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# Scientific Productivity of Cryogenic Research During 2014-2018:A Scientometric Study

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## Abstract

The study attempts the analysis of research output of the cryogenic during 2014-2018. The data extracted from Web of Science and analyzed and tabulated. The study analyses the author patterns, language, year, journal, continent wise distributions. This paper analyzed 8073 papers in cryogenic research output of which is 2018 topmost publication year and IEEE Transaction on Applied Superconductivity ranked first with 1104 Citations, Articles are preferred source of publications and English language got top position; Continent wise Europe occupied top position, degree of collaborations is 0.96 during the study.

Keywords:- Scientometrics, Bibliometrics, Cryogenic Research, Web of Science, Citation Analysis, Research Trends.

**Introduction:-** Reputation of any institute is based upon the research productivity and its impact. The funding organization gives respective weight to research publications and long life scientific impact over the scientific community. The present study evaluates the cryogenic research output by using the scientometric techniques for a period of five years. Scientometrics is the study and measurement of the patterns of all forms of published knowledge and it deals with the quantification of written communication. Nalimov and malchenico(1969) of the USSR define scientometric as quantitative methods that deal with the analysis of science viewed as information processing. Scientometric analysis fundamentally deals with the study of quantifying analysis of science and technology performance of the research field by applying mathematical and statistical methods to evaluate the scientific productivity. Scientometrics is “The study of measurement of scientific and technological progress (Garfield, 1979)”. It helps to develop policy in the research field and utilization of the scientific community and the dynamics of publication trends and overall impact on the field. It helps the economic and social growth of the society for the implantation of policy decisions.

Cryogenic is defined as that branch of physics which deals with the production of very low temperatures and their effect on matters. Etymologically cryogenics means the science and art of producing very low temperatures. National Institute of Standard and Technology has chosen to consider the field of cryogenics as that involving temperature below  $-180\text{ }^{\circ}\text{C}$  ( $93\text{ K}$ ;  $-292\text{ }^{\circ}\text{F}$ ). The cryoryogenicists use the Kelvin and Rankine scales to measure these very low temperatures, which do not naturally occur on the earth and study its nature or human industry. The fluids such as oxygen, nitrogen, methane, argon, hydrogen, neon and helium are said to be cryogenic fluids or cryogens, whose boiling point temperature ranges from as low as 4K to 112K as shown in table 1.

Table 1. Cryogenic fluids with Normal boiling point

Cryogen	Normal boiling point(K)
Methane	111.6
Oxygen	90.2
Argon	87.3
Nitrogen	77.3
Neon	27.1
Hydrogen	20.4
Helium	4.2

The cryogenics such as Liquid hydrogen and Liquid oxygen (LOX) are used as cryogenic fuels in the rocket engines. The Nuclear magnetic resonance (NMR) is by supercooling electromagnets with cryogenics. The Magnetic resonance imaging (MRI) is carried out in the Hospital industry with the Liquid Helium for supercooling the electromagnets to produce nuclear magnetic resonance (NMR). Cryogenic cooling of superconductors may be used to increase electric power transmission for big cities. Cryogenic processing is used as part of some alloy treatments and to facilitate low-temperature chemical reactions. Cryogenic freezing is used in transporting and storing large quantities of food for longer periods of time. The cryogenics are also used for recycling the materials, which are difficult to separate composite materials. So the study of cryogenics has attracted many researchers and scientists since the beginning and continued to have enormous applications in day to day lives.

**Need for the study:** There are several applications of cryogenics in the fields of Cryogenic fuels, Cryogenic Engineering, Cryogenic Treatment, Cryotherapy, Cryogenic Rocket Engines, Cryogenic Processors, Cryogenic Seals, and uses in the chemical and metallurgical mechanical process of different fields. The present study is an attempt to identify certain characteristics in the field of Cryogenic research using scientometric technique.

### **Review of Literature:-**

Scientometric studies are also conducted in large for the different subjects. Such studies will identify the core areas of research activity, authorship pattern, Collaboration, Country, and other such scientometric indicators. Under the circumstance, a few selective subject studies are reviewed.

Zhao and Zhao<sup>1</sup> have examined the study of the collaboration network in the field of scientometrics. The growth of the discipline is divided into three stages and studied Macro-level analyses show both the average degree and average distance steadily increase with time and clusters analysis in the collaboration networks suggests the emergence of more collaborative fields in scientometrics. Micro-level the authors/researchers with high performance in raw degree measure, degree centrality all of which are dynamic across different time spans. From three dimensions collaboration dominators identified in the time span. Pal<sup>2</sup> has explained the publication growth, collaboration trends, authorship pattern and predominant areas of research in cryptology. Major findings reveal that Cryptographers prefer to work in a highly collaborative manner; the author value of a (productivity parameter) approximated to 2.35 (instead of 2) and the number of articles does not exceed two. While the large majority of Collaborations constituted across the countries (56 %), mostly the USA and Israel have researched output published. More interestingly top authors are affiliated in the USA and Israel. The University of California is placed on the top of the productive institutions.

Zhang., Lyu, and Yan<sup>3</sup> have explored the tourism research literature past few decades. The data from SCI-Expanded and SSCI databases since 1900 and 17,413 were Papers found. USA, UK, and Australia were the productive countries; New Zealand, Peoples R China, UK, Australia were in the cooperation groups, and Austria; New Zealand, Japan and Peoples R China had the most innovation. Overall most productive Online tourism, behavioral Intentions, tourism consumer perceptions demand forecasting, as well as competitiveness, are the research frontiers of Tourism Discipline.

Santhakumar and Kaliyaperumal<sup>4</sup> have focused on the growth and development of mobile technology during 2000 -2013 a total of 10,638 publications were published in the field. USA has contributed the maximum number of publications in this study period. The most prolific author is Kim with 36 publications. The degree of Collaboration is 4.32 per joint authored paper during the study. Highly contributed institutions were the University of California System (USA), University of London (UK), Florida State University System (USA), National Chiao Tung University (China).

Xiang, Zhang, Zhu<sup>5</sup> have Explored earthworm research citation data was download from the Science Citation Index during the period from 2000 to 2015. HistCite software was used to analyses the yearly journal, output, country, citation impact, and institution, citation relationships in the field. Analysis indicated that the research of earthworms has increased over the 16-year period. USA was the highest research output, while the institution with the highest research output was the Chinese Academy of Sciences. The top journals were Biochemistry and Soil Biology, Pedobiologia and Applied Soil Ecology.

Dutt, Bharvi and Nikam, Khaiser<sup>6</sup> have described collaborative aspects of research publications pertaining to global solar cell research as reflected in Science Citation Index-Expanded (SCI-E) for the years 1991, 1995, 2000, 2005 and 2010. Using bibliometric indicators, the researcher examined the pattern of co-authorship and nature of collaboration of institutions, countries and prolific institutions. The study observed a peculiar behavior wherein publications from certain prolific countries and institutions emerging from domestic collaboration resulted in higher impact than those from international collaboration.

### **Objectives:-**

1. To examine the year wise growth of the Cryogenic research.
2. To distinguish the leading prolific authors in the field of Cryogenic.
3. To identify the highly cited research paper and Co-author patterns.
4. To identify the source and language wise distribution.

5. To distinguish the leading prolific journals in the field.
6. To identify the continent wise research contributions.
7. To assess the institution's wise contributions in the respective field.

**Methodology:-** For this study, all the publication data of cryogenic was retrieved from the Web of Science database during- 2014-2018. The researcher has used string (IS=Cryogenic) for getting data which include Science Citation Index(SCI), Social Science Citation Index Expand (SSCI), Arts and Humanities Citation Index(AHCI), downloaded the bibliographic details in the form of text format. Overall data retrieved 8076 and eliminated three duplicate Papers, authors 30523, Journals 1439, Countries 91, Institutes 5133, Language 11, Subject Keywords 11287, Cited References 220506. Hence refined data taken for analysis of the present study. Downloaded data was converted into MS-EXCEL for detail study and Histcite software was used for analyzing and classifying the data. VOS-Viewer mapping software used to analyze the scattering of research in different dimensions. The measures directly obtained from the downloaded data are total paper (TP) and total citations (TC) and calculated average citations per paper (ACPP), Highly cited papers, number of single and multi-authored, degree of collaboration, Total Local Cited References (TLCR), H-index(HI). The average citations per paper (ACPP) are calculated by the total number of citations received collectively by the total number of publications. For calculating all type of indicators, the full counting method has been used. Thus, for example, if a publication has multi-authored from different countries than one publication count is credited to each of the contributing countries, if a paper has received  $n$  citations then  $n$  citations each are credited to the authors as well as countries and institutions of affiliations. Older publications tend to have large citations value when compared to new ones.

**Table-1: Year Wise Research Output**

S.No	Publication Year	TP	%	TC	ACPP
1	2018	1948	24.12	5923	3.04
2	2017	1741	21.56	12730	7.31
3	2016	1578	19.54	17012	10.78
4	2015	1440	17.83	21012	14.59
5	2014	1366	16.92	20669	15.13
Total		8073	100	77346	50.86

**TP= Total Papers TC= Total Citations ACPP= Average Citations per Paper**

Table 1 exhibits the year-wise distribution of Cryogenic research. The study analyses the annual distribution and growth pattern during 2014-2018 with total citations of 77346, the maximum number of papers published in the year 2018 with 1948 (24.1%), followed by the year 2017 with 1741(21.6%), 2016 with 1578(19.5%), 2015 with 1440(17.8%) and in the year 2014 with 1366(16.9%) papers. A total of 8073 research publications during 2014-2018 were published with an average of 1614 articles per year. ACPP was dominance in 2014 with (15.13%) and minimum in 2018 with (3.04%).

**Table 2: Top Ten Prolific Authors**

S.No	Author	TP	%	TC	TLCR	HI
1	Wang L	50	0.62	375	47	8
2	Li YZ	38	0.47	330	94	8
3	Lee S	36	0.45	503	41	13
4	Li J	36	0.45	323	24	8
5	Liu Y	36	0.45	407	28	9
6	Wang H	36	0.45	350	16	10
7	Wang J	34	0.42	263	26	8
8	Giuliani A	33	0.41	569	59	14
9	Zhang Y	33	0.41	707	25	12
10	Li Y	31	0.38	351	36	8
Total of Authors		363	4.5	4178		

**TP= Total Papers TC= Total Citations, TLCR=Total Local Cited References. HI=H=Index**

Table 2: indicates the top ten authors in the field of Cryogenic Research. “Wang L”, ranked first with the contributions of 50 (0.6 %) papers, followed by “Li YZ”, with second-highest productivity output of 38 (0.5 %) papers, “Lee S” has the third highest productivity of Cryogenic research output 36 (0.5 %) papers. It could be found from this analysis, ‘Wang L’, ‘Li YZ’, ‘Lee S’ were identified the most prolific authors in the area of Cryogenic research and Li Y has got the last position 36(0.4%), citations wise Zhang Y has got 707 citations and followed by Giuliani A with 569 citations and least position Wang J with 263 citations.

**Table 3: Ten Highly Cited Paper in Cryogenic Research**

S.No	Author/Title/Journal	LCS	TC	NA
1	Gludovatz B, Hohenwarter A, Catoor D, Chang EH, George EP, et al/ A fracture-resistant high-entropy alloy for cryogenic applications/ SCIENCE. 2014 SEP 5; 345 (6201): 1153-1158	58	1037	6
2	Zhang M, Feng GX, Song ZG, Zhou YP, Chao HY, et al/ Two-Dimensional Metal-Organic Framework with Wide Channels and Responsive Turn-On Fluorescence for the Chemical Sensing of Volatile Organic Compounds/ JOURNAL OF THE AMERICAN CHEMICAL SOCIETY. 2014 MAY 21; 136 (20): 7241-7244	0	330	12
3	Ushijima I, Takamoto M, Das M, Ohkubo T, Katori H/ Cryogenic optical lattice clocks/ NATURE PHOTONICS. 2015 MAR; 9 (3): 185-189	3	282	5
4	Tran TT, Bray K, Ford MJ, Toth M, Aharonovich I/ Quantum emission from hexagonal boron nitride monolayers/ NATURE NANOTECHNOLOGY. 2016 JAN; 11 (1): 37-+	5	269	5
5	Song F, Chen P, Sun DP, Wang MZ, Dong LP, et al/ Cryo-EM Study of the Chromatin Fiber Reveals a Double Helix Twisted by Tetranucleosomal Units/ SCIENCE. 2014 APR 25; 344 (6182): 376-380	3	230	9
6	Wei ZW, Gu ZY, Arvapally RK, Chen YP, McDougald RN, et al/ Rigidifying Fluorescent Linkers by Metal-Organic Framework Formation for Fluorescence Blue Shift and Quantum Yield Enhancement/ JOURNAL OF THE AMERICAN CHEMICAL SOCIETY. 2014 JUN 11; 136 (23): 8269-8276	0	220	10
7	Ye YF, Wang Q, Lu J, Liu CT, Yang Y/ High-entropy alloy: challenges and prospects/ MATERIALS TODAY. 2016 JUL-AUG; 19 (6): 349-362	2	219	5
8	Wu KW, Bera A, Ma C, Du YM, Yang Y, et al/ Temperature-dependent excitonic photoluminescence of hybrid organometal halide perovskite films/ PHYSICAL CHEMISTRY CHEMICAL PHYSICS. 2014; 16 (41): 22476-22481	3	210	7
9	Agnese R, Anderson AJ, Aramaki T, Asai M, Baker W, et al/ New Results from the Search for Low-Mass Weakly Interacting Massive Particles with the CDMS Low Ionization Threshold Experiment/ PHYSICAL REVIEW LETTERS. 2016 FEB 17; 116 (7): Art. No. 071301	0	208	89
10	Gludovatz B, Hohenwarter A, Thurston KVS, Bei HB, Wu ZG, et al/ Exceptional damage-tolerance of a medium-entropy alloy CrCoNi at cryogenic temperatures/ NATURE COMMUNICATIONS. 2016 FEB; 7: Art. No. 10602	0	196	7

**LCS= Local Citations Score, TC= Total Citations NA= Number of Authors**

Table 3: Among the top ten highly cited paper on cryogenic research output is received by “A fracture-resistant high-entropy alloy for cryogenic applications” by Gludovatz B, Hohenwarter A, Catoor D, Chang EH, George EP, et al published in SCIENCE. 2014 SEP 5; 345 (6201): 1153-1158, with 1037 citations with an average of 1.34%, 8 paper published in 200-300 citation range and one paper got 196 citations. Most of the papers originate from USA(2275), China(1564), Germany(1046), Australia(247), Brazil(116) according to country wise distribution.

**Single Vs Multiple Author Research Output**

S.No	Year	Single Author		Multiple Author		Total	DoC
		No of Output	%	No of Output	%		
1	2018	62	0.8	1886	23.4	1948	0.96
2	2017	47	0.6	1694	21	1741	0.97
3	2016	50	0.6	1528	18.9	1578	0.96
4	2015	53	0.7	1387	17.2	1440	0.96
5	2014	59	0.7	1307	16.2	1366	0.95
Total		271	3.4	7802	96.6	8073	0.96

**DoC= Degree of Collaboration**

Table 4 shows that the details about the authorship pattern and degree of collaboration. Single author contribution is just 3.36 percent in the field of Cryogenic research whereas Multi author’s contribution is 96.6 percent. The study interpreted that single author contributed papers maintained the low profile among Cryogenic research community. It could be seen clearly from the above Table that the degree of collaboration in producing research output on Cryogenic research has shown an increasing trend during the study period. Based on this study, the result of the degree of collaboration  $C = 0.96$ .i.e, 96 percent of collaborative authors articles are published. The degree of collaboration is calculated by using the following formula (K. Subramanyam, 1982):

$C = \text{Degree of Collaboration (DoC)}$

$N_m = \text{Number of multiple authors}$

$N_s = \text{Number of single authors}$

$C = N_m \div (N_m + N_s)$

$C = 7802/8073$

In the present study, the value of C is  $C = 0.96$ . This openly indicates its dominance upon multi-author collaboration in the Cryogenic Research.

**Table 5: Source Wise Document Distribution**

S.No	Document Type	TP	%	TC
1	Article	7276	90.1	69227
2	Article; Proceedings Paper	461	5.7	2373
3	Review	231	2.9	5316
4	Meeting Abstract	44	0.5	1
5	Editorial Material	22	0.3	180
6	Correction	17	0.2	23
7	Review; Book Chapter	12	0.1	181
8	News Item	5	0.1	16
9	Article; Data Paper	1	0	15
10	Biographical-Item	1	0	0
11	Letter	1	0	1
12	Retraction	1	0	0
13	Software Review	1	0	0
Total		8073	100	77346

**TP=Total Papers, TC= Total Citations**

Table 5: explains that the document type-wise research performance in Cryogenic Research, Articles has predominant place with 7276 (90.1 %) of papers followed by, Article Proceedings papers has 461 (5.71%) of papers, Review has 231(2.9%) of papers, in this way very least of papers published as Software Review.

**Table 6: Language Wise Distribution of the Publications**

S.No	Language	TP	%	TC
1	English	7999	99.1	77262
2	Chinese	46	0.6	52
3	Korean	5	0.1	10
4	Portuguese	5	0.1	8
5	Spanish	5	0.1	7
6	German	4	0.0	1
7	Italian	3	0.0	3
8	Japanese	2	0.0	2
9	Polish	2	0.0	1
10	French	1	0.0	0
11	Russian	1	0.0	0
Total		8073	100.0	77346

TP=Total Papers, TC= Total Citations

Table 6 indicates that maximum number of articles is published in the English language (99.1%), followed by Chinese (0.6%), remaining (0.3%) of the articles are published in various languages like Korean, Portuguese, Spanish, etc.,

**Table 7: Top Ten Journal Publications**

S.No	Journal Title	TP	%	TC	Rank
1	IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY	300	3.72	1104	1
2	CRYOGENICS	247	3.06	1063	2
3	REVIEW OF SCIENTIFIC INSTRUMENTS	195	2.42	1094	3
4	JOURNAL OF LOW-TEMPERATURE PHYSICS	136	1.68	490	4
5	JOURNAL OF INSTRUMENTATION	124	1.54	451	5
6	APPLIED PHYSICS LETTERS	102	1.26	1090	6
7	NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT	102	1.26	375	7
8	APPLIED THERMAL ENGINEERING	93	1.15	746	8
9	MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIALS PROPERTIES MICROSTRUCTURE AND PROCESSING	93	1.15	830	9
10	SCIENTIFIC REPORTS	83	1.03	1011	10
Total of Ten Journals		1475	18.27	8254	

TP=Total Papers, TC= Total Citations

Table 7 depicts top ten journals in Cryogenic research is IEEE Transactions on Applied Superconductivity which has highest number of papers that is 300 (3.7%) followed by Cryogenics 247(3.1%), Review of Scientific Instruments 195(2.4%), Journal of Low Temperature Physics 136(1.7%), Journal of Instrumentation 124(1.5%) and so on. Least among ten journals is scientific reports with 83(1%) papers.





Figure 3: depicts the institution wise distribution Chinese Academy of Science published 349 papers with topmost position followed by Russian Academy of Sciences published 202, University of California published 142 papers and also respected percentage of top citations score 4264.

### **Conclusion:**

The data suggest that there was a significant research activity in the field of cryogenic during the period. It was established that the research papers published every year by distinguished scientist is in increasing order. The older paper has the advantage of more citations compared to new ones. The author patterns clearly indicate a healthy progress in the field in which multi-author involvement and degree of collaboration. We found that about 90.1% of published items were articles and topmost journal is IEEE Transactions on Applied Superconductivity, the study clearly indicates that journals articles are the most preferred form of publication to communicate research works by the researchers. More than 90 countries involved in this emerging field, Europe has contributed more followed by Asia and North America, The Chinese Academy of Science published more research content in the field of cryogenic.

### **REFERENCES:-**

1. Zhao, Yuehua & Zhao, Rongying. An evolutionary analysis of collaboration networks in scientometrics. *Scientometrics*, 2016,107,759-772. doi:10.1007/s11192-016-1857-x.
2. Pal, Jiban K. Scientometric dimensions of cryptographic research. *Scientometrics*, 2015, 105, 179-202. doi:10.1007/s11192-015-1661-z
3. Zhang, Shao-jie., Lyu, Peng-hui & Yan, Yan. Global geographical and scientometric analysis of tourism-themed research. *Scientometrics*, 2015,105, 385-401. doi:10.1007/s11192-015-1678-3.
4. Santha kumar, R & Kaliyaperumal, K. A scientometric analysis of mobile technology Publications. *Scientometrics*,2015, 105, 921-939. doi:10.1007/s11192-015-1710-7.
5. Xiang, Huimin., Zhang, Jiaen & Zhu, Qiangdong. Worldwide earthworm research: a scientometric analysis, 2000-2015. *Scientometrics*, 2015, 105, 1195-1207. doi:10.1007/s11192-015-1725-0.
6. Dutt, Bharvi & Nikam, Khaiser. A scientometric overview of collaboration pattern in global solar cell research. *Annals of Library and Information Studies*, 2015, 62(3), 157-167.
7. Chen, Yunwei., Borner, Katy & Fang, Shu. Evolving collaboration networks in Scientometrics in 1978-2010: a micro-macro analysis. *Scientometrics*, 2013,95, 1051-1070. doi:10.1007/s11192-012-0895-2.
8. Qian, G. Scientometrics analysis on the intellectual structure of the research field of bioenergy. *Journal of Biobased Materials and Bioenergy*, 2013, 7(2), 305-308.
9. Konur, O. The evaluation of the research on the biodiesel: A scientometric approach. *Energy Education Science and Technology Part A: Energy Science and Research*, 2012, 28(2), 1003-1014.
10. Tasli, L., Kacar, N & Argenziano, G. (2012). A scientometric analysis of dermoscopy literature over the past 25 years. *Journal of the European academy of dermatology and venereology*, 26(9), 1142-1148.
11. Nalimov, V.V. and Mulchenko, Z.M. Scientometrics. The Study of the Development of Science as an Information Process, (1969), Science, Moskow.
12. Arunachalam S and Garg KC, Science on the periphery: A scientometric analysis of science in the ASIAN countries,
13. Harvi Dutt, Garg, K.C and Anita bali. Scientometrics of the International Journal scientometrics. *Scientometrics*, 2003, 56(1), 81-93.
14. Chuber.A. Web of Scientometrics, *Scientometrics*, 2002, 53.3-20.
15. Unningham, J and Dillon, S.M. Authorship pattern in information systems, *Scientometrics*,1997,39, 19-27.
16. Mutha, G and Senthamilselvi, A Scientometric analysis of Remote sensing literature, *Research methodology in social science*. 2010, 282- 284.
17. Aswathy S. & Gopikuttan, A. Productivity pattern of universities in Kerala: A scientometric analysis. *Annal. Libr. Inf. Stud.*, 2013, 60(3), 176-185.
18. Singh, Neeraj Kumar Contribution and citation impact of Panjab University in Chemistry research during 2008-15. *Int. J. Inf. Dissemination Technol.*, 2016, 6(1), 583-587.
19. Trapp, J. Web of Science, Scopus, and Google scholar citation rates: A case study of medical physics and biomedical engineering: What gets cited and what doesn't? *Australasian Phy. Eng. Sci. Med.*, 2016, 1-7. doi:10.1007/s13246-016-0478-2.

20. Abdullah, N.; Roffeei, S.H.M. & Kamarulzaman, Y. Evaluating the performance of electromagnetic fields (EMF) research work (2003–2013). *Scientometrics*, 2015, **105**, 261. doi:10.1007/s11192-015-1657-8
21. Bansal, Madhu. Contribution and citation impact of Panjab University in mathematics research during 2005-14'. *Library Philosophy and Practice (e-journal)*. 2015, Paper 1325. <http://digitalcommons.unl.edu/libphilprac/1325>
22. Nagarkar, S.; Veer, C. & Kumbar, R. Bibliometric analysis of papers published by Faculty of Life Science Departments of Savitribai Phule Pune University during 1999-2013. *DESIDOC J. Lib. Inf. Tech.*, 2015, **35**(5), 368-75.
23. Siwach, Anil Kumar & Kumar, Satish. Bibliometric analysis of research publications of Maharshi Dayanand University (Rohtak) during 2000-2013. *DESIDOC J. Lib. Inf. Tech.*, 2015, **35**(1), 17-24.
24. Hanumappa, Anilkumar; Desai, Asha & Dora, Mallikarjun. A bibliometric profile of Gujarat University, Ahmedabad during 2004-2013. *DESIDOC J. Lib. Inf. Tech.*, 2015, **35**(1), 9-16.
25. Vasishta, Seema. Assessment of Academic Research Output during 1996-2009: A case study of PEC University of Technology, Chandigarh. *DESIDOC J. Lib. Inf. Tech.*, 2011, **31**(2), 136-142.
  
26. <https://en.wikipedia.org/wiki/Cryogenics> (Accessed on 13/10/2019)
27. [https://en.wikipedia.org/wiki/Cryogenic\\_engineering](https://en.wikipedia.org/wiki/Cryogenic_engineering) (Accessed on 13/10/2019)

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