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Quantitative Analysis of Quality Research Output in the Field of Physics: A Bibliometric Evaluation of Literature in Bahrain and Kuwait

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Abstract

The present study compares research productivity in physics in Bahrain and Kuwait, as indexed in the Web of Science database during 2011-2020. Scientometric indices, such as the yearly research growth, type of research, prolific author, most impactful source, productive institutions, and most cited country and documents, portray the different dimensions. It was examined that during 2011-2020, there was a substantial increase in the yearly output of physics literature in Bahrain and Kuwait. The study reveals that the literature in physics is gradually increasing, and there is an upwards trend. The year 2019 was the leading year for contributions from Bahrain (78 papers) as well as Kuwait (272 papers). Coincidently, Bououdina M (189 papers) was the most prolific author in both Bahrain and Kuwait. 'Optic' (24 papers) was the most productive source for Bahrain, while it was 'AIP Conference Proceedings' (54 papers) for Kuwait. X-Ray Diffraction (84) was the most researched title topic in Bahrain, while it was Nano Fluidics (132) for Kuwait. Single author collaboration for Bahrain was 69, while it was 160 for Kuwait; documents per author collaboration for Bahrain was 0.513 and was 0.233 for Kuwait; and authors per documents collaboration for Bahrain was 1.95 and for Kuwait was 4.3. However, the research trends specify a greater scope for higher research in physics in Bahrain and Kuwait.

Keywords: Scientometric, Physics, Bahrain, Kuwait, Research Output, Source Impact, Author Impact

Introduction

Physics is a fundamental and all-inclusive science and has had a comprehensive influence on the growth of science and society. Physics is the equivalent of what used to be known as natural philosophy today, from which most of our modern sciences developed. Physics defines the analytical study and accounting of the universe in which we work. It forms an essential component of human culture. Physics helps us, from the smallest to the most significant objects, to discover the universe. Many of the pillars of modern society and culture are responsible for the application of physics. Physics functions globally, based on the interaction of groups of physicists in various countries and regions. Developments in many fields have gained directly from the discovery of physics, including medicine, transport, communications, information technology, and even the arts. Their techniques would be important to solve many problems, including environmental ones. Therefore, the success of the physical sciences would profoundly impact other disciplines' growth, contributing to a country's prosperity and economy. Scientometrics evaluation, on the other hand, is a crucial aspect of R&D activity. The number of publications contributed by writers, countries, and organisations is one of the most popular productivity indices. Scientometric studies enable researchers, scientists, and policymakers to provide sufficient facilities and advice, by offering insight into various research and development activities. Therefore, scientometrics is an important instrument used within a specific geographical region to analyse the quality and quantity of literature published across disciplines. In this paper, an attempt is made on the scientometric study of physics literature published in Bahrain and Kuwait during 2011-2020.

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Literature Review

Dabas and Kumar (2018) have investigated the research productivity of Indian women scientists of the few selected Indian research institutes in physics and astronomy during 2011-2015. The study identified that active women scientists make up only 12.35% of the population, while men scientists made up 87.65%; it was found that 73 women scientists out of 583 women scientists published 713 research papers from 2011 to 2015. The study explored that the National Physical Laboratory has published the largest number of publications (144). In contrast, the Indian Institute of Astrophysics has the maximum citations and the maximum research papers published in collaboration with other national and international institutes; the average CC is 0.7480. It also described that most women scientists published their research work in the Journal of Astronomy and Astrophysics. The most prolific author was Adity Sen De, Harish Chandra Research Institutes, with 38 articles.

Mryglod (2018) has evaluated the Journal of Condensed Matter Physics from 1993 to 2017. The study analysed different parameters of the journal data. The study examined the authorship pattern, co-authorship pattern, international collaboration, topical spectrum of the journal, and statistics of downloaded papers, citations received, and network of collaborating countries. The study revealed that 130 authors published almost 57/58 papers per year in the journals, 20% of the paper was single authorship, 72 countries contributed to this journal during the 25 years, and Poland was the most productive country (117) papers, while Germany contributed 15 papers, the USA 109, France 84, and Russia 64.

Khanna, Singh, Tewari and Saini (2017) have investigated physics and astronomy's research productivity at the Guru Nanak Dev University, Amritsar, during 2006-2015. A total of 652 data has been retrieved from the Scopus database in physics and astronomy. The study focused on different scientometric tools such as year-wise research output, productive authors, a preferred journal for communication, national and international collaboration patterns, and number of citations from 2006 to 2015. The average citation impact of the university is 7.07% per paper. Six research papers received 51 to 100 citations, Guru Nanak Dev University ranked 23rd among all the Indian universities in terms of research performance (652) in the field of physics and astronomy, H-Index (29), ranked 16th in average citations per paper (7.01%), ranked 18th in the share of high cited papers (1%), and ranked 19th in terms of international collaborative papers (27.45%), during the study period. The study also showed that 68.71% of the publications have national collaboration with Guru Nanak Dev University in physics and astronomy. It revealed that journals are the most preferred form of publication by a research scientist.

Bebi and Kumar (2017) have investigated the research performance of the women staff of physics in some Delhi institutions from 2011 to 2015. The study finds that a total of 44 women faculties published 802 papers. The study analysed 463 articles using different scientometric parameters, including a pattern of authorship, an interested area of research, the most prolific authors, and the most used journals. The study revealed that the most productive author was Ratnamala Chatterjee from IIT Delhi, and that single authors are less dominated than multi-authors. Journal of Applied Physics was the most productive journal (146 research papers). The study found that most women authors preferred to be the second author while writing a paper jointly.

Rahaman, Ansari and Al-Attas (2021) have performed the scientometric analysis in Saudi Arabia for about five years, from 2015 to 2019, to evaluate research efficiency on big data. Research data was downloaded from the Scopus database and analysed and viewed using Microsoft Excel and Vosviewer. The study focused on various scientometric tools such as most popular authors, DC, RGR & DT, AGR, year-wise research development, the publication of the subject, international collaboration, pattern of authorship, and so on. The study recorded 230 (28.12%) maximum research papers in 2019 and relative growth rate (RGR) was recorded in 2016 (0.866), while in 2019 it was 0.330; the Saudi Arabian researcher's degree of collaboration was 0.91, the journal 'IEEE Access' was the most productive source.

A scientometric study was conducted by Rahaman et al. (2021) on coronavirus research from 1996-2020. A total of 2,661 publications were downloaded from the Scopus database. The result indicates that the publication of 68% is in the form of articles. The highest publication was provided by the University of Hong Kong, i.e., 362. The Journal of Virology (JIF = 4.324) was the most productive

source. Yuen KY has been described as a prolific author (75) and has the most collaborative publications (62). The author considered the keyword 'coronavirus' to be the most accurate keyword. Similarly, Panda (2020) examined the status of scholarly literature on coronavirus indexed in the big database, the Lens, taking into account top-cited articles, top contributors, top active country region, most accepted study field, and open access status. Relative growth rate (RGR) and doubling time (Dt) calculation are also major reflections of the paper. The study analyses the status of scholarly publications on coronavirus research as indexed by Lens, spanning a period from the oldest record until July 15, 2020.

Ramy, Floody, Ragab and Arisha (2018) have explored research literature in knowledge management and practice from 2003 to 2015. There were 506 research articles published in Knowledge Management Research and Practices between the years 2003 and 2015. The study is based on three sets of review questions: literature output, research themes and methods, and citation analysis. The study explains the substantial global interest in knowledge management and increasing research trends in more than one author collaboration. It found that 55 different industries have been featured in the journal. Research productivity of a few countries shows them taking the lead, while correlations between research activity and economic prosperity are increasing, and the empirical method is increasing, while literature review papers are decreasing. The recent trends of KMPR are knowledge management and information technology. The first scientometric analysis of the KMRP explained the state of the art for the future researcher.

Fang, Yin and Wu (2018) have described the research output in climate change and tourism from 1990 to 2015. The study collected 1,976 research publications during 1990-2015 on climate change and tourism, using CiteSpace analysing software. The study visualised collaboration network, co-citation network, and recent emerging trends. The study found that the number of research publications has increased exponentially, becoming an interdisciplinary subject. The highly productive authors and institutions belong to Australia, the United States of America, Canada, New Zeeland, and European countries. The study finds out that hot topics on climate change and tourism are consequences of climate change on tourism, necessary adaptations, the vulnerability of the tourism industry, tourist behaviour, demand in response to climate change, and emission reductions in tourism. The paper highlighted an in-depth analysis of climate change and tourism research activity to understand global trends and directions in this field over the last 25 years.

Objectives

The primary objectives of this study are to compare the research performance of Bahrain and Kuwait in physics research, as reflected in the Web of Science database, from 2011 to 2020. In particular, the study defined the following objectives:

- To study the yearly research growth in Bahrain and Kuwait.
- To know the type of research papers in Bahrain and Kuwait.
- To find out the most impactful sources of publications.
- To study the most prolific authors in physics in Bahrain and Kuwait.
- To analyse the institution-wise research productivity.
- To identify the most cited research papers and country.
- To find out research trends in both countries in physics.

Methodology

The research data were collected from the Web of Science (WOS) (www.isiknowledge.com) database maintained by Thomson Reuters (now Clarivate Analytics); it offers an exhaustive citation search for this study, using keywords SU = Physics AND CU = Bahrain / Kuwait on physics for ten years, i.e., 2011-2020, and further refined by the English language (Clarivate Analytics, 2020). The search was conducted at King Fahd University of Petroleum and Minerals as of 15 January 2021. The investigation was run separately for Bahrain and Kuwait. (SUBJAREA (Phys) AND (LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR,

2012) OR LIMIT-TO (PUBYEAR, 2011)) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (AFFILCOUNTRY, "Bahrain" / "Kuwait"). A total of 518 research papers were indexed against Bahrain in physics from 2011-2020, and 1,340 research papers were indexed for Kuwait. All the papers were downloaded in Microsoft Excel and BibTeX format and analysed with Microsoft Excel, Biblometrix software (Massimo Aria & Corrado Cuccurullo, 2019), and VOS viewer (van Eck & Waltman, 2010).

Results and Discussion

Table 1 shows a comparative analysis of research in physics in Bahrain and Kuwait from 2011 to 2020. The table reveals that Bahrain contributed 518 research papers in physics, with 173 sources, 1.938 average citations per year per document, 3,756 keywords plus (3756), 1,009 authors, 2,125 author appearances, 20 authors of single-authored documents, 989 authors of multi-authored papers, and a collaboration index of 2.2. At the same time, Kuwait contributed 1,340 research papers in physics, with 390 sources, 3.134 average citations per year per document, 9,054 keywords plus (9054), 5,759 authors, 11,000 author appearances, 69 authors of single-authored documents, 5,690 authors of multi-authored papers, and a collaboration index of 4.82.

Table 1: Comparative Primary Information of Bahrain and Kuwait Research in Physics

Bahrain		*Kuwait*	
Description	*Results*	*Description*	*Results*
Timespan	2011:2020	Timespan	2011:2020
Sources (Journals, Books, and so on)	173	Sources (Journals, Books, and so on)	390
Documents	518	Documents	1340
Average years from publication	3.87	Average years from publication	3.32
Average citations per document	9.278	Average citations per document	11.32
Average citations per year per doc	1.938	Average citations per year per doc	3.134
References	16840	References	41172
Document Contents		*Document Contents*	
Keywords Plus (ID)	3756	Keywords Plus (ID)	9054
Author's Keywords (DE)	1332	Author's Keywords (DE)	3348
Authors		*Authors*	
Authors	1009	Authors	5759
Author Appearances	2125	Author Appearances	11000
Authors of single-authored documents	20	Authors of single-authored documents	69
Authors of multi-authored documents	989	Authors of multi-authored documents	5690
Authors Collaboration		*Authors Collaboration*	
Single-authored documents	69	Single-authored documents	160
Documents per Author	0.513	Documents per Author	0.233
Authors per Document	1.95	Authors per Document	4.3
Co-Authors per Document	4.1	Co-Authors per Document	8.21
Collaboration Index	2.2	Collaboration Index	4.82

Comparative Yearly Research Growth between Bahrain and Kuwait

Table 2 shows the 10 year research growth in physics literature in Bahrain and Kuwait. The table revealed that Kuwait produced the maximum research (1,340) papers in physics from 2011-2020, followed by Bahrain (518) papers. The year 2019 was the year with the leading contributions for Bahrain (78 papers) and Kuwait (272 papers), while 2012 was the lowest productive year for

both countries (Bahrain = 32 papers and Kuwait = 74 papers). Both the countries show a similar pattern of yearly research growth, i.e., increasing research trends in physics in Bahrain and Kuwait during the last ten years. The year 2014 has the maximum mean total citations per article for Bahrain (17.977) and Kuwait (20.529). Bahrain has 3.87 average years from publication, followed by 3.32 for Kuwait.

Table 2: Yearly Research Output of Bahrain and Kuwait

Year	*Bahrain*				*Kuwait*			
	Papers	*MTCPA*	*MTCPY*	*CY*	*Papers*	*MTCPA*	*MTCPY*	**CY**
2011	42	11.214	1.246	9	76	18.421	2.046	9
2012	32	14.03125	1.753	8	74	18.878	2.359	8
2013	49	14.204	2.029	7	84	15.404	2.200	7
2014	45	17.977	2.996	6	102	20.529	3.421	6
2015	42	15.619	3.123	5	83	10.903	2.180	5
2016	47	6.276	1.569	4	112	8.455	2.113	4
2017	46	13.652	4.550	3	149	8.429	2.809	3
2018	72	5.166	2.583	2	196	10.331	5.165	2
2019	78	4.487	4.487	1	272	12.768	12.768	1
2020	65	1.230		0	192	1.968		0
Total	518				1340			

*MTCPA = Mean Total Citations per Article, **MTCPY = Mean Total Citations per Year, ***CY = Citable Years.

Comparison of Type of Research in Physics between Bahrain and Kuwait

Table 3 shows the type of physics research in Bahrain and Kuwait. There are ten types of physics research: articles, articles in press, books, book chapters, conference papers, editorials, errata, letters, retracted papers, and reviews. Articles were the leading type of research form in physics in Bahrain (83.58% papers) and Kuwait (77.61% papers), followed by conference papers (Bahrain = 12.35% and Kuwait = 18.43%). Book chapters consisted of eight papers in Bahrain and seven papers in Kuwait, and reviews comprised seven papers for Bahrain and 23 papers for Kuwait. The study revealed the same research trends in physics between Bahrain and Kuwait, except in letters and retracted research.

Table 3: Type of Research

Bahrain			*Kuwait*		
Document Types	*NP*	*%*	*Document Types*	*NP*	*%*
Articles	433	83.58	Articles	1040	77.61
Articles in Press	1	0.19	Articles in Press	1	0.07
Book Chapters	8	1.52	Books	1	0.07
			Book Chapters	7	0.52
Conference Papers	64	12.35	Conference Papers	247	18.43
Editorials	3	0.57	Editorials	8	0.6
Errata	2	0.38	Errata	5	0.38
Letters	0		Letters	5	0.38
Retracted Papers	0		Retracted Papers	3	0.22
Reviews	7	1.34	Reviews	23	1.72
Total	518	100		1340	100

*NP = Number of Publications.

Comparison of Author Impact between Bahrain and Kuwait in Physics Research

Table 4 describes the top ten most productive authors in physics research in Bahrain and Kuwait. It shows that Bououdina M (189 papers) was the most prolific author in both the countries (Bahrain & Kuwait), with 2,990 total citations and 30 H-index. Dakhel AA was the most prolific author in Bahrain, with 52 research papers with 560 total citations. In Kuwait, Shafee A was the most prominent physics author with 81 papers (TC = 3,150, H-index = 25). The table also reveals the most cited authors in physics research in both countries. It was found that Bououdina M was the most cited in Bahrain (TC = 2,990 for 189 papers) and the second most-cited in Kuwait, while Shafee A was the most cited in Kuwait (TC = 3,150 for 81 papers). Total number of authors were 1,009 in Bahrain in physics research, while it was 5,759 in Kuwait.

Table 4: Author Impact

Bahrain				*Kuwait*			
Author	*H-Index*	*TC*	*NP*	*Author*	*H-Index*	*TC*	*NP*
Bououdina M	30	2990	189	Bououdina M	30	2990	189
Dakhel AA	12	560	52	Shafee A	25	3150	81
Metwally N	11	313	50	Chamkha AJ	27	2339	70
Hassan SS	6	123	41	Al-Rashed Aaaa	18	1020	62
Abdel-Aty M	8	177	26	Li Z	22	2688	58
Vijaya JJ	12	546	22	Sheikholeslami M	25	2935	57
Ahmed NM	10	214	20	Dakhel AA	12	560	52
Kennedy LJ	12	671	20	Metwally N	11	313	50
Hassan Z	10	293	19	Hassan SS	6	123	41
Henari FZ	5	86	16	Mokkath JH	3	45	31

*NP = Number of Publications, **TC = Total Citations

Source Impact between Bahrain and Kuwait in Physics Research

Table 5 compared the top ten physics research sources in Bahrain and Kuwait. In Bahrain, researchers mostly preferred to publish their research in 'Optic' (24 papers), followed by 'Journal of Superconductivity and Novel Magnetism' (23 papers), 'Journal of Materials Science: Materials in Electronics (19 papers), and 'AIP Conference Proceedings' (16 papers), while Kuwait researchers mostly published their work in 'AIP Conference Proceedings' (54 papers), followed by 'International Journal of Heat and Mass Transfer (38 papers), and 'Journal of Molecular Liquids' (31 papers). It also revealed the most cited sources in Bahrain and Kuwait. It found that 'Superlattices and Microstructures' was the most cited source (TC = 518 for 13 papers) in Bahrain, while 'International Journal of Heat and Mass Transfer' was the most cited source (TC = 2,972 for 38 papers) in Kuwait. One hundred seventy-three sources have been used to publish 518 papers in Bahrain, while 390 sources were used to produce 1,340 papers in Kuwait.

Table 5: Source Impact

Bahrain				*Kuwait*			
Source	*H-Index*	*TC*	*NP*	*Source*	*H-Index*	*TC*	**NP**
Optic	10	222	24	AIP Conference Proceedings	5	83	54
Journal of Superconductivity and Novel Magnetism	6	70	23	International Journal of Heat and Mass Transfer	26	2972	38
Journal of Materials Science: Materials in Electronics	8	134	19	Journal of Molecular Liquids	15	655	31

Bahrain				*Kuwait*			
Source	*H-Index*	*TC*	*NP*	*Source*	*H-Index*	*TC*	**NP**
AIP Conference Proceedings	3	30	16	Physica A: Statistical Mechanics and Its Applications	12	575	29
Materials Science in Semiconductor Processing	8	310	14	Journal of Physics: Conference Series	3	25	28
2017 9th IEEE-GCC Conference and Exhibition, GCCE 2017	1	10	13	Journal of Thermal Analysis and Calorimetry	14	591	27
Superlattices And Microstructures	9	518	13	Proceedings of Spie – The International Society for Optical Engineering	3	22	26
International Journal of Hydrogen Energy	6	152	12	International Communications in Heat and Mass Transfer	16	718	25
Journal of Magnetism and Magnetic Materials	9	341	12	International Journal of Hydrogen Energy	11	361	23
Nonlinear Optics Quantum Optics	3	27	12	Sensors (Switzerland)	8	223	21

Most Relevant Institutions in Physics Research in Bahrain and Kuwait

Table 6 compares the top ten institutions that contributed to research in physics in Bahrain and Kuwait. In Bahrain, the University of Bahrain was the institution that contributed the most (478 papers), followed by Aswan University (30 papers), University Sains Malaysia (27 papers), and Sohag University (24 papers). At the same time, in Kuwait, Kuwait University (449) was the leading contributor, followed by College of Technological Studies (254 papers), and Ton Duc Thang University (153 papers).

Table 6: Productive Institutions

#	*Bahrain*		*Kuwait*	
	Affiliations	*Articles*	*Affiliations*	*Articles*
1	University of Bahrain	478	Kuwait University	449
2	Aswan University	30	College of Technological Studies	254
3	University Sains Malaysia	27	Ton Duc Thang University	153
4	Sohag University	24	American University of the Middle East	139
5	Al-Azhar University	21	Babol Noshirvani University of Technology	98
6	Bahrain University	21	Manufacturing Engineering Department	63
7	Applied Science University	17	Australian College of Kuwait	62
8	Loyola College	17	Kuwait College of Science and Technology	62
9	Vellore Institute of Technology (Vit) University	17	University of Wollongong	57
10	Manchester Metropolitan University	16	Islamic Azad University	55

Comparing Most Cited Countries in Physics Literature

Table 7 illustrates the top ten most-cited countries in physics research indexed in Bahrain and Kuwait. The table reveals that India (TC = 900) was the most cited country in Bahrain physics literature, followed by Bahrain (TC = 756), Saudi Arabia (TC = 343), and Malaysia (TC = 297). In the case of Kuwait, the country received the highest number of total citations (3,511), followed by India (TC = 1,292), Saudi Arabia (TC = 781), Bahrain (TC = 756), and the USA (TC = 648). Ukraine

has the highest average article citations (AAC = 39) in Bahrain research on physics, while Bangladesh has the maximum average article citations (AAC = 39.50). Table 1 shows that the average citations per document in Bahrain is 9.278, while it is 11.32 in Kuwait.

Table 7: Cited Countries

Rank	Bahrain			Kuwait		
	Country	TC	AAC	Country	TC	AAC
1	India	900	30.00	Kuwait	3511	8.67
2	Bahrain	756	5.95	India	1292	28.09
3	Saudi Arabia	343	17.15	Saudi Arabia	781	21.11
4	Malaysia	297	15.63	Bahrain	756	5.95
5	Algeria	167	8.79	USA	648	16.62
6	Ukraine	156	39.00	Malaysia	525	20.19
7	Egypt	137	8.06	Egypt	372	10.05
8	USA	67	11.17	Iran	357	23.80
9	Ireland	45	9.00	Bangladesh	332	41.50
10	Morocco	39	4.88	United Kingdom	231	19.25

*TC = Total Citations, **AAC = Average Article Citations

Most Globally Cited Documents in Bahrain and Kuwait in Physics Research

Table 8 shows the top ten most-cited papers in Bahrain and Kuwait. 'Manikandan A, 2013, Superlattices Microstruct' was the most cited paper (TC = 157) in Bahrain, followed by 'Manikandan A, 2014, J Magn Mater' (TC = 139), and 'Lemine Om, 2012, Superlattices Microstruct' (TC = 119). The most cited papers in Kuwait were 'Sheikholeslami M, 2019, Int J Heat Mass Transf-A-B-C-D' (TC = 291), 'Sheikholeslami M, 2019, Int J Heat Mass Transf-A-B-C' (TC = 244), and 'Sheikholeslami M, 2019, Int J Heat Mass Transf-A' (TC = 204).

Table 8: Global Cited Documents

Rank	Bahrain			Kuwait		
	Paper	TC	TCPY	Paper	TC	TCPY
1	Manikandan A, 2013, Superlattices Microstruct	157	19.625	Sheikholeslami M, 2019, Int J Heat Mass Transf-A-B-C-D	291	97
2	Manikandan A, 2014, J Magn Mater	139	19.857	Sheikholeslami M, 2019, Int J Heat Mass Transf-A-B-C	244	81.3333
3	Lemine OM, 2012, Superlattices Microstruct	119	13.222	Sheikholeslami M, 2019, Int J Heat Mass Transf-A	204	68
4	Katlakunta S, 2015, Mater Res Bull	94	15.667	Sheikholeslami M, 2019, Int J Heat Mass Transf-A-B	197	65.6667
5	Bensouici F, 2017, Appl Surf Sci	92	23	Sheikholeslami M, 2019, Int J Heat Mass Transf	176	58.6667
6	Omri K, 2013, Superlattices Micro-struct	88	11	Sheikholeslami M, 2019, Comput Meth-ods Appl Mech Eng-A	166	55.3333
7	Tatarchuk T, 2017, Nanoscale Res Lett	85	21.25	Sheikholeslami M, 2018, Int J Heat Mass Transf	164	41
8	Jesudoss SK, 2016, J Photochem Photobiol B Biol	69	13.8	Chamkha AJ, 2012, Eur J Mech B Fluids	147	14.7
9	Brisset Jl, 2011, Plasma Sources Sci Technol	63	6.3	Bumajdad A, 2014, Phys Chem Phys	144	18
10	Javadi AH, 2017, Nat Commun	60	15	Arani AAA, 2017, Int J Heat Mass Transf	141	28.2

Comparison of Three Fields Plot of Institutions, Author, and Country between Bahrain and Kuwait in Physics Research

Comparison of the three fields plot has been used to ascertain the connection between institutions, authors, and country in physics research in Bahrain and Kuwait (Fig. 1 & 2). Fig. 1 visualised a powerful relationship between 'The University of Bahrain', 'Bououdina M', and Bahrain on research in physics in Bahrain. It shows that the University of Bahrain was the most productive institution, Bououdina M was the most prolific author, and Bahrain was the leading country in contributions. Similarly, in Kuwait, research in physics (Table 2) shows that there is a strong correlation between the College of Technological Studies, Shafee A, and Kuwait. This analysis is in agreement with Dadkhah et al. (2020).

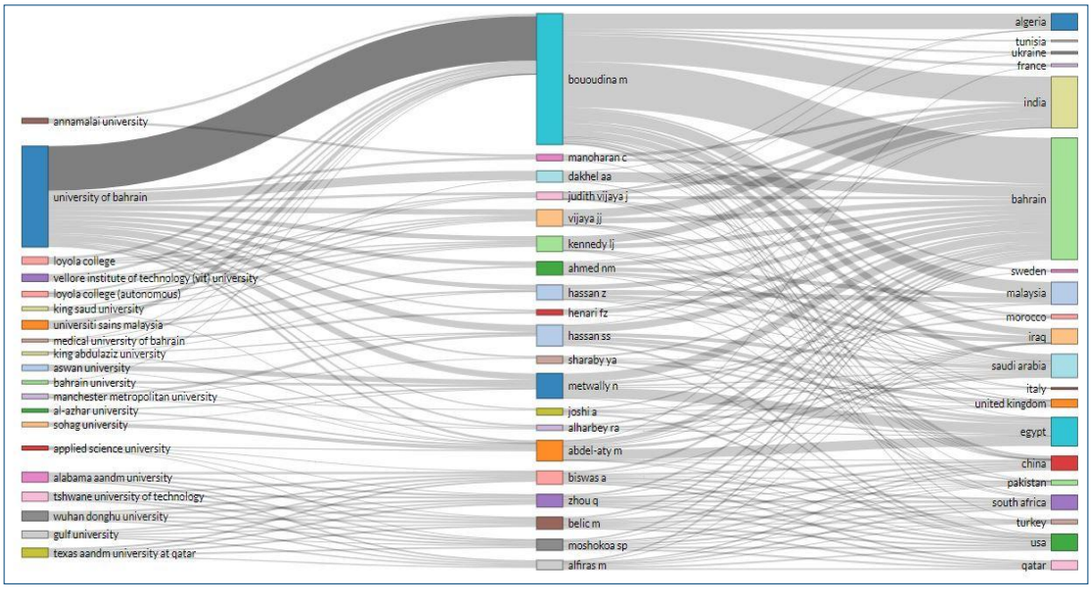

Fig. 1: Relationship between the Institutions (Left), Authors (Middle), and Country (Right), in Physics Research in Bahrain

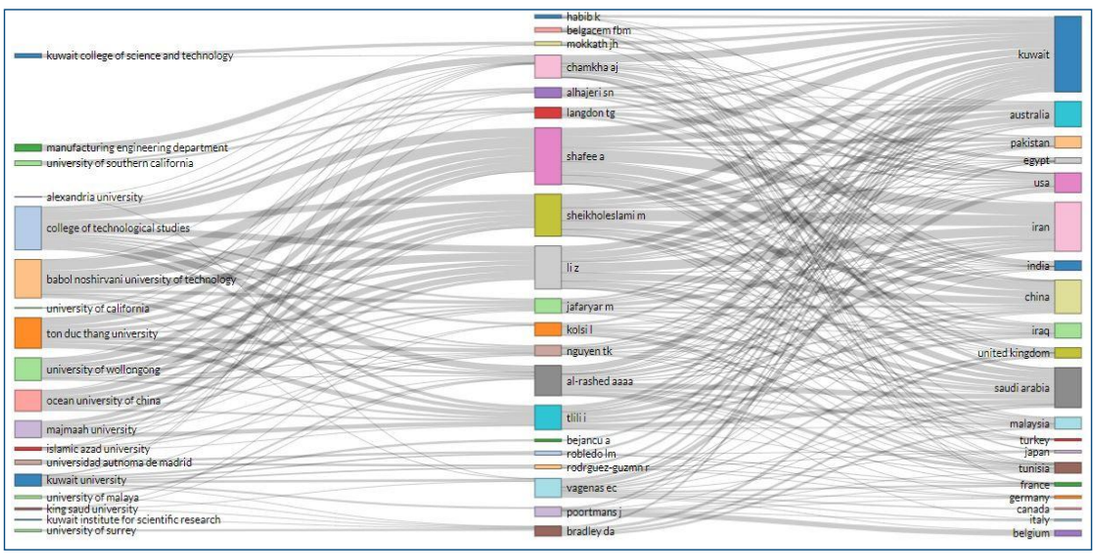

Fig. 2: Relationship between the Institutions (Left), Authors (Middle), and Country (Right) in Physics Research in Kuwait

Comparing Word Cloud by Title Analysis for Bahrain and Kuwait Research in Physics

Table 9 analysed the word titles for research in physics in Bahrain and Kuwait. The top 15 studies conducted in Bahrain for a word in titles were X-Ray Diffraction (N = 84), followed by Optical Properties (N = 73), Optical Properties Scanning Electron Microscopy (N = 69), Energy Gap (N = 54), Magnetic Properties (N = 51), Semiconductor Doping (N = 41), Zinc Oxide (N = 39), Thin Films (N = 38), Ferromagnetism (N = 35), Nanoparticles (N = 35), and Substrates (N = 32). In Kuwait, the top 15 research in physics for a word in tiles were Nano Fluidics (N = 132), Nanoparticles (N = 108), Heat Transfer (N = 107), Nanofluids (N = 85), Natural Convection (N = 69), Porous Materials (N = 56), and Reynolds Number (N = 49). Fig. 3 visualised that X-Ray Diffraction was the influential word in titles, followed by Optical Properties and Scanning Electron Microscopy, which were ranked second and third, respectively, for physics research in Bahrain. For physics research in Kuwait, Fig. 4 revealed that Nano Fluidics was the most common researched word in titles, followed by Nanoparticles and Heat Transfer, which were ranked second and third, respectively.

Table 9: Word Cloud by Titles in Bahrain and Kuwait

Bahrain		*Kuwait*	
Keywords	*Frequency*	*Keywords*	*Frequency*
X Ray Diffraction	84	Nano Fluidics	132
Optical Properties	73	Nanoparticles	108
Scanning Electron Microscopy	69	Heat Transfer	107
Energy Gap	54	Nanofluids	85
Magnetic Properties	51	Natural Convection	69
Semiconductor Doping	41	Porous Materials	56
Zinc Oxide	39	Reynolds Number	49
Thin Films	38	Heat Convection	45
Ferromagnetism	35	Article	43
Nanoparticles	35	Entropy	40
Substrates	32	Nusselt Number	40
Saturation Magnetisation	31	Finite Element Method	38
Synthesis (Chemical)	31	Friction	34
Magnetism	28	Human	34
Nanostructures	28	Thermal Conductivity	34

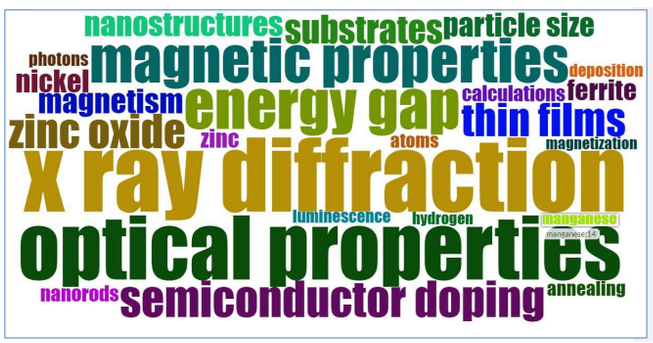

Fig. 3: Word Cloud by Titles for Physics Research in Bahrain

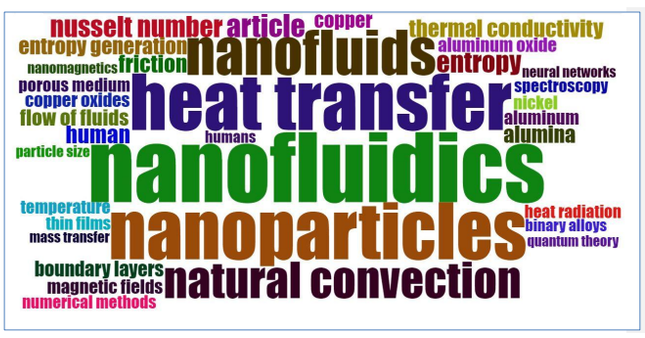

Fig. 4: Word Cloud by Titles for Physics Research in Kuwait

Mapping Visualisation of Co-Authorship by Country

Table 10 shows that Kuwait has the highest number of co-authorship by country, in terms of total link strength (1,990), documents (1,334), and citations (15,072), followed by Iran (documents = 161, citations = 5,191, and total link strength = 555), and Saudi Arabia (documents = 155, citations = 2,901, and total link strength = 539). In Bahrain, Table 10 shows that the maximum number of documents (518), citations (4,806), and total link strength (750) of co-authorship by country for physics research is Bahrain, followed by Saudi Arabia (documents = 87, citations = 918, and total link strength = 213) and Egypt (documents = 95, citations = 620, and total link strength = 184).

Table 10: Top Ten Co-Authorship by Country

Bahrain				*Kuwait*			
Country	*Documents*	*Citations*	*Total Link Strength*	*Country*	*Documents*	*Citations*	*Total Link Strength*
Bahrain	518	4806	750	Kuwait	1334	15072	1990
Saudi Arabia	87	918	213	Iran	161	5191	555
Egypt	95	620	184	Saudi Arabia	155	2901	539
Malaysia	66	696	128	China	111	3621	477
USA	36	363	127	USA	187	3010	473
India	75	1669	122	Australia	110	3184	464
China	33	451	119	Vietnam	85	2207	335
Algeria	56	388	105	Malaysia	97	1944	293
Iraq	35	331	82	Egypt	133	1441	264
South Africa	17	266	77	Pakistan	61	1479	227

For visualisation of co-authorship by country for physics research in Bahrain, first, co-authorship from types of analysis was selected, then from the unit of analysis, country was selected. Full counting method was selected in the counting method criteria. The selected minimum number of documents of the authors was two. There was a total of 54 countries, and 40 met the threshold. For each of the 40 countries, the total strength of co-authorship links with other countries was calculated. The countries with the greatest total link strength were selected. Total items was 40, cluster 9, links 204, and total link strength 1,278 (Fig. 5).

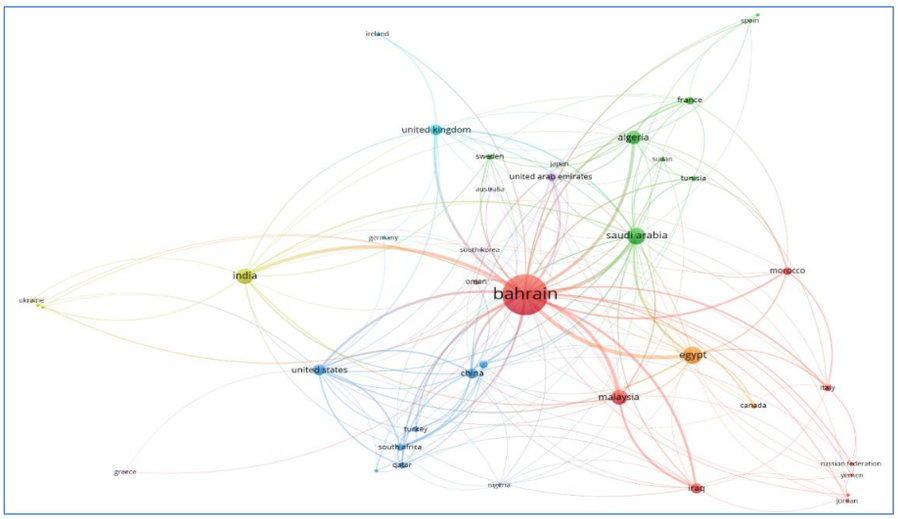

Fig. 5: Visualisation of Co-Authorship by Countries for Physics Research in Bahrain

For visualisation of co-authorship by country for physics research in Kuwait, first, co-authorship from types of analysis was selected, then from the unit of analysis, country was selected. Full counting method was selected in the counting method criteria. The selected minimum number of documents of the authors was five. There was a total of 83 countries, and 45 met the threshold. For each of the 45 countries, the total strength of the co-authorship links with other countries was calculated. The countries with the greatest total link strength were selected. Total items was 45, cluster 8, links 432, and total link strength 4,011 (Fig. 6).

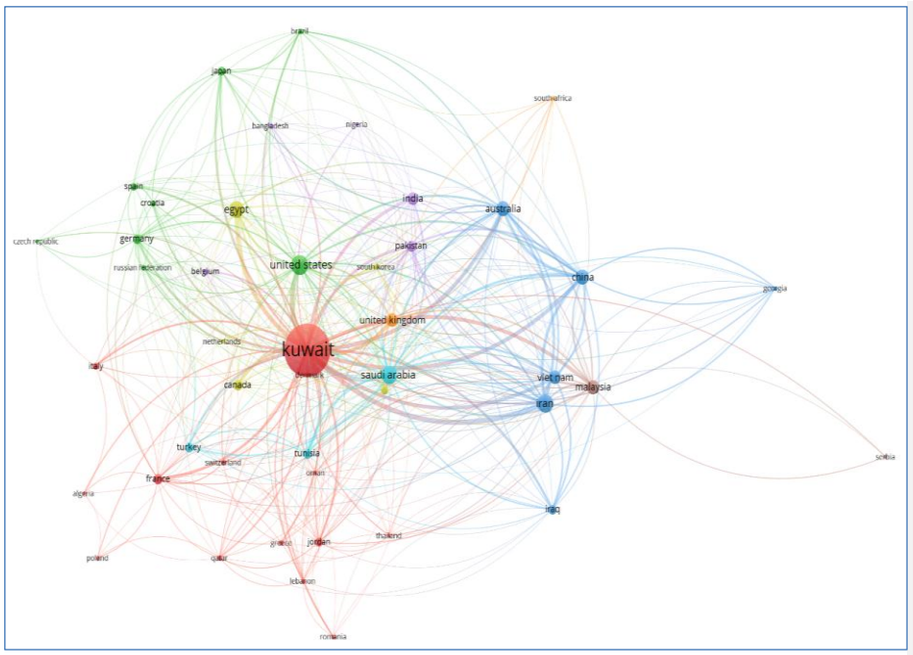

Fig. 6: Visualisation of Co-Authorship by Countries for Physics Research in Kuwait

Conclusion

This paper has made an attempt to examine and compare the research patterns in physics in Bahrain and Kuwait. Physics envisages distinct natural phenomena, and we may assume that physics governs our universe. Many items, such as refrigerators, vehicles, escalators, and microwaves are regulated by physics. Thus, advances in physical sciences and their implementation have a direct influence on the national economy. This study analyses the growth of physics literature by researchers in Bahrain and Kuwait from 2011 to 2020, based on data from the Web of Science. The study shows that research in physics is growing steadily, and there is an upwards trend in Bahrain and Kuwait. The article was the leading form of research for both Bahrain and Kuwait, and 'Bououdina M' was the most prolific author in both countries. The source 'Optic' (24 papers) and 'AIP Conference Proceedings' (54 papers) have produced the maximum research papers for Bahrain and Kuwait. University of Bahrain (478 papers) and Kuwait University (449 papers) recorded the highest number of research in physics. Table 1 revealed that 16,840 references had been used for 518 research papers in Bahrain, while 41,172 references were used for 1,340 research papers in Kuwait. However, the data's findings are restricted to only the Web of Science (WOS) database, containing only peer-reviewed articles; there would be a better view of research in physics and its related fields in Bahrain and Kuwait by including some of the other reputed journals in the countries. This scientometric paper offers a statistical analysis of the study of 'X-Ray Diffraction' and 'Nano Fluidics' in Bahrain and Kuwait's near future research in physics and its related fields.

References

Aria, M., & Cuccurullo, C. (2019). *Bibliometrix 3.0*. Retrieved from https://www.bibliometrix.org/about.html. https://www.bibliometrix.org/index.html

Dabas, B., & Kumar, S. (2017). Contributions by women faculties of physics from select institutions of Delhi: A scientometrics study. *DESIDOC Journal of Library and Information Technology*, *37*(6), 410-416. doi:https://doi.org/10.14429/djlit.37.6.11713

Clarivate Analytics. (2020). *Journal citation reports*. Thomson Reuters. Retrieved from https://clarivate.com/

Dabas, B., & Kumar, S. (2018). Research output of Indian women scientists in the field of physics and astronomy: A scientometrics study. *Library Philosophy and Practice*, *2018*. Retrieved from https://www2.scopus.com/inward/record.uri?eid=2-s2.0-85057449276&partnerID=40&md5=74f337d83ff67440ad0a99a2e1f95ee3

Dadkhah, M., Lagzian, M., Rahimnia, F., & Kimiafar, K. (2020). What do publications say about the internet of things challenges/barriers to uninformed authors? A bibliometric analysis. *JLIS.It*, *11*(3), 77-98. doi:https://doi.org/10.4403/jlis.it-12634

Fang, Y., Yin, J., & Wu, B. (2018). Climate change and tourism: A scientometric analysis using CiteSpace. *Journal of Sustainable Tourism*, *26*(1), 108-126. doi:https://doi.org/10.1080/09669582.2017.1329310

Khanna, S., Singh, N. K., Tewari, D., & Saini, H. S. (2017). Scientometric analysis of the research output of physics and astronomy of Guru Nanak Dev University during 2006-15. *DESIDOC Journal of Library and Information Technology*, *37*(5), 337-345. doi:https://doi.org/10.14429/djlit.37.10683

Mryglod, O. (2018). Scientometric analysis of condensed matter physics journal. *Condensed Matter Physics*, *21*(2), 1-18. doi:https://doi.org/10.5488/CMP.21.22801

Panda, S. (2020). A meta-analysis of scholarly research on corona virus through big data approach. *International Journal of Research in Library Science*, *6*(2), 66-83. doi:https://doi.org/10.26761/IJRLS.6.2.2020.1339

Rahaman, M. S., Ansari, K. M. N., & Al attas, H. H. (2021). Saudi Arabian research output on big data publications using the Scopus database: A scientometric study. *Library Philosophy and Practice*, 1-18. Retrieved from https://digitalcommons.unl.edu/libphilprac/4429/

Rahaman, M. S., Kumar, S., Ansari, K. M. N., & Rahman, M. R. (2021). Twenty-five years of global research publications trends of novel coronavirus: A scientometrics assessment. *Library Philosophy and Practice*, 1-17. Retrieved from https://digitalcommons.unl.edu/libphilprac/4294/

Ramy, A., Floody, J., Ragab, M. A. F., & Arisha, A. (2018). A scientometric analysis of knowledge management research and practice literature: 2003-2015. *Knowledge Management Research and Practice*, *16*(1), 66-77. doi:https://doi.org/10.1080/14778238.2017.1405776

van Eck, N. J., & Waltman, L. (2010). Software survey: VOS viewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523-538. doi:https://doi.org/10.1007/s11192-009-0146-3