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SCIENTOMETRIC ANALYSIS OF THE RESEARCH PERFORMANCE ON ASTRONOMY: THE WORLD PERSPECTIVE

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ABSTRACT

A study examined astronomy research performance from 2010 to 2019 by conducting in the following paper. The results are study based on the objectives of the Astronomy research. Scientometric analysis of collected data has been downloaded from the Web of Science database, a total of 6905 bibliography records. The highest number of publications 861 (12.47%) in the year 2018, It is found the degree of author collaboration in astronomy ranges from 0.66 to 0.78 during the period from 2010 to 2019. The maximum annual growth rate of 0.14 was found during 2011 with 582 publications. In the mean of a degree of collaboration where C =degree of collaboration 0.71. Average citations per paper and h-index it reveals that Katz U with 38 articles the most productive author contributing the USA is the world's major contribution in the field of astronomy research has contributed 2554 (36.99%) with number one rank. The above mentioned points are deeply analyzed.

Keywords: Astronomy, Authorship pattern, Time serious analysis, h-index, Scientometric and Web of Science.

INTRODUCTION

Scientific productivity in the form of intellectual contributions and communicated in written form are commonly considered to be one of the fundamental importance to scientific career advancement. In the last one decade, there has been an unprecedented growth of Scientometric studies in different fields, mainly because of the government and private organizations that invested in a large amount of money for the research activities which needs accountability. Scientometric studies include studies of the growth involved in the literature in many subjects in this aspect we would like to examine how Scientometric is contributed towards various individuals, groups, organizations or Countries and languages. The most important point to be discussed in the paper is how Scientometric studies evolve the sources of the writer and their citation of the discussed papers irrespectively. By keeping this view in mind, the researchers wish to analyze the research involvement of the astronomy research during 2010-2019.

Cosmology is a branch of astronomy concerned with the studies of the origin and evolution of the universe, from the big bang today and on into the future. Astronomy is the research of everything in the universe beyond Earth's atmosphere. That includes objects we can see with our naked eyes, like the sun, the moon, the planets, and the star. It also includes objects we can only see with telescopes or other instruments, like faraway galaxies and tiny particles. And it even includes questions about the things we can't see at all, like dark matter and dark energy, and the lines between them blur. In this regard, the present study entitled "Scientometric Analysis of the Research Performance on Astronomy: the world perspective". The present study is an attempt to Scientometric measures of the published research Performance of astronomy in terms of using various statistical tools.

REVIEW OF LITERATURE

Satish Kumar (2020) has studied the analyses "Scientometric analysis in India astronomy and astrophysics research for the period of during 1988-2019. The numbers of 20311 bibliographic data were harvested from Web of Science database. The main purpose of Astronomy and Astrophysics research is literature growth, prolific source journals, open access publications and collaborative countries. Major findings indicate Astronomy and Astrophysics research has shared only 1.79% of research publications in Indian Astrophysics are more focused on group research independent research.

Muneer Ahmad and Sadik batcha, M. (2020) this study examines on the Coronary Artery disease research in India: A Scientometric the bibliographic data collected Web of Science database during the period 1990-2019. A total number of bibliography record 4698, the main objective of India's output in coronary artery disease research, the study analyzed, the annual growth of Indian publication top six most productive countries, citation impact, productive, citation impact and most productive author.

Thangamani, T., Palaniappan, M., & Vijayakumar, R. (2019) conducted a study that presents "Journal of clinical biochemistry and nutrition: Bibliometric Analysis the data collection Web of Science database the study period leavens years (2007-2017), the overall bibliographic record 813. The main objectives of article year wise authorship pattern, degree of collaboration, the author based on productivity, h-index, most productive institution, future growth of publication, annual growth and citation of the source journal.

Vijayakumar, R., and Hariharan, R. (2016) have studied the analyses "A Scientometric Analysis of malaria research during 2010-2014: A study" between the year 2010-2014 as data download Web of Science database. The main aim of this paper is to bring into light such as, the year wise distribution of article papers, pattern of Co-authorship, author wise distribution article, citation, author productivity and key wise distribution. 1421 bibliographic records of contribution in the field of malaria research in the year 2014 highest contribution 329 (23.15%) respectively collaboration index that is a measure of the mean number of authors between 5.92 for the block year 2010.

Keshava and Gireesh A Ganjihah (2014) have analyzed Scientometric dimensions of Astronomy and Astrophysics research in India 2001 to 2010 as data download science citation index a total number of bibliography records 3795. The main objectives of growth of publication, authorship, collaboration pattern, international collaborations and journals preferred by the scientists. The highest number of contributions to astronomy and astrophysics 518 (13.65%) were published in the year 2009. It was found that the most of the highest number contributions are two authors 1006 (26.51%). The Indian authors' 74 (1.95%) articles were published. The USA is the top country in share rank with 1479 (19.29%).

Velmurugan, C. (2013) have analyzed the Bibliometric approach on the journal of Annals of Library and Information studies based on the Bibliometric approach and during the period from 2007-2012 a total number of bibliographic record 203. The main objectives of authorship

pattern, institution wise and degree of collaboration. The highest number of contributions 43 (21.19%) were published in the year 2010. It was found that the most of the highest number of contributions are by two authors 88 (43.35%). It was also noted that out of 203 articles single author contributed only 72 (35.46%). The degree of collaboration ranges from 0.57 to 0.82 and the average degree of collaboration on the journal of annuals of library and information studies journals.

OBJECTIVES OF THE STUDY

The major objectives are framed with the exclusive notion of the present study as mentioned below:

- To identify the year wise output of Astronomy research
- To find out the year wise distribution of the Authorship pattern
- To study ranking of Authors based on contribution
- To determine the ranking of Country wise distribution
- To find out the most productive Institution wise distribution
- To identify the annual ratio of growth and annual growth rate

METHODOLOGY

The required data were collected from Web of Science database maintained by Thomson Reuters for a period of ten years from 2010 to 2019. It can be seen that nearly 6905 bibliographic records were retrieved from astronomy research. A total number of 6905 records were analyzed based on bibliographic data i.e. year wise, year wise of authorship pattern, degree of collaboration, annual growth, time series analysis, countries, institution, etc. The astronomy research bibliographic record was analyzed using the Bibexcel software, web of science statistical report and Microsoft Sheet.

ANALYSIS AND RESULTS

Table 1: Year wise output of Astronomy Research

Year	Number of Publication	Publication %	Cumulative	Cumulative %
2010	511	7.40	511	7.4
2011	582	8.43	1093	15.83
2012	620	8.98	1713	24.81
2013	653	9.45	2366	31.27
2014	665	9.63	3031	43.9
2015	665	9.63	3696	53.53

2016	732	10.60	4428	64.13
2017	771	11.17	5199	75.29
2018	861	12.47	6060	87.76
2019	845	12.24	6905	100
Total	6905	100		

Table 1 and figure 1 indicates that the year-wise distribution of publication of astronomy research; it is observed that the research output in the field of Astronomy showing the ranges of growth year wise. The total number of publication 6905 was published, the highest number of publications in the year 2018 which was 861 articles with a percentage of 12.47. The minimum number of publications which was recorded in the year 2010 numbered in 511 articles with the percentage of 7.40. From 2011 the publication seemed to rise gradually from 511 to 582. In the year 2010 to 2018 the growth of research output was proved to be very effective in the growth whereas in 2019 the research slow down its growth in the field of Astronomy.

Figure 1

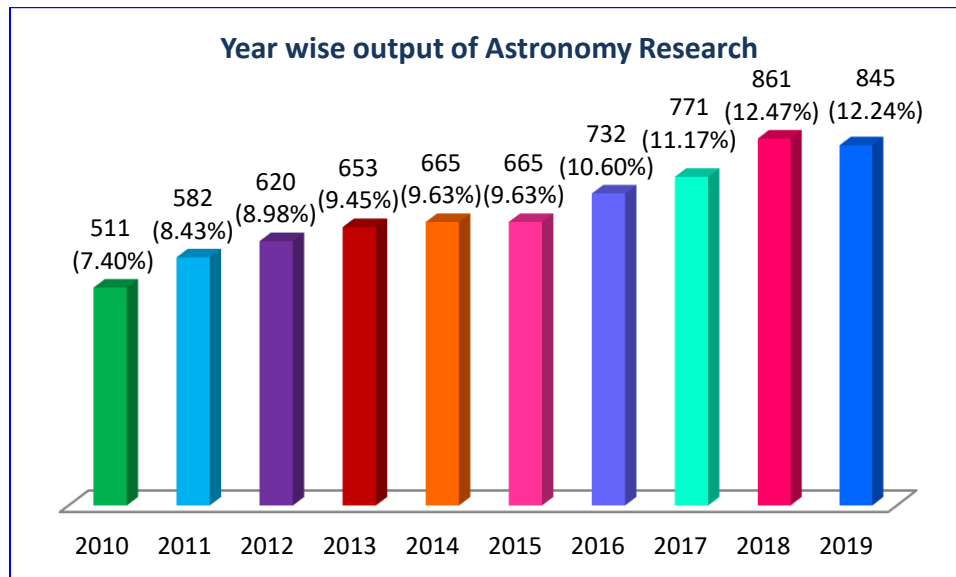


Table 2: Year wise distributions of Authorship pattern

Numbers of Authors	Year										Total Author
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
1	172	179	189	183	229	195	204	213	186	206	1956
2	88	102	96	114	86	98	87	128	103	113	1015
3	161	68	74	81	73	74	92	82	127	119	951
4	25	44	46	50	62	61	71	77	93	84	613
5	16	36	43	49	52	34	59	51	69	53	462
6	8	28	30	33	34	34	34	39	47	55	342
7	7	16	17	17	19	26	27	39	29	37	234
8	3	13	28	15	16	18	26	18	28	25	190
9	4	16	8	19	16	16	21	21	22	20	163
10 & above	27	80	89	92	78	109	111	103	157	133	979
Total	511	582	620	653	665	665	732	771	861	845	6905

Table 2 shows year wise of the authorship pattern of astronomy research articles published during the period studied 2010 to 2019. The total publication numbered 6905 articles was published. The single author was the highest number of contributed 1956 articles, followed by two authors 1015 articles, above ten authors 979 articles, three authors 951 articles and four authors 613 articles. There are very few contributions were in the form of nine authors 163. It shows that the single authorship rates are increasing almost double whereas the mutable authorship is in the same range.

Table 3: Degree of Collaboration

Year	Single	Multiple	Ns + Nm	DC
2010	172	339	511	0.66
2011	179	403	582	0.69
2012	189	431	620	0.7
2013	183	470	653	0.72
2014	229	436	665	0.66
2015	195	470	665	0.71
2016	204	528	732	0.72
2017	213	558	771	0.72
2018	186	675	861	0.78
2019	206	639	845	0.76
Total	1956	4949	6905	Mean DC 0.71

Table 3 shows that the degree of collaboration in astronomy research. It was calculated using the Subramanian formula. It is found the degree of author collaboration in the astronomy research ranges from 0.66 to 0.78 during the period from 2010 to 2019. In the mean of the degree of collaboration where a C = degree of collaboration 0.71. It the number of single author 1956 and number multiple authors 4949. From 2011 the degree of collaboration seemed to increase gradually from 0.69 to 0.76, in the year 2010 to 2018.

Table 4: Relative Growth Rate and Doubling Time of publication

Year	Publication	Cumulative	W1	W2	R(a) (W2- W1)	Mean R(a)= W2- W1	Dt (0.693/R(a))	Mean Dt(a)
2010	511	511	-	6.23	-	0.89	-	0.58
2011	582	1093	6.37	7.00	0.63		1.10	
2012	620	1713	6.43	7.45	1.02		0.68	
2013	653	2366	6.48	7.77	1.29		0.54	
2014	665	3031	6.50	8.02	1.52		0.56	
2015	665	3696	6.50	8.22	1.72	1.89	0.40	0.37
2016	732	4428	6.60	8.40	1.80		0.39	
2017	771	5199	6.65	8.55	1.90		0.36	
2018	861	6060	6.76	8.71	1.95		0.36	
2019	845	6905	6.74	8.84	2.10		0.33	
Total	6905					1.39		0.48

Table 4 indicates the relative growth rate and doubling time calculated for the publication of astronomy research from the period 2010 to 2019. The mean relative growth rate of publications comes increased from 0.63 the in year 2011 to 2.10 in the year 2019 for the ten years 2010 to 2019. The mean relative growth for the first five years 2010 to 2014 exhibits growth of 0.89. Similarly for the next five years 2015 to 2019 for the growth is 1.89. The overall research period has witnessed a mean relative growth rate of 0.83. The mean doubling time for the periods of 2010-2014 and 2015-2019 are 0.58 and 0.37 years respectively. The overall research period has witnessed a doubling time for astronomy publications in 0.48.

Table 5: Year wise Annual ratio of growth and annual growth rate

Years	Number of Publication	ARoG	AGR
2010	511		
2011	582	0.88	0.14
2012	620	0.94	0.07
2013	653	0.95	0.05
2014	665	0.98	0.02
2015	665	1	0
2016	732	0.91	0.1
2017	771	0.95	0.05
2018	861	0.9	0.12
2019	845	1.02	0.02
Total	6905		

Table 5 and figure 2 shows that year wise annual ratio of growth and annual growth rate in the astronomy research during the period from 2010 to 2019 ten years. The highest annual growth rate 0.14 was found during 2011 with 582 publications, followed by 0.12 was found during 2018 with 732 articles and 0.07 was found during 2012 with 620 articles. The lowest annual growth rate 0 was found during 2015 with 665 publications.

Figure 2

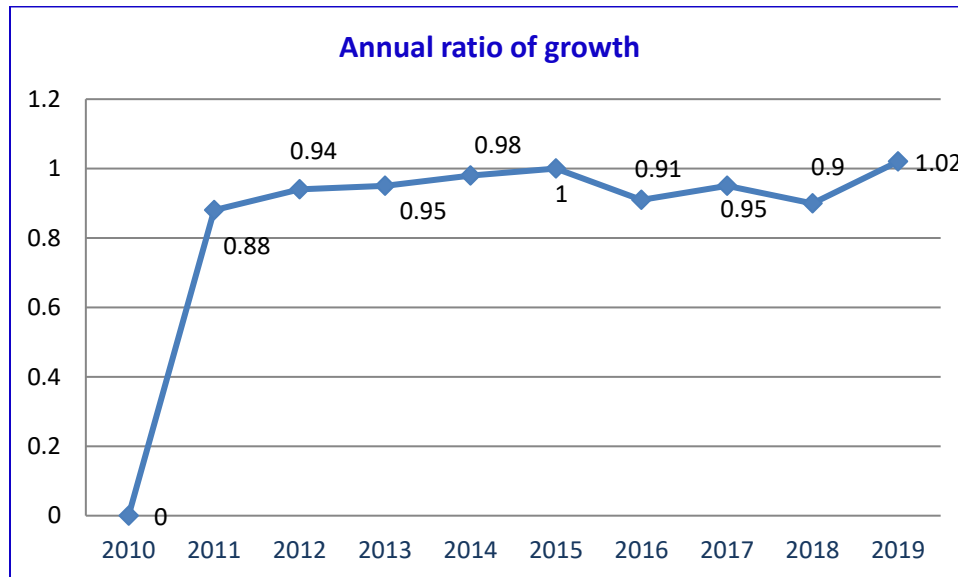


Table 6: Time Serious Analysis

Years	Number of Publication	X	X²	XY
2010	511	-4.5	20.25	-2299.5
2011	582	-3.5	12.25	-2037
2012	620	-2.5	6.25	-1550
2013	653	-1.5	2.25	-979.5
2014	665	-0.5	0.25	-332.5
2015	665	0.5	0.25	332.5
2016	732	1.5	2.25	1098
2017	771	2.5	6.25	1927.5
2018	861	3.5	12.25	3013.5
2019	845	4.5	20.25	3802.5
Total	6905		82.5	2975.5

Straight line equation: $Y_t = a+bx$

$$a = \frac{\sum y}{n}$$

$$b = \frac{\sum xy}{\sum x^2}$$

$$a = \frac{6905}{10} = 690.5$$

$$b = \frac{2975.5}{82} = 36.07$$

Estimated literature in 2024 is when $X = 2024-2010.5 = 13.5$

$$= 690.5 + 36.07 * 13.5$$

$$= 690.5 + 486.95$$

$$= 1177.45$$

Estimated literature in 2029 is when $X = 2029-2010.5 = 18.5$

$$= 690.5 + 36.07 * 18.5$$

$$= 690.5 + 667.30$$

$$= 1357.8$$

The calculated value of time serious analysis of deforestation for the year 2024 is 1177.45 and the research output of the year 2029 is 1357.8.

Table 7: Ranking of Authors based on contributions

Authors	Number of Publication	No. of Citation	H index	Rank
Katz U	38	1645	20	1
Yoshida S	37	1841	20	2
Santangelo A	35	1659	14	3
Bulik T	34	3738	20	4
Mitsuda K	33	262	10	5
Rhode W	33	2218	20	6
Halzen F	31	1211	20	7
Montaruli T	31	1828	20	8
Funk S	30	1707	15	9
Spiering C	30	1171	19	10
Zhang L	30	2715	16	11
Schussler F	29	968	15	12
Tanaka T	29	1073	11	13
Vecchio A	29	4153	23	14
Anton G	28	1305	17	15
Zhang Y	28	2056	11	16
Mandel I	27	3434	21	17
Clery D	26	17	2	18
Costantini H	26	1728	15	19

(ACPP -Average Citations per Paper)

Results found - 6905
H-index - 132
Average citation per item - 16.35
Sum of times cited - 112921
Without self citations - 105567
Citing articles - 75710
Without self citation - 72873

Figure 3

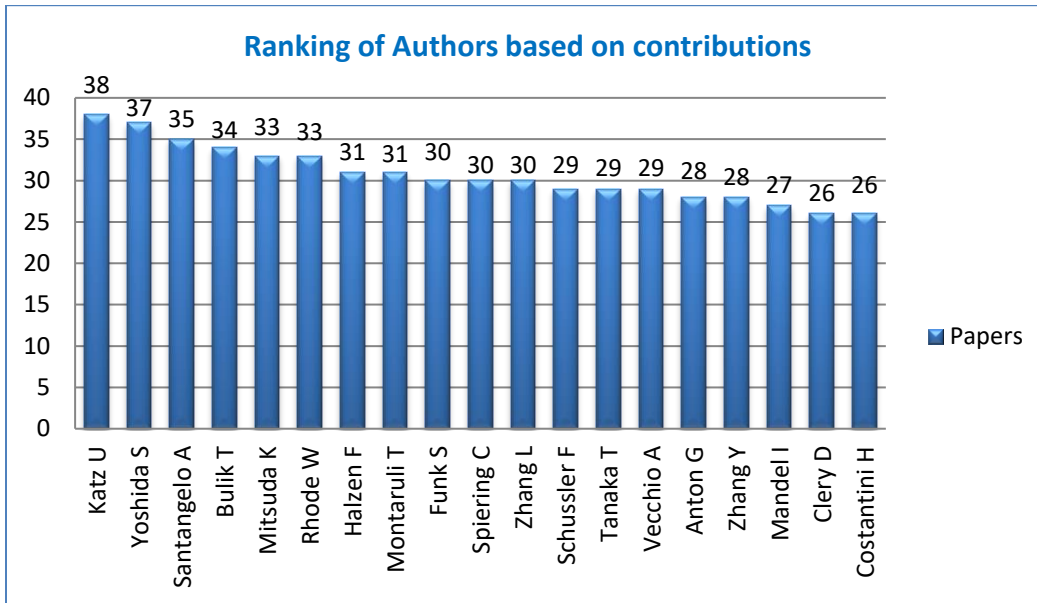


Table 7 and figure 3 depicts ranking authors of the top twenty most productive authors of astronomy research. The table also explains the individual author’s productivity, citations per paper and h-index. Katz U occupied the first position with 38 articles, 1645 citation and 20 h-index, Yoshida S is the second position with 37 articles 1841 citations and 20 h-index, Santangelo A third position with 35 articles, 1659 citations and 14 h-index, and Bulik T fourth position with 34 articles, 3738 citations and 20 h-index respectively. The lowest publication of prolific authors Clery D and Costantini H 26 articles published.

Table 8: Ranking of Countries based on publications

Countries	Number of Publication	Publication %	Rank
USA	2554	36.99	1
Germany	1029	14.90	2
England	879	12.73	3
France	756	10.95	4
Italy	653	9.46	5
Peoples R China	571	8.27	6
Spain	516	7.47	7
Japan	466	6.75	8
Australia	449	6.50	9
Netherlands	427	6.18	10
Russia	392	5.68	11

Canada	352	5.10	12
India	260	3.77	13
Switzerland	216	3.13	14
Sweden	199	2.88	15
South Africa	184	2.67	16
South Korea	173	2.51	17
Brazil	166	2.40	19
Poland	163	2.36	20

Figure 4

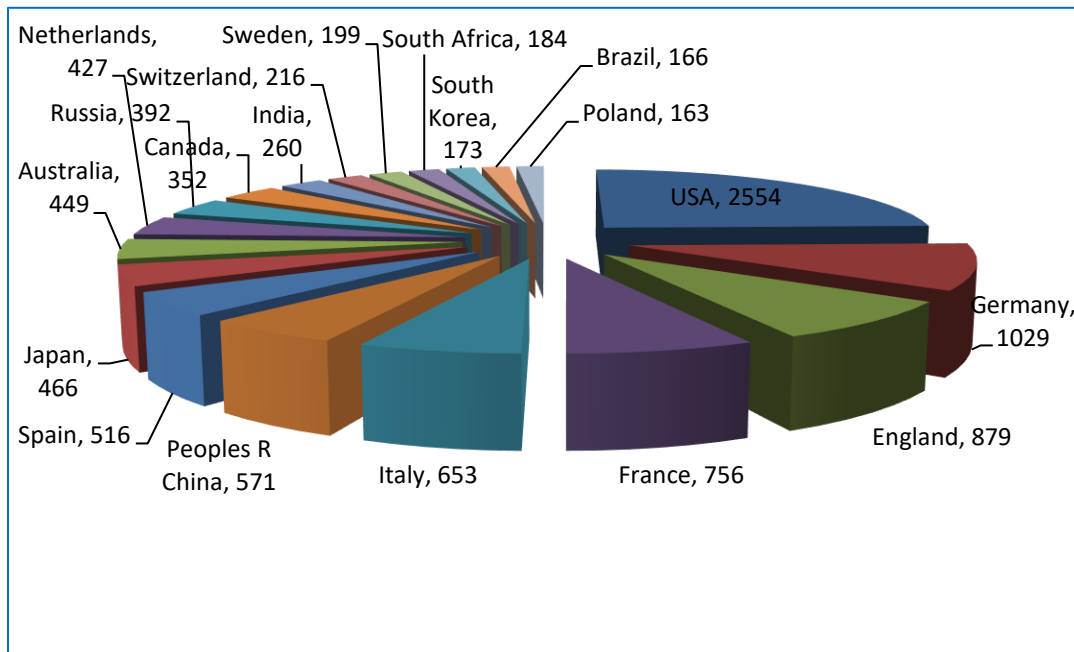


Table 8 and Figure 4 the countries based on the publication of astronomy research, the observed in the study 2010 to 2019 during the period, as per the source available in the web of science database. The result indicates that total number of 85 countries participated; the top 20 countries were selected for the current analysis. The most productive papers published by the USA with 2554 (36.99%) research paper and ranked first, and followed by Germany 1029 (14.90%), England 879 (12.73%), France 756 (10.95%) and Italy 653 (9.46%) holds second, third, fourth and fifth ranks respectively. India holds thirteen rank with 260 (3.77%) research published in the of astronomy research in the world.

Table 9: Most productive Institutions

Organizations	Number of Publication	Publication %
California Institute of Technology	362	5.24
NASA	277	4.01
Chinese Academic Science	273	3.95
Russian Academic Science	214	3.10
Harvard Smithsonian Center Astrophysics	184	2.67
University of California, Berkeley	168	2.43
University Paris Diderot	161	2.33
Centre Nation de la Recherche Scientifique	156	2.26
Ist Nazl Fis Nucl	152	2.20
University Maryland	142	2.06
University Tokyo	137	1.98
National Radio Astronomy Observatory	134	1.94
University Cambridge	128	1.85
University Wisconsin	127	1.84
Massachusetts Institute of Technology	121	1.75
Penn State University	121	1.75
university Michigan	121	1.75
University Oxford	121	1.75
Leiden University	115	1.67
University Arizona	110	1.59

Figure 5

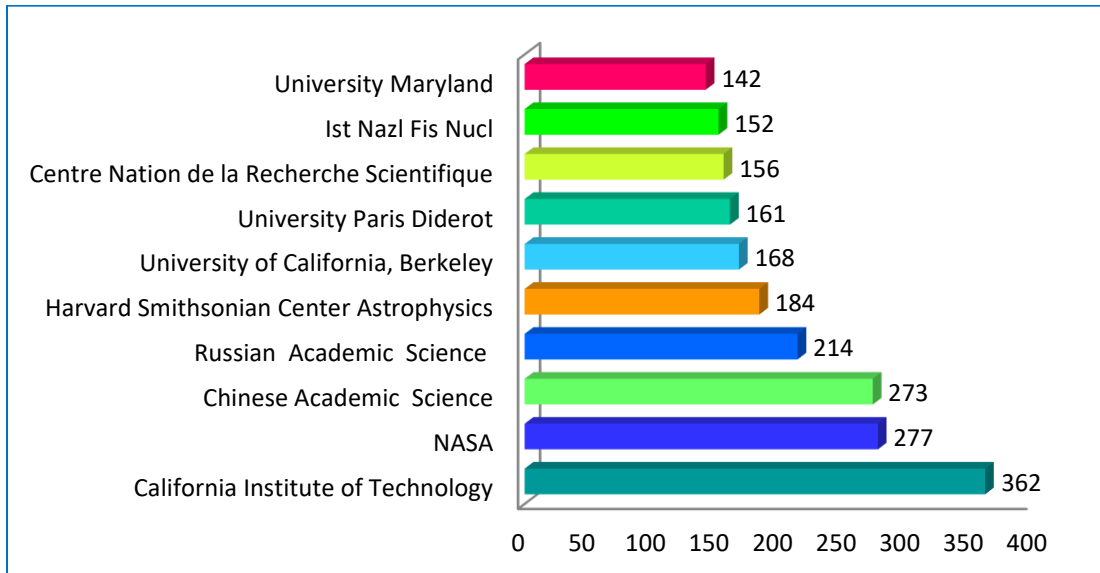


Table 9 and Figure 5 show that most productive institution wise distributions of astronomy research articles published during the period studied from 2010 to 2019. It was found that output of 6905 publications. California Institute of Technology occupied the first position with 362 (5.24%) publications; NASA in the second position with 277 (4.01%) publication, Chinese Academic Science in the third position with 273 (3.95%) publication and Russian Academic Science in the fourth position with 214 (3.10%) publication in astronomy research in the world.

FINDINGS

- The highest number of publications 861 articles with an average of 12.47 percentages in the year 2018. In the year 2010, the research output 511 articles with an average of 7.40 percentages and increased slightly from the year 2019 decreased the astronomy research improved identically.
- The total publication 6905 articles, the majority of publications a collaborative way rather than single publications. The single author highest number of contributed 1956, followed by two authors 1015 and above ten authors 979.
- The normal Degree of Collaboration from 0.66 to 0.78. The average degree of collaboration rate is 0.71.
- The annual ratio of growth and annual growth rate is the highest annual growth rate 0.14 was found during 2011 with 582 publications the astronomy research.
- The value of time serious analysis of deforestation for the year 2024 in 1177.45 articles and the research output for the year 2029 is 1357 articles.
- The total research output of 6905 publications. California Institute of Technology has the highest distribution 362 articles with an average of 5.24 percentages and NASA 277 articles with an average of 4.01 percentages.

CONCLUSION

The research activity of astronomy research has been examined thoroughly based on the publication data of 6905 research articles in astronomy research from 2010 to 2019. It was observed that the numbers counted 112921 sums of time citation, h-index 132, without self citations 105567 and citing articles 75710 astronomy research respectively. The average citations

per paper of the total publication of astronomy research are 16.35 based on the citation window. Astronomy has progressed in terms of excellence in the research field. The modern trend towards research is one of the steps for the updated currency day by day. Astronomy has become the most indispensable one in the field of research activity which leads to the researcher to equip themselves and to bring new innovative ideas for the growth of Astronomy.

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