
Scientometric Analysis of Astrophysics Research Output in India: A Study Based On Web of Science Database

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Abstract

Astrophysics is a branch of space science that applies the laws of physics and chemistry to describe planets, galaxies, the birth, life, death of stars, nebulae and other objects in the space. Astrophysics creates physical theories of small to medium-size structures in the space. It is purely in the lost stages of the lives of more recent stars that the elements making up the Earth, such as iron (32.1 percent), oxygen (30.1 percent), silicon (15.1 percent), are produced. One more of these elements are carbon, which together with oxygen, make up the bulk of the mass of all living things including us. Thus, astrophysics tells us that, while we are not all stars, we are all stardust. The highest exponential growth rate (1.18%) was found during the year 1995 with 341 publications. A total of 17046 records were published during the 1989-2016 study period. The maximum number of publications is in the year 2016 with 1179 records and minimum number of records published in the year 1995.

Keywords

Scientometrics, Web of Science, Astrophysics, Exponential growth rate, cited references.

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INTRODUCTION

Scientometric study is a statistical method as well as to evaluate and quantify the growth of a subject. The research development during the said time span would be clearly understood from this study and an extrapolative projection may be made for anticipatable future. There are several areas in arts, science and social science for which scientometric studies be carried out. A number of researches have been accomplished to evaluate research output and productivity in different subjects. Rupak Chakravarty et al. ¹ (2015) have focused on publication productivity in some select Universities of Chandigarh and Punjab for the period of 2004-2013. The methodology used for scrutinizing the research output in the field of Mathematics is reflected in Scopus Database. The study deals with 532 publications of Panjab University, Chandigarh (PU), Punjabi University, Patiala (PUP) and Guru Nanak Dev University, Amritsar (GNDU) in the field of Mathematics. It observes the Mathematics output by different ways like document type, source type, authorship pattern and degree of collaboration. The study also shows the relative growth rate of publications, doubling time for publications and participative index rate of Universities. Birnholtz et al. ² (2013) have illustrated Institutions that are spread across multiple geographic locations face additional challenges. To enhance value of the nature of cross-campus collaboration within a single institution and the cause of institutional efforts to spark collaboration, they perform a case study of collaboration at Cornell University using scientometric and network analyses. Results recommend that cross-campus collaboration is progressively more common, but is accounted for primarily by a relatively small number of departments and individual researchers. Specific researchers implicated in many collaborative projects are depicted, and their unique characteristics are described. Institutional efforts, such as seed contribution and topical retreats, have some outcome for researchers who are central in the collaboration network, but were less clearly effective for others. Nishy et.al. ³ (2012) have analysed the Indian Journal of Chemistry, Section B during 2005-2009 and have been examined using various scientometric parameters like authorship patterns, geographical distribution, citations received each year, etc. Builova et al. ⁴ (2011) have examined the thematic scope of publications in the literature center of attention on graphene in the period between 2010 and the first half of 2011. The growth patterns for physics

of graphene are highlighted. Hotspots and emerging trends are sketch out in this area, based on the analysis of publications in volumes 1-12 of the 2010 edition and volumes 1-6 of the 2011 edition of the peer-reviewed journal 'The Physics of Nano objects and Nano technologies published' by the All Union Institute for Scientific and Technical Information of the Russian Academy of Sciences. Raja et.al.⁵(2011) have examined plasmodium falciparum research publication output in India précised from Histcite software and other tools. The findings give an idea about the increase of Indian literature in plasmodium falciparum deposition and create the quantitative assessment of the study in terms of year-wise research output, nature of collaboration, geographical distribution, the channel of communication used by the scientists and characteristics of highly productive institutions. Mooghali et al. ⁶ (2011) exposed that out of 691 articles in the field of Scientometrics, a total number of 183 articles (26.48%) were written during 1980 to 2009 by the top ten authors. Some of these articles were produced in authors' collaboration and some of them were by single authors. Geographical analysis showed that the field had developed considerably in different regions of the world. Hungarian Academy of Science with 40 records (5.71%) was the large amount of dynamic institution in the field of Scientometrics.

2. OBJECTIVES

- To calculate yearly output of astrophysics research in India
- To find out the exponential growth rate (EGR)
- To identify the top 20 institutions with subdivisions contribution in astrophysics research output in India
- To calculate top 20 cited references in astrophysics research output in India.

3. METHODOLOGY

The data for the study were retrieved from web of science ⁷database which is a scientific and indexing service maintained by Thomson Reuters. The Astrophysics research output of India was analyzed. The bibliographic details such as astrophysics research output, exponential growth rate ,top 20 institutions with subdivisions, top 20cited references etc. were analyzed using the software package Histcite and Statistical tools which is useful for bibliometric analysis and information visualization.

4. ANALYSIS

A total of 17046 astro physics records were published in India. The research output was analyzed using various scientometric indicators.

4.1 RANKING THE YEAR WISE DISTRIBUTION OF ASTROPHYSICS RESEARCH OUTPUT

Table1: Ranking the Year wise Distribution of Astrophysics Research Output

S.No.	Year	Records	%
1	1989	358	2.10
2	1990	416	2.44
3	1991	420	2.46
4	1992	389	2.28
5	1993	434	2.55
6	1994	403	2.36
7	1995	341	2.00
8	1996	370	2.17
9	1997	437	2.56
10	1998	417	2.45
11	1999	412	2.42
12	2000	447	2.62
13	2001	499	2.93
14	2002	498	2.92
15	2003	460	2.70
16	2004	468	2.75
17	2005	493	2.89
18	2006	622	3.65
19	2007	617	3.62
20	2008	697	4.09
21	2009	731	4.29
22	2010	753	4.42
23	2011	893	5.24
24	2012	986	5.78
25	2013	1019	5.98
26	2014	1112	6.52
27	2015	1175	6.89
28	2016	1179	6.92
	Total	17046	100

The above table shows the year wise distribution of astrophysics research output in India from the year 1989-2016. A total of 17046 records were published during the given period. The highest number of publications is in the year 2016 with 1179 records, followed by1175 records in the year 2015 and 1112 records in the year 2014.

4.2 . EXPONENTIAL GROWTH RATE (EGR)

Table 42 : Exponential Growth Rate (EGR)

S.NO.	Year	Publications	Exponential Growth Rate
1	1989	358	--
2	1990	416	0.86
3	1991	420	0.99
4	1992	389	1.08
5	1993	434	0.90
6	1994	403	1.08
7	1995	341	1.18
8	1996	370	0.92
9	1997	437	0.85
10	1998	417	1.05
11	1999	412	1.01
12	2000	447	0.92
13	2001	499	0.90
14	2002	498	1.00
15	2003	460	1.08
16	2004	468	0.98
17	2005	493	0.95
18	2006	622	0.79
19	20007	617	1.01
20	2008	697	0.89
21	2009	731	0.95
22	2010	753	0.97
23	2011	893	0.84
24	2012	986	0.91
25	2013	1019	0.97
26	2014	1112	0.92
27	2015	1175	0.95
28	2016	1179	1.00
	TOTAL	17046	Average 0.961

Average 25.95-27=0.961

The above table reveals the exponential growth rate of publications for the period of twenty eight years(1989-2016). The highest growth rate (1.18%) was found during the year 1995with 341 publications. The year of 2011 witnessed the lowest growth (0.84%) with 893 publications. It finds the average exponential growth rate as 0.961 during the period.

4.3 INSTITUTIONS WITH SUB DIVISIONS IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

Table 3: Institutions with Sub Divisions in Astrophysics Research Output in India

S. NO.	INSTITUTION WITH SUBDIVISION	RECS	TLCS	TGCS
1	INDIAN INSTITUTE ASTROPHYSICS, BANGALORE	1189	2770	17576
2	TATA INSTITUTE FUNDAMENTAL RESEARCH,MUMBAI	1155	2783	40292
3	INSTITUTE HIGH ENERGY PHYSICS	992	1792	31615
4	INSTITUTE FOR THEORETICAL & EXPERIMENTAL PHYSICS	902	1499	28858
5	PRINCETON UNIVERSITY	852	1647	26075
6	PUNJAB UNIVERSITY	774	1208	25044
7	CALTECH	742	1468	39984
8	NORTHEASTERN UNIVERSITY	693	1624	22614
9	UNIVERSITY CALIFORNIA RIVERSIDE	673	1090	21012
10	RAMAN RESEARCH INSTITUTE BANGALORE	646	1430	12267
11	UNIVERSITY OF MICHIGAN	610	1212	19027
12	UNIVERSITY OF MISSISSIPPI	583	903	20170
13	UNIVERSITY OF MARYLAND	579	964	21271
14	PURDUE UNIVERSITY	576	1448	20788
15	NATIONAL CENTRAL UNIVERSITY	572	988	17848
16	UNIVERSITY OF NOTRE DAME	572	940	18462
17	NORTHWESTERN UNIVERSITY	557	1029	22392
18	SUNGKYUNKWAN UNIVERSITY	552	869	19069
19	UNIVERSITY OF ROCHESTER	531	1057	21883
20	KOREA UNIVERSITY	520	750	17967

The above table shows the institutions with subdivisions contribution in astrophysics research output in India .The Indian institute of astrophysics, Bangalore contributed more number of records 1189

during the study period .Followed by the Tata institute fundamental research, Mumbai contributes 1155 records and Institute high energy physics with 992 records with 1792 TLCS and 31615 TGCS.

4.4 TOP 20 CITED REFERENCES IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

Table 4:Top 20 Cited References in Astrophysics Research Output in India

S. NO.	Author / Year / Journal / DOI	Records
1	ADE PAR, 2014, ASTRON ASTROPHYS, V571, DOI [10.1051/0004-6361/201321529, 10.1051/0004-6361/201321554]	1071
2	RIESS AG, 1998, ASTRON J, V116, P1009, DOI 10.1086/300499	488
3	PERLMUTTER S, 1999, ASTROPHYS J, V517, P565, DOI 10.1086/307221	486
4	AGOSTINELLI S, 2003, NUCL INSTRUM METH A, V506, P250, DOI 10.1016/S0168-9002(03)01368-8	341
5	SPERGEL DN, 2003, ASTROPHYS J SUPPL S, V148, P175, DOI 10.1086/377226	323
6	SJOSTRAND T, 2006, J HIGH ENERGY PHYS, DOI 10.1088/1126-6708/2006/05/026	307
7	ABASHIAN A, 2002, NUCL INSTRUM METH A, V479, P117, DOI 10.1016/S0168-9002(01)02013-7	264
8	RANDALL L, 1999, PHYS REV LETT, V83, P3370, DOI 10.1103/PHYSREVLETT.83.3370	258
9	SCHLEGEL DJ, 1998, ASTROPHYS J, V500, P525, DOI 10.1086/305772	247
10	BERINGER J, 2012, PHYS REV D, V86, DOI 10.1103/PHYSREVD.86.010001	245
11	SAHNI V, 2000, INT J MOD PHYS D, V9, P373, DOI 10.1142/S0218271800000542	244
12	COPELAND EJ, 2006, INT J MOD PHYS D, V15, P1753, DOI 10.1142/S021827180600942X	243
13	ADEVA B, 1990, NUCL INSTRUM METH A, V289, P35, DOI 10.1016/0168-9002(90)90250-A	235
14	KUROKAWA S, 2003, NUCL INSTRUM METH A, V499, P1, DOI 10.1016/S0168-9002(02)01771-0	233
15	ADE PAR, 2011, ASTRON ASTROPHYS, V536, DOI 10.1051/0004-6361/201116459	225
16	MOHAPATRA RN, 1980, PHYS REV LETT, V44, P912, DOI 10.1103/PHYSREVLETT.44.912	221
17	PADMANABHAN T, 2003, PHYS REP, V380, P235, DOI 10.1016/S0370-1573(03)00120-0	221
18	SHAKURA NI, 1973, ASTRON ASTROPHYS, V24, P337, DOI 10.1016/S0168-9002(01)00089-4	219
19	LANGE DJ, 2001, NUCL INSTRUM METH A, V462, P152, DOI 10.1016/S0168-9002(01)00089-4	215
20	BRANS C, 1961, PHYS REV, V124, P925, DOI 10.1103/PHYSREV.124.925	211

The above table shows the top 20 cited references in astrophysics research output in India. The first place

cited reference is “ADE PAR, 2014, ASTRON ASTROPHYS, V571,” with 1071 records. Followed by the next place “RIESS AG, 1998, ASTRON J,

V116, P1009” with 488 records and .in the third place “PERLMUTTER S, 1999, ASTROPHYS J, V517, P565,” with 486 records. Other cited references are below 400 records.

5. CONCLUSION

The astrophysics research output in India as evidenced from the study has the highest number of publications is in the year 2016 with 1179 record and lowest number of records in 1995 with 341 records .The highest growth rate (1.18%) was found during the year 1995with 341 publications. The year of 2011 witnessed the lowest growth (0.84%) with 893 publications. The average exponential growth rate is 0.961 for the study period. The Indian institute of astrophysics, Bangalore contributed more number of records 1189 .Followed by the Tata institute fundamental research, Mumbai contributes 1155 records and Institute high energy physics with 992 records with 1792 TLCS and 31615 TGCS. The top 20 cited references study in astrophysics research output in India shows the first place in “ADE PAR, 2014, ASTRON ASTROPHYS, V571,” with 1071 records. Followed by the next place “RIESS AG, 1998, ASTRON J, V116, P1009” with 488 records and .in the third place “PERLMUTTER S, 1999, ASTROPHYS J, V517, P565,” with 486 records. Other cited references are below 400 records.

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