

# A Bibliometric Review Of Optical Physics With Laser Beam

Dr.Kamala Srinivasan<sup>1\*</sup>, Jyothi Budida<sup>2</sup>

<sup>1\*</sup>Academic consultant, Department of Physics, Sri Venkateshwara University, Tirupati, E-mail:- kamalasrinivasan@rediffmail.com

<sup>2</sup> Assistant Professor, Aditya College of Engineering, Surampalem, India, E-mail:- Jyothi\_bse@acoee.edu.in

\*Corresponding Author: - Dr.Kamala Srinivasan

\*Academic consultant, Department of Physics, Sri Venkateshwara University, Tirupati, E-mail:- kamalasrinivasan@rediffmail.com

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## Abstract

This Paper aims to analyze the work done in the field of optical physics with free electron laser beam from 2000 to 2021, using bibliometric methods. This study presents a Scopus database review on "Optical physics using free electron Laser beam". In recent decades, optics research has blossomed with the invention of the laser, an increasing interaction between optics and electronics, the development of new materials with unique optical properties, and other extraordinary advances. In this paper, we constructed a citation network of papers to investigate the structure of research and to detect emerging research domains in optics. This bibliometric survey helps to know advantages of optical physics in various fields with emission of light. This paper presents bibliometric survey of optical physics from the year 2000 to 2021 May. The database analysis of the Lasers is done through Scopus and tool like VOSviewer Version 1.6.15. This database survey is represented for maximum number of publications are from conferences and journals, from books and articles, affiliated to science and engineering, from India and other countries.

**Methods:** We collected citation data of optics-related publications from the Scopus data base from 2000 to 2021. Scopus analyzer is used for representing analysis in terms of Document by author, source, year, and country. VOS viewer Version 1.6.15 is used for the analysis of different types such as co-authorship, co-occurrences, citation analysis etc.

**Results:** In this study, a database search outputs a total of 182 articles on Optical physics from 2000 to 2021. Statistical analysis and network analysis shows the maximum articles are published in the years 2019 and 2020 with United States contributed the largest number of documents. From Scopus analysis, it is clear that large number of articles were published by Erratum(Physics Review). Network analysis of different parameters shows a good potential of the topic in terms of research.

**Conclusions:** Scopus search outcome has 182 articles, in this 173 were in English, 7 were in Chinese and 2 were published in Italian. Authors, documents, country, Funding sources etc analyzed. Network analysis of different parameters indicates that, there is a lot of scope to contribute in the further research in terms of medicine and electronics.

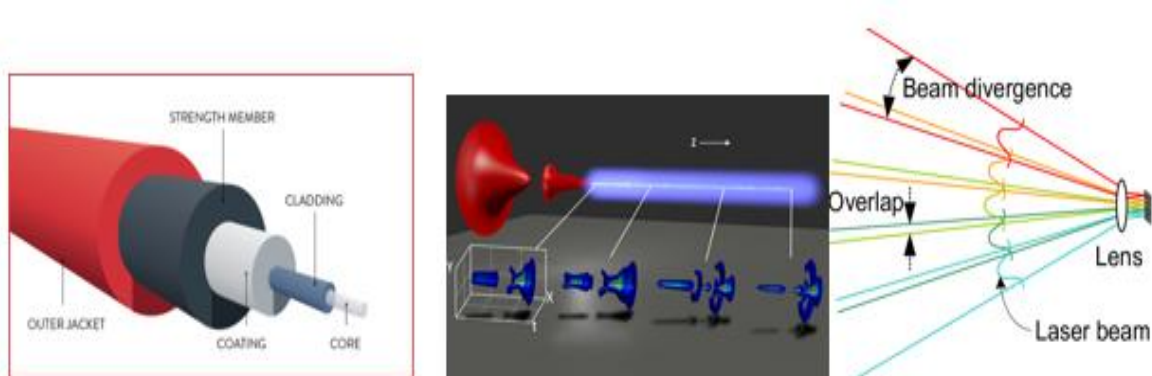
**Keywords:** Optical Physics, Atomic physics, Laser beam, Coherence, Non-linear optics, directionality.

## 1. INTRODUCTION

Optical physics is the study of the generation of electromagnetic radiation, the properties of that radiation, and the interaction of that radiation with matter, especially its manipulation and control. It differs from general optics and optical engineering in that it is focused on the discovery and application of new phenomena. There is no strong distinction, however, between optical physics, applied optics, and optical engineering, since the devices of optical engineering and the applications of applied optics are necessary for basic research in optical physics, and that research leads to the development of new devices and applications. Researchers in optical physics use and develop light sources that span the electromagnetic spectrum from microwaves to X-rays. The field includes the generation and detection of light, linear and nonlinear optical processes, and spectroscopy. Lasers and laser spectroscopy have transformed optical science. Major study in optical physics is also devoted to quantum optics and coherence, and to femtosecond optics. In optical physics, support is also provided in areas such as the nonlinear response of isolated atoms to intense, ultra-short electromagnetic fields, the atom-cavity interaction at high fields, and quantum properties of the electromagnetic field.

Other important areas of research include the development of novel optical techniques for nano-optical measurements, diffractive optics, low-coherence interferometry, optical coherence tomography, and near-field microscopy. Research in optical physics places an emphasis on ultrafast optical science and technology. The applications of optical physics create advancements in communications, medicine, manufacturing, and even entertainment.

The aim of this study is to investigate academic landscape of optics research and to detect emerging research domains there. In the previous works, bibliometric studies on semiconductor and related industries were already published.



**Fig. 1** .Schematic diagram of Laser beam

## 2. MATERIALS AND METHODS

### 2.1 Primary Database Collection

There are many popular databases worldwide, such as scopus, web of science, google scholar, scimago etc. These databases are having a very wide range of publications. Out of these scopus- the most popular and one of the largest database, is used for the analysis. The keywords are used for search have given a total of 182 number of publication results. The different keywords are used for the searching of the databases across the world. There is no any restriction on country, language etc. Each publication has the information such as author, country, citations, documents, sources etc. This information is used for the analysis.

**Table 1:** List of Primary and Secondary Keywords

Fundamental Keyword	Optical physics using Laser
Primary Keywords using (AND)	Optical physics and Atomic physics
Secondary Keywords using	Free electron Laser beam

Using Scopus database related to optical physics, 182 publications are obtained. in this 173 were in English , 7 were in Chinese and 2 were published in Italian. Largest number of publications were published in English.

**Table 2:** Language Trends of Publications

Language of Publishing	Publication Count
English	173
Chinese	7
Italian	2

### 2.2 Publication outcome based on Top 10 Keywords

During the search, many keywords are found in addition to the fundamental keywords. Top 6 keywords are listed here in the table. “Optical Physics “ is the keyword having the highest publications. Generally all these keywords are found to be related to science and engineering.

**Table 3:** Publication Analysis based on Top 6 keyword Analysis

S.No.	Keyword	Publications
1	Optical Physics	41
2	Atomic Physics	22
3	Non-Linear optics	14
4	Laser Beams	11
5	Light	11
6	Atoms	10

**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June. 2021)

## 3. PERFORMANCE ANALYSIS

VOSviewer 1.6.15 is the software that is used for the database analysis in addition to the analysis from Scopus. It provides a very effective way to analyze the co-citations, cooccurrences, bibliometric couplings etc. Following types of analysis is performed .

### Statistical Analysis of Databases

1. Documents by Source
2. Documents by year
3. Documents by subject area
4. Documents by Type

5. Documents by Country
6. Documents by author
7. Documents by affiliation
8. Documents by top funding agencies.

### Network Analysis of Databases

1. Co-authorship: Authors, organizations, country
2. Co-occurrence: All keywords, Author keywords, Index keywords
3. Citation Analysis: Sources, authors, organizations, country

## 4. RESULTS AND DISCUSSION

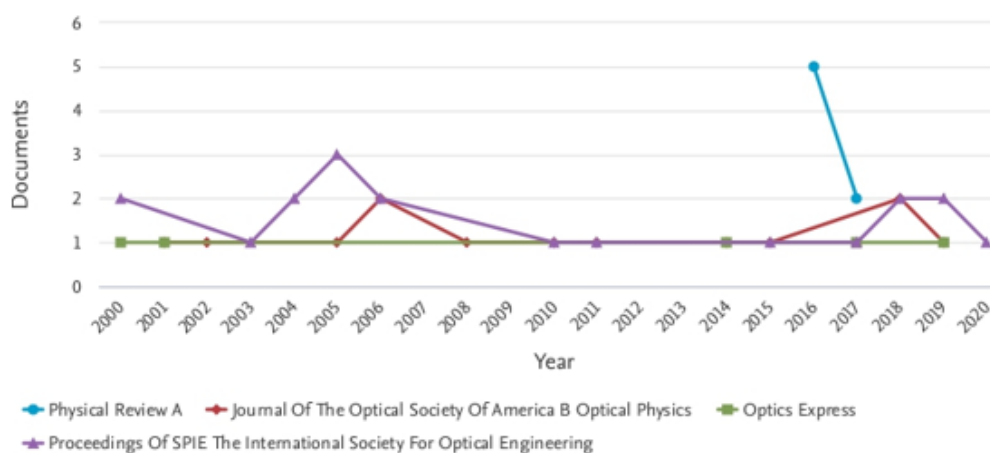
Analysis is performed by two different ways, statistical analysis of database and network analysis.

### 4.1 Statistical Analysis

#### 4.1.1 Document Analysis by Sources

Database indicates different sources such as conferences, journal, book chapter, conference review, reviews and so on. Year-wise publication statistics are shown in the table. Fig. shows the graphical representation of the different sources with number of documents published year-wise.

#### Documents by Source



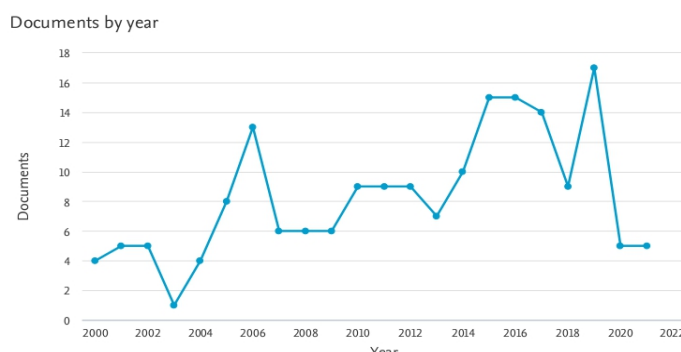
**Fig. 2:** Analysis of Documents by Sources

**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June 2021)

#### 4.1.2 Documents Analysis by year

Documents are collected from scopus database in the year 2000 to 2021 including different sources such as conferences, journal, book chapter etc. The table shows the statistical information and graphical representation is as shown in Fig.. It is observed from the analysis that, highest number of publication is in the year of 2019 followed by 2020. This shows that, there is a good scope for working in this area in the preceding years.

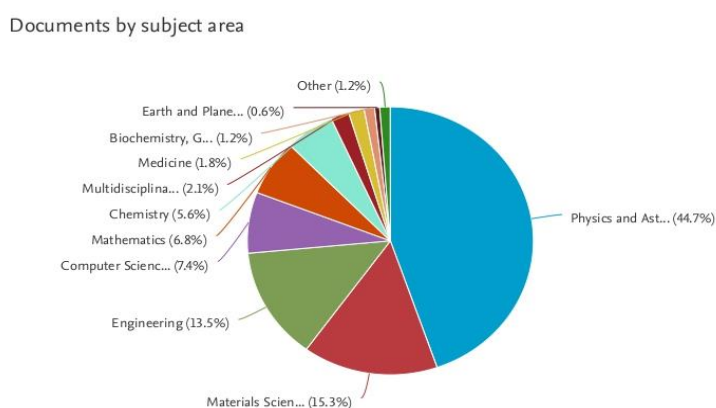
Year	Number of Publications
2021	5
2020	5
2019	17
2018	9
2017	14
2016	15
2015	15
2014	10
2013	7
2012	9
2011	9
2000	4



**Fig. 3:** Analysis of Documents by years  
**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June 2021)

#### 4.1.3 Documents by Subject Area

Optical physics maximum papers are found under Physics and Astronomy (44.7%). Although material science covers 15.3% of the papers and remaining documents are published in other subject area.

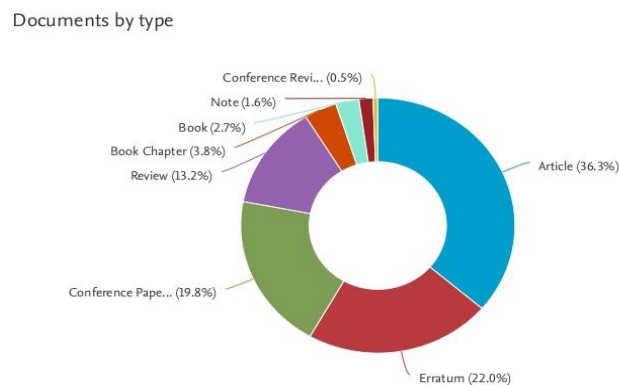


**Fig. 4:** Analysis of Documents by Subject Area  
**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June 2021)

#### 4.1.4. Documents by Type

It is seen from the analysis that, most of the publications are journal articles followed by conference papers.

S.No.	Document Type	Publications
1	Article	66
2	Erratum	40
3	Conference paper	36
4	Review	24
5	Book Chapter	7
6	Book	5
7	Note	3
8	Conference Review	1



**Fig. 5:** Analysis of Publications by Document Type  
**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June 2021)

#### 4.1.5 Analysis of Publications by Country or Territory

Scopus database is analyzed for countries by considering the number of documents published. It shows that United States has the highest number of documents published between the elected timeline. Followed by China.

#### 4.1.6 Documents by Author

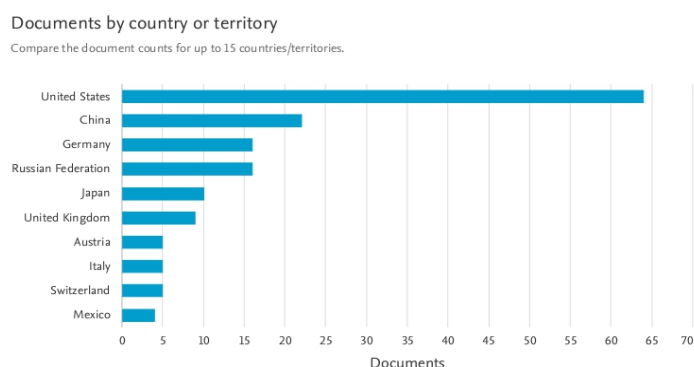
In this analysis, authors with the number of publications are considered. Publications with a very large number of authors (6) are excluded. Top 5 authors with this comparison are shown here. It is found that Zheiltikov, A.M. has the highest number of publications of 10 in this area. Maximum authors have an approximate average publication count 3 to 4.

#### 4.1.7 Documents by Affiliations

In this analysis, top 10 affiliations are considered. It is found that, Lomonosov Moscow State University has 13 affiliations. Texas A&M university has 11 affiliations.

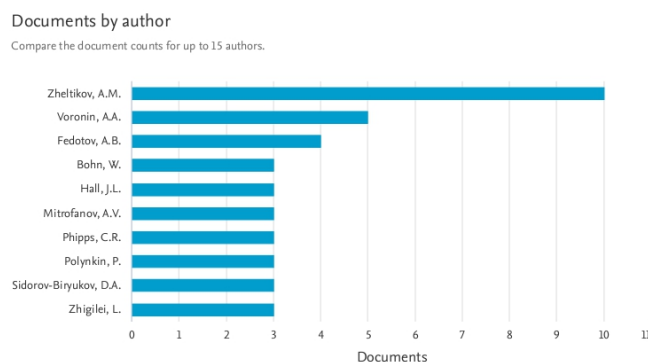
#### 4.1.8 Analysis by Funding Sponsors

In this case, China is ahead amongst all, with highest funding to the National Nature Science Foundation, China. Analysis found most of the funding institutes are form Research and science field.



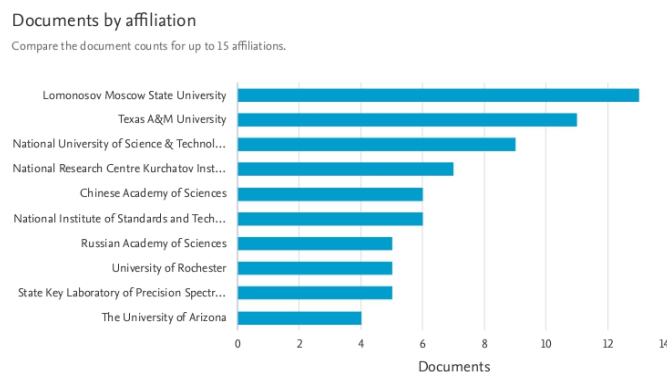
**Fig. 6:** Analysis by Country

**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June 2021)



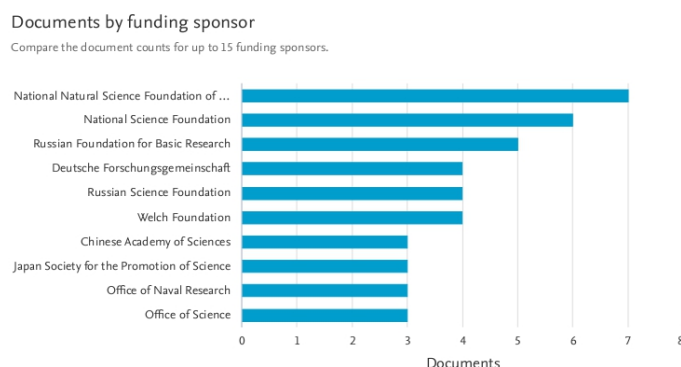
**Fig. 7:** Analysis of Documents by Author

**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June 2021)



**Fig. 8:** Analysis of Documents by Affiliation

**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June 2021)



**Fig. 9:** Analysis of Documents by Funding Sponsor  
**Source:** <http://www.scopus.com> (assessed on 2<sup>nd</sup> June 2021)

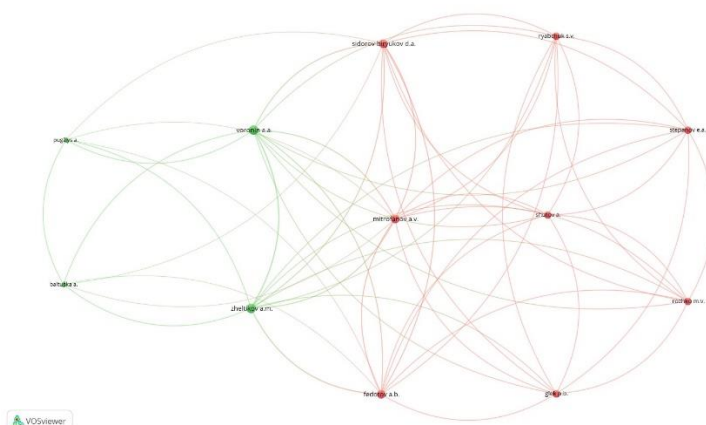
## 4.2 Network Analysis

### 4.2.1 Co-authorship Analysis

#### A) Co-authorship in terms of Authors

This parameter of analysis is considered with 03 different parameters related to it. The authors, organizations, and countries are considered for analyzing this parameter. Documents with a very large number of authors are ignored in this analysis. This number is considered to be 25. Threshold is considered as 2 for minimum number of documents of an author. Out of 555 authors, 59 authors met threshold. By this method, the link strengths are obtained. Maximum link strength 30 were obtained.

These results were shown in Fig..



**Fig. 10:** Co-authorship Network Analysis in Terms of Authors

Selected	Author	Documents	Citations	Total link strength
<input checked="" type="checkbox"/>	zheltikov a.m.			
<input checked="" type="checkbox"/>	voronin a.a.	8	44	29
<input checked="" type="checkbox"/>	fedotov a.b.	5	5	28
<input checked="" type="checkbox"/>	mitrofanov a.v.	4	20	25
<input checked="" type="checkbox"/>	sidorov-biryukov d.a.	3	1	24
<input checked="" type="checkbox"/>	glek p.b.	3	1	24
<input checked="" type="checkbox"/>	rozsko m.v.	2	0	18
<input checked="" type="checkbox"/>	ryabchuk s.v.	2	0	18
<input checked="" type="checkbox"/>	shutov a.	2	0	18
<input checked="" type="checkbox"/>	stepanov e.a.	2	0	18
<input checked="" type="checkbox"/>	bohn w.	3	2	17
<input checked="" type="checkbox"/>	phippis c.r.	3	2	17
<input checked="" type="checkbox"/>	polynkin p.	3	2	17
<input checked="" type="checkbox"/>	zhigilei l.	3	2	17
<input checked="" type="checkbox"/>	baumert t.	2	2	14
<input checked="" type="checkbox"/>	bulgakova n.	2	2	14
<input checked="" type="checkbox"/>	reif j.	2	2	14
<input checked="" type="checkbox"/>	sarnet t.	2	2	14
<input checked="" type="checkbox"/>	bober m.	2	3	10
<input checked="" type="checkbox"/>	ciurylo r.	2	3	10

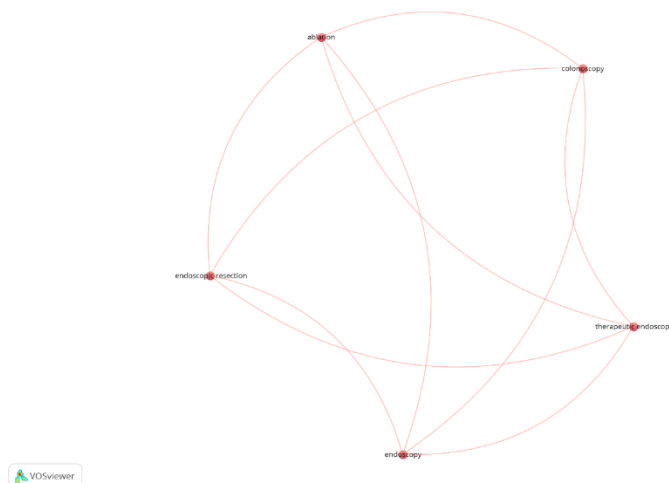
#### B) CO-authorship in terms of Organizations

Co-authorship in the unit of organizations is calculated considering minimum 02 documents in organizations with neglecting the citation of the same, Out of 284 organizations, 15 met threshold criteria. Here 15 organizations were selected. Five organizations have highest link strengths as 8.



### B) Co-occurrence analysis in terms of Author keywords

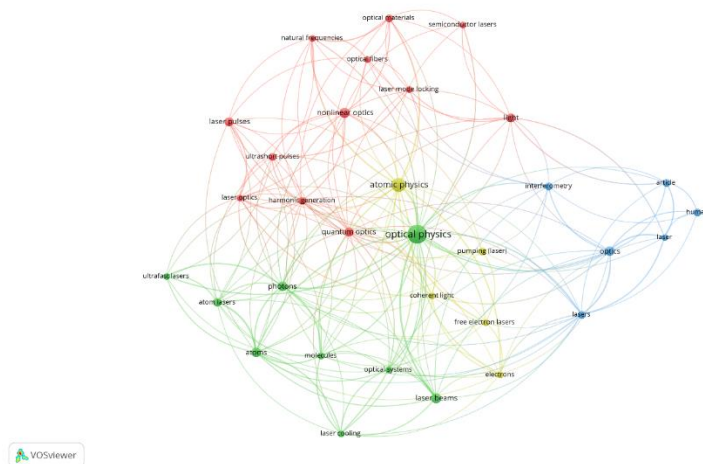
Co-occurrence of author keywords is analyzed with the minimum threshold of 2 per author. Out of 401 keywords by the authors, 18 keywords met the threshold. Wearable antennas keyword occurrence is 7 times with 2 link strength.



**Fig. 14:** Co-occurrence Network Analysis (Author Keywords)

### C) Co-occurrence in terms of Index Keywords

Co-concurrence is also considered by index keywords of 1280, only 32 met the threshold.



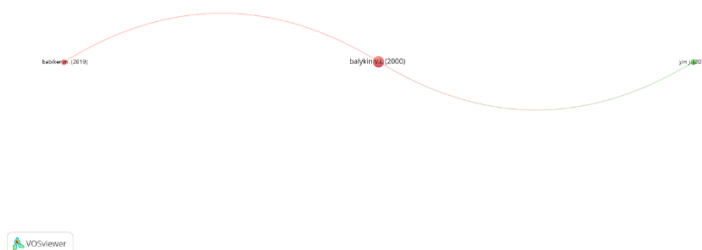
**Fig. 15:** Co-occurrence of Index Keywords

### 4.2.3. Network Analysis of Citations

This analysis is done with the units of analysis including documents, sources, authors, country and organization.

#### A) Citation Analysis of Documents

Out of total of 168 documents, minimum 3 citations are considered as a threshold per document. So 62 documents met the threshold. balykin .v.i (2000) has the highest number of citations 148 while the link strength is 2.



**Fig. 16:** Network Analysis of Citations

### B) Citation Analysis of Sources

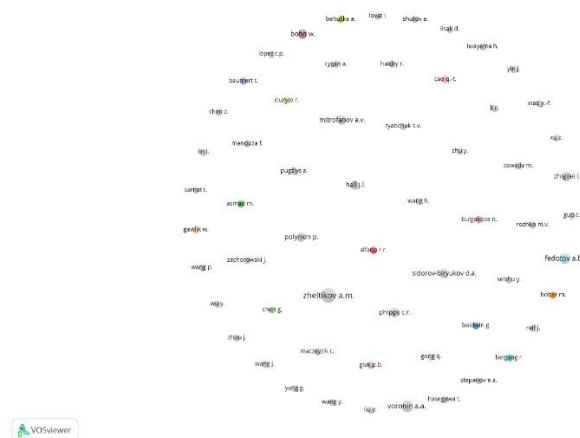
Citation analysis of sources is obtained by considering the threshold of 3 citations per source. Out of the 82 sources only 11 met the threshold. Optics express has got maximum citations of 1337.



**Fig. 17:** Network Analysis of citation by sources

### C) Citation analysis by Authors

Threshold considered here is 2 citations per author. A total of 59 authors met the threshold amongst the total of 555 authors. Chen.g has maximum citations of 82.

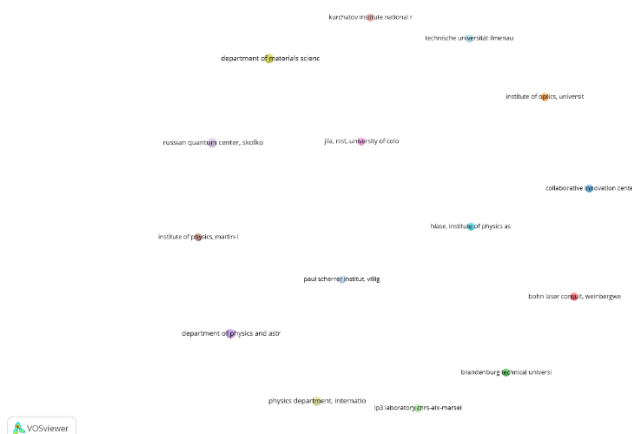


**Fig. 18:** citation analysis by Authors

### D) Citation analysis by organization

Considering minimum documents of 2 per organization as threshold, 15 organizations met the threshold out of 284 organizations.

Institute of Optics, University of Rochester, has Maximum citations of 1294.



**Fig. 19:** Citations by Organizations



## V. CONCLUSION

Bibliometric survey on Optical Physics by using laser beam is carried out by considering the most popular and the largest database used worldwide- Scopus. The database is considered from the year 2000 to 2021. By using the keyword search with AND operator and OR operator the database searching is done. A total of 182 documents are obtained as the outcome of the specific keywords search. The different parameters are considered for analysis of this database. It is seen that English language has most of the documents 173 followed by Chinese.

The outcome of Keyword search indicates that maximum publications are with the keyword "Optical physics". Maximum documents are published in the year 2019 followed by the year 2020. The subject area Physics and Astronomy covered almost 44.7% of the documents. As far as, the type of document is considered, article of journal are the major occupants followed by the conference papers. The analysis of countries proved, Unites States has the highest number of documents within the period. Documents by different authors also analyzed and maximum authors average Publications account 3 to 4. The highest number of documents is from Lomonosov Moscow State University has 13 affiliations and China is the highest funding sponsor in this area. The network analysis is also done by VOSVierer 1.65 version software. The different analysis types such as co-authorship analysis co-occurrence analysis citation analysis and bibliographic coupling are done with the same database. All these different network analysis indicates a quite significant information about different mentioned above. It could also be seen that the major work in Optical physics is done in 2019 and 2020 so in coming years vast and major work is expected in this area.

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