

Patent literature in Astronomy and Astrophysics

Subject Area: Scientometrics analysis.

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Abstract:

This paper attempts to analyse the pattern and trends of patent-based literature in Astronomy and Astrophysics retrieved from the SCOPUS database from a bibliometric stand point. This is one of the first attempts to explain and describe the patterns in the Astronomy and Astrophysics patent literature. There are 293 patent-based published documents in the fields of astronomy and astrophysics. The examination of productivity by country/region, institution, and funding source revealed that the research landscapes in the United States, Germany, and Spain, in particular, are focused on the confluence of patent-based literature in astronomy and astrophysics. Exploration of the publication type, source, keyword, and language analysis provided background, status, and trends for the topic, as well as potential suggestions for future study in this field. Overall, publishing patterns predict that integration of topic will continue to be written and studied in the United States, Germany, and Spain, as well as within the worldwide community.

Keywords: Scientometrics, Bibliometrics, Patent, Biblioshiny, Astronomy, Astrophysics

Introduction:

The research assessment report is very much important for any institution. Patents filed by any Institute decides rank and quality research activities by Institute. To address the urgent need to mitigate research activities, patent-based literature impacts globally. The call to integrate patent-based literature has started in the 17 centuries but gained momentum in recent years. Despite the volume of research activities and variety of publications, still patent-based literature receives less attention. To introduce some evolutionary new trends, a bibliometric analysis is conducted. This analysis provides a significant insight into the progression and distribution of bibliographic information of patent-based published documents. Understanding the scientific and technological components of breakthrough technologies is crucial to businesses' or institutions' strategic planning for research and development (R&D). Determining the knowledge topography and mapping of a study topic is extremely useful for both future and current decision-making. This research offers data on the most recent advancements in astronomy and astrophysics, such as the country's position as a leader in development and contribution. The institutes publish the most prolific and well-known astronomy and astrophysics research publications, which may be utilized to forecast world trends. Many studies have been conducted in recent years to analyze the qualitative progress of scientific technology research and patenting. In the context of an organization's research environment, the process of gathering, analysing, and transforming information into practical knowledge. Its main goal is to assist any institution, university, or country in making decisions and developing strategic plans.

Bibliometric analysis: -

The classical definition of bibliometrics is "statistical and mathematical methods to books and other media of communication" Pritchard, A. (1969). "Bibliometrics (or scientometrics) is the quantitative analysis and statistics of publications and bibliography output in various reputable mediums to understand emerging trends and the knowledge structure of a research field" [Reuters, T. (2008)]. The quantitative analysis of PEB publications in SCOPUS provides a snapshot of previous patterns, present developments, and future trends. Bibliometric analysis reveals the potential for identifying gaps and new study fields, though the result is not as comprehensive as an in-depth assessment of related literature. [Boshoff, N., & Akanmu, M. A. (2017)]. The SCOPUS database has garnered a lot of attention in recent years for bibliometric research, especially from poor countries, on a variety of databases. Because Elsevier publishes this database, it has been used for a number of reasons throughout the years, including detecting scientific indicators, choosing journals, assessing scientific output, forecasting research potential, and acting as a standard tool for research policy and management. [G. P. Khiste and R. R. Paithankar (2017)]. As a result of the database's benefit and relevance, the literature for this study was acquired from SCOPUS. Bibliometric analysis is widely recognised as one of the most reliable methods for quantitatively examining documents created in a certain topic. This study employs statistical techniques such as learning patterns in the literary features of a certain topic of interest, weighing authors, institutions,

countries/regions, and journals and determining research trends. The process comprises extracting key information from a large number of documents, yielding descriptive data.

Methodology:

Based on a scientific search technique ran on the Scopus database for the period 2011–2020, bibliometric analysis in Patent literature in Astronomy and Astrophysics Subject Area was performed on a sample of 293 documents. The study employed Biblioshiny, a web-based tool contained in the Bibliometrix package built in R-language (Ariaa and Cuccurullo, 2017). Important journals, authors, countries, articles, and themes were selected using the software's automated process, and citation, co-citation, and social network analyses were performed.

Objectives:

The main objective of this study is to analyze the global research output in patent-based research and literature in the field of astronomy and astrophysics from 2011 to 2020 withanaim. (i) To study annual citation production,average citation per year,total documents citations, source citations, authors citations, Country-wise citations, and Co-citations with Cited reference, sources, authors.(ii) To study Source impact i.e. h-index, g-index, m-index as well as source dynamics, most relevant sources, most cited sources, most cited references (iii) To study author impact i.e. h-index, g-index, m-index,author production over time, author’s productivity, Co-Authorship with authors, Institutions, Country. (iv)country-wise percentage of documents,Country Scientific production, most cited countries, most global cited documents(v) To study most relevant institutional affiliations.(vi) To study Bibliographic coupling of documents, Sources, Authors,Organizations.

Data Analysis:

Data Set

Table 1 depicts a bird's-eye view of the bibliometric data frame of 293 documents selected from the SCOPUS database using a systematic search query. These documents were cited in 80 sources, with an **Average Citation/ Year /Document** score of 0.5528 and a collaboration index of 3.83, indicating extensive previous research and collaboration among researchers.

Table 1:Main Information of Patent related literature on Astronomy and Astrophysics

Sr.No.	Details	Description	Sr. No.	Details	Description
1.	Reference date	2020-09-25	15	Authors keywords	514
2	Publication years	2011-2020	16	Citations	917
3	Citation years	9 (2011-2020)	17	Citations/year	101.89 (acc1=56, acc2=28, acc5=7, acc10=2, acc20=1)
4	Documents	293	18	Average Citation/ Year /Document	0.5528
5	Sources (Journals, Books etc)	80	19	Citations/paper	3.13
6	Article	69	20	Authors/paper	3.58/3.0/multi (mean/median/mode)
7	Book	1	21	Age-weighted citation rate	209.98 (sqrt=14.49), 72.23/author
8	Book Chapter	6	22	h-index	16 (a=3.58, m=1.78, 540 cites=58.9% coverage)
9	Conference paper	211	23	g-index	25 (g/h=1.56, 648 cites=70.7% coverage)
10	Conference Review	1	24	PoPhI,Norm	8
11	Review	4	25	PoPhI,Annual	0.89
12	Short survey	1	26	Authors	989
13	Total References	6283	27	Collaboration Index	3.83
14	Keyword Plus	2323			

Table 2 :Annual Scientific Production:

Year	Articles	Year	Articles
2011	18	2016	25
2012	25	2017	39
2013	21	2018	26
2014	19	2019	87
2015	13	2020	20

Annual Scientific Production

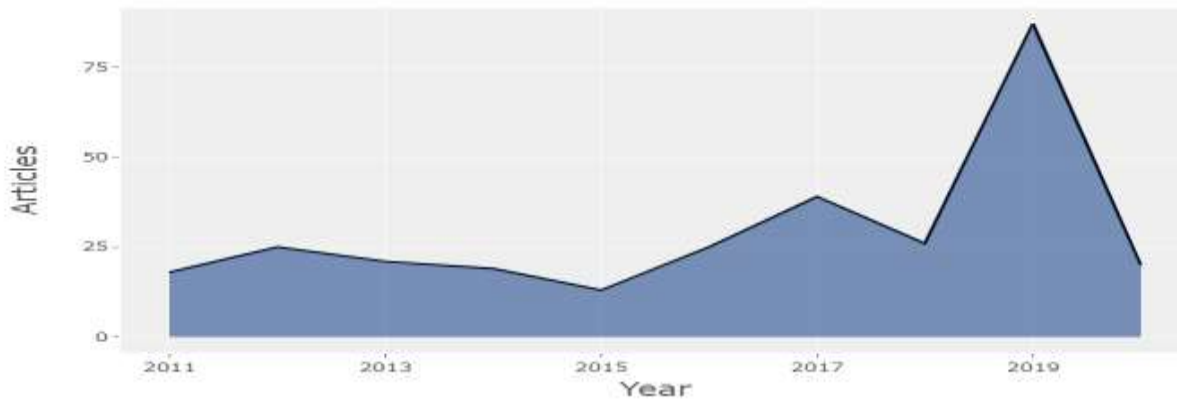


Fig No :1 Annual Scientific Production

The largest number of articles produced in the year 2019 is clearly shown in Table No:2 and Fig No:1. In total, 87 papers were published in 2019.

Table No: 3 Average Citations per Year

Year	N	Citation Per Article (Mean)	Citation Per Year (Mean)	Citable Years
2011	18	5.611111111	0.62345679	9
2012	25	5.84	0.73	8
2013	21	2.857142857	0.408163265	7
2014	19	5.210526316	0.868421053	6
2015	13	19.84615385	3.969230769	5
2016	25	3.12	0.78	4
2017	39	1.717948718	0.572649573	3
2018	26	3.538461538	1.769230769	2
2019	87	0.183908046	0.183908046	1
2020	20	0		0

Average Article Citations per Year

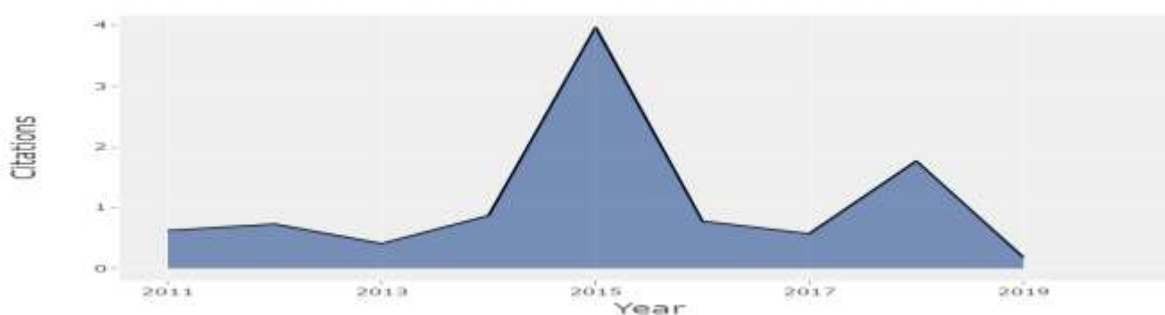


Fig No: 2 Average Citations per Year

The average citations in articles connected to Patent based literature in Astronomy and Astrophysics, both on an annual and per-article basis, are also used in the research. From 2011 to 2020, research on this topic was published for nine years. The most widely published publications in the field of patent literature in astronomy and astrophysics are included in the table No 3. The year with the highest average total citations for each article was 2015, with an average of 19.84 citations. Meanwhile, the study with the greatest average annual citation was published in 2015, with 3.96. This indicates that articles published in 2015 received more citations than articles published in any previous year in the field of Patent based literature in Astronomy and Astrophysics.

Author, Country, and Affiliating Institution:

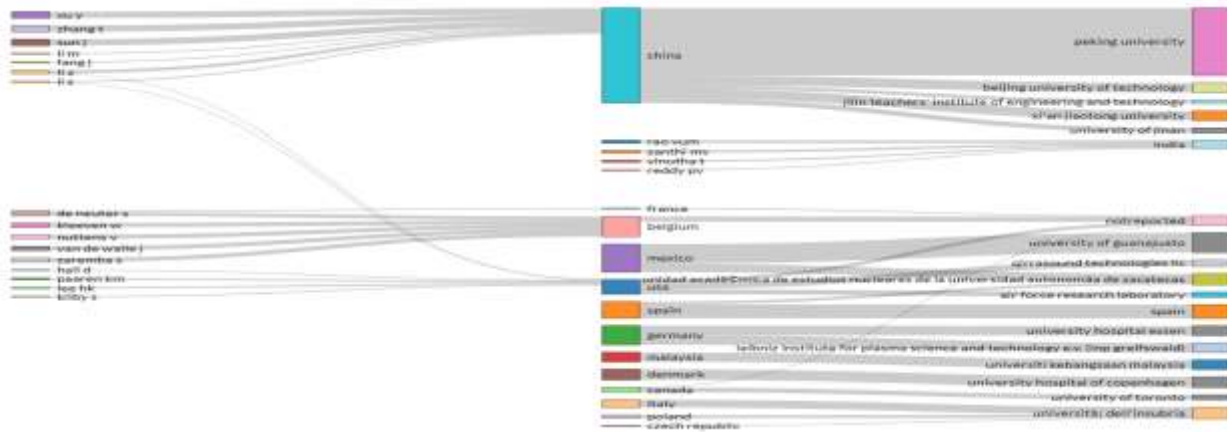


Fig. No 3 Author, Country, and Affiliating Institution

The graphic above depicts the Three Fields Plot, which is made up of three elements: author, country, and affiliated institutions. A grey plot connects the three parts and is related to one another. Starting with the authors' names, countries, and institutions affiliated with them. Each country displays the institutions that frequently contribute to the author's publication. Each author identifies the country and institution where they conducted research for patent-based astronomy and astrophysics publications. The number of research conducted by Chinese writers connected with Peking University is the highest. Some authors write for both the China and USA. The graph above displays the author's relationship with numerous affiliated institutions.

Table No:4 Most Relevant Sources:

Sr. No	Sources	Articles
1	JOURNAL OF PHYSICS: CONFERENCE SERIES	99
2	AIP CONFERENCE PROCEEDINGS	50
3	JOURNAL OF APPLIED PHYSICS	8
4	OPTICS INFOBASE CONFERENCE PAPERS	8
5	IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM IUS	7
6	APPLIED RADIATION AND ISOTOPES	5
7	ENTROPY	5
8	EPJ WEB OF CONFERENCES	5
9	PHYSICS PROCEDIA	5
10	PROCEEDINGS OF MEETINGS ON ACOUSTICS	4

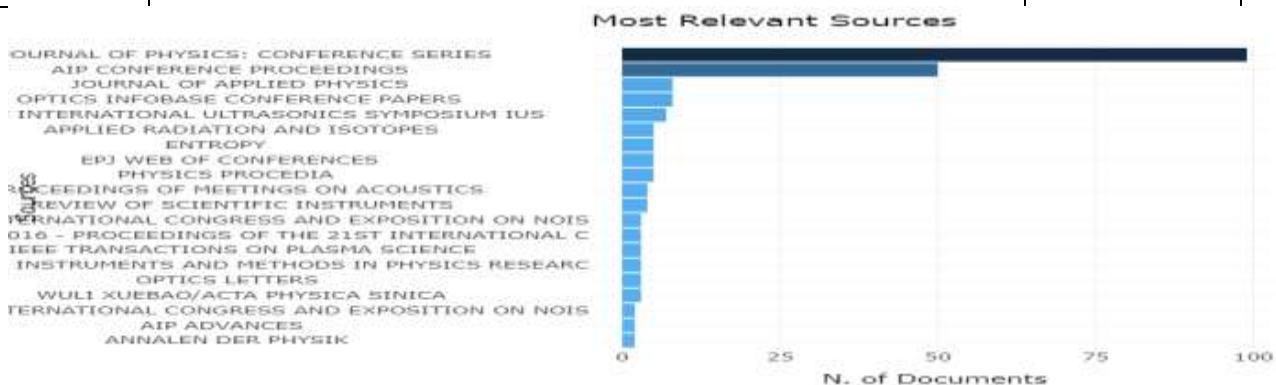


Fig. No:4 Most Relevant Sources

The graph above depicts the number of research papers published by each journal based on their level of relevance to the issue of patent-based publishing in astronomy and astrophysics. The names of the top journals published, as well as the interval of the number of documents published, are depicted in a blue bar chart (Fig 4). The larger the quantity and relevance of the research topic, the darker the blue colour; the total number of documents published by all journals ranges from 0 to 100. In the dark blue bar chart, the JOURNAL OF PHYSICS: CONFERENCE SERIES is the top-ranking journal, having the most published documents compared to the other journals' bars. This is due to the journal's relevance to the topic at hand. Meanwhile, there are two journals designated in brilliant blue for the journals in the lowest place with the least number of publications (3). This suggests that the issue of patent-based publishing in astronomy and astrophysics is still deficient in terms of quantity and importance. In addition, the most relevant data sources identify a total of 20 journals.

Table No 5: Most Local Cited Sources (from Reference Lists)

Sr. No	Sources	Articles	Sr. No	Sources	Articles
1	J APPL PHYS	85	11	NATURE	35
2	J MAGN RESON	78	12	SCIENCE	34
3	REV SCI INSTRUM	69	13	APPL OPT	32
4	ASTROPHYS SPACE SCI	64	14	IEEE TRANS MAGN	32
5	APPL PHYS LETT	62	15	PHYS REV	32
6	PHYS REV LETT	58	16	PHYS REV B	30
7	PHYS REV D	55	17	ASTROPHYS J	29
8	MAGN RESON MED	41	18	INT J THEOR PHYS	25
9	J CHEM PHYS	37	19	PHYS LETT B	24
10	J MAGN MAGN MATER	35	20	BIOPHYS J	22

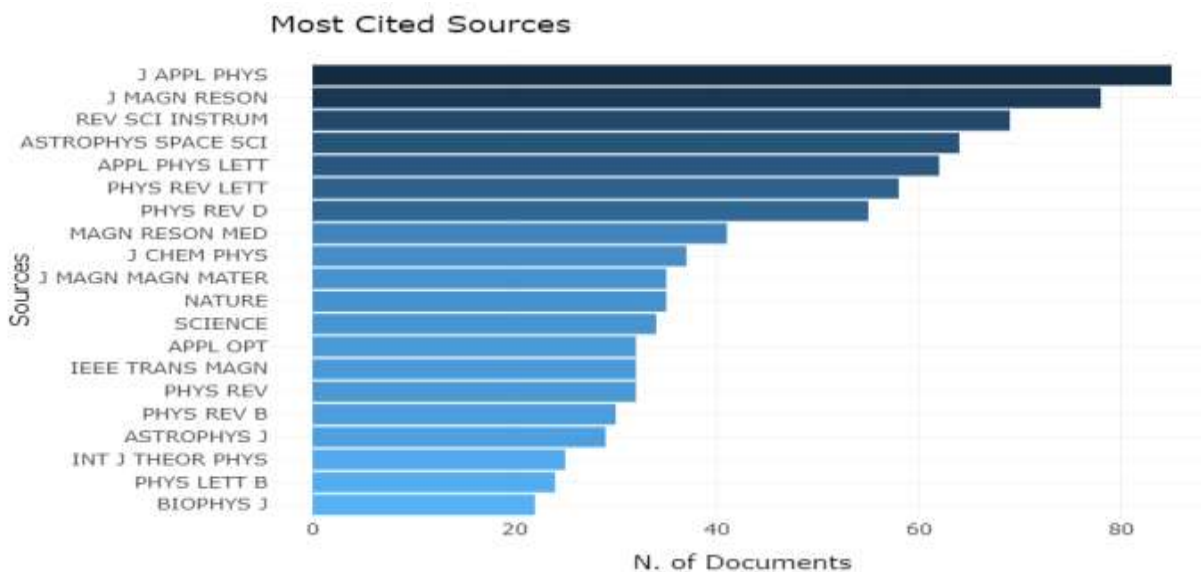


Fig No 5: Most Local Cited Sources (from Reference Lists)

Total references (citations) were analyzed, and sources were chosen from the references. These are the sources that authors use to publish their work. Table No. 5 and Fig. No. 5 show the most frequently mentioned sources from the reference list.

Table No: 6 Source Impact (h-Index, m-Index, g-Index)

Source	h_ index	g_ index	m_ index	TC	NP	PY_start
JOURNAL OF PHYSICS: CONFERENCE SERIES	4	9	0.4	97	99	2011
AIP CONFERENCE PROCEEDINGS	5	8	0.5	81	50	2011
JOURNAL OF APPLIED PHYSICS	5	8	0.5	72	8	2011
OPTICS INFOBASE CONFERENCE PAPERS	0	0	0	0	8	2011
IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM, IUS	2	2	0.222222222	5	7	2012
APPLIED RADIATION AND ISOTOPES	1	1	0.125	4	5	2013
ENTROPY	2	5	0.666666667	27	5	2018
EPJ WEB OF CONFERENCES	2	2	0.222222222	9	5	2012
PHYSICS PROCEDIA	3	5	0.333333333	41	5	2012
PROCEEDINGS OF MEETINGS ON ACOUSTICS	1	1	0.111111111	1	4	2012
REVIEW OF SCIENTIFIC INSTRUMENTS	4	4	0.444444444	32	4	2012
41ST INTERNATIONAL CONGRESS AND EXPOSITION ON NOISE CONTROL ENGINEERING 2012, INTER-NOISE 2012	0	0	0	0	3	2012
CYC 2016 - PROCEEDINGS OF THE 21ST INTERNATIONAL CONFERENCE ON CYCLOTRONS AND THEIR APPLICATIONS	1	1	0.2	1	3	2016
IEEE TRANSACTIONS ON PLASMA SCIENCE	2	3	0.222222222	32	3	2012
NUCLEAR INSTRUMENTS AND METHODS IN PHYSICS RESEARCH, SECTION A: ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT	2	3	0.2	29	3	2011
OPTICS LETTERS	2	3	0.2	20	3	2011
WULI XUEBAO/ACTA PHYSICA SINICA	1	2	0.125	7	3	2013
42ND INTERNATIONAL CONGRESS AND EXPOSITION ON NOISE CONTROL ENGINEERING 2013, INTER-NOISE 2013: NOISE CONTROL FOR QUALITY OF LIFE	1	1	0.125	1	2	2013
AIP ADVANCES	1	1	0.25	3	2	2017
ANNALEN DER PHYSIK	1	2	0.166666667	29	2	2015

Fig No:6Source (h-Index) plot



Fig : 7 Source (g-index) plot

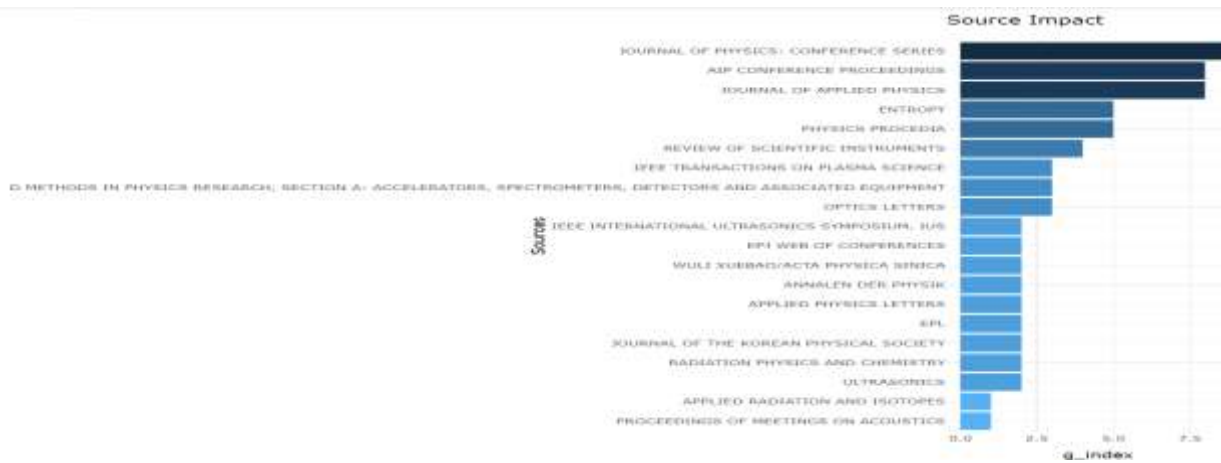


Fig No 8 Source (m-index)plot

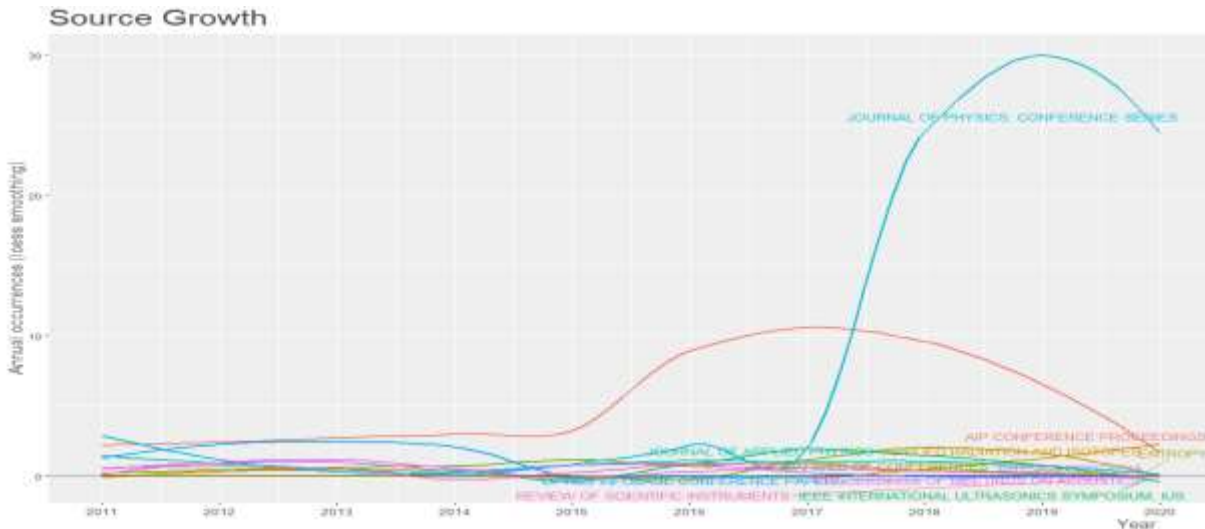


The quantity produced and its significance aren't the only factors that go into journal calculations. However, The impact of each journal that publishes a paper on the issue of patent-based publication in astronomy and astrophysics, as measured by the journal's h-index, which is shown in a blue bar chart, is the basis for this research. In addition to presenting the h-Index number, the blue tint in the graphic above reflects the journal's influence. The darker the blue in the chart, the greater the journal's impact. The g-index gives more weight to highly cited publications. **JOURNAL OF PHYSICS: CONFERENCE SERIES, AIP CONFERENCE PROCEEDINGS, JOURNAL OF APPLIED PHYSICS** have received maximum number of citations i.e 97,81,72 and their g index are 9,8,8 respectively.

Table: No 7 Source Dynamics (Source Growth Per Year)

Year	JOURNAL OF PHYSICS: CONFERENCE SERIES	APPLIED RADIATION AND ISOTOPES	AIP CONFERENCE PROCEEDINGS	JOURNAL OF APPLIED PHYSICS	ENTROPY	IEEE INTERNATIONAL	EPJ WEB OF CONFERENCES
2011	3	0	2	1	0	0	0
2012	1	0	3	2	0	1	1
2013	0	1	2	0	0	2	0
2014	1	0	4	0	0	0	1
2015	0	0	3	1	0	0	1
2016	3	0	6	1	0	0	1
2017	5	0	17	1	0	3	0
2018	11	0	2	1	4	1	1
2019	65	2	10	1	1	0	0
2020	10	2	1	0	0	0	0

Source Growth Fig No: 9



The development of journals that are a source of research on patent-based literature in astronomy and astrophysics is also discussed in this study. From 2011 to 2020, the annual occurrence of each journal is shown in the graph above. The graph shows that astronomy and astrophysics research with patent-based publications has a tendency to fluctuate in its publishing. The graph above also illustrates that certain journal, such as JOURNAL OF PHYSICS: CONFERENCE SERIES, have been growing since 2015 and are continuing to grow even though they have fallen in some years.

Prolificscholars:

Fig No : 10Top Authors' Production over Time:

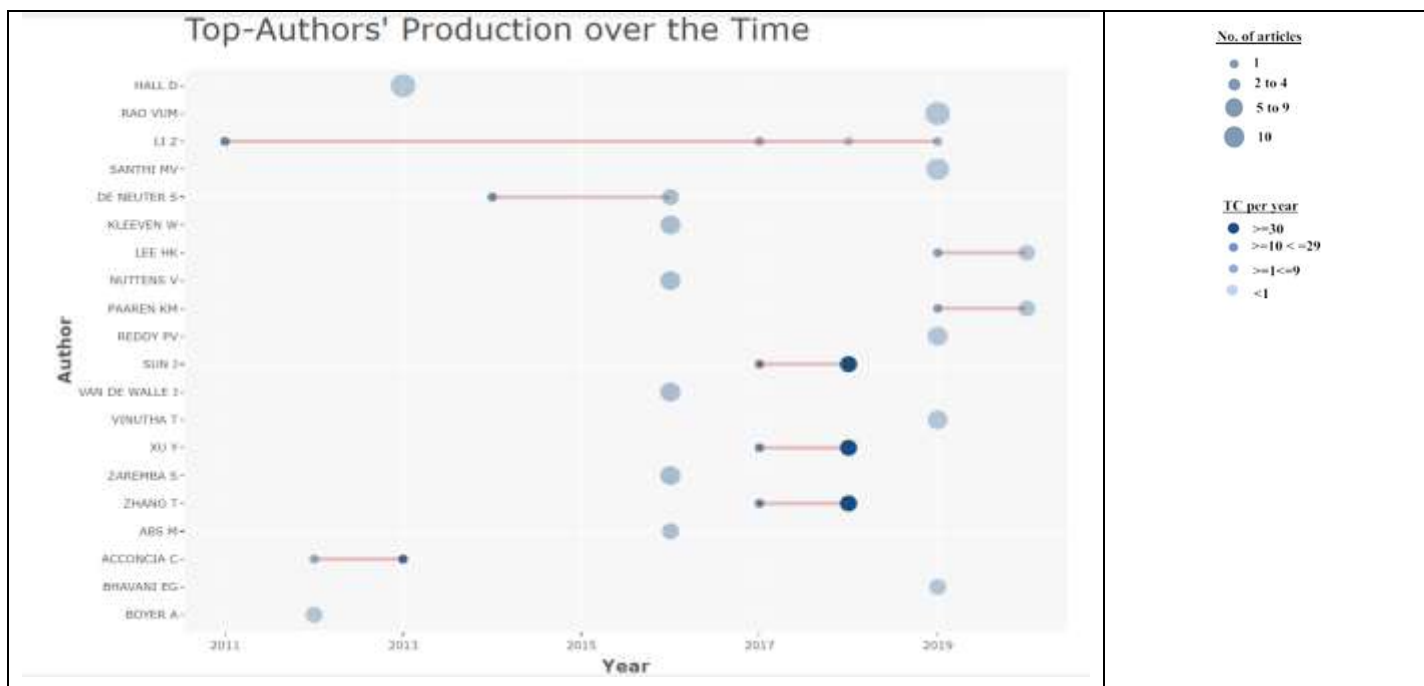
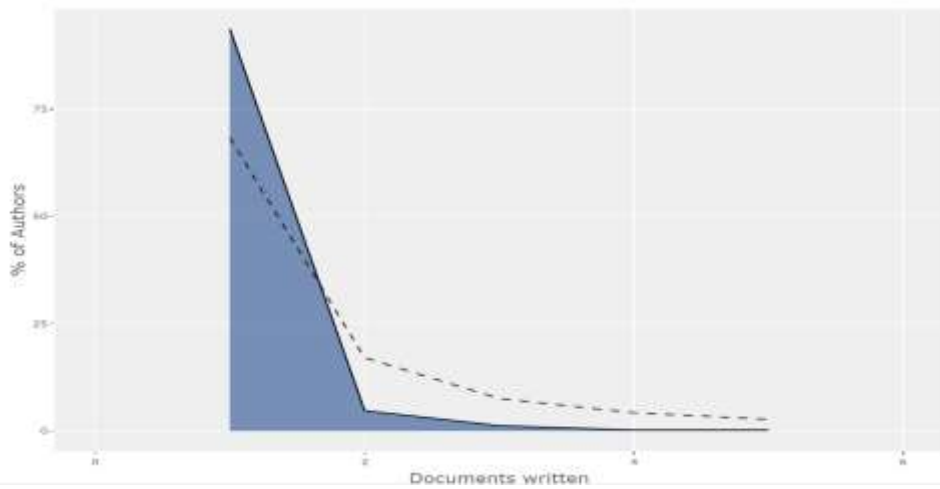


Figure 11 shows the productivity of the top 20 authors over time: The line indicates an author's chronology; the size of the bubbles corresponds to the number of documents created per year by the author. The number of citations per year is proportional to the colour intensity of the bubble. The larger the bubble, the more articles that author publishes in a given year. Higher citation counts are shown by bubbles with a darker color intensity. On the basis of the dataset, the top twenty most prolific authors in the field of patent-based astronomy and astrophysics from 2011 to June 2020 are shown in Fig. 11. Author LI Z from China authored a total of four documents and received the highest citation count of 22, according to the results. He also has the highest G-index, indicating that LI Z is still the most influential author in the field of patent-based astronomy and astrophysics literature. LI Z's first paper was published in 2011 and received an average of 1.6 citations each year. Despite the fact that our results reveal that LI Z did not publish from 2012 to 2016, he has consistently published in this sector from 2017 to 2018.

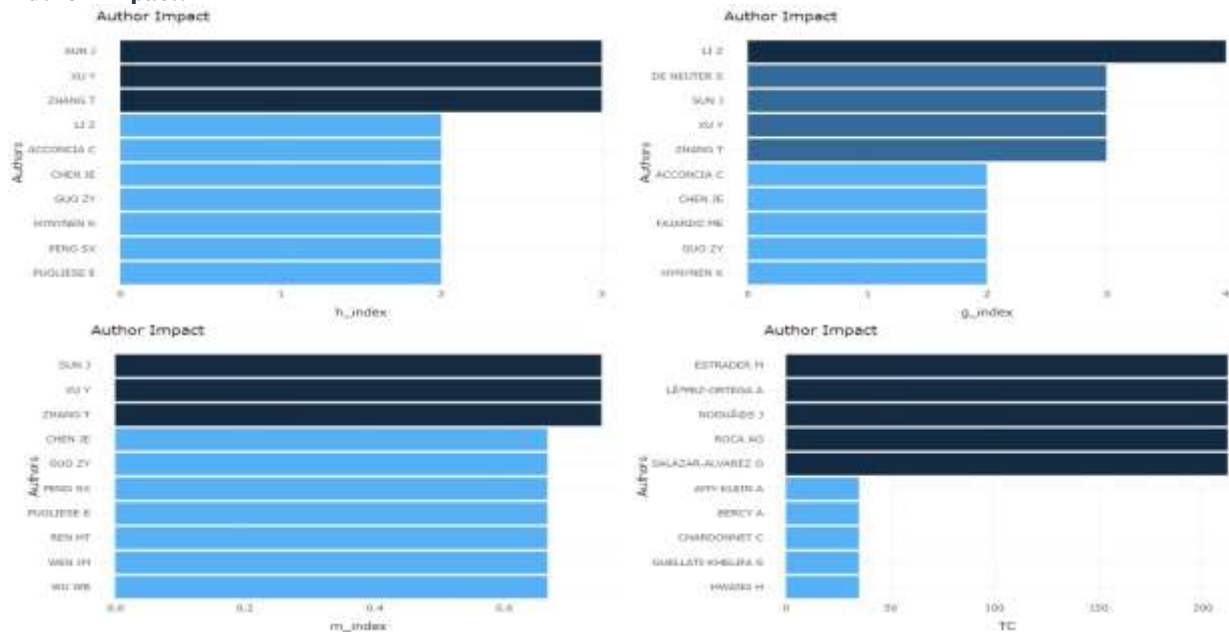
Author Productivity through Lotka's Law:

Documents written	N. of Authors	Proportion of Authors
1	926	0.936
2	47	0.048
3	12	0.012
4	2	0.002
5	2	0.002

The Frequency Distribution of Scientific Productivity

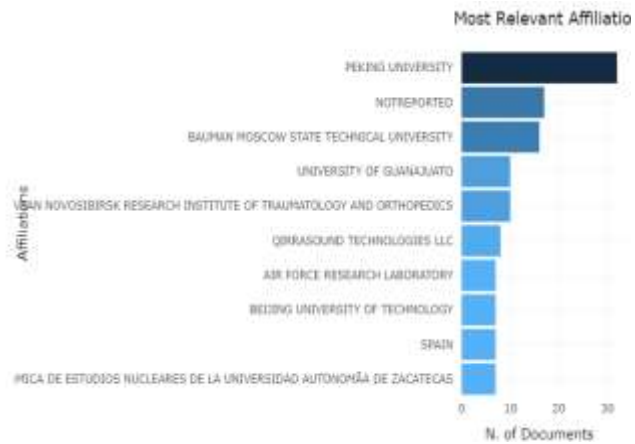


Author Impact: -



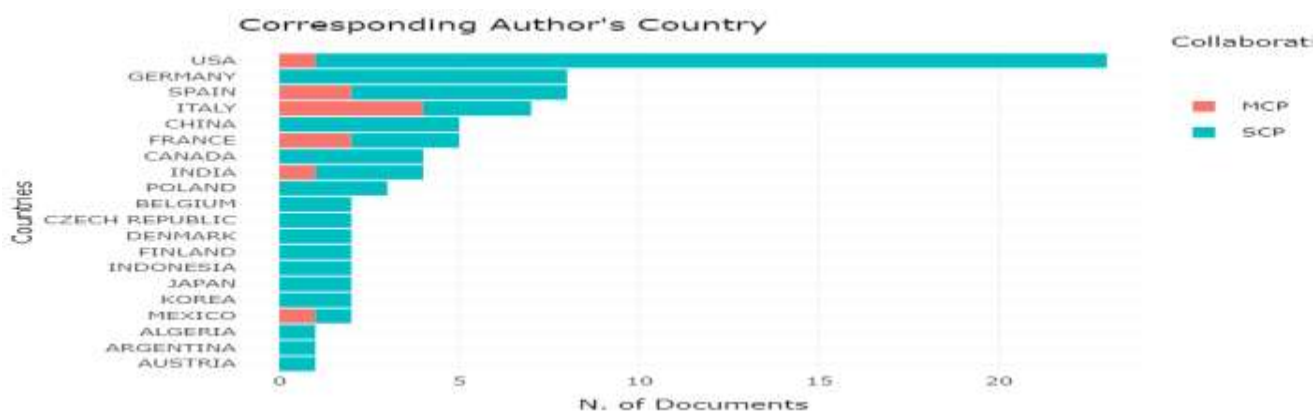
Most Relevant Affiliations: -

Affiliations	Articles
PEKING UNIVERSITY	33
NOTREPORTED	17
BAUMAN MOSCOW STATE TECHNICAL UNIVERSITY	16
UNIVERSITY OF GUANAJUATO	10
Y.A.L. TSVYAN NOVOSIBIRSK RESEARCH INSTITUTE OF TRAUMATOLOGY AND ORTHOPAEDICS	10
QIBRASOUND TECHNOLOGIES LLC	8
AIR FORCE RESEARCH LABORATORY	7
BEIJING UNIVERSITY OF TECHNOLOGY	7
SPAIN	7
UNIDAD ACADÉMICA DE ESTUDIOS NUCLEARES DE LA UNIVERSIDAD AUTÓNOMA DE ZACATECAS	7
UNIVERSITY HOSPITAL ESSEN	7
JILIN TEACHERS' INSTITUTE OF ENGINEERING AND TECHNOLOGY	6
LEIBNIZ INSTITUTE FOR PLASMA SCIENCE AND TECHNOLOGY E.V. (IPF)	6
UNIVERSITI KEBANGSAAN MALAYSIA	6
UNIVERSITY HOSPITAL OF COPENHAGEN	6
UNIVERSITY OF TORONTO	6
XIAN JIAOTONG UNIVERSITY	6
AUSTRALIAN NATIONAL UNIVERSITY	5
BEIJING UNIVERSITY OF CHEMICAL TECHNOLOGY	5
CATHOLIC UNIVERSITY	5



Corresponding Author's Country: -

Country	Articles	Freq	SCP	MCP	MCP_Ratio
USA	23	0.2421	22	1	0.0435
GERMANY	8	0.0842	8	0	0
SPAIN	8	0.0842	6	2	0.25
ITALY	7	0.0737	3	4	0.5714
CHINA	5	0.0526	5	0	0
FRANCE	5	0.0526	3	2	0.4
CANADA	4	0.0421	4	0	0
INDIA	4	0.0421	3	1	0.25
POLAND	3	0.0316	3	0	0
BELGIUM	2	0.0211	2	0	0
CZECH REPUBLIC	2	0.0211	2	0	0
DENMARK	2	0.0211	2	0	0
FINLAND	2	0.0211	2	0	0
INDONESIA	2	0.0211	2	0	0
JAPAN	2	0.0211	2	0	0
KOREA	2	0.0211	2	0	0
MEXICO	2	0.0211	1	1	0.5
ALGERIA	1	0.0105	1	0	0
ARGENTINA	1	0.0105	1	0	0
AUSTRIA	1	0.0105	1	0	0



Most Cited Countries: -

	Country	Total Citations	Average Article Citations		Country	Total Citations	Average Article Citations
1	SPAIN	237	29.62	11	GERMANY	12	1.50
2	USA	102	4.43	12	AUSTRIA	9	9.00
3	FRANCE	55	11.00	13	SLOVENIA	8	8.00
4	KOREA	39	19.50	14	MALAYSIA	6	6.00
5	CHINA	32	6.40	15	POLAND	6	2.00
6	CANADA	30	7.50	16	PORTUGAL	6	6.00
7	JAPAN	25	12.50	17	CZECH REPUBLIC	5	2.50
8	ROMANIA	17	17.00	18	BRAZIL	4	4.00
9	FINLAND	16	8.00	19	INDIA	4	1.00
10	ITALY	13	1.86	20	INDONESIA	4	2.00

Most Global Cited Documents: -

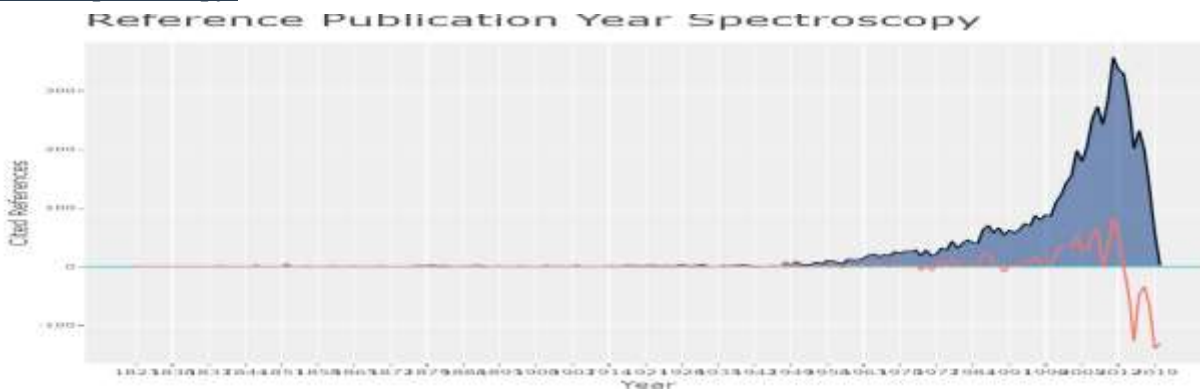
SN	Paper	Total Citations	TC per Year	SN	Paper	Total Citations	TC per Year
1	LÁ³PEZ-ORTEGA A, 2015, PHYS REP	212	35.333	6	ACCONCIA C, 2013, APPL PHYS LETT	22	2.75
2	SUNG C, 2018, J APPL PHYS	35	11.667	7	HOFF BW, 2012, IEEE TRANS PLASMA SCI	22	2.444
3	BERCY A, 2014, J OPT SOC AM B	35	5	8	KIM M-G, 2014, J PHYS CONF SER	20	2.857
4	NAKAMURA S, 2015, ANN PHYS LEIPZIG	29	4.833	9	LARSON LA, 2012, REVIEWS OF ACCELERATOR SCIENCE AND TECHNOLOGY	20	2.222
5	KANETO K, 2016, J PHYS CONF SER	25	5	10	HU J, 2018, ENTROPY	18	6



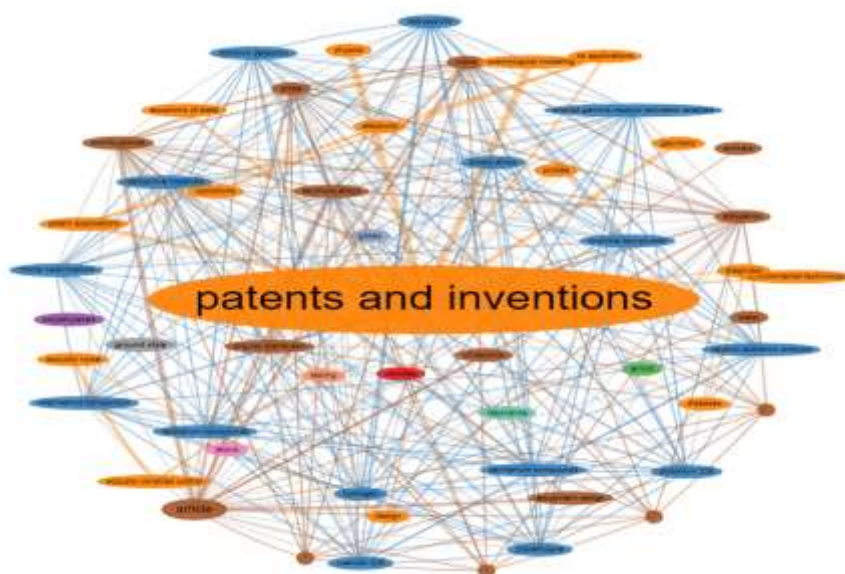
Most Local Cited References: -



Reference Spectroscopy:



Keyword Co-occurrence Network: -



Author Collaboration Network:



Country Collaboration Table: -

Sr. No	From	To	Frequency	Sr. No	From	To	Frequency
1	AUSTRIA	GERMANY	1	23	ITALY	USA	1
2	AUSTRIA	IRELAND	1	24	MALAYSIA	PAKISTAN	1
3	BAHRAIN	MALAYSIA	1	25	MALAYSIA	SAUDI ARABIA	1
4	BAHRAIN	SAUDI ARABIA	1	26	MALAYSIA	SUDAN	1
5	BAHRAIN	SUDAN	1	27	MALAYSIA	UNITED KINGDOM	1
6	BAHRAIN	UNITED KINGDOM	1	28	MEXICO	SPAIN	1
7	BRAZIL	GERMANY	1	29	POLAND	SAUDI ARABIA	1
8	CHINA	USA	2	30	POLAND	SPAIN	1
9	CZECH REPUBLIC	ITALY	1	31	SAUDI ARABIA	SPAIN	1
10	CZECH REPUBLIC	POLAND	2	32	SAUDI ARABIA	SUDAN	1
11	FRANCE	BELGIUM	1	33	SAUDI ARABIA	UNITED KINGDOM	1
12	FRANCE	LEBANON	1	34	SPAIN	SWEDEN	1
13	FRANCE	TURKEY	1	35	SUDAN	UNITED KINGDOM	1
14	GERMANY	IRELAND	1	36	UNITED KINGDOM	AUSTRALIA	1
15	GREECE	FRANCE	1	37	USA	AUSTRIA	1
16	INDIA	ISRAEL	1	38	USA	CANADA	1
17	IRAN	SWITZERLAND	1	39	USA	CYPRUS	1
18	ITALY	GERMANY	1	40	USA	GERMANY	1
19	ITALY	POLAND	1	41	USA	IRELAND	1
20	ITALY	SPAIN	3				
21	ITALY	SWEDEN	1				
22	ITALY	SWITZERLAND	1				

Findings and Conclusions:**1. Citations to Documents, Sources, Authors, Organizations, and Country:-**

The analysis of citations to documents shows that Out of 293 documents 43,24,19 and 9 documents received a minimum of 5,10,15,20 citations respectively. The study of citations to sources revealed that Out of 80 sources, 26,17,14,8 sources received a minimum of 5,10,20,30 citations respectively. The examination of the citations for the authors found that out of 988 authors, 104,32,16,05 obtained a minimum of 10,20,30,40 citations respectively. Organizations' citations were examined. 184,84,52,40,18,10 organisations received a minimum of 2,5,10,15,20,30 citations out of a total of 535. According to the analysis, 34,26,18,12,10 countries earned a minimum of 2,5,10,20,30 citations out of 49 countries.

2. Bibliographic Coupling of Documents, Sources, Authors, Organizations, and countries:-

According to the findings, 90,43,24,19,9 papers out of 293 have bibliographic coupling with a minimum of 2,5,10,15,20 citations. The study of source bibliographic coupling, out of 80 sources, 44,26,17,16,14,8 have 2,5,10,15,20,30 citations and demonstrate bibliographic coupling. Authors' Bibliographic Coupling Analysis With a minimum of 5,10,15,20,30 citations, 176,104,68,32,16 authors out of 988 demonstrate bibliographic coupling respectively. The analysis of the bibliographic coupling of organizations reveals that with a minimum of 5,10,15,20,30 citations, 84,52,40,18,10 organizations out of 535 exhibit bibliographic coupling respectively. Countries are analyzed via bibliographic coupling. There is bibliographic coupling in 34,26,18,14,12 nations, with a minimum of 2,5,10, 15,20 citations each.

3. Cocitation of Cited References, Cited sources, Cited Authors: -

Cocitations of cited references are examined. 6,16,144 references earned a minimum of 4,3,2 co-citations out of 6227 cited references. According to the analysis of co-citations of cited sources, 142,53,28,23,16,15 sources obtained a minimum of 5,10,15,20,25,30 co-citations of cited sources out of 3440 sources. Co-citations of referenced authors who have published their papers in all sources and references are analyzed. A minimum of 5,10,15,20,25,30 co-citations were received by 342,88,39,22,10,09 authors respectively out of 11462.

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