Scientometric dimensions of Astronomy and Astrophysics research in India (2001-2010): A study based on SCI

Dr. Keshava
Associate Professor,
Department of Studies and Research in Library and Information Science
Tumkur University, Tumkur, India

Gireesh A Ganjihal
Assistant Librarian
University of Horticultural Sciences, Bagalkot, India

Abstract

This study discusses the research performance and productivity of India in its publications reflected in Science Citation Index Expanded in the field of Astronomy and Astrophysics (A&A) research during the year 2001-2010. This study gives a bird's eye view of the extent of research activities and research productivity in the field of astronomy and astrophysics literature

Introduction

From the dawn of civilization, astronomy has provided important stepping-stones for human progress. Astronomy is not only the oldest of all sciences, but it can also be called the fountainhead of all sciences (Abhyankar, 2007). The calendar and the system of timekeeping came from astronomy. Astronomy offers scientists from a wide range of backgrounds with a nearly infinite variety of cosmic 'laboratories' for observing physical phenomena (Herrman, D B. 1986).

Astronomy in India was well developed in ancient times culminating in the writing of Surya Siddhanta in the fifth century. Astronomy is one of the branches of science that have had much stimulus to its advancement by virtue of the contributions made by early Indian thinking. The efforts of Arybhatta, Varahamihira, Brahmagupta and Bhaskara are monumental and have been. Keeping up to this tradition, India has quite a large number of active astronomers and astrophysicists whose interests put together cover the entire span of the electromagnetic spectrum (Kochhar, 1991).

The assessment of research performance by using scientometric technique, a valuable method for the identification of new scientific and technological knowledge, has accelerated over the past several years. In recent years, increasing attention has been paid to the social dimension of scientific community that produces science. But this unprecedented growth of literature has become a major concern for the scientists, scholars and library professionals, as they have to keep themselves abreast with the new advances in their subject. Scientometric dimensions used to mean communication process and science of science with more stress on quantitative aspects in Astronomy and Astrophysics research.

Objectives

The main objective of the study is to present the growth of literature published by the Indian scientists in the field of Astronomy and Astrophysics during 2001-2010 as reflected in Web of Science (SCI) database. In particular, the study focuses on the following objectives:

- To study the growth of publications,
- To study the authorship and collaboration pattern,
- To study the international collaborations,
- To study the journals preferred by the scientists,

Methodology

The data for the study were retrieved from Web of Science, Science Citation Index Expanded (SCIE) reflected in subject category Astronomy and Astrophysics, records pertaining to India were collected for the year 2001-2010. The data was then analyzed using SPSS and MS excel.

Results and Discussion

Growth pattern of Publication

Year-wise distribution of total research output in the field of Astronomy and Astrophysics

(A&A) is captured in table 1 and depicted in figure 1. It is observed that the output of Indian scientists has grown steadily during the period of study from 281(7.4%) in the year 2001 to 518(13.61%), however the growth rate has decreased from 13.65% to 12.52 in the year 2010 by Indian scientists.

Table 1. Year wise distribution of publications during 10 years

Year	Input by India	%	Cumulative	% of Cumulative
2001	281	7.4	281	7.40
2002	286	7.54	567	14.94
2003	294	7.75	861	22.69
2004	309	8.14	1170	30.83
2005	337	8.88	1507	39.71
2006	391	10.3	1898	50.01
2007	417	10.99	2315	61.00
2008	487	12.83	2802	73.83
2009	518	13.65	3320	87.48
2010	475	12.52	3795	100
Total	3795	100		

The application of selected growth models (Egghe & Rao, 1992) to the cumulative growth of publications by India (2001-2010). The models were evaluated in terms of their model parameters, fit statistics.

Table 2: Fit statistics derived from the application of various models to the Indian cumulative growth of publications in 2001-2010.

Period	Best results obtained in Indian literature	
	Name of Model	R^2
2001-2010	Power	0.941
	Exp	0.988
	Logistic	0.988

It was, therefore, concluded that; Logistic and Exponential models are likely to be applicable in growth of Indian and Chinese publications respectively.

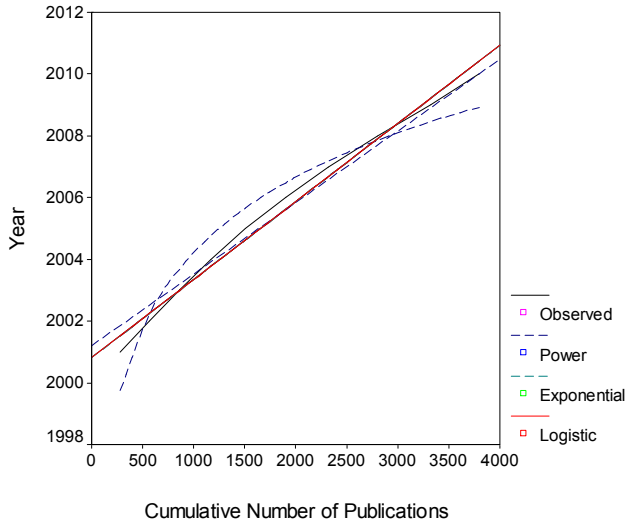

Figure 2 Growth rate of publications by Indian Scientists

Authorship and collaboration pattern

An attempt has been made to identify the nature of authorship pattern in scientific research output made by Indian scientists. As seen in table 3 and figure 3, it could be noted that two authored papers rank first sharing 26.51% (1006 papers) of the total research output followed by the three authored papers with 22.56% (856) of the total research contributions, followed by one, four, and five authored contributions sharing 15.94%, 11.78%, 6.11% respectively.

Table 3 Authorship and collaboration trend in A&A research by Indian scientists

Number of papers under various Authorship												
Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**Total**	%
1-authored	45	71	49	47	66	74	62	67	70	54	**605**	15.94
2-auth	92	78	76	94	96	99	113	115	127	116	**1006**	26.51
3-auth	66	67	63	75	62	81	95	123	109	115	**856**	22.56
4-auth	25	32	36	32	39	43	51	61	71	57	**447**	11.78
5-auth	14	8	13	17	23	27	22	40	32	36	**232**	6.11
6-auth	11	9	12	8	8	12	18	12	20	16	**126**	3.32
7-auth	6	5	9	7	4	7	11	14	20	7	**90**	2.37
8-auth	4	3	4	3	6	7	8	8	12	5	**60**	1.58
9-auth	5	3	3	1	1	5	3	2	6	6	**35**	0.92
10-auth	2	1	3	1		7	2	6	1	5	**28**	0.74
11 to 100 auth	11	8	24	13	22	18	19	25	26	36	**213**	5.61
204-auth									1		**1**	0.03
300-400 auth			2	10	6	7	8	6	13	12	**64**	1.69
401-500 auth					4	1	5	7	2	1	**20**	0.53
Above 501 auth				1		1			5	5	**12**	0.32
Total	**281**	**286**	**294**	**310**	**337**	**391**	**417**	**487**	**517**	**475**	**3795**	
%	7.40	7.54	7.75	8.14	8.88	10.30	10.99	12.83	13.65	12.52	**100**	

Most prolific contributors in Astronomy & Astrophysics research

Table 4 gives a rank list of ten most prolific contributors. A total of 11904 authors contributed 3795 by Indian scientists over period of 10 years (2001-2010). It is observed that Gupta N has contributed highest, that is 74 (1.95%) publications, followed by Das, D; Ghosh, P; Mohanty, B with 69 (1.82%) papers each, Chattopadhyay, S and Sharma, M with 68 (1.79%) each respectively.

Table 4 Most prolific Indian contributors

International Collaboration

In recent years, every country has realized the importance of scientific research for its growth and started initiating programs which makes scientists to have more interactions with other scientists, both at national and international levels, Table 5 provide India's international collaboration pattern in A&A research. Indian scientists have collaborated with 86 countries around the world, USA tops in sharing rank with 821 (21.63%)

Table 4

Rank	Indian Contributor	No. of Articles	%
1	Gupta, N	74	1.95
2	Das, D; Ghosh, P; Mohanty, B	69	1.82
3	Chattopadhyay, S; Sharma, M	68	1.79
4	Srianand, R; Viyogi, YP	66	1.74
5	Nayak, TK	65	1.71
6	Chakrabarti, SK; Das, S; Phatak, SS; Raniwala, R	64	1.69
7	Aggarwal, MM; Ganti, MS; Mahapatra, DP; Mangotra, LK; Singaraju, RN	63	1.66
8	Ahammed, Z; Gupta, A; Potukuchi, BVKS; Raniwala, S	62	1.63
9	Nandi, BK; Pal, SK	61	1.61
10	Kumar, A; Sagar, R	60	1.58

papers, followed by Germany with 392 (10.33%) papers, France with 366 (9.64%) and England with 328 (8.64%) Share of publications.

Table 5 Publication productivity with International collaboration

Preference of Channels of Communication

The Indian publications spread over 511 journals. The leading journals preferred by the scientists were Monthly Notices of the Royal Astronomical Society with 432 (11.38%) papers, followed by Astronomy & Astrophysics with 335 (8.83%), Astrophysical Journal 279 (7.35%). Table 6 provides the top 15 journals, which have published 50 or more articles and Figure provides year-wise distribution of top five journals.

Table 5

	International Collaboration by Chinese Scientists		
Rank	**Country**	**Number of Papers**	**% Share of papers**
1	USA	1479	19.29
2	Germany	750	9.78
3	England	507	6.61
4	France	433	5.65
5	Japan	364	4.75
6	Italy	347	4.53
7	Canada	248	3.24
8	Russia	218	2.84
9	Taiwan	202	2.64
10	Netherlands	193	2.52
11	Spain	191	2.49
12	South Korea	183	2.39
13	Brazil	158	2.06
14	India	157	2.05
15	Australia	145	1.89
			Truncated

Table 6

Rank	Source Title	Number of Papers	%	IF*
1	Monthly Notices of the Royal Astronomical Society	432	11.38	-
2	Astronomy & Astrophysics	335	8.83	4.410
3	Astrophysical Journal	279	7.35	4.548
4	Physical Review D	277	7.30	4.964
5	Journal of High Energy Physics	157	4.14	6.049
6	Astrophysics and Space Science	133	3.50	1.437
7	International Journal of Modern Physics D	103	2.71	1.109
8	Physics Letters B	98	2.58	5.255
9	Pramana-Journal of Physics	84	2.21	0.561
10	Journal of Astrophysics and Astronomy	78	2.06	0.531
11	Classical and Quantum Gravity	77	2.03	3.098
12	Modern Physics Letters A	72	1.90	0.990
13	Physical Review C	70	1.84	3.416
14	International Journal of Theoretical Physics	63	1.66	0.670
15	General Relativity and Gravitation	58	1.53	2.538
			Truncated	

*IF-Impact Factor 2010

Table 6 Journals most preferred by the Indian scientists

Conclusion

As seen from publications data in the field of Astronomy and Astrophysics research over period of 10 years (2001-10) by the Indian researchers, the output of Indian scientists has grown steadily during the period of study from 7.4% to 13.65%, however the growth rate has decreased from 13.65% to 12.52% in the year 2010 by Indian scientists. Logistic models are likely to be applicable in growth of Indian publications; two authored papers rank first sharing 26.51% of publications by Indian scientists. International collaboration pattern in Astronomy and Astrophysics research as by Indian scientists have collaborated with 86 countries around the world, USA tops in sharing rank with 821 (21.63%) papers, followed by Germany with 392 (10.33%) papers, France with 366 (9.64%) and England with 328 (8.64%) share of publications.

Scientometric studies help in the analysis of R&D trends in identifying areas that are most active

and those which are becoming important; identifying the influences and cross fertilizations. This study gives a bird's eye view of the extent of research activities and research productivity in the field of astronomy and astrophysics literature.

References

1. Abhyankar, K. D. (2007). Astrophysics: Stars and Galaxies. Hyderabad: Universities Press.
2. Basu, Aparna and Lewison, Grant (2005). Going beyond journal classification for evaluation of research outputs: A case study of global astronomy and astrophysics research. Aslib Proceedings, 57(3), 232-246.
3. Davoust, E. and Schmadel, L.D. (1991). A study of the publishing activity of astronomers since 1969. Scientometrics, 22(1), 9-39.
4. Egghe, L & Ravichadra Rao, I.K. (1992). Classification of growth models based on growth rate and its applications. Scientometrics. 25. 5-46.
5. Harris, Eirik L. Astronomy of Vedic India. Retrieved on June 6, 2008, from http://www.astronomy.pomona.edu/archeo/india/india3.html
6. Herrman, D B. (1986). Astronomy in the twentieth century. Scientometrics, 9(3-4), 187-191.
7. Keshava., Ganjihal, Gireesh. & Savanur, K. (2010). Status of India in Astronomy and Astrophysics as reflected in its publications output in SCI: a scientometric study. In. Proceedings of the National Seminar on Webometrics, Informatrics and Scientometrics (WIS) under UGC/SAP, pp. 118-133.
8. Keshava., Ganjihal, Gireesh & Gowda, MP. (2008). ACM transaction on information systems (1989-2006): A bibliometric study. Information Studies, 14(4), 223-234.
9. Kochhar, R. K. (1991). The growth of modern astronomy in India, 1651-1960. Vistas in Astronomy, 34, 69-105.
10. Leta, Jacqueline (2005). Human resources and scientific output in Brazilian science: Mapping astronomy, immunology and oceanography. Aslib Proceedings, 57(3), 217-231.
11. Liu, J and Shu, S. (1995). Statistical analysis of astronomical papers of China during 1986-1990. Scientometrics, 32(3), 237-45.
12. Osareh, Farideh. (2006). Gant collaboration in astronomy knowledge production at international level. In. Proceedings International Workshop on Webometrics, Informetrics and Scientometrics & Seventh COLLNET Meeting, Nancy (France). Retrieved on June 12, 2008, fromhttp://eprints.rclis.org/archive/00006052/01/OsarehNancy.pdf
13. Sangam, S., Liming, L., & Ganjihal, Gireesh (2010). Modeling the growth of Indian and Chinese liquid crystals literature as reflected in Science Citation Index (1997–2006). Scientometrics, 84(1), 49-52.
14. Sridhar, M. S. (1985). Citing patterns of Indian space technologists. International Library Review, 17(3), 259-274.
15. Keshava., Chennakumaraswamy, Lokeshappa & Ganjihal, Gireesh. (2010). A scientometric portrait of Prof. SS Kubakaddi. Pearl: A Journal of Library and Information Science. 4 (1), 21-27.
16. Keshava., Hiremath, VC., Lamani, MG., & Ganjihal, Gireesh. (2009). h-Index: A Review of Literature. Pearl: A Journal of Library and Information Science, 3 (2), 42-47.