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An overview on increasing trend (growth) in the optics in India

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Abstract

The present study focuses with the assessment of Indian optics research output as represented in Web of Science (WOS) database for the period 2008 to 2018 for identifying the research output in the field of optics literature. It also gives a comparative evaluation and performance of many forms of scientometric metrics, such as number of publications, number of citations and collaboration from India. The Indian optics research has risen significantly during the previous decade.

Keywords*: trend, optics*

Introduction

When it comes to physics, opttics is a discipline of study that investigates the behaviour and characteristics of light, as well as its interactions with matter and the development of devices that utilise or detect it. The behaviour of visible, ultraviolet, and infrared light is often described by the science of optics. The field of optics is typically associated with the behaviour of visible, infrared, and ultraviolet light; however, because light is an electromagnetic radiation, analogous phenomena can be observed in X-rays, microwaves, radio waves, and other types of electromagnetic waves as well as in visible light. The pure science parts of the industry are referred to as optical science or optical physics, depending on the context. Applied optical sciences are sometimes referred to as optical engineering in some circles. Lighting engineering is a term used to describe applications of optical engineering that are especially connected to illumination systems. There are significant differences between the applications, technical skills, concentration, and professional connections of each of those fields. Photonics and optoelectronics are two terms that are frequently used to describe more recent advances in optical engineering. When it comes to scientific output, scientometrics is a field of science that characterises output features in terms of organisational research structure, resource inputs, and outputs, as well as developing benchmarks to evaluate the quality of information output. Researchers' scientometric research papers serve as a quantitative indicator of a country's fundamental research activity. Scientists can categorise scientometrics indicators according to the number of scientometrics sets they represent and the use of reference standards. GROUND INDICATORS: Scientometrics indicators that refer to a measure of a

single science-related feature of a science-related system that is represented by a single scientometrics set and has a single hierarchical level are known as gross indicators. A composite index or compound index is a scientometric indication that is made up of numerous gross or complicated indicators (ideally with weighting factors) with each indicator expressing a component of the scientometrics system that is specific to that system (Chaman, Dharani & Biradar, 2017).

Optics in India

> Indian mythology provides several examples of the profound respect that Indians had for optical phenomena more than two millennia ago, as evidenced by the numerous examples of the appreciation that Indians had for optical phenomena. However, it wasn't until Sir Jagadish Chandra Bose's groundbreaking work on millimetre electromagnetic waves in 1895 that scientific research in optics began to take root in earnest. Bose also investigated the behaviour of dielectrics at high frequencies, as well as double refraction in birefringent materials, among other things. He had a same interest in optics with Jogesh Chandra Roy, another of his contemporaries who was so involved in optics-related activities that he was elected Fellow of the Royal Microscopical Society in 1901 and the Royal Astronomical Society (London) in 1902. Sir Chandrasekhara Venkata Raman, who was awarded the Nobel Prize in Physics in 1930, was one of the Indian optical scientists who produced major discoveries in optical spectroscopy throughout the 1920s. His team of researchers has also made significant contributions to the fields of acousto-optics, vision science, and the science of colour.

An optical instrument facility was founded in India as early as 1836, according to historical records. The "Mathematical Instruments Offi ce," as it was known, was responsible for the repair and maintenance of surveying optical instruments. In later years, the center's mission was expanded to include military optical devices, and it played a critical role in the maintenance of all optical instruments for the British Army and Royal Navy stationed east of the Suez Canal during World War II. It was called "National Instruments Limited" after that, and it continued to run well until the 1990s, when it was closed. Andhra Scientific, a firm that developed optical instruments, commenced operations in Machilipatnam on India's east coast in the 1930s. The company was eventually acquired by Bharat Electronics Limited, which is now known as Bharat Electronics Limited. A postgraduate programme in applied and modern optics was established in 1953 at the University of Calcutta in Kolkata, and was later expanded to include the physics department of the Indian Institute of Technology (IIT), Delhi, in 1965, among other institutions. Both courses are still being taught today. Later on, the National Institute of Technology in Warangal and the Cochin University of Science and Technology both introduced courses in optics and photonics that were identical to the ones offered at the National Institute of Technology. Other universities provide special papers on optics-related areas as part of their master's degree in physics, which is common at many other institutions. Centers for optical research and development have now been established around the country. The Laser Technology Center, the National Physical Laboratory, and the Indian Institute of Technology (IIT) Delhi are located in the northern city of Delhi. The Central Scientific Instruments Organization, based in Chandigarh, is responsible for several of the world's most important optical instrumentation programmes. Ambala is known as India's "Microscope City" because of a concentration of small-scale enterprises that have gathered there to form a centre. There are also three institutions at Dehradun, some 200 kilometres northeast of Delhi, that are part of the Ministry of Defense: the Instruments Research and Development Establishment, the Ordnance Factory, and the Optoelectronics Factory. In addition, an observatory is operated by the Aryabhatta Research Institute of Observational Sciences. At Kolkata in the eastern part of the country, many institutes are engaged in optical research

and development, such as the department of applied optics and photonics at the University of Calcutta, the Central Glass and Ceramic Research Institute, and the Indian Association for the Cultivation of Science, to name a few. Bose Institute and Satyendra Nath Bose National Centre for Basic Sciences, both located in Kolkata, as well as Burdwan University, also do optical research in their respective fields. The Tata Institute of Fundamental Research, the Bhaba Atomic Research Center, and the Indian Institute of Technology Bombay—all of which are located in Mumbai—as well as the Physical Research Laboratory and the Space Application Center in Ahmedabad and the Indian Institute of Tropical Meteorology in Pune—are the major optics research and development centres in western India. The Inter-University Consortium for Astronomy and Astrophysics, which is based in Pune, operates a radiotelescope for research purposes. The Raja Ramanna Facility for Advanced Technology in Indore, India, is a prominent research and development centre for optics and lasers in the country's central region. There are two synchrotrons at the facility, INDUS-1 (450 MeV), which has five beamlines, and INDUS-2 (2.5 GeV), which has nine beamlines. Both synchrotrons were built in the United States. The University of Hyderabad and the Electro Optics Instruments Research Association, both located in Hyderabad, do research and development in the fields of optics and laser instrumentation, respectively.

Objectives of the study

1. To study the Language wise distribution of records in the Indian optics.
2. To identify the groups performing the research in Indian optics.
3. The top productive writers in the Indian optical Research.

Methods and Materials

The literature on Indian optics was obtained from the online multidiscipline database "Web of Science," which is a worldwide indexing and abstracting database, for the purpose of this investigation. We looked for the phrase 'Optics' in the 'Topic' box for the years 2008 to 2018 and found nothing. On the 21st of November, 2019, a total of 101,415 world research articles were retrieved, of which 3862 research papers were obtained after India was re-fined in terms of countries and regions. For the purpose of analysis, the acquired data has been organised into categories using Microsoft Excel. The researchers employed statistical methods such as frequency distribution and percentage analysis in their investigation. It was discussed how papers were distributed year by year, what subjects were addressed, and whose organisations provided articles.

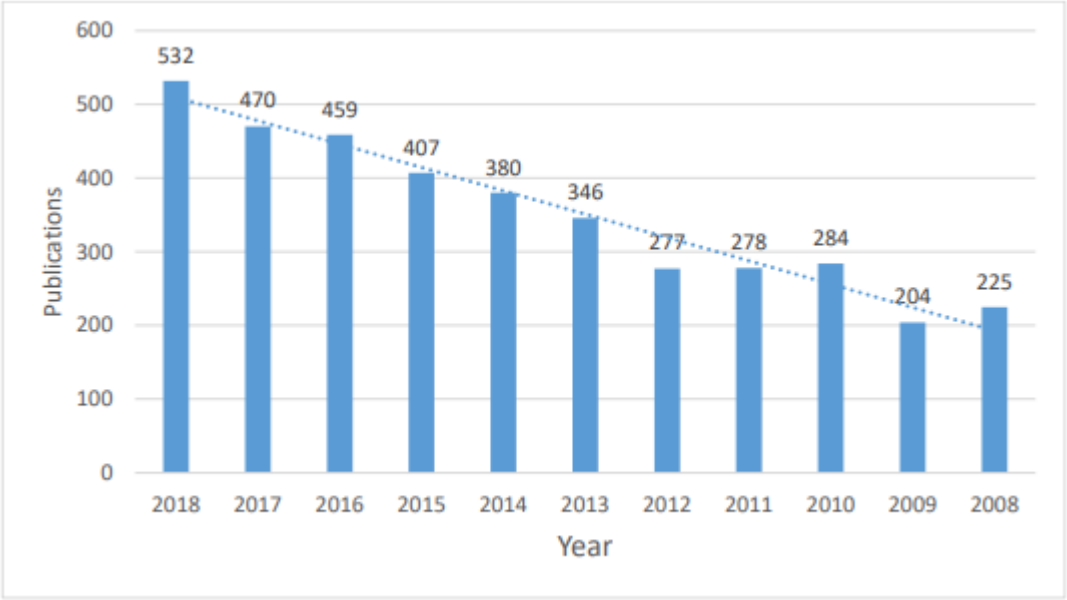
Results and Discussion

Year wise growth rate of publications.

After the use of scientometric methods to examine the outcome, the results are presented in this subsection. The productivity of optical research in India has grown from 407 in 2015 to 532 in 2018. The productivity of optics research in India has increased from 407 in 2015 to 532 in 2018.

Table: 1 Year wise growth rate of publications

Publication Years	Publication	Citations	% of 3862	ACP	h - Index
2018	532	1506	13.775	2.83	14
2017	470	3049	12.17	6.49	23
2016	459	3867	11.885	8.42	24
2015	407	4575	10.539	11.24	28
2014	380	4163	9.839	10.96	28
2013	346	4966	8.959	14.35	32
2012	277	4392	7.172	15.86	33
2011	278	4171	7.198	15	32
2010	284	4828	7.354	17	31
2009	204	3625	5.282	17.77	29
2008	225	4663	5.826	20.72	30



Graph: 1 Year wise growth rate of publications

The research output of India and the average number of citations per publication in India can be easily seen in the table 1 and graph 1, which are both included in the table 1. During the period 2008-2018,

India has published 3862 papers and received 430805 citations for those works. In the year 2018, 532 articles were published, with 1506 citations (2.83 percent) of average citations per paper, and the h-index is 14. In the year 2017, 470 papers were published, with 4575 citations with an average of 6.49, and the h-index is 23. In the year 2008, 225 publications were published, with 4663 citations, and the h-index is 30. In the year 2008, 225 publications were published, with 4663 citations From 2008 to 2018, according to the Web of Science database, India has contributed the most number of articles in the field of optometry. The year 2015 saw the highest number of citations (4575) and the lowest number of publications (204), both of which occurred in 2009.

Distribution of Publications Based On Document Types

The contributions to Indian optics publications came in a variety of bibliographical forms, including research articles, reviews, conference proceedings papers, editorials materials, book reviews, book chapters, news items, and letters, among others. The full list of contributions can be found in Table 2.

Table: 2 Document type growth rate of publications

Document Types	Publication	% of 3862
Article	3563	92.258
Review	144	3.729
Proceedings Paper	98	2.538
Letter	56	1.45
Editorial Material	47	1.217
Meeting Abstract	44	1.139
Correction	7	0.181
Retracted Publication	3	0.078
Biographical Item	1	0.026
Book Chapter	1	0.026

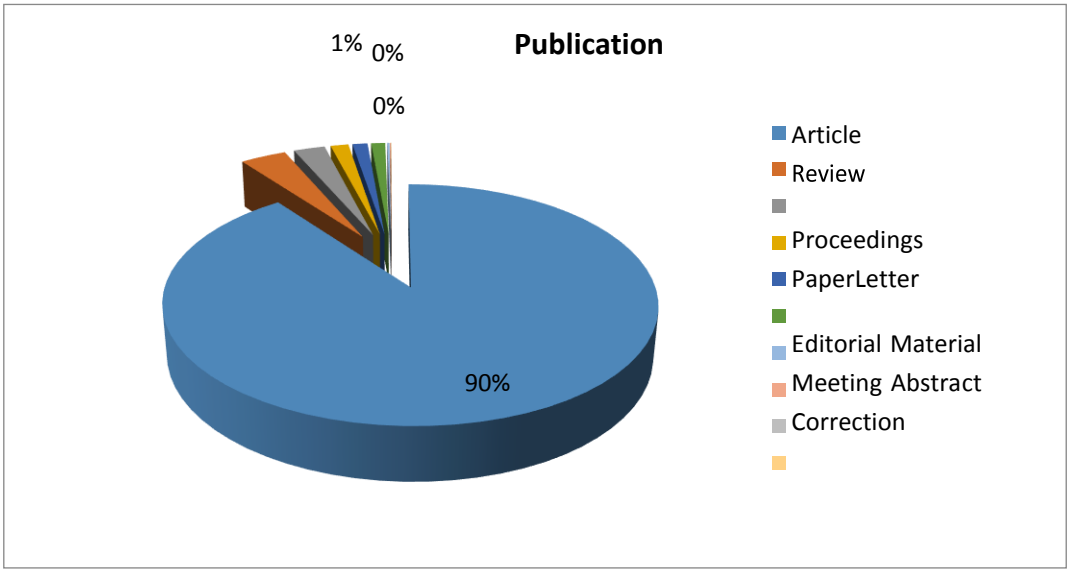


FIG: 2 Document type growth rate of publications

Table 2 shows that the vast majority of papers are published in the form of articles, with 3563 (92.258 percent) of them appearing in peer-reviewed journals. Following that, 144 papers (3.729 percent) are published, 98 papers (2.538 percent) are published, 56 papers (1.45 percent) are published, Editorial Materials 47 papers (1.217 percent) are published, Meeting abstracts 44 papers (1.139 percent) are published, and Corrections 7 papers (0.181 percent) are published. There are 3 retracted papers (0.078 percent) that have been published. The fact that just one publication (or 0.00 percent of the total) is accessible in the categories of Biographical Item and Book Chapter should be noticed.

Language based distribution of publications

Language is an important medium for disseminating scientific production across a wide range of topic areas. As a result, the researcher attempted to determine the language in which the author wished to publish the paper. All 3862 (one hundred percent) of the publications are printed in the English language.

Table 3 – Language based distribution of publications

Sl No	Languages	Records	% of 3862
1	ENGLISH	3862	100.000

Research output of major Research Institutions and Universities in India

Subject-Wise Productivity of Indian Optics Research

The productivity of Optics research in India is depicted in Table 4 according to topic area. Optics has 1079 publications (27.939 percent of all publications), Physics has 1055 publications (27.317 percent of total publications), and Mathematics has 0 publications. Materials Science had 609 articles (15.769 percent), Ophthalmology had 504 publications (15.769 percent), Engineering had 484 publications (12.532 percent), Chemistry had 427 publications (11.056 percent), and other fields have publications as

well. Instruments Instrumentation 222 publications (5.748 percent) publications, Neurosciences 222 publications (5.748 percent) publications, Science Technology Other Topics 242 (6.266 percent), Instruments Instrumentation 222 publications (5.748 percent) publications, Neurosciences Neurology has 185 articles (4.79 percent) in total. Crystallography received 149 points (43.858 percent), while Telecommunications received 117 points (3.03 percent) Spectroscopy has 113 articles (2.926 percent of the total). Surgery has published 100 papers (2.926 percent) in total. Electrochemistry has 69 articles (2.712 percent) in total. Astronomy Astrophysics and computer science are two of the most popular majors in the United States (1.579 percent) Radiology Nuclear Medicine is a type of medicine that uses nuclear energy to treat patients. Medical Imaging received 58 papers (1.502 percent), Pediatrics received 57 publications (1.476 percent), and others. Biochemistry and Molecular Biology published 53 papers (1.372 percent), Genetics and Heredity published 34 papers (0.88 percent), Metallurgy published 34 papers (0.88 percent), and Nuclear Science Technology published 34 papers (0.88 percent). Metallurgical Engineering had 29 papers (0.751 percent of total), Oncology had 28 publications (0.725 percent of total), Research Experimental Medicine had 25 publications (0.647 percent of total), and Biophysics had 23 publications (0.596 percent of the total).

Table 4- Subject-Wise Productivity of Indian Optics Research

Research Areas	Publications	% of 3862
Optics	1079	27.939
Physics	1055	27.317
Materials Science	609	15.769
Ophthalmology	504	13.05
Engineering	484	12.532
Chemistry	427	11.056
Science Technology Other Topics	242	6.266
Instruments Instrumentation	222	5.748
Neurosciences Neurology	185	4.79
Crystallography	149	3.858
Telecommunications	117	3.03
Spectroscopy	113	2.926
Surgery	100	2.589

Electrochemistry	69	1.787
Astronomy Astrophysics	61	1.579
Computer Science	61	1.579
Radiology Nuclear Medicine Medical Imaging	58	1.502
Pediatrics	57	1.476
Biochemistry Molecular Biology	53	1.372
Genetics Heredity	34	0.88
Nuclear Science Technology	34	0.88
Metallurgy Metallurgical Engineering	29	0.751
Oncology	28	0.725
Research Experimental Medicine	25	0.647
Biophysics	23	0.596

Conclusion

The research examines India's success in the field of optics, based on data from publications as well as several quantitative and qualitative indicators, among other things. In this study, 11 years of data from the Web of Science database is used to look at India's worldwide contribution to publishing, growth rate, citation quality, international collaborative publications, and its contribution to publishing and distribution in sub-fields. According to the findings of the study, it is necessary to accelerate the speed of Indian optical research while simultaneously improving its quality. Scientometric analysis is also highly important in order to design the right steps that will be implemented in order to improve the research efforts. It's a small detail Scientometric study of Indian optical research and comparison with other nations is vitally significant in order to obtain a transparent picture of the situation and to demand the required changes in order to improve the research performance. Evaluation of the research performance of the country's major optical research institutes, as well as comparisons between them and comparable institutes in other countries, are critical steps in the advancement of the field of optics. As scientists, researchers, and library professionals struggle to stay up with the latest breakthroughs in their fields, the expansion of literature has become a major source of concern for them. Information professionals are tasked with organising the vast amount of information that is becoming available. During the period 2008-2018, India has published 3862 papers and received 430805 citations for those works. The majority of papers are published in the form of articles, with 3563 (92.258 percent) of them appearing in peer-reviewed publications. It has been noticed that there is a steadily expanding tendency toward

collaboration across various sectors of marketing, which results in joint authorship in the realm of literary production.

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