contribution. Out of the 21034 research outputs published in nuclear physics during the study period of the years 1999 to 2013, in the year 1999 out of the published 94 research outputs, Double Authors contributed 20 publications and they rank first. In 2000 three authors collaboratly contributed 21 publications out of the total 90 publications and stands in first rank. Out of the 85 publications in the year 2001 the first rank is occupied by single author with 18 publications. During 2002, 59 publications were published in that three authors with 15 publications rank's first. In the year 2003, 63 research outputs were published and first rank was held by Double authors with 19 publications. During the year 2004, out of the 78 total publications, 18 publications contributed by the three authors working colloboratly ranks first. In the year 2005 Double authors rank first with 15 publications out of the total 53 publications. In the year 2006 out of the published 64 research outputs, Single author contributed 16 publications and they rank first. In 2007 also Single author stands first with 13 Publications out of the total 69 out puts. In the year 2008 three authors collaboratly contributed 661 publications out of the total 3613 publications and stands in first rank. During the year 2009, which is the peak period with the highest of 5794 publications were published out of the 21034 research out puts during the whole study period, in that three authors authorship pattern ranks first with 1043 publications. In the year 2010 out of the published 3344 research outputs, four Authors contributed 635 publications and they rank first. In 2011 three authors collaboratly contributed 591 publications out of the total 2786 publications and stands in first rank. Out of the 2272 publications in the year 2012 the first rank is occupied by three authors with 490 publications. During 2013, 2571 publications were published in that three authors with 549 publications rank's first. It is seen from the above analysis that collaborative authors' productivity is more than the single author contribution. Single author productivity is only 6.0 percent whole multi author's productivity is at 94 percent. Three or Four authored team is leading their research work and is very successful at every year output in the subject of Nuclear physics. The collaborative research has been increased during the research study period.

Table -4.9 – Year wise Authorship Patterns in the Area of Nuclear physics

Year	Single Author	Double Authors	Three Authors	Four Authors	Five Authors	Six Authors	Seven Authors	Eight Authors	Nine Authors	Ten & above	Total
1999	19	20	17	08	08	07	07	06	01	01	**94**
2000	14	20	21	05	08	04	06	05	02	05	**90**
2001	18	17	09	17	06	06	02	04	01	05	**85**
2002	10	09	15	07	05	03	03	02	03	02	**59**
2003	15	19	06	05	04	05	02	03	02	02	**63**
2004	16	14	18	12	05	01	05	03	03	01	**78**
2005	08	15	12	04	06	01	03	02	01	01	**53**
2006	16	12	10	08	06	06	04	01	---	01	**64**
2007	13	11	11	06	07	07	05	06	01	02	**69**
2008	188	508	661	647	559	369	273	182	93	133	**3613**
2009	249	860	1043	1031	877	636	454	261	153	230	**5794**
2010	154	559	627	635	497	341	246	149	63	73	**3344**
2011	170	496	591	496	411	266	163	86	41	66	**2786**
2012	176	429	490	425	298	214	107	68	35	30	**2272**
2013	197	461	549	533	351	243	122	57	22	33	**2571**
Total	**1263**	**3450**	**4080**	**3839**	**3051**	**2109**	**1406**	**835**	**421**	**585**	**21034**
	6.0%	**16.40%**	**19.40%**	**18.24%**	**14.50%**	**10.02%**	**6.69%**	**3.97%**	**2.0%**	**2.78%**	**100%**

Table 4.12 – Single Vs Multi-Authored and Degree of Collaboration of Nuclear physics Research Output

S.No	year	Single Authors(Ns)		Multi Authored (Nm)		Total	Degree of Collaboration
		No of output	%	No of output	%		
1	1999	19	1.50	75	0.38	94	0.80
2	2000	14	1.11	76	0.38	90	0.84
3	2001	18	1.43	67	0.34	85	0.79
4	2002	10	0.79	49	0.25	59	0.83
5	2003	15	1.19	48	0.24	63	0.76
6	2004	16	1.27	62	0.31	78	0.79
7	2005	08	0.63	45	0.23	53	0.85
8	2006	16	1.27	48	0.24	64	0.75
9	2007	13	1.03	56	0.28	69	0.81
10	2008	188	14.89	3425	17.32	3613	0.95
11	2009	249	19.47	5544	28.04	5794	0.96
12	2010	154	12.19	3190	16.13	3344	0.95
13	2011	170	13.46	2616	13.23	2786	0.94
14	2012	176	13.94	2096	10.60	2272	0.92
15	2013	197	15.60	2374	12.00	2571	0.92
	Total	**1263 (6.0)**	**100.00**	**19776 (94)**	**100.00**	**21034**	**12.86 (0.94)**

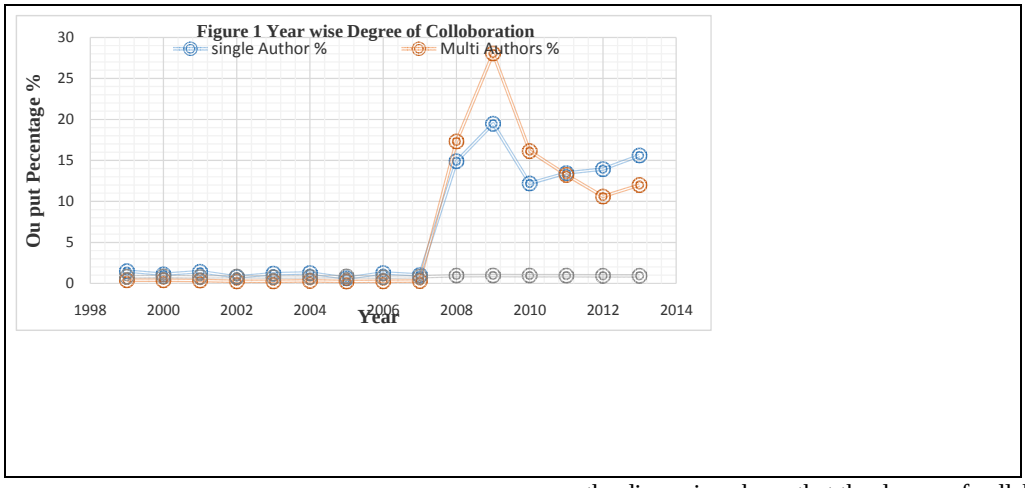


Table 4.12 shows that the single vs Multi authored and degree of collaboration of Nuclear physics research output. The among the entire sample duration period, the years of 2009, 2008 and 2010 has the highest degree of collaboration (0.96 and 0.95 respectively). The Least degree of collaboration (0.75) was found during the year 2006.Overall the average degree of collaboration of the whole sample year is 0.94. Further it is identified that 94 percentage of authors were contributing their research output worked as a team or joint venture. It could be seen clearly from the discussion above that the degree of collaboration in producing research output on Nuclear physics research has shown the fluctuation trend during the study period, because the researcher has identified the selection area of Nuclear physics as a new discipline. Based on this study, the result of the degree of collaboration C = 0.94. i.e., 94 percent of collaborative authors' articles were published during the study periods. Figure1 shows that year wise degree of collaboration of the research output produced in Nuclear physics research during the study period of 1999 to 2013. The degree of collaboration was found high in the year 2009. Both the single author and Multi

authors percentage (28.04 and 19.47) was found high during year 2009.

CONCLUSION

The among the entire sample duration period, the years of 2009, 2008 and 2010 has the highest degree of collaboration (0.96 and 0.95 respectively). The Least degree of collaboration (0.75) was found during the year 2006.Overall the average degree of collaboration of the whole sample year is 0.94. Further it is identified that 94 percentage of authors were contributing their research output worked as a team or joint venture. It could be seen clearly from the discussion above that the degree of collaboration in producing research output on Nuclear physics research. Single authored work is less than that of the multiple authored contributions. It means that the collaborative authors' contribution is very high.

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