

## A Scientometric Analysis of Astrophysics Research Output in India (1989-2016): Study Based on Web of Science Database

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**Abstract** - Astrophysics is a bough of space science that applies the laws of physics and chemistry to explain planets, galaxies, the birth, life, death of stars, nebulae and other objects in the universe. Astrophysics creates physical theories of small to medium-size structures in the universe. Astrophysicists seek to understand the universe and our place in it. At NASA, the objective of astrophysics be "to discover how the universe work, explore how it began & evolved, and search for life on planets around other stars." The h index was suggested in 2005 by Jorge E. Hirsch, a physicist at University of California, San Diego (UCSD). The h-index is a factor determining both the quantity and the quality of a scientist's research output. The h-index can be calculated without human intervention in Scopus and Web of Science or manually in other databases that give citation information (e.g., PsychINFO, SciFinder, Google Scholar). The index is based on a list of publications ranked in descending array by the number of citations these publications received. The value of h is equal to the number of papers (N) in the list that have N or more citations. This study analyzes the h index of Astrophysics research output in India from the year 1989-2016. The data was downloaded from Web of Science database which was maintained by Thomson Reuters. The findings of the study revealed that the author S.Banerjee has published 12 papers with 12 or more citations. Followed by the author A.Kumar has published 11 papers with 11 or more citations.

**Keywords:** Scientometrics, Web of Science, Astrophysics. H Index

### I. INTRODUCTION

Scientometric study is a statistical method of counting 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 areas of physics. Lutz Bornmann, Moritz Stefaner, Felix de Moya Anegón & Rüdiger Mutz<sup>1</sup> (2014) have described based on data collected from Scopus, field-specific excellence which can be identified in institutions where highly-cited papers have been frequently published. Birnholtz, J., Guha, S., Yuan, Y.C., Gay, G., and Heller, C<sup>2</sup> (2013) have described Institutions that extend

across multiple geographic locations face additional challenges. To better know the nature of cross-campus association within a single institution and the effects of institutional hard work to spark collaboration, they carry out a case study of collaboration at Cornell University with scientometric and network analyses. Ozcan Konur<sup>3</sup> (2012) has evaluated the Global Research on the Education, the research has become one of the most used methods to evaluate the research performance of the individual researchers, journals, departments, faculties, universities, and countries in current years. Gupta, B. M, Kaur, H, & Kshitig, A<sup>4</sup> (2013) have analyzed the dementia research output from India during 2002-11 on dissimilar parameters. SCOPUS Citation Database has been used to get back the data for 10 years (2002-11) by searching different appropriate keywords in its combined title, keywords, abstract and fields. Nishy, P, Parvatharajan, P, & Prathap, G.<sup>5</sup> (2012) have studied the Indian Journal of Chemistry, Section B during the period 2005-2009 and have been analysed using various scientometric parameters like, citations received each year, authorship patterns, geographical distribution etc.

The papers are collected under four main fields: (i) Synthetic Organic Chemistry, (ii) Heterocyclic Chemistry, (iii) Theoretical Chemistry and (iv) Natural Products Chemistry assessment and performance of these and the 45 specialized sub-fields in organic chemistry have been considered. Mooghali, A, Alijani, R, Karami, N, & Khasseh, A.<sup>6</sup> (2011) revealed 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. Si, Linbo et.al.<sup>7</sup> (2010) have carried out the statistical analysis to the published papers, column set, author & citation of Tsinghua Journal of Education year (2007-2008) through applying the method of scientometrics, and made the appraisal of its publication characteristic and academic weight accordingly. A.I. Bonilla-Calero,<sup>8</sup> (2008) has described a "scientometric" analysis of a sample of research output in Physics taken from the institutional repository of the University of Strathclyde ("Strathprints"). Garg, K.C.<sup>9</sup>

(2003) analyzed 1317 papers published in the first fifty volumes of the international journal of Scientometrics during 1978 to 2000. They found that the United States of America share of papers is always declining while that of the Netherlands, France, India and Japan is on the rise.

The research output is highly scattered as indicated by the average number of papers per institution. Vinkler.P.<sup>10</sup> (2000) have reviewed that the evaluation of real scientometric systems needs compromises among the parties interested and between the realistic applicability and the theoretical necessities of scientometrics. In the Chemical Research Center of the Hungarian Academy of Sciences, special scientometric indicators have been used for evaluating publication activity of research teams for about 30 years. Rodrigo Costas, María Bordons.<sup>11</sup> (2007) have analyzed the relationship of the h-index with other bibliometric indicators at the micro level for Spanish (Consejo Superior de Investigaciones Científicas) CSIC scientists in Natural Resources, using publications data collected from the Web of Science database (1994–2004). Different activity and impact indicators be obtained to describe the research performance of scientists in various dimensions, being the h-index sited through factor analysis in a quantitative dimension extremely correlated with the absolute number of publications and citations.

## II. OBJECTIVES

1. To calculate the authors h index in astrophysics research output in India.
2. To find out the journals h Index in astrophysics research output in India
3. To identify the institutions h index contribution in astrophysics research output
4. To determine the international collaboration h index of astrophysics research output in India.

## III. METHODOLOGY

The data for the study were retrieved from web of science<sup>12</sup> database which is a scientific and indexing service maintained by Thomson Reuters. The h index of Astrophysics research output of India was analyzed. The bibliographic details such as astrophysics research output h index for authors, journals, institutions, collaboration etc. were evaluated using Histcite which is a software package used for bibliometric scrutiny and information visualization.

## IV. ANALYSIS

A total of 16909 astro physics records were published in India. The research output was analyzed using various scientometric indicators.

TABLE 1 TOP 15 AUTHORS H INDEX IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

S.No.	Author	Records	h-index LCS	h-index LCS <sub>x</sub>	h-index GCS
1	S.Banerjee	897	12	5	62
2	A.Kumar	482	11	5	52
3	M.Weber	482	11	4	56
4	T.Hebbeker	629	11	4	58
5	C.Tully	624	11	4	57
6	S.Jain	323	11	3	48
7	S.Malik	391	11	3	49
8	S.Bhattacharya	363	9	3	48
9	H.Kim	405	11	4	56
10	A.Dominguez	526	11	3	53
11	M.Biasini	522	9	4	52
12	P,Zhang	515	9	3	53
13	Y.H.Chang	431	9	4	52
14	S.Reucraft	514	11	4	57
15	F.Filthaut	500	10	4	49

The above table reveals that authors h index based citation scores.

**h-index (LCS)** is the h-index based on the local citations in the collection. The author S.Banerjee has published 12

papers with 12 or more citations. Followed by the author A.Kumar has published 11 papers with 11 or more citations.

**h-index (LCS<sub>x</sub>)** is the h-index based on the local citations in the collection excluding self-citations. The author

S.Banerjee and A.kumar has published only 5 papers with 5 or more external citations. The LCSx-based h-Index has great value.

h-index (GCS) is the h-index based on the global citation scores. The author S.Banerjee’s global citation score is 62 followed by the Author A.Kumar’s global citation score is 52.

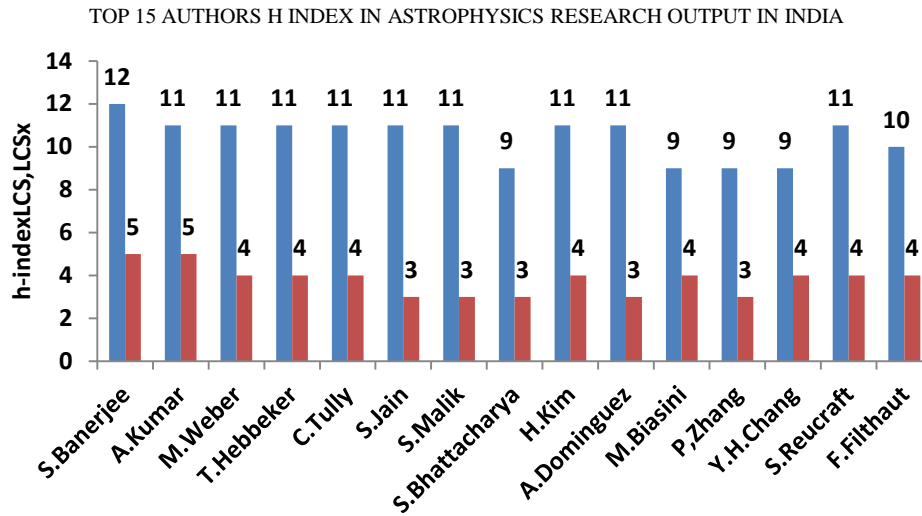


Fig.1 Top 15 authors h index in astrophysics research output in india

TABLE 2 TOP 15 JOURNALS H INDEX IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

S.No	Journal	Records	h-index LCS	h-index LCSx	h-index GCS
1	Physical Review D	3423	17	10	94
2	Physical Letters B	1966	18	11	88
3	Monthly Notices of The Royal Astronomical Society	1588	23	11	60
4	Astrophysics & Space Science	1531	15	13	33
5	Astrophysical Journal	1332	23	10	71
6	Astronomy & Astrophysics	1139	21	12	70
7	Journal of Geophysical Research – Space Physics	452	11	7	32
8	Classical & Quantum Gravity	431	16	10	48
9	Journal of Astrophysics & Astronomy	431	10	6	19
10	Solar Physics	420	14	8	34
11	Indian Journal of Radio & Space Physics	400	5	4	13
12	International Journal of Modern Physics D	368	12	7	28
13	Advances in Space Research	342	7	5	16
14	General Relativity & Gravitation	314	13	11	27
15	Annales Geophysicae	282	8	6	24

The above table depicts that the Physical Review D journal’s h-index based local citation score is 17 and h-index based on the local citation score excluding self-citations is 10 and Global citation score is 94. Similarly the

second journal Physics Letters B journal’s h index based local citation score is 18 and h-index based on the local citation score excluding self-citations is 11 and Global citation score is 88.

TOP 15 JOURNALS H INDEX IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

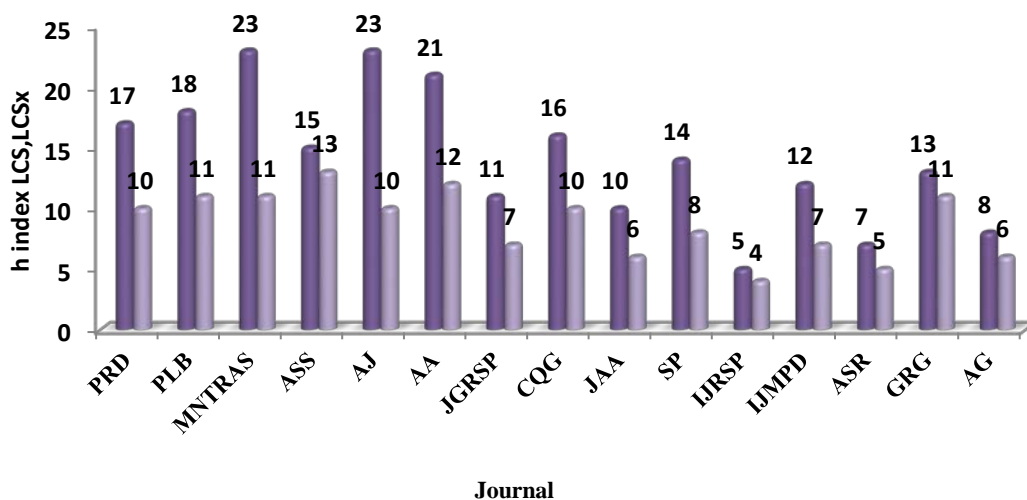


Fig.2 top 15 journals h index in astrophysics research output in india

TABLE 3 TOP 15 INSTITUTIONS H INDEX IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

S.No.	Institutions	Records	h-index LCS	h-index LCSx	h-index GCS
1	Tata Inst.Fundamental Res.	2702	23	15	88
2	Indian Inst.Astrophysics	1512	16	9	54
3	Inst.High Energy Physics	1049	12	5	73
4	Physics Research Lab	994	13	6	43
5	CALTECH	988	14	8	83
6	Ist Nazl Fis Nucl.	955	14	7	77
7	Princeton Univ.	949	12	5	73
8	Panjab Univ.	917	13	5	71
9	Inst.Theoret .&Expt.Phys.	899	12	5	67
10	MIT	852	13	5	71
11	Univ.Delhi	828	12	5	57
12	Indian Inst. Tech.	827	14	9	49
13	Univ. Michigan	761	12	5	67
14	Saha Inst..	755	12	7	58
15	Univ.Calif.Riverside	718	11	5	61

The above table shows that Tata Institute of Fundamental Research has contributed 2702 records in astrophysics research during the study period of 1989-2016. This institute’s h index based local citation score is(LCS) 23 and h-index based on the local citation score excluding self-

citations is (LCS<sub>x</sub>)15 and Global citation score (GCS) is 88.Likewise the Indian Institute of Astrophysics has published 1512 records in astrophysics. The institute’s h index based local citation score is (LCS) 16 and h-index based on the local citation score excluding self-citations(LCS<sub>x</sub>) is 9 and Global citation score (GCS)is 54.

Top 15 Institutions H Index in Astrophysics Research Output in India

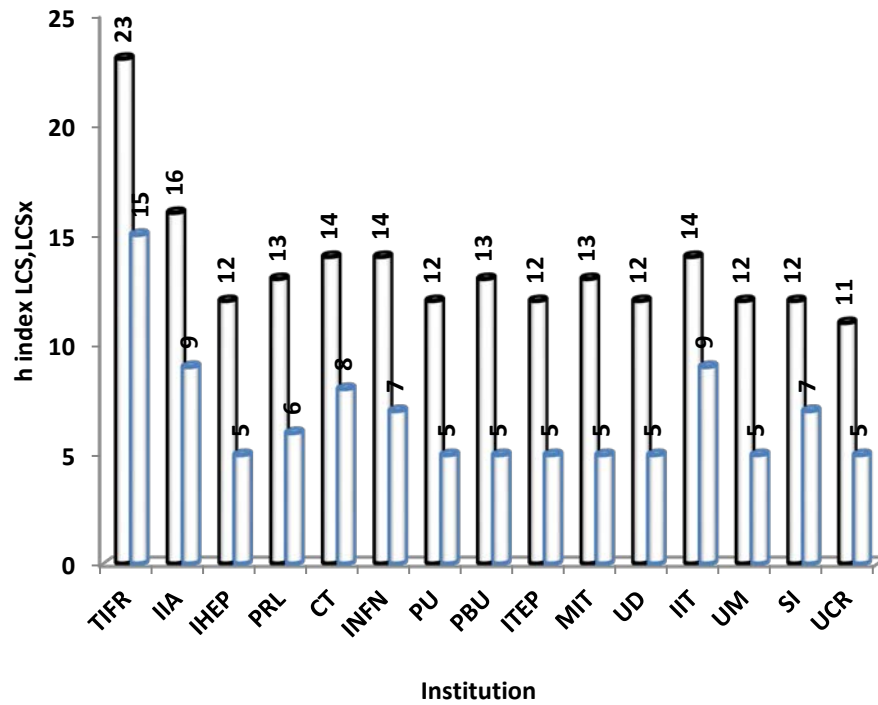


Fig.3 Top 15 Institutions H Index in Astrophysics Research Output in India

TABLE 4 TOP 15 COUNTRIES H INDEX IN ASTROPHYSICS RESEARCH OUTPUT IN INDIA

S.No.	Country	Records	h-index LCS	h-index LCSx	h-index GCS
1	India	16036	35	22	145
2	USA	3648	24	13	116
3	Germany	2186	17	11	95
4	France	1892	21	9	96
5	UK	1748	19	10	102
6	Italy	1469	17	10	92
7	Russia	1428	15	7	86
8	Spain	1319	14	7	84
9	Peoples R.China	1295	13	6	78
10	South Korea	1181	13	7	70
11	Japan	1143	18	10	82
12	Switzerland	1139	13	8	80
13	Netherland	1066	13	6	71
14	Taiwan	919	12	5	72
15	Australia	913	16	9	76

The above table presents the India’s astrophysics research collaboration with other countries. It is clearly seen that India has often collaborated with USA, Germany and France contributing 3648, 2186 and 1892 records respectively. The India’s h index based local citation score

(LCS) is 35 and h-index based on the local citation score excluding self-citations (LCS<sub>x</sub>) is 22 and Global citation score (GCS) is 145. Likewise USA, Germany and France countries LCS is respectively 24, 17 and 21.

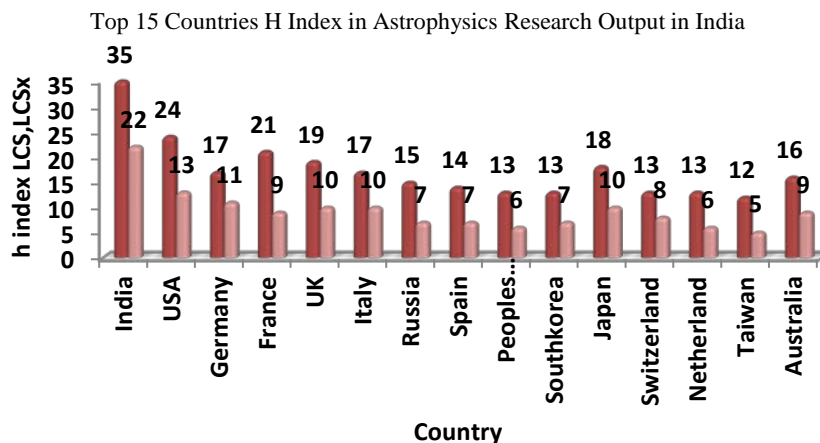


Fig.4 Top 15 Countries H Index in Astrophysics Research Output in India

## V. CONCLUSION

The h index combines a measure of quantity and its citations. It permits us to characterize the scientific output of a researcher with objectivity, and therefore may play an important role when creating decisions about promotions, fund allocation and awarding prizes. It performs better than other single-number criteria generally used to evaluate the scientific output of a researcher (total number of documents, total number of citations, impact factor, number of highly cited papers and citation per paper rate). The h-index can be simply obtained by anyone with access to the Thomson ISI Web of Science. The h-index study of Astrophysics research output in India reveals that the author S. Banerjee has published 12 papers with 12 or more citations. Followed by the author A. Kumar has published 11 papers with 11 or more citations. The present study envisages that the Physical Review D journal's h-index based local citation score is 17 and h-index based on the local citation score excluding self-citations is 10 and Global citation score is 94. The study shows that Tata Institute of Fundamental Research has contributed 2702 records in astrophysics research during the study period of 1989-2016. This institute's h-index based local citation score is (LCS) 23 and h-index based on the local citation score excluding self-citations is (LCS<sub>x</sub>) 15 and Global citation score (GCS) is 88. The study depicts that India has often collaborated with USA, Germany and France contributing 3648, 2186 and 1892 records respectively. The India's h-index based local citation score (LCS) is 35 and h-index based on the local citation score excluding self-citations (LCS<sub>x</sub>) is 22 and Global citation score (GCS) is 145.

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