



Mapping of Research on Planetary Systems (PS) in India

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Abstract

The present study explores the characteristics of the literature and growth of Planetary System research in India during 1960-2014, based on Web of Science (WoS) database and makes quantitative and qualitative assessment by way of analysing various features of research output by using the scientometric techniques. A total of 1914 literature were published on Planetary System, which received total 20373 citations. The average number of publications per year was 45.57; with Compound Annual Growth Rate (CAGR) 0.10% and the average number of citations per publication was 10.64. The publications peaked in the year 2014 with 223 publications and the highest number of citations (1703) were in 2009. This study analyzes the research studies based on year of publication, journal, international collaboration, spatial distribution and keyword occurrence frequency. The results of this work reveal that the publication on the Planetary System have grown high at a slow rate over the past 54 years and the curve fits the polynomial curve with $R^2 = 0.975$. Publications on Planetary System appeared in 422 journals of which most active journal was "Astronomy Astrophysics" published by Oxford University Press on behalf of the Royal Astronomical Society originating from United Kingdom and 111 (5.79 %) of the total 1914 publications. A total of 9051 authors contributed on Planetary System research. The most active author was Goswami, JN who produced maximum no. of publications 48 i.e. 2.50 % of total publications. 1813 institutions contributed of which Physical Research Laboratory; Ahmedabad, India is the most productive institution. For globalization of Planetary System Research in India, the results show there were 76 Countries/territories which participated in Planetary System research. USA produced maximum publications 331 that is 17.29% of total publication with higher citations (7866). A Keyword analysis reveals that "Comets", "Meteorites", "Earth", "Moon" and "Formation" are the most used keywords.

Keywords: Planetary Systems, Scientometric, Bibliometrics, Citation Indicator, Bibliometric Indicator, India

1. Introduction

A planetary system is a set of gravitationally bound non-stellar objects in orbit around a star or star system. Generally speaking, systems with one or more planets constitute a planetary system, although such systems may also consist of bodies such as dwarf planets, asteroids, natural satellites, meteoroids, comets, planetesimals and circumstellar disks. The Sun together with its planetary system, which



includes Earth, is known as the Solar System. The term exoplanetary system is sometimes used in reference to other planetary system. There are at least 2,597 known planetary systems, including 589 systems consisting of multiple planets as of 15 July 2016. These systems contain more than 3,472 known exoplanets (“Planetary System”, n.d.).

Planetary Systems research has experienced a considerable increase over the last few decades. However, there were no attempts to provide a more quantitative assessment of the current status and trends of this research thus far. There has been much interest recently in the use of Scientometric which is the study of measuring and analysing science, technology and innovation; It is Quantitative study of science and technology. The study of measuring and analyzing science research. In practice, scientometrics is often done using bibliometrics which is a measurement of the impact of (scientific) publications (IGI Global Disseminator of Knowledge, n.d). The bibliometric analysis is a powerful tool that enables the analysis of research priorities across an entire discipline and to assess the quality and quantity of research. It has the ability to reveal interesting information about knowledge producers and their interactions (Jaric & Gessner, 2012).

2. Objectives

The objective of this paper is to map the growth of Planetary Systems research productivity in India by applying bibliometric and impact indicators as reflected in the Science Citation Index (SCI) for the period 1960-2014.

3. Methodology

3.1 Database and Scope

To assess the growth of research publication on Planetary Systems and to locate and collect the literature i.e. journal articles only, Web of Science (WoS) was used. The Search Strategy used to conduct Web of Science (WoS) search is as mentioned below:

TS= “Planetary Systems” = (Search Term)

Where TS is a topic search that retrieves occurrences of the search term in the article title, abstract, keywords within a time span of 1960-2014, and were used to locate publications that contained these words in publications’ titles, abstracts, and keyword lists. This process was followed for another series of search terms given by (AAS, 2013). These were used to locate publications that contained the words in publications’ titles, abstracts, and keyword lists.

3.2 Filtering Process

An extensive search of the Web of Science (WoS) database with the above mentioned Keywords produced vast amount of data. Resulting articles were filtered by Subject category-Astronomy & Astrophysics followed by Document Types: (Article), and Languages: (English). The filtered articles were again filtered by Countries/Territories: (INDIA). This final round of filtering produced 1914 (Astronomy & Astrophysics) articles with which analysis was done.



4. Analysis

There were 1914 articles that met the selection criteria which appeared in the WoS database during 1960-2014 and these were analyzed. The specific characteristics of the publications such as number of publications, number of authors involved in the production of these publication, institutions, journals etc. were taken into consideration.

4.1 Publication Characteristics

A total of 1914 articles of Indian scientists during 1960-2014 were covered in from WoS related to PS publications. From Table 1 and 2, it can be observed that the output of 1914 papers received 20373 citations during the said period with an average of about 10.64 citations per paper. The average number of publications per year is 45.57 and CAGR is 0.10%.

4.2 Publication Pattern

Publication pattern of PS research from 1960 to 2014 is presented in Figure 1. The initial publication in the sub-field of PS research is observed in the year 1973. A near about 70 time's increase is observed over the study period, (from 3 in 1973 to 223 in 2014). The highest number of papers were published in the year 2014, with 223 publications and the lowest in 1973 and 1975 with 1 publication.

4.3 Growth Trend

The cumulative progression is represented by a 4th degree power law distribution during 1960-2014 giving an idea of growth curve as shown in Figure 2. To choose the best fit growth model, various regression types with regression coefficient have been tested as shown in Table 3. The best fit model is 4th degree polynomial curve, where $R^2 = 0.975$. The polynomial best fit for PS research is found to be: $y = 0.0004x^4 - 3.1295x^3 + 9330.4x^2 - 1E+07x + 6E+09$, where y is the cumulative number of publications and x is the number of years. The growth of literature shown in Figure 2 can be divided into two parts, in the 1st part (1960-1972), no literature is published by Indian scientists and in the 2nd part (1973-2014), growth trend follows a polynomial growth curve.

Table 1
Bibliographic Records of Planetary Systems (PS) in India during 1960-2014

Bibliometric Indicators	No.
Total Number of Articles	1914
Total Number of Contributing Countries	76
Total Number of Contributing Authors	9051
Total Number of Contributing Institutions	1813
Total Number of Journals appeared	422
Total Number of Keywords (raw) appeared	8761

Source: WoS

Table 2
Citation Metrics of Planetary Systems (PS) research in India during 1960-2014

Citation-based Indicators	No.
Sum of the Times Cited	20373
Sum of Times Cited without self-citations	18424
Citing Articles	15769
Citing Articles without self-citations	14869
Average Citations per Item	10.64
h-index	54

Source: Wos

4.4 Citation Pattern

Figures 3 and 4 represent the citation pattern and number of citations vs. number of publications per year of PS research in India during 1960-2014. A total of 1914 research papers have received 20373 citations. The pattern of citations is very fluctuating. In the initial year 1973, the total number of citations received is 37 with an average citation of 12.33. The minimum citation received in the year 1976 is six (6) and the maximum citations received in the year 2009 are 1703 with an average citation of 13.20. From Figure 4, it has been observed that after the year 2010, citations decrease while publications continue to increase.

Table 3
Different Regression Types with Regression coefficient (R²) of PS research

Regression Type	Equation	(R ²)
Exponential	$y = 2E-85e^{0.0993x}$	0.925
Linear	$y = 3.7161x - 7362.4$	0.688
Logarithmic	$y = 7396.4\ln(x) - 56150$	0.686
Polynomial	$y = 0.0004x^4 - 3.1295x^3 + 9330.4x^2 - 1E+07x + 6E+09$	0.975
Power	$y = 0x^{197.96}$	0.925

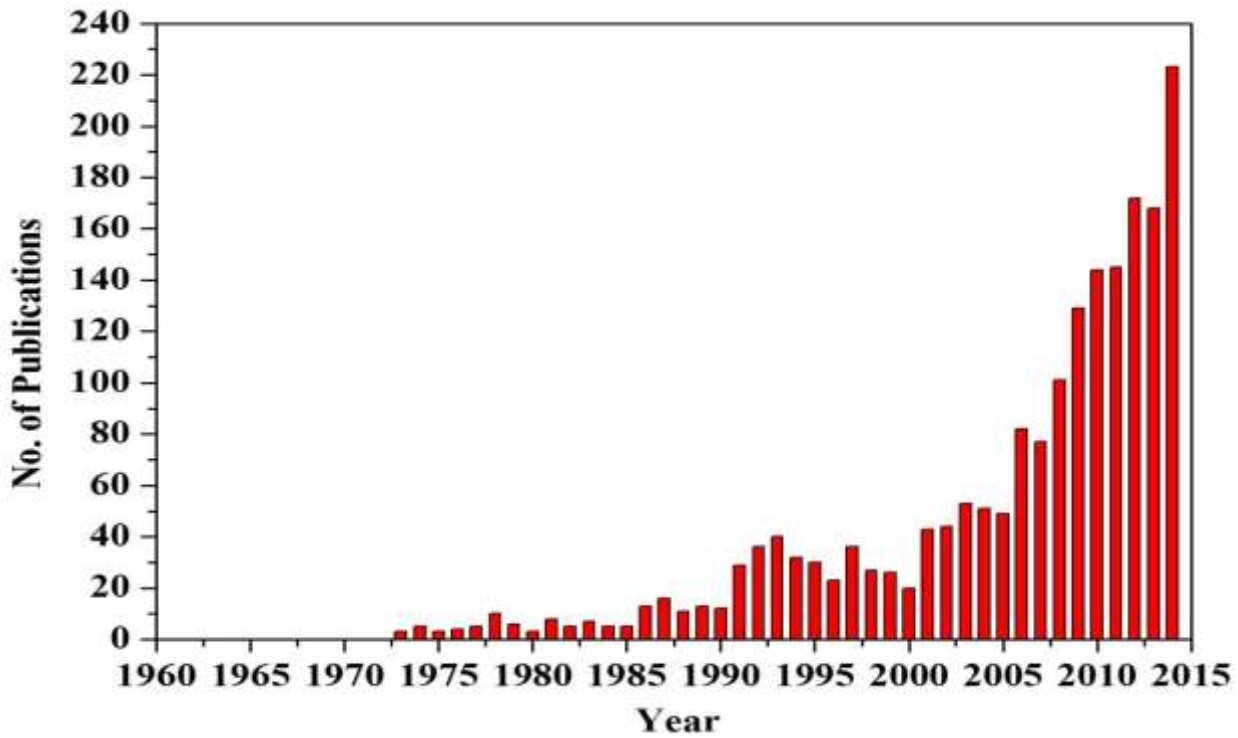


Figure 1: Publication Pattern of PS research in India during 1960-2014. From the period 1960-1972, no publication appeared in the WoS database.

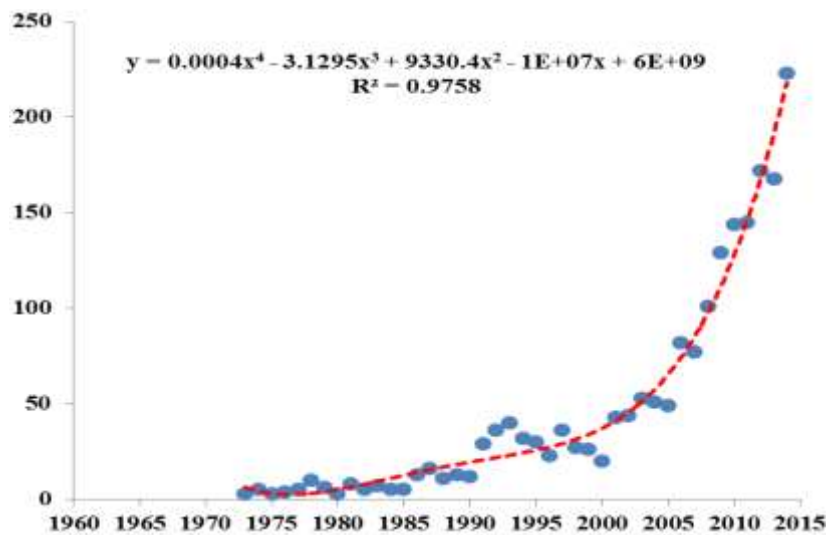


Figure 2: Growth Trend of PS research in India during 1960-2014. The dots describes the distribution of publications (observed value) and dashed line describes the correlation of distribution of publications where regression coefficient $R^2 = 0.975$

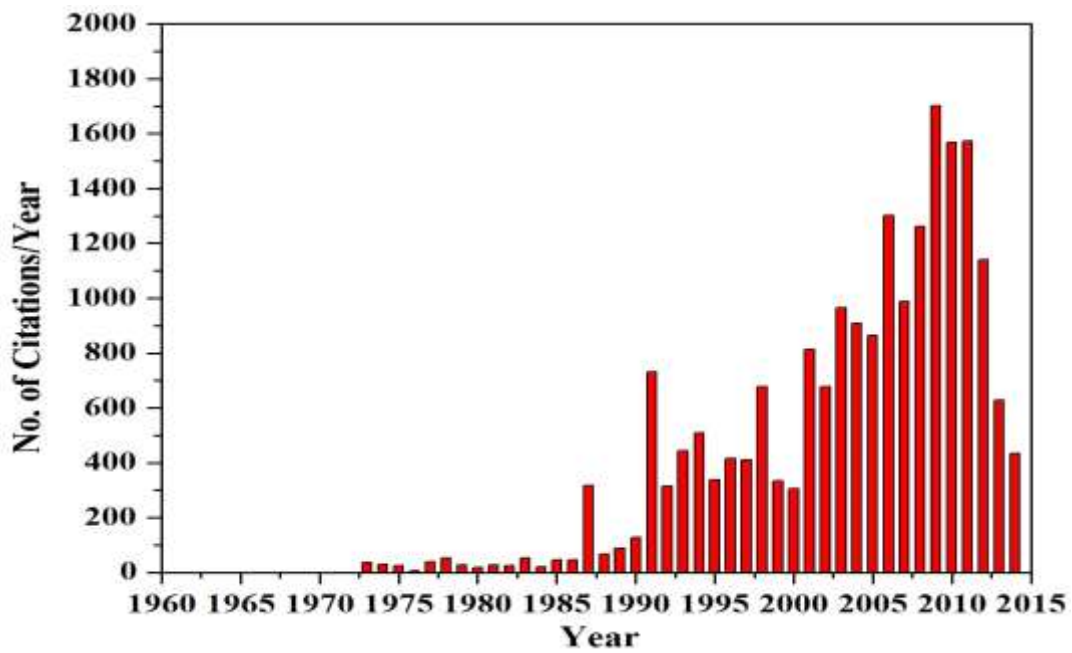


Figure 3: Citation Pattern of PS research in India during 1960-2014. From 1960-1972, no citation received as no publication appeared in the WoS database.

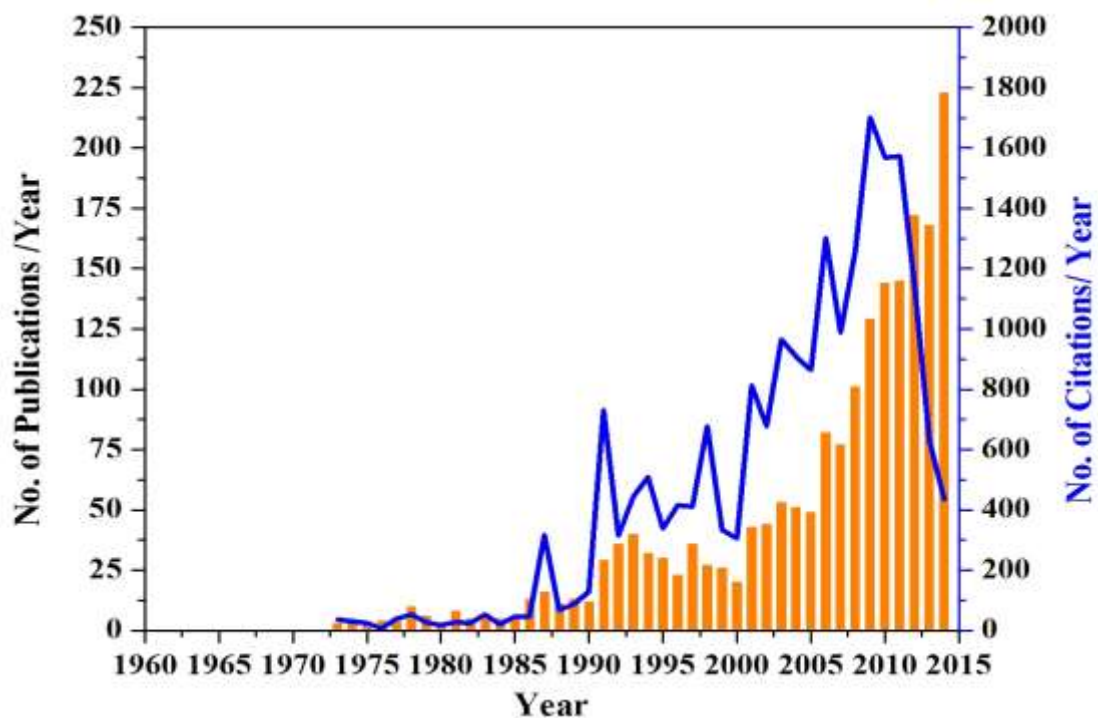


Figure 4: Citation Pattern Vs Publication Pattern of PS research in India during 1960-2014: Right Y axis indicates the citation pattern against bar (Left Y axis) that describes the publication pattern.

4.5 Top Institutions and their research impact

The contribution of different institutions was estimated by affiliated institution of at least one author. A total of 1914 articles on Planetary Systems appeared from 1813 institutions. Table 4 shows the top 20 productive institutions during the last 54 years, 1960-2014. Out of these top 20 institutions, 10 are Indian. Physical Research Laboratory which contributed highest publication had published 253 papers followed by Tata Institute of Fundamental Research (125) and Indian Institute of Astrophysics (117). There are 10 foreign institutions. Among these 6 belong to the USA namely National Aeronautics Space Administration (NASA), California Institute of Technology, University of California System, Jet Propulsion Laboratory, University of Texas Austin and United States Department of Energy, USA; 2 are from France namely Centre National De La Recherche Scientifique CNRS and Observatoire De Paris, France; 1 from Germany namely Max Planck Society; and 1 from Russia i.e. the Russian Academy of Sciences.

Table 4 reveals the impact of research in terms of quality of papers. The AvgCPA and h-index are used to identify which institution has the largest number of high quality articles in the PS. It is seen from the above Table 4 that PS related articles authored in collaboration with University of Texas, Austin have the highest average impact (AvgCPA = 55.69). Among the Indian institutions, Indian Institute of Astrophysics has the highest impact (21.02) in the AvgCPA index.

Table 4
Top Institutions on PS research and their research impact, 1960- 2014

Institution	Region	TP (%)	TC	AvgCPA	h-index
Physical Research Laboratory	India	253(13.218)	3413	13.49	30
Tata Institute of Fundamental Research	India	125(6.531)	1613	12.90	23
Indian Institute of Astrophysics	India	117(6.113)	2459	21.02	21
Vikram Sarabhai Space Center VSSC	India	108(5.643)	988	9.15	17
National Aeronautics Space Administration NASA	USA	108(5.643)	3337	30.90	33
Centre National De La Recherche Scientifique CNRS	France	95(4.963)	2301	24.22	28
California Institute of Technology	USA	74(3.866)	1790	24.19	24
Max Planck Society	Germany	71(3.7102)	225	31.34	29
Indian Institute of Geomagnetism	India	71(3.710)	638	8.99	16
Observatoire De Paris	France	65(3.396)	2081	32.02	29
Inter University Centre for Astronomy Astrophysics	India	65(3.396)	1184	18.22	21
Aligarh Muslim University	India	61(3.187)	645	10.57	14
Bhabha Atomic Research Center	India	59(3.083)	637	10.80	16
University of California System	USA	57(2.978)	1735	30.44	22
University of Calcutta	India	54(2.821)	527	9.76	15
Jet Propulsion Laboratory	USA	46(2.403)	952	20.70	18
University of Texas Austin	USA	45(2.351)	2506	55.69	27
United States Department of Energy	USA	43(2.247)	1428	33.21	21
Russian Academy of Sciences	Russia	43(2.247)	1053	24.49	22
Indian Institute of Technology IIT Kanpur	India	40(2.09)	422	10.55	13

TP= Total no. of PS related articles published by an institution; TC = Total no. of citation received; AvgCPA= Average no. of citations per article; h-index=defined by the no. of h papers among an institution's no. of publications that have at least h citations each. Source: WoS

4.6 Top Journals and their research impact

PS papers have appeared in 422 journals. Papers have appeared in highest number in the journal ‘Astronomy Astrophysics’ published by Oxford University Press from the United Kingdom. Table 5 shows the top 20 productive journals. The ‘Astronomy Astrophysics’ journal ranks first with 111 (5.79%) publications; ‘Astrophysical Journal with 91 (4.75%) publications’, ‘Astrophysics and Space Science with 90 (4.70%) publications’, ‘Advances in Space Research’ with 79 (4.12%) publications and ‘Monthly Notices of the Royal Astronomical Society’ with 75 (3.91%) publications. These journals ranked at 2nd, 3rd, 4th and 5th places respectively.

Table 5 also shows the citation impact on top 20 journals. The AvgCPA and h-index are used to identify which journals have the largest number of high quality articles in the PS. It is seen from the Table 5 that the journal ‘Geochimica Et Cosmochimica Acta’ published by Elsevier from North-Holland has the highest average impact (AvgCPA = 49.60) and the journal ‘Astronomical Journal’ published by IOP Publishing for the American Astronomical Society in USA has the highest average impact (AvgCPA = 30.93). It is also seen that though the journal ‘Astronomy Astrophysics’ has the highest number of publications, still it ranks 4th in the AvgCPA index.

Table 5
Top Journals on PS research and their research impact, 1960-2014

Journal	TP (%)	TC	JournalMetrics (2013)				Country
			AvgCPA	SJR	IPP	SNIP	
Astronomy Astrophysics	111(5.799)	2168	19.53	1.471	1.932	0.612	France
Astrophysical Journal	91(4.754)	2464	27.08	3.159	4.348	1.145	UK
Astrophysics and Space Science	90(4.702)	311	3.46	1.081	1.748	1.056	Netherlands
Advances in Space Research	79(4.127)	376	4.76	0.751	1.416	1.291	Netherlands
Monthly Notices of the Royal Astronomical Society	75(3.918)	1144	15.25	3.196	4.911	1.494	UK
Journal of Geophysical Research Space Physics	74(3.866)	804	10.86	2.376	3.286	1.412	USA
Planetary and Space Science	62(3.239)	476	7.68	0.925	1.560	0.800	Netherlands
Earth Moon and Planets	61(3.187)	103	1.69	0.254	0.660	0.600	Netherlands
Current Science	39(2.038)	80	2.05	0.293	0.841	0.771	India
Physical Review D	36(1.881)	548	15.22	1.899	3.192	1.136	USA
Annales Geophysicae	33(1.724)	275	8.33	1.176	1.533	1.533	Germany
Journal of Astrophysics and Astronomy	31(1.620)	72	2.32	0.477	0.541	0.224	India
Meteoritics Planetary Science	30(1.567)	382	12.73	1.551	2.115	0.857	USA
Solar Physics	26(1.358)	382	14.69	2.256	3.184	1.769	Netherlands
Icarus	25(1.306)	233	9.32	1.966	2.967	1.198	USA
Indian Journal of Radio Space Physics	23(1.202)	51	2.22	0.347	0.514	0.621	India
Geochimica Et Cosmochimica Acta	17(0.888)	844	49.6	-	-	-	UK
Radio Science	16(0.836)	91	5.69	0.994	1.265	1.078	USA
Proceedings of the Indian Academy of Sciences Earth and Planetary Sciences	15(0.784)	75	5.00	0.467	1.152	0.939	India
Astronomical Journal	15(0.784)	464	30.93	2.795	3.282	1.092	UK

TP= Total no. of PS research related articles published by a Journal; TC = Total no. of citation received; AvgCPA= Average no. of citations that PS related articles in a journal received; h-index= no. of h papers among a journal’s no. of publications that have at least h citations each. SJR = SCImago Journal Rank; IPP = Impact per Publication; SNIP = Source Normalized Impact per Paper; Source: WoS and SCOPUS

4.7 Top Authors and their research impact

A total of 1914 articles included the author addresses having India as the country of affiliation. Articles on PS have been contributed by 9051 authors. Table 6 shows the top 20 productive authors during the last 54 years, 1960-2014. Top 20 productive authors are ranked based on the decreasing productivity of total publications. Goswami, J. N. has produced 48 publications, which is the maximum and accounts for 2.50% of total publications. He is followed by Bhandari, N., Bhardwaj, A. and Lakhina, G. S. who rank 2nd, 3rd and 4th respectively.

Table 6 also reveals the impact of research in terms of quality of papers. The AvgCPA and h-index are used to identify which author has the largest number of high quality publications in the PS research. It is seen from the Table 6 that PS related articles authored by Wood, M. A. have the highest average impact (AvgCPA = 45.95) followed by Winget, D. E. (AvgCPA = 44.00) who ranked 2nd in the AvgCPA index. It is observed that Goswami, J. N. ranks 1st in the number of publications and ranks 7th in the AvgCPA index.

Table 6
Top Authors of PS research and their research impact, 1960-2014

Author	TP (%)	TC	TC woSC	CI	CIwoSC	AvgCPA	h-index
Goswami, J.N.	48(2.508)	1427	1331	1018	987	29.73	18
Bhandari, N.	42(2.194)	685	606	494	467	16.31	14
Bhardwaj, A.	40(2.090)	556	443	334	305	13.90	15
Lakhina, G.S.	35(1.829)	490	449	395	371	14.00	15
Murty, S.V.S.	34(1.776)	355	306	277	253	10.44	12
Nair, C.K.K.	30(1.567)	389	324	294	268	12.97	13
Ramkumar, G.	29(1.515)	226	172	162	139	7.79	9
Kumar, R.	29(1.515)	550	522	430	419	18.97	12
Jena, G.B	28(1.463)	314	254	256	232	11.21	12
Sen, A.K.	26(1.358)	207	154	135	116	7.96	9
Mukherjee, A.	26(1.358)	327	299	291	275	12.58	10
Kumar, K.K.	26(1.358)	187	132	121	102	7.19	9
Ashoka, B.N.	26(1.358)	1123	1079	729	711	43.19	20
Vauclair, G.	25(1.306)	1063	1019	677	659	42.52	19
Kepler, S.O.	25(1.306)	1063	1026	689	672	42.52	19
Kanaan, A.	25(1.306)	1049	1007	682	665	41.96	19
Kumar, S.	24(1.254)	238	236	221	219	9.92	7
Winget, D.E.	23(1.202)	1012	979	657	642	44.00	18
Nather, R.E.	23(1.202)	1005	968	645	630	43.70	18
Wood, M.A.	22(1.149)	1011	969	660	644	45.95	17

TP: Total no. of PS related articles published by a author; TC: Total no. of citation; TC woSc: Sum of Times Cited without self-citations; CI: Citing Articles ; CIwoSC: Citing Articles without self-citations; AvgCPA: Average Citations per Article; h-index : no. of h papers among a author's no. of publications that have at least h citations each. Source: WoS

4.8 Collaboration Pattern: Continents

Based on the author attributions, world-wide collaboration of PS research publications has been mapped. From Figure 5, it is seen that the major spatial clusters of research institutes are located in Europe, followed by Asia and Africa. Several minor clusters are distributed in other parts of the world. North America and South America have equal contribution.

4.9 Collaboration Pattern and research impact among Countries

There are 1914 articles which included author addresses, source country and research institutes. 76 collaborating Countries/territories have participated in collaborative research with the Indian institutions in the PS sub-field. As shown in the Table 7, top 20 countries / territories are ranked based on the number of total articles, along with the citations and percentage of international collaborations. Out of these 20 countries / territories, The USA has produced 331 publications which is the maximum, with high citations as well (7866). The AvgCPA and h-index are used to identify which country has the largest number of high quality articles in the PS research. It is seen from the Table 7 that PS related articles authored in collaboration with Canada (North America) have the highest average impact (AvgCPA = 42.47) followed by Australia (AvgCPA = 35.16). It is also seen that the USA ranks 15th in the AvgCPA index.

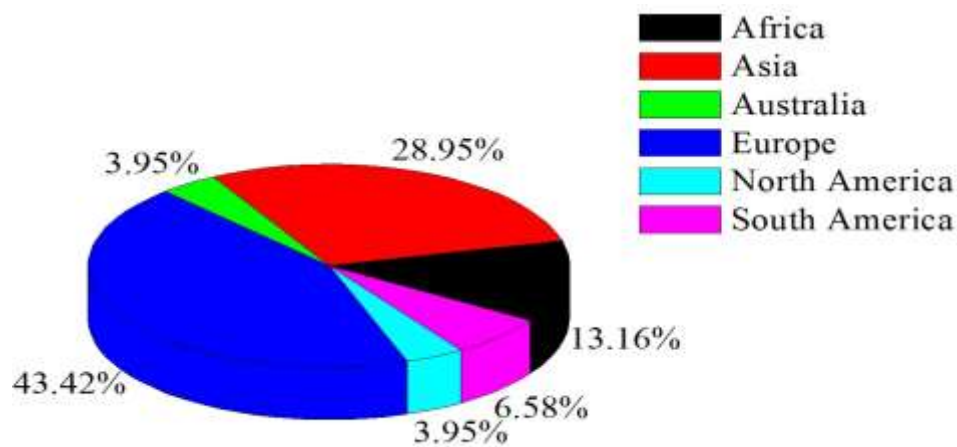


Figure 5: Continent wise Collaboration pattern of PS research

Table 7
Country wise Collaboration Pattern and research impact of PS research

Country	Continent	TP (%)	TC	AvgCPA	h-index
USA	North America	331(17.294)	7866	23.76	44
Germany	Europe	140(7.315)	3340	23.86	34
France	Europe	136(7.106)	3657	26.89	34
England	Europe	109(5.695)	3409	31.28	34
Italy	Europe	106(5.538)	2583	24.37	30
Japan	Asia	104(5.434)	2048	19.69	23
Spain	Europe	91(4.754)	2678	29.43	32
Brazil	South America	58(3.030)	1898	32.72	23
Australia	Australia	57(2.978)	2004	35.16	27
Russia	Europe	56(2.926)	1343	23.98	23
Peoples R. China	Asia	54(2.821)	1415	26.20	20
Canada	South America	45(2.351)	1911	42.47	24
Poland	Europe	41(2.142)	1022	24.93	22
Taiwan	Asia	40(2.090)	1170	29.25	17
Netherlands	Europe	39(2.038)	1112	28.51	21
South Africa	Africa	38(1.985)	1303	34.29	22
Chile	South America	37(1.933)	1096	29.62	17
Switzerland	Europe	34(1.776)	674	19.82	15
Norway	Europe	33(1.724)	1124	34.06	22
South Korea	Asia	32(1.672)	385	12.03	12

TP= Total no. of PS related articles published by a country; TC = Total no. of citation received; AvgCPA= Average no. of citations per Article; h-index= no. of h papers among a country's no. of publications that have at least h citations each. Source: WoS

4.10 Keyword Analysis

The process of keyword analysis has been described by various authors in many ways. Li and Zhao performed the keyword analysis to demonstrate research trends and frontiers. The keywords analysis in their study utilised author keywords, which were provided by article authors as part of the articles and termed as Keywords (Li and Zhao, 2015). Another such analysis was used in a study by Montoya et al., (2014) in order to follow and search the trends in the science and engineering. Yanhua et al. (2012) used keyword analysis to reveal the trends and identify hot topics that draw most research efforts. In another study, the authors mention that the keywords provide a reasonable description of an article's theme and could reveal the profile of an author's research preferences.

A total of 8761 different keywords, from 1960 to 2014 in the PS have been identified. To obtain accurate results, the keywords have been pre-processed by merging the singular and plural forms of the same terminology, and those keywords with the same meaning while using different expressions. A total 7623 unique keywords are obtained. Among these unique keywords 4653 (61.03%) appear once or twice at the most. Table 8 shows the most used keywords during the considered period.

4.10.1 Hotspots

An analysis of the keywords was undertaken to pick out the research hotspots that have attracted most research attention and to reveal the research tendencies in the fields of PS. The top most frequently used keywords for the study period are listed in Table 8. The five most frequently used keywords were 'Comets', 'Meteorites', 'Earth', 'Moon' and 'Formation'

Table 8
Top most frequently used keywords in PS research

Keyword	NO	%	R
Asteroids	13	0.17	12
Atmospheres	13	0.17	12
Comets	502	6.58	1
Composition	39	0.51	6
Detection	13	0.17	12
Earth	118	1.54	2
Formation	64	0.83	4
Interiors	10	0.13	13
Interplanetary medium	20	0.26	9
Magnetic fields	21	0.27	8
Meteorites	109	1.42	3
Meteoroids	16	0.20	10
Moon	54	0.70	5
Oceans	15	0.19	11
Planets and satellites	24	0.31	7

NO: Number of time occurrences; R: rank; Source: WoS

4.10.2 Quick rising themes

The Compound Annual Growth Rate (CAGR) was used to identify the top most frequently used keywords and to select quick rising themes of Planetary Systems, which could be indicators of future research directions. The Compound Annual Growth Rate (CAGR) of top keywords were separately calculated based on the following formula:

$$CAGR(t_0, t_n) = (V(t_n)/V(t_0))^{\frac{1}{t_n-t_0}} - 1$$

$V(t_0)$: Initial observed value, $V(t_n)$: last observed value, $t_n - t_0$: number of years (Compound annual growth rate, n.d.).

The CAGR provides smoothed growth rates free from the annual fluctuations of keywords occurrences during the study period. Table 9 lists the top keywords according to the CAGR and sorted them by their rank. The ranks in Table 9 show that “Comets”, “Moon” and “Formation” are three leading hot issues that continue to attract broad attention. “Comets” (CAGR, 0.124%) kept its dominance in terms of total quantity and CAGR.

Table 9
Top Quick rising themes in PS research

Keyword	V (t ₀)	V (t _n)	t ₀	t _n	CAGR (%)	R
Asteroids	1	1	1999	2014	0.000	14
Atmospheres	1	3	1996	2013	0.062	7
Comets	4	59	1991	2014	0.124	1
Composition	1	5	1991	2014	0.072	5
Detection	1	4	1993	2014	0.068	6
Earth	2	14	1993	2014	0.097	4
Formation	1	8	1992	2014	0.099	3
Interiors	1	1	1998	2014	0.000	14
Interplanetary medium	2	3	1995	2014	0.021	12
Magnetic fields	1	3	1995	2014	0.059	8
Meteorites	4	6	1991	2014	0.017	13
Meteoroids	1	2	1996	2012	0.039	10
Moon	1	11	1992	2014	0.115	2
Oceans	1	2	1993	2014	0.033	11
Planets and satellites	1	3	1994	2014	0.056	9

t₀: the Initial (first) year (The Year in which no. of keywords occurrence first time; *t_n*: the last year (No. of keywords occurrence); *V(t₀)*: Initial observed value (no. of keywords occurrence); *V(t_n)*: last observed value (no. of keywords occurrence); *CAGR*: Compound Annual Growth Rate; *R*: Rank. Source: WoS.

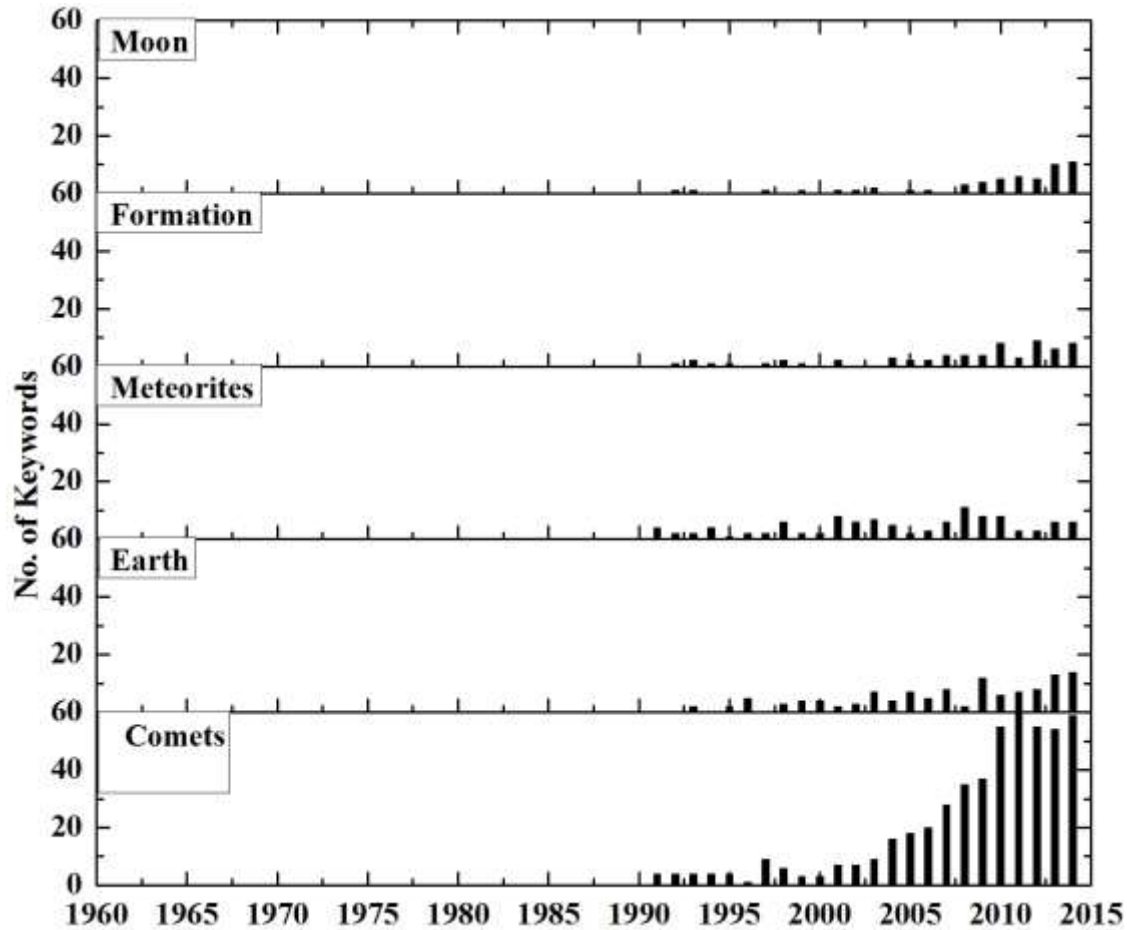


Figure 6: Evolution of top 5 author used keyword in Planetary Systems research during 1960-2014

5. Summary

A total of 1914 publications were published on PS, which received total 20373 citations and the average number of citations per publication was 10.64. Publications on PS appeared in 422 journals of which most active journal was “Astronomy Astrophysics” published by Oxford University Press from the United Kingdom with 111 (5.79%) publications. A total of 9051 authors contributed to the PS research. The most active author was Goswami, J.N. who produced maximum number of publications (48) i.e. 2.50% of total publications. 1813 institutions contributed of which Physical Research Laboratory; Ahmedabad, India turns out to be the most productive institution. For globalization of PS research in India, the results show there were 76 Countries/Territories which participated in PS research. The USA has produced maximum publications in collaboration i.e. 331 which accounts for 17.29% of the total publications with high citations (7866). A Keyword analysis reveals that ‘Comets’, ‘Meteorites’, ‘Earth’, ‘Moon’ and ‘Formation’ are the most used keywords.



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