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Research Article

Measuring Citation Diffusion of Selective Indian Physics and Astronomy Journals by Citation Swing Factor (CSF)

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ABSTRACT
The *h*-index, introduced by Hirsch, is based on the mutual variation between the number of cited and source items. The continuous citation accumulation process over time results in diffusion of cited items from the h-core zone to the adjacent citation-asymmetric h-excess and/or h-tail zones. The indicator Citation Swing Factor (CSF) has recently been developed to measure this diffusion process quantitatively on the basis of h-core citations, excess citations and total citations. CSF is defined as the ratio of change in FHE to change in FET, where FHE (Fractional H-core to Excess citation) indicates the ratio of h-core citations to excess citations and FET (Fractional Excess to Total citation) indicates the ratio of excess citations to total citations. The observed or experimental value of CSF as followed from the basic definition, i.e. the ratio of change in FHE to change in FET over consecutive years, results ($-R^3/he^2$) that was obtained on the basis of a theoretical calculation, where R^2, h^2 and e^2 indicate total citations, h-core citations and excess citations respectively. The later expression indicates the expected or theoretical value of CSF. This paper found observed values of CSF for fifteen esteemed Indian physics journals over the last decade (2010-2019) and compared it with the respective theoretical values. The average error over all journals for ten years is found 2.94% indicating close proximity between theoretically expected and practically observed values. Only one journal, viz. *Bulletin of the Astronomical Society of India* shows large discrepancy between expected and observed values with an average error of 14.3%.

Keywords: *h*-Index, Excess Citation, *e*-Index, R Index, Total Citation, Citation Diffusion, Citation Swing Factor, Indian Physics Journal.

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INTRODUCTION

The citation analysis is a tool for quantitative studies of science research output. Pinski and Narin[1,2] were first who applied citation analysis in a systematic way to assess institutions using a standard methodology. Eugene Garfield[3-7] illustrated in several articles the potentialities of citation analysis in the evaluation of research faculty. According to Price,[8] citation patterns in research articles indicate the research front in a particular subject domain. The citation is a recognition of intellectual works that is reckoned as principal rewards of science.[9] Other viewpoints recommend that publishing papers is a means of protecting an individual's intellectual property rights, or it is a way to convince others to accept certain ideas.[10] The usual citation-based metrics like *h*-index or Eigenfactor have recently been complemented by alternative indicators,[11] mostly due to the rise of the social web and its fast uptake by scholars.[12] The accretion of citation by papers, though varies widely across disciplines, yet the diffusion of citation shows the S-curve for cumulative citations in all major science disciplines that is reckoned as a general citation diffusion model introduced by Price.[8]

Citation Swing Factor: An Indicator to Measure Citation Diffusion

The *h*-index of Hirsch is very well-known nowadays. A scientist has *h*-index equal to H if the top H of his/her N publications from a ranked list have at least H citations each.[13] Besides, there are numbers of indices developed so far known as h-type indices.[14] One of the major objectives of h-type indices were to normalise *h*-index by dividing number of publications or the age of citation (time normalization). An author or journal once receives one citation enters in the domain of the cited vs. citing graph (Figure 1) through the tail zone that is the entry point. The number of citations received may be increased in due course of time causing the said cited item gradually shifting from the tail zone towards h-core zone and h-excess zone eventually. Such a movement of a cited item in the cited vs. citing graph (Figure 1) may be termed as

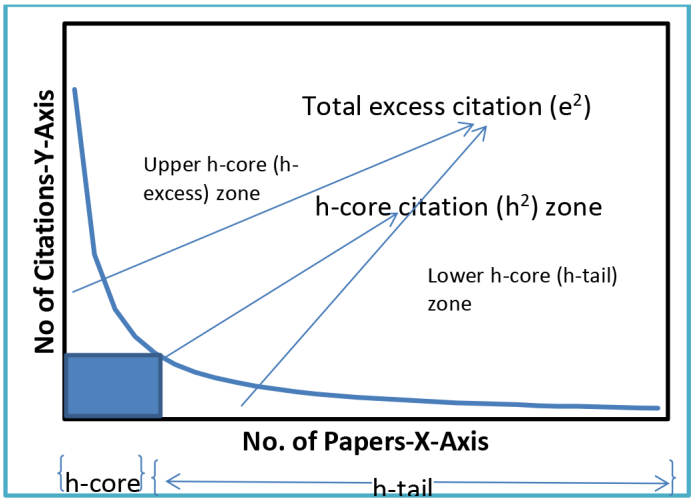

Figure 1: Three h-zones (excess, core and tail) in a cited vs. citing graph.[15]

diffusion of cited item. The indicator Citation Swing Factor (CSF) has recently been developed to measure this diffusion quantitatively,[15] which is the ratio of change in FHE (dθ) to change in FET (dε). The parameters FHE and FET indicate the fraction of h-core to excess citations and fraction of excess to total citations respectively and equivalent to the fractional h-core citations over fractional excess citations. The observed or experimental value of CSF that is followed from the basic definition is represented as (dθ/dε). Here both θ and ε are continuous variables and consequently, both FHE and FET are also continuous variables. The differentiation of θ with respect to ε yielded the value ($-R^3/he^2$), where R^2, h^2 and e^2 indicate total citations, h-core citations and excess citations respectively.[16,17] The indicator CSF thus points out the shift of h-core citations with respect to fold of excess citations to total citations, which in turn, Figures the citation shift from h-core to h-excess zone.

Aims of the Study

A new indicator Citation Swing Factor (CSF) has recently been developed[15] to measure the diffusion of cited items (authors, journals, institutions etc.) from h-tail zone to h-core zone and subsequently from h-core zone to h-excess zone by continuously receiving citations. It is axiomatic that the citation accretion process is an incessant time-dependent phenomenon, which results a shift of cited items from the h-tail to h-excess zones via the central h-core zone. The h-tail and h-excess zones are asymmetric while the h-core zone is a symmetric zone, as h-tail zone represents large number of low-cited papers whereas the h-excess zone represents small number of high-cited papers. But the h-core zone, a square-shaped symmetric box, represents 'h' number of papers received 'h' citations. This paper aims to find out observed values of CSF for fifteen esteemed Indian physics and astronomy journals over the last decade (2010-2019) and to compare the same consequently with the respective calculated theoretical values. The main objective of this study is to practically testify the formulation of the new indicator Citation Swing Factor.

Formulation of the Problem

The excess citations received by all articles in the h-core zone, which is denoted by e^2 (Figure 1), may be represented as:

$$e^2 = \sum(C_j - h) = \sum C_j - h^2 \ (1 \le j \le h) \quad (1)$$

Where c_j are the citations received by the j^{th} paper and e^2 denotes the excess citations within the h-core zone. Assuming,

$$d^2 = \sum C_j \quad (2)$$

It is obtained, $d^2 = e^2 + h^2$; (3)

Here $e \ge 0$ and e is a real number.

Or $$e = \sqrt{(d^2 - h^2)} \quad (4)$$

The relationship between h and e, as expressed in equation (3) and equation (4), instantly depicts a plane spanned by two axes, h and e, or h-e plane. Now, an arbitrary point in the h-e plane represents the overall information of citations received by all papers in the h-core. It is interesting to point out that the Euclidean distance between the origin and the point P(h,e) is equal to

$$R = \sqrt{(h^2 + e^2)} = d \quad (5)$$

The X-axis and Y-axis represent a number of publications and citations, respectively. The area under the rectangular hyperbolic curve (Figure 1) represents the total number of citations received, which is segmentized into three components. The *h*-core citation is represented by the shaded square (h^2) area, while the total excess citation is scattered outside the shaded square area, under the curve (Figure 1) separated into two segments by the h^2-zone, viz. upper h-core zone and lower h-core zone. The upper and lower h-core zones residing adjacent to Y-axis and X-axis, together represent the total number of excess citations or net excess citations over h-core citations. The number of citations in the lower h-core zone is also known as Tail Citation.[16,17] Broadly speaking, tail citation also belongs to the category of excess citation, but as it consists of a large number of publications received a low number of citations (1, 2, 3 ....), therefore the name 'Tail' resembling trough of the graph. The citations in the upper h-core zone are also known as an h-core excess citation[16,17] that distinguishes it from its 'Tail' counterpart. The h-core citation indicates the cluster of h-h citations vs. papers, which is the result of the accumulation of 'h' citations over at least 'h' papers. Larger the area of h^2 (Figure 1), the value of *h*-index will be proportionately greater. For any fixed total number of citations, the steady increase in the value

of h-core citations (h^2) would gradually reduce the excess citation (e^2). The *h*-core citations echo the concentration of citations through clustering over 'h' number of core values. On the contrary, the excess citations portray the scattering of citations outside the h-core or h^2 domain. The relative share of h-core citation and excess citation in the corpus of total citation depicts the relative centralization and scattering phenomenon of citation over time.

Now,

$$\varepsilon^2 = \frac{e^2}{R^2} = \frac{\text{Excess Citation}}{\text{Total Citation}} = \frac{\text{Excess Citation}}{\text{(h-core citation + excess citation)}}$$

so that,

$$\varepsilon = \frac{e}{R} = \frac{e}{\sqrt{(h^2+e^2)}} = \frac{e}{\sqrt{e^2\left(1+\frac{h^2}{e^2}\right)}} = \left(1+\frac{h^2}{e^2}\right)^{-\left(\frac{1}{2}\right)} \quad (6)$$

Also. $\theta^2 = \frac{h^2}{e^2}$, so, $\theta = \frac{h}{e}$.....(7) and substituting in equation (6)

It is obtained, . $\varepsilon = (1+\theta^2)^{-\frac{1}{2}}$.....(8) (Only positive roots are considered here)

If h-core citation << Excess citation, i.e. $\theta < 1$, which may occur for relatively small h-core citation or *h*-index and high excess citation or *e*-index, then

$$\varepsilon = 1 - \frac{\theta^2}{2} + \frac{3}{8}\theta^4 - \frac{5}{16}\theta^6 + \ldots\ldots \approx 1 - \frac{\theta^2}{2} \quad \text{.....(8A)}$$ (obtained from equation (8) by applying Maclaurin's expansion theorem and neglecting small quantities of higher order),

or $\theta = \sqrt{2(1-\varepsilon)}$ .....(9) (Taking positive root only)

Differentiating both sides of equation (9) with respect to ε, it is obtained[15],

$$\frac{d\theta}{d\varepsilon} = \text{Citation Swing Factor (CSF)} = -\frac{1}{\theta\varepsilon^3} = -\frac{R^3}{he^2} \quad \text{.....(10)}$$

The $\frac{d\theta}{d\varepsilon}$ is represented by CSF(Observed) or CSF(O), while $\left(-\frac{R^3}{he^2}\right)$ is represented by CSF(Expected) or CSF(E). The observed values are calculated directly from the available data for the fifteen journals (Table) while the expected values are calculated on the basis of the derived formula $\left(-\frac{R^3}{he^2}\right)$ (Equation (10)).

Hypothesis Formulated

The following ten null hypotheses (H_0) grouped into four categories have been formulated for this study. The first and second categories including two null hypotheses each state the constancy of FET and FHE respectively both for eleven consecutive years (2009-2019) and twelve journals respectively. The third category including four null hypotheses state the constancies of CSF(O) and CSF(E) both for eleven consecutive years (2009-2019) and twelve journals. The fourth category including two null hypotheses has stated the equalities between CSF(O) and CSF(E) both for eleven consecutive years (2009-2019) and twelve journals.

It is to be noted that, although the numerical values of FET, FHE, CSF(O) and CSF(E) presented in Table 1 to Table 4 include fifteen journals, but the following ten null hypotheses are tested for twelve journals only. As the *Scopus* has not indexed the 2018-19 data for *Indian Journal of Radio and Space Physics* and the 2010-14 data for *Journal of Vibrational Engineering and Technologies*, and also the journal entitled *Bulletin of the Astronomical Society of India*, was discontinued on and from 2015, therefore the data for these three journals are not fully comprehensive over the stipulated time span. The testing of hypotheses has been executed by ANOVA (F-Test) method and T-test method, which are presented in Table 5 and Table 6. The Hypothesis No. 4 is tested by T-test for the sample mean. The results of the testing of hypotheses for the eleven consecutive years from 2009 to 2019 are presented in Table 5, while the same for the twelve said journals are presented in Table 6.

Hypothesis 1

H_0(1.1): The *e*-index bears a constant ratio with R-Index, i.e. FET (ε) remains constant for eleven years (2009-19)

H_0(1.2): The *e*-index bears a constant ratio with R-Index, i.e. FET (ε) remains constant for twelve physics and astronomy journals considered for this study

Hypothesis 2

H_0(2.1): The *h*-index bears a constant ratio with *e*-Index, i.e. FHE (θ) remains constant for eleven years (2009-19)

H_0(2.2): The *h*-index bears a constant ratio with *e*-Index, i.e. FHE (θ) remains constant for twelve physics and astronomy journals considered for this study

Hypothesis 3

H_0(3.1): The numerical values of CSF (O) are constant for the twelve physics and astronomy journals

H_0(3.2): The numerical values of CSF (O) are constant for the ten consecutive years (2010-2019)

H_0(3.3): The numerical values of CSF (E) are constant for the twelve physics and astronomy journals

H_0(3.4): The numerical values of CSF (E) are constant for the ten consecutive years (2010–2019)

Hypothesis 4

H_0(4.1): The numerical values of CSF (O) for twelve physics and astronomy journals are equal to the numerical values of CSF(E) for the same

H_0(4.2): The numerical values of CSF (O) for ten consecutive years (2010–2019) are equal to the numerical values of CSF(E) for the same.

SCOPE AND METHODOLOGY

This paper has found out the observed numerical values of Citation Swing Factor or ($d\theta/d\varepsilon$) (as deduced in equation (10)) for fifteen esteemed Indian physics journals over the last decade (2010–2019) and compared it with the respective theoretical numerical values or $-\frac{R^3}{he^2}$. Of the fifteen journals, eight journals belong to core domain of physics and astronomy (S. No. 1, 3, 5, 6, 7, 8, 10 and 13), while five journals belong to allied interdisciplinary areas of physics but publish articles on physics regularly (S. No. 2, 4, 9, 11 and 12). The last two journals belong to entire natural science discipline but publish physics articles on regular basis. These two journals are very old and esteemed Indian science journals.

The number of papers published in each journal from 2009 to 2019 along with total citations, h-core citations and excess citations are noted down at first. The number of published papers along with the corresponding number of citations received for each of the fifteen said journals for all the consecutive years from 2009 to 2019 have been collected from *Scopus* database. On the basis of these data, the h-core and h-excess citations are calculated to find out FET and FHE. The annual changes in the values of FHE and FET yielded $d\theta$ and $d\varepsilon$ respectively. The ratio of $d\theta$ to $d\varepsilon$ or $d\theta/d\varepsilon$ gives the observed value of CSF, which is compared with the theoretical value, i.e. $-R^3/he^2$, where R^2, h^2 and e^2 indicate total citations, h-core citations and h-core excess citations respectively.[16,17] The titles of the physics and astronomy journals published from India selected for this study is furnished below with the respective abbreviations given in the adjacent parenthesis.

1. Bulletin of the Astronomical Society of India (BASI)
2. Defence Science Journal (DSJ)
3. Indian Journal of Biochemistry and Biophysics (IJBB)
4. Indian Journal of Engineering and Materials Sciences (IJEMS)
5. Indian Journal of Physics (IJP)
6. Indian Journal of Pure and Applied Physics (IJPAP)
7. Indian Journal of Radio and Space Physics (IJRSP)
8. Journal of Astrophysics and Astronomy (JAA)
9. Journal of Earth System Science (JESS)
10. Journal of Medical Physics (JMP)
11. Journal of Scientific and Industrial Research (JSIR)
12. Journal of Vibrational Engineering and Technologies (JVET)
13. Pramana – Journal of Physics (PJP)
14. Proceedings of the Indian National Science Academy (PINSA)
15. Proceedings of the National Academy of Sciences India Section A – Physical Sciences (PNASI)

RESULTS AND ANALYSIS

The numerical data representing both temporal variations and journal-wise variations of FET, FHE, CSF(O), CSF(E) and Percentage Errors of fifteen journals are presented in Table 1, 2, 3, 4 and 7 respectively and the variational patterns of FET, FHE, CSF(O), CSF(E) and Percentage Errors for fifteen said journals are graphically presented in Figures 2, 3, 4, 5 and 6 respectively. The values of FET, FHE and CSF are calculated from total citations, h-core citations and h-core excess citations of fifteen journals. The numerical Figures of FET, FHE, CSF(O), CSF(E) and Percentage Errors for the individual journals are presented in Table 8 to Table 22 (Appendix).

The overall average values of FET and FHE for fifteen journals are 0.86 and 0.59 with average standard deviations 0.05 and 0.13 respectively. Also, the overall average values of FET and FHE for eleven consecutive years from 2009 to 2019 are 0.86 and 0.59 with average standard deviations 0.04 and 0.12 respectively. The overall average values of CSF(O) and CSF(E) for fifteen journals are 2.72 and 2.77 with average standard deviations 0.12 and 0.21 respectively. Again, the overall average values of CSF(O) and CSF(E) for eleven consecutive years from 2009 to 2019 are 2.71 and 2.75 with average standard deviations 0.13 and 0.21 respectively. The average percentage error for fifteen journals Figures 2 with an average standard deviation 2.61.

The value of FET ranges from 0.7 to 1 indicating proximal Figures of excess citation with respect to total citation. The value of FHE ranges from 0.1 to 1, which indicates the fraction of h-core citation with respect to excess citation widely varies compared to the variation of excess citation with respect to total citation. Both of the observed and expected values of Citation Swing Factor (CSF) range from 2.5 to 3 indicating

Table 1: Variations of FET (ε).

Journals / Year	BASI	DSJ	IJBB	IJEMS	IJP	IJPAP	IJRSP	JAA	JESS	JMP	JSIR	JVET	PINSA	PJP	PNASI
2009	0.99	0.89	0.83	0.85	0.89	0.87	0.84	0.74	0.82	0.84	0.87		0.71	0.88	0.87
2010	0.74	0.83	0.83	0.82	0.87	0.87	0.87	0.89	0.86	0.92	0.88		0.89	0.88	0.84
2011	0.91	0.84	0.85	0.81	0.86	0.86	0.79	0.82	0.84	0.81	0.86		0.88	0.86	0.77
2012	0.82	0.83	0.84	0.78	0.90	0.85	0.82	0.79	0.84	0.89	0.84		0.81	0.85	0.85
2013	0.96	0.82	0.82	0.86	0.90	0.86	0.82	0.85	0.87	0.84	0.89		0.77	0.86	0.92
2014	0.98	0.85	0.85	0.85	0.90	0.86	0.82	0.88	0.90	0.79	0.89	0.71	0.83	0.93	0.77
2015		0.84	0.91	0.80	0.86	0.88	0.85	0.87	0.87	0.85	0.91	0.86	0.85	0.90	0.85
2016		0.85	0.88	0.82	0.88	0.89	0.71	0.87	0.89	0.83	0.87	0.90	0.86	0.92	0.85
2017		0.87	0.85	0.89	0.85	0.87	0.71	0.80	0.88	0.88	0.72	0.87	0.87	0.89	0.85
2018		0.89	0.88	0.86	0.89	0.89		0.88	0.92	0.82	0.86	0.85	0.91	0.90	0.89
2019		0.88	0.92	0.87	0.91	0.93		0.85	0.95	0.95	0.89	0.89	0.91	0.89	0.92
Mean	0.90	0.85	0.86	0.84	0.88	0.87	0.80	0.84	0.88	0.86	0.86	0.85	0.85	0.89	0.85
Standard Deviation	0.10	0.03	0.03	0.03	0.02	0.02	0.06	0.05	0.04	0.05	0.05	0.07	0.06	0.03	0.05

Table 2: Variations of FHE (θ).

Journal / Year	BASI	DSJ	IJBB	IJEMS	IJP	IJPAP	IJRSP	JAA	JESS	JMP	JSIR	JVET	PINSA	PJP	PNASI
2009	0.10	0.51	0.67	0.62	0.52	0.58	0.65	0.91	0.69	0.64	0.56		0.98	0.55	0.58
2010	0.90	0.68	0.68	0.71	0.57	0.58	0.56	0.51	0.59	0.44	0.54		0.51	0.54	0.65
2011	0.47	0.65	0.61	0.73	0.58	0.59	0.79	0.71	0.65	0.72	0.60		0.55	0.60	0.83
2012	0.69	0.66	0.64	0.80	0.49	0.62	0.69	0.77	0.65	0.52	0.64		0.72	0.62	0.63
2013	0.28	0.70	0.69	0.59	0.49	0.59	0.69	0.62	0.56	0.64	0.50		0.82	0.61	0.43
2014	0.19	0.61	0.61	0.61	0.48	0.60	0.69	0.53	0.49	0.77	0.50	1.00	0.67	0.40	0.83
2015		0.64	0.47	0.74	0.58	0.55	0.61	0.58	0.58	0.63	0.45	0.60	0.61	0.49	0.63
2016		0.62	0.55	0.70	0.54	0.51	1.00	0.57	0.52	0.66	0.56	0.47	0.59	0.44	0.63
2017		0.56	0.62	0.50	0.62	0.58	1.00	0.76	0.53	0.54	0.96	0.57	0.58	0.51	0.61
2018		0.50	0.54	0.60	0.51	0.52		0.55	0.42	0.71	0.59	0.62	0.46	0.49	0.52
2019		0.54	0.44	0.58	0.46	0.39		0.63	0.32	0.33	0.52	0.51	0.46	0.51	0.43
Mean	0.44	0.61	0.59	0.65	0.53	0.56	0.74	0.65	0.55	0.60	0.58	0.63	0.63	0.52	0.61
Standard Deviation	0.31	0.07	0.08	0.09	0.05	0.06	0.16	0.12	0.11	0.13	0.14	0.19	0.16	0.07	0.13

near-constancy of CSF for the fifteen stipulated Indian physics and astronomy journals over the last decade (2010-'19). The close proximity of observed and expected values of CSF as signalled by low percentage error (2.74%) has established the theoretical background of the indicator CSF. It is interesting to note that, only one journal viz. *Bulletin of the Astronomical Society of India*, shows discrepancy in the values of FET, FHE and CSF. The high asymmetric citation pattern of this journal, i.e. very few articles received extremely large number of citations with large number of articles leaving uncited, which may be the reason behind this aberration. The percentage error for this journal is also highest, i.e. 14.4% indicating broad variations of CSF values over the years along with the remoteness between theoretical and practically observed CSF values. Besides, other 14 journals show consistent values of FET, FHE and CSF.

It is observed from Table 5 and Table 6, of the ten null hypothesis formulated in total, four null hypotheses [H_0(1.2),

Table 3: Variations of CSF(O) [The magnitude is taken only].

Journal / Year	BASI	DSJ	IJBB	IJEMS	IJP	IJPAP	IJRSP	JAA	JESS	JMP	JSIR	JVET	PINSA	PJP	PNASI
2010	3.18	2.66	2.60	2.61	2.71	2.67	2.64	2.64	2.62	2.74	2.70		2.66	2.71	2.64
2011	2.66	2.61	2.61	2.60	2.67	2.66	2.62	2.65	2.63	2.70	2.68		2.74	2.68	2.61
2012	2.69	2.61	2.62	2.61	2.73	2.64	2.60	2.60	2.61	2.64	2.63		2.63	2.63	2.61
2013	2.92	2.60	2.61	2.61	2.82	2.64	2.60	2.60	2.64	2.67	2.68		2.61	2.63	2.76
2014	4.60	2.61	2.61	2.64	2.83	2.65	2.60	2.67	2.75	2.60	2.79		2.61	2.81	2.68
2015		2.62	2.73	2.61	2.74	2.67	2.61	2.69	2.73	2.60	2.85	2.66	2.62	2.95	2.61
2016		2.62	2.78	2.60	2.69	2.73	2.66	2.67	2.71	2.61	2.79	2.73	2.64	2.89	2.62
2017		2.66	2.66	2.66	2.67	2.71		2.62	2.74	2.65	2.65	2.75	2.66	2.86	2.63
2018		2.74	2.67	2.71	2.69	2.71		2.62	2.85	2.64	2.65	2.65	2.76	2.80	2.68
2019		2.75	2.83	2.66	2.83	2.93		2.66	3.27	2.83	2.70	2.69	2.90	2.80	2.86
Mean	3.21	2.65	2.67	2.63	2.74	2.70	2.62	2.64	2.75	2.67	2.71	2.70	2.68	2.78	2.67
Standard Deviation	0.81	0.06	0.08	0.04	0.07	0.09	0.02	0.03	0.20	0.07	0.07	0.04	0.09	0.11	0.08

Table 4: Variations of CSF(E) [The magnitude is taken only].

Journal / Year	BASI	DSJ	IJBB	IJEMS	IJP	IJPAP	IJRSP	JAA	JESS	JMP	JSIR	JVET	PINSA	PJP	PNASI
2010	2.70	2.60	2.60	2.60	2.68	2.67	2.69	2.76	2.65	2.97	2.72		2.77	2.71	2.61
2011	2.88	2.61	2.63	2.60	2.66	2.65	2.62	2.60	2.61	2.60	2.65		2.71	2.64	2.65
2012	2.60	2.61	2.62	2.63	2.82	2.63	2.60	2.61	2.61	2.75	2.61		2.60	2.63	2.62
2013	3.97	2.60	2.60	2.66	2.81	2.65	2.60	2.62	2.69	2.62	2.79		2.64	2.64	3.01
2014	5.55	2.63	2.63	2.63	2.85	2.64	2.60	2.73	2.82	2.61	2.80		2.60	3.11	2.65
2015		2.61	2.88	2.60	2.66	2.71	2.63	2.66	2.67	2.62	2.92	2.64	2.63	2.82	2.62
2016		2.63	2.71	2.60	2.72	2.77	2.83	2.68	2.76	2.61	2.69	2.86	2.65	2.98	2.62
2017		2.69	2.63	2.79	2.63	2.66		2.61	2.73	2.72	2.78	2.67	2.67	2.77	2.63
2018		2.79	2.72	2.65	2.77	2.76		2.71	3.02	2.60	2.65	2.63	2.89	2.82	2.75
2019		2.72	2.97	2.67	2.89	3.17		2.62	3.60	3.51	2.76	2.78	2.90	2.78	3.00
Mean	3.54	2.65	2.70	2.64	2.75	2.73	2.65	2.66	2.81	2.76	2.74	2.72	2.71	2.79	2.72
Standard Deviation	1.25	0.06	0.13	0.06	0.09	0.16	0.08	0.06	0.30	0.29	0.09	0.10	0.11	0.16	0.16

$H_0(2.2)$, $H_0(3.3)$ and $H_0(4.2)$] are accepted at 1% level of significance. Only the null hypothesis $H_0(3.3)$ is accepted at 5% of level of significance also. Other null hypotheses are rejected at both 5% and 1% levels of significance. The correlation analysis between CSF(O) and CSF(E) yielded the values of the Correlation Coefficients (r_{xy}) as 0.967 (for yearwise study) and 0.88 (for journalwise study), which indicates strong positive correlation between the numerical values of CSF(O) and CSF(E). Since $H_0(1.2)$ is accepted, the *e*-index bears a constant ratio with R-index for twelve journals (excluding BASI, IJRSP and JVET). Also, *h*-index bears a constant ratio with *e*-index for the same sample, as $H_0(2.2)$ is accepted. The numerical values of CSF(E) for the same sample are equal, as $H_0(3.3)$ is accepted. The acceptance of $H_0(4.2)$ and the strong positive correlation coefficients has established the validity of the Equation (10), i.e. the accuracy of the theoretical background of the concept of Citation Swing Factor is proved here.

Table 5: Testing of hypothesis for population means of FET, FHE, CSF(O) and CSF(E) for the eleven consecutive years from 2009 to 2019.

Indicators	F_O/ t_o	Value of P	F_C/ t_C	α (Level of Significance)	Observation	Inference: Null Hypothesis (H_0) is
FET	3.474	0.00048	1.909	0.05 (at 5% level of significance)	$F_C < F_O$; P < α	H_0(1.1) is Rejected
			2.471	0.01 (at 1% level of significance)		
FHE	3.523	0.00041	1.909	0.05 (at 5% level of significance)	$F_C < F_O$; P < α	H_0(2.1) is Rejected
			2.471	0.01 (at 1% level of significance)		
CSF(O)	5.29	0.00005	1.966	0.05 (at 5% level of significance)	$F_C < F_O$; P < α	H_0(3.2) is Rejected
			2.573	0.01 (at 1% level of significance)		
CSF(E)	5.357	0.00005	1.966	0.05 (at 5% level of significance)	$F_C < F_O$; P < α	H_0(3.4) is Rejected
			2.573	0.01 (at 1% level of significance)		
Whether CSF(O) = or ≈ CSF(E) ?? (tested by T-Test and Correlation Analysis respectively)	t_O = 2.308	0.0232	t_C = 1.833	0.05 (at 5% level of significance)	$t_C < t_O$; P < α	H_0(4.2) is Rejected
			t_C = 2.262	0.025 (at 2.5% level of significance)	$t_C < t_O$; P < α	
			t_C = 2.821	0.01 (at 1% level of significance)	$t_C > t_O$; P > α	H_0(4.2) is Accepted
	Pearson's Product-Moment Correlation Coefficient between CSF(O) and CSF(E) (r_{xy} = 0.967)				The value of r_{xy} is very close to one, which indicates 'Strong correlation' or very close proximity between CSF(O) and CSF(E)	

F_C/ t_C - $F_{Critical}$/ $t_{Critical}$; α - Level of Significance Value; F_O/ t_O - $F_{Observed}$/ $t_{Observed}$; P - *P*-Value; H_0 - Null Hypothesis; df(bg) - Degrees of Freedom (Between groups) = 11; df(wg) - Degrees of Freedom (Within groups) = 120

Table 6: Testing of hypothesis for population means of FET, FHE, CSF(O) and CSF(E) for the twelve journals.

Indicators	F_O	Value of P	F_C	α (Level of Significance)	Observation	Inference: Null Hypothesis (H_0) is
FET	1.892	0.0468	1.869	0.05 (at 5% level of significance)	$F_C < F_O$; P < α	H_0(1.2) is Rejected
FET	1.892	0.0468	2.399	0.01 (at 1% level of significance)	$F_C > F_O$; P > α	H_0(1.2) is Accepted
FHE	1.877	0.0489	1.869	0.05 (at 5% level of significance)	$F_C < F_O$; P < α	H_0(2.2) is Rejected
FHE	1.877	0.0489	2.399	0.01 (at 1% level of significance)	$F_C > F_O$; P > α	H_0(2.2) is Accepted
CSF(O)	2.547	0.0067	1.878	0.05 (at 5% level of significance)	$F_C < F_O$; P < α	H_0(3.1) is Rejected
			2.416	0.01 (at 1% level of significance)		
CSF(E)	1.154	0.328	1.878	0.05 (at 5% level of significance)	$F_C > F_O$; P > α	H_0(3.3) is Accepted
CSF(E)			2.416	0.01 (at 1% level of significance)		
Whether CSF(O) = or ≈ CSF(E) ?? (tested by T-Test and Correlation Analysis respectively)	t_O = 4.207	0.00074	t_C = 1.796	0.05 (at 5% level of significance)	$t_C < t_O$; P < α	H_0(4.1) is Rejected
			t_C = 2.201	0.025 (at 2.5% level of significance)		
			t_C = 2.718	0.01 (at 1% level of significance)		
	Pearson's Product-Moment Correlation Coefficient between CSF(O) and CSF(E) (r_{xy} = 0.880)				The value of r_{xy} is little dispersed from one here, but still it indicates 'Strong correlation' and close proximity between CSF(O) and CSF(E)	

F_C/ t_C - $F_{Critical}$/ $t_{Critical}$; α - Level of Significance Value; F_O/ t_O - $F_{Observed}$/ $t_{Observed}$; P - P-Value; H_0 - Null Hypothesis; df(bg) - Degrees of Freedom (Between groups) = 11; df(wg) - Degrees of Freedom (Within groups) = 120

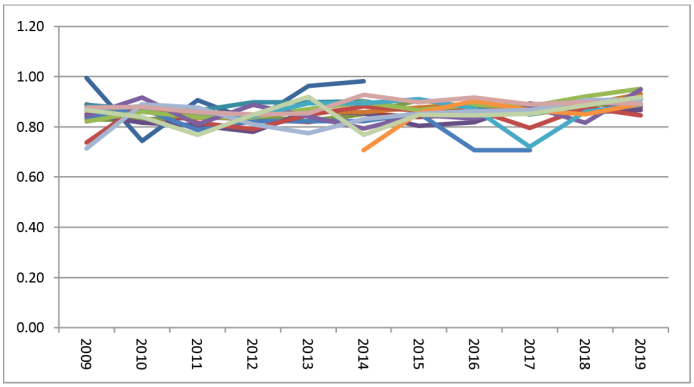

Figure 2: Temporal Variation of FET (ε) for fifteen journals.

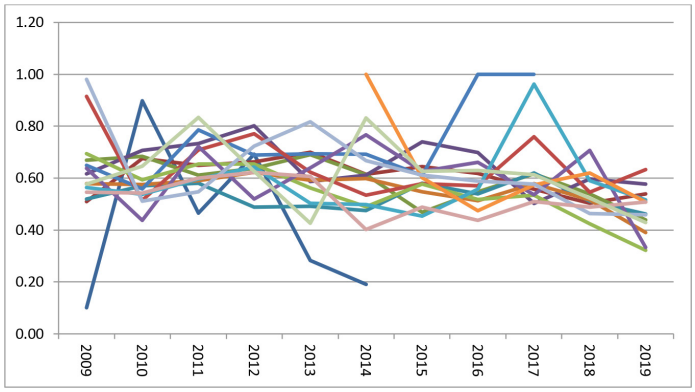

Figure 3: Temporal Variation of FHE (θ) for fifteen journals.

Table 7: Variations of Percentage Errors.

Journal / Year	BASI	DSJ	IJBB	IJEMS	IJP	IJPAP	IJRSP	JAA	JESS	JMP	JSIR	JVET	PINSA	PJP	PNASI
2010	17.50	2.30	0.05	0.39	1.34	0.07	1.75	4.34	1.23	7.81	0.78		3.92	0.06	0.89
2011	7.69	0.18	0.77	0.06	0.23	0.30	0.06	1.94	0.67	3.90	1.30		1.10	1.19	1.38
2012	3.41	0.09	0.30	0.58	3.19	0.47	0.17	0.34	0.01	4.06	0.57		1.15	0.33	0.44
2013	26.31	0.10	0.26	1.64	0.13	0.50	0.01	0.76	1.70	2.11	3.90		0.85	0.24	8.31
2014	17.06	0.82	0.80	0.40	0.72	0.11	0.001	2.17	2.62	0.26	0.14		0.16	9.80	1.42
2015		0.33	5.13	0.20	3.05	1.22	0.87	1.10	2.47	0.71	2.20	0.67	0.66	4.56	0.44
2016		0.33	2.77	0.03	1.11	1.15	5.94	0.21	1.78	0.30	3.58	4.48	0.42	2.75	0.04
2017		1.32	1.28	4.70	1.51	1.71		0.37	0.52	2.69	4.67	2.99	0.23	3.28	0.22
2018		1.83	1.89	2.31	3.05	1.90		3.12	5.62	1.50	0.28	0.76	4.51	0.89	2.46
2019		1.19	4.74	0.39	2.26	7.53		1.45	9.20	19.52	2.17	3.22	0.21	0.75	4.72
Mean	14.40	0.85	1.80	1.07	1.66	1.50	1.26	1.58	2.58	4.29	1.96	2.42	1.32	2.38	2.03
Standard Deviation	9.01	0.78	1.85	1.47	1.17	2.22	2.16	1.34	2.81	5.82	1.62	1.66	1.57	3.00	2.61

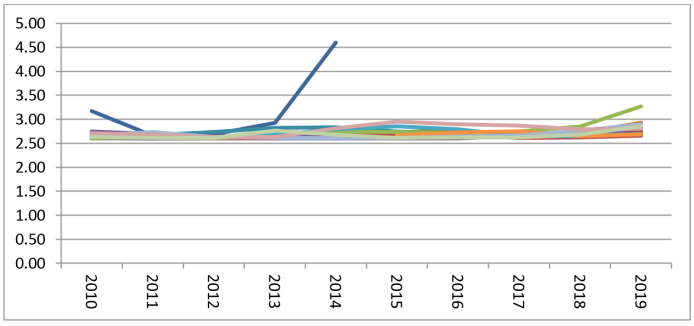

Figure 4: Temporal Variation of Citation Swing Factor (Observed) for fifteen journals.

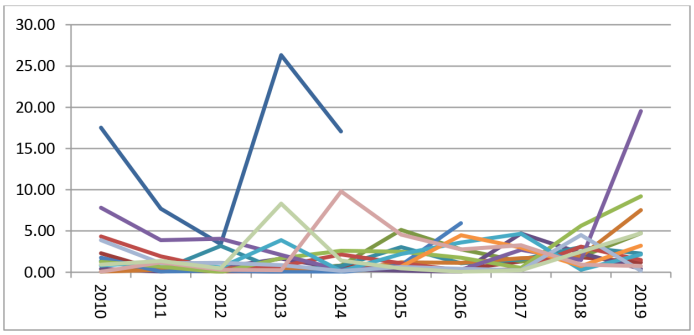

Figure 6: Temporal Variation of the Percentage Errors for fifteen journals. journals.

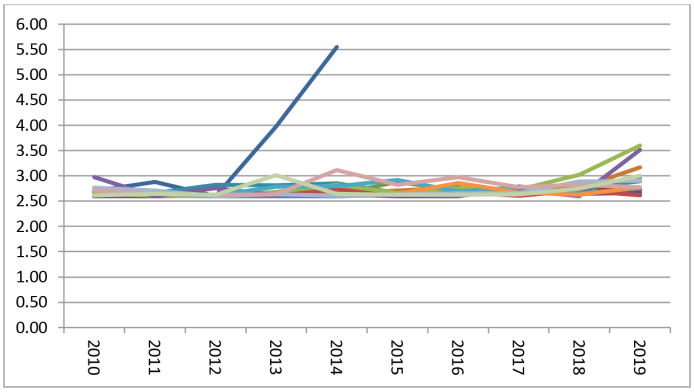

Figure 5: Temporal Variation of Citation Swing Factor (Expected) for fifteen journals.

CONCLUSION

There are some significant findings have been observed in this study. For instance, the *h*-index bears an almost constant ratio with *e*-index and consequently, the *e*-index bears a nearly constant ratio with R-index for twelve journals (excluding BASI, IJRSP and JVET). That is to say, $\frac{h}{e} \approx \frac{e}{R} \approx$ Constant (for 12 journals), which leads to the conclusion, $e \approx \sqrt{h * R}$, or *e*-index is almost equal or of the same numerical order to the geometric mean of *h*-index and R-index. The near-equality of CSF(E) for twelve journals indicates the almost identical citation accumulation pattern of the concerned journals.

In this paper, the values of a new indicator viz. Citation Swing Factor (CSF) are calculated for fifteen selected Indian physics and astronomy journals. The close proximity between practically observed and theoretically expected values justifies the theoretical background of the concept of CSF. It is found that CSF remains nearly constant for all journals with very little variation. Now, whether it may be considered as a parameter for the journals will depend on the results of further studies with other core journals from other subject domains. This study may also be extended for authors. Further studies are also required to testify whether CSF remains constant for a subject over a stipulated time period, or varies for different subjects.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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APPENDIX

Table 8: Bulletin of the Astronomical Society of India.

	2009	2010	2011	2012	2013	2014
No. of papers	7	14	31	34	17	11
Total citation (TC)	397	56	561	309	216	258
H-core citation (HC)	4	25	100	100	16	9
Net excess citation (EC)	393	31	461	209	200	249
ε=Sqrt(EC/TC) (FET)	0.995	0.744	0.907	0.822	0.962	0.982
θ=Sqrt(HC/EC) (FHE)	0.101	0.898	0.466	0.692	0.283	0.190
dε		−0.251	0.162	−0.084	0.140	0.020
dθ		0.797	−0.432	0.226	−0.409	−0.093
CSF = dθ/dε (Observed Value)		−3.177	−2.661	−2.687	−2.924	−4.601
CSF = -R^3/(h*e^2) (Expected Value)		−2.704	−2.882	−2.599	−3.968	−5.548
% Error		17.500	7.695	3.407	26.312	17.062

Table 9: Defence Science Journal.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	64	50	63	52	72	62	54	74	83	67	74
Total citation (TC)	818	539	485	396	368	365	218	362	207	178	71
H-core citation (HC)	169	169	144	121	121	100	64	100	49	36	16
Net excess citation (EC)	649	370	341	275	247	265	154	262	158	142	55
ε=Sqrt(EC/TC) (FET)	0.891	0.829	0.839	0.833	0.819	0.852	0.840	0.851	0.874	0.893	0.880
θ=Sqrt(HC/EC) (FHE)	0.510	0.676	0.650	0.663	0.700	0.614	0.645	0.618	0.557	0.504	0.539
dε		−0.062	0.010	−0.005	−0.014	0.033	−0.012	0.010	0.023	0.020	−0.013
dθ		0.166	−0.026	0.013	0.037	−0.086	0.030	−0.027	−0.061	−0.053	0.036
CSF = dθ/dε (Observed Value)		−2.661	−2.605	−2.608	−2.601	−2.610	−2.621	−2.620	−2.657	−2.736	−2.752
CSF = -R^3/(h*e^2) (Expected Value)		−2.602	−2.610	−2.605	−2.598	−2.631	−2.613	−2.629	−2.693	−2.787	−2.719
% Error		2.297	0.183	0.094	0.098	0.824	0.333	0.330	1.319	1.830	1.185

Table 10: Indian Journal of Biochemistry and Biophysics.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	72	58	59	61	74	71	43	24	32	50	60
Total citation (TC)	1291	908	719	585	697	443	139	39	58	111	99
H-core citation (HC)	400	289	196	169	225	121	25	9	16	25	16
Net excess citation (EC)	891	619	523	416	472	322	114	30	42	86	83
ε=Sqrt(EC/TC) (FET)	0.831	0.826	0.853	0.843	0.823	0.853	0.906	0.877	0.851	0.880	0.916
θ=Sqrt(HC/EC) (FHE)	0.670	0.683	0.612	0.637	0.690	0.613	0.468	0.548	0.617	0.539	0.439
dε		−0.005	0.027	−0.010	−0.020	0.030	0.053	−0.029	−0.026	0.029	0.035
dθ		0.013	−0.071	0.025	0.053	−0.077	−0.145	0.079	0.069	−0.078	−0.100
CSF = dθ/dε (Observed Value)		−2.601	−2.613	−2.624	−2.606	−2.611	−2.728	−2.781	−2.663	−2.668	−2.826
CSF = -R^3/(h*e^2) (Expected Value)		−2.600	−2.633	−2.616	−2.599	−2.632	−2.875	−2.706	−2.629	−2.720	−2.967
% Error		0.052	0.765	0.300	0.260	0.796	5.130	2.771	1.283	1.886	4.743

Table 11: Indian Journal of Engineering and Materials Sciences.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	67	63	53	44	71	88	82	47	60	59	42
Total citation (TC)	439	676	560	368	562	445	342	195	124	61	16
H-core citation (HC)	121	225	196	144	144	121	121	64	25	16	4
Net excess citation (EC)	318	451	364	224	418	324	221	131	99	45	12
ε=Sqrt(EC/TC) (FET)	0.851	0.817	0.806	0.780	0.862	0.853	0.804	0.820	0.894	0.859	0.866
θ=Sqrt(HC/EC) (FHE)	0.617	0.706	0.734	0.802	0.587	0.611	0.740	0.699	0.503	0.596	0.577
dε		−0.034	−0.011	−0.026	0.082	−0.009	−0.049	0.016	0.074	−0.035	0.007
dθ		0.089	0.027	0.068	−0.215	0.024	0.129	−0.041	−0.196	0.094	−0.019
CSF = dθ/dε (Observed Value)		−2.608	−2.599	−2.611	−2.613	−2.644	−2.607	−2.599	−2.658	−2.708	−2.656
CSF = -R^3/(h*e^2) (Expected Value)		−2.598	−2.600	−2.626	−2.656	−2.634	−2.602	−2.598	−2.790	−2.647	−2.667
% Error		0.394	0.062	0.577	1.637	0.401	0.204	0.029	4.698	2.306	0.385

Table 12: Indian Journal of Physics.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	160	181	204	169	189	190	154	171	183	172	254
Total citation (TC)	920	1178	1146	1167	1484	1219	670	750	706	584	364
H-core citation (HC)	196	289	289	225	289	225	169	169	196	121	64
Net excess citation (EC)	724	889	857	942	1195	994	501	581	510	463	300
ε=Sqrt(EC/TC) (FET)	0.887	0.869	0.865	0.898	0.897	0.903	0.865	0.880	0.850	0.890	0.908
θ=Sqrt(HC/EC) (FHE)	0.520	0.570	0.581	0.489	0.492	0.476	0.581	0.539	0.620	0.511	0.462
dε		−0.018	−0.004	0.034	−0.001	0.006	−0.038	0.015	−0.030	0.040	0.017
dθ		0.050	0.011	−0.092	0.003	−0.016	0.105	−0.041	0.081	−0.109	−0.049
CSF = dθ/dε (Observed Value)		−2.711	−2.669	−2.731	−2.818	−2.834	−2.744	−2.689	−2.667	−2.686	−2.828
CSF = -R^3/(h*e^2) (Expected Value)		−2.675	−2.663	−2.821	−2.814	−2.854	−2.663	−2.719	−2.627	−2.771	−2.894
% Error		1.343	0.229	3.193	0.130	0.724	3.049	1.111	1.507	3.053	2.262

Table 13: Indian Journal of Pure and Applied Physics.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	138	142	121	150	124	97	105	102	99	86	111
Total citation (TC)	1150	1605	989	917	755	546	433	388	255	171	68
H-core citation (HC)	289	400	256	256	196	144	100	81	64	36	9
Net excess citation (EC)	861	1205	733	661	559	402	333	307	191	135	59
ε=Sqrt(EC/TC) (FET)	0.865	0.866	0.861	0.849	0.860	0.858	0.877	0.890	0.865	0.889	0.931
θ=Sqrt(HC/EC) (FHE)	0.579	0.576	0.591	0.622	0.592	0.599	0.548	0.514	0.579	0.516	0.391
dε		0.001	−0.006	−0.012	0.011	−0.002	0.019	0.013	−0.024	0.023	0.043
dθ		−0.003	0.015	0.031	−0.030	0.006	−0.051	−0.034	0.065	−0.062	−0.126
CSF = dθ/dε (Observed Value)		−2.666	−2.660	−2.638	−2.637	−2.648	−2.673	−2.734	−2.710	−2.708	−2.930
CSF = -R^3/(h*e^2) (Expected Value)		−2.668	−2.652	−2.626	−2.651	−2.645	−2.706	−2.766	−2.665	−2.761	−3.168
% Error		0.070	0.295	0.470	0.505	0.114	1.224	1.146	1.708	1.900	7.528

Table 14: Indian Journal of Radio and Space Physics.

	2009	2010	2011	2012	2013	2014	2015	2016	2017
No. of papers	42	50	40	58	46	34	22	14	10
Total citation (TC)	216	206	317	376	151	111	59	18	8
H-core citation (HC)	64	49	121	121	49	36	16	9	4
Net excess citation (EC)	152	157	196	255	102	75	43	9	4
ε=Sqrt(EC/TC) (FET)	0.839	0.873	0.786	0.824	0.822	0.822	0.854	0.707	0.707
θ=Sqrt(HC/EC) (FHE)	0.649	0.559	0.786	0.689	0.693	0.693	0.610	1.000	1.000
dε		0.034	−0.087	0.037	−0.002	0.000	0.032	−0.147	0.000
dθ		−0.090	0.227	−0.097	0.004	0.000	−0.083	0.390	0.000
CSF = dθ/dε (Observed Value)		−2.643	−2.619	−2.604	−2.599	−2.599	−2.612	−2.660	
CSF = -R^3/(h*e^2) (Expected Value)		−2.690	−2.618	−2.599	−2.599	−2.599	−2.635	−2.828	
% Error		1.748	0.055	0.167	0.009	0.001	0.869	5.942	

Table 15: Journal of Astronomy and Astrophysics.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	14	17	116	19	30	118	47	42	72	75	50
Total citation (TC)	79	43	431	67	175	162	195	102	331	109	56
H-core citation (HC)	36	9	144	25	49	36	49	25	121	25	16
Net excess citation (EC)	43	34	287	42	126	126	146	77	210	84	40
ε=Sqrt(EC/TC) (FET)	0.738	0.889	0.816	0.792	0.849	0.882	0.865	0.869	0.797	0.878	0.845
θ=Sqrt(HC/EC) (FHE)	0.915	0.514	0.708	0.772	0.624	0.535	0.579	0.570	0.759	0.546	0.632
dε		0.151	−0.073	−0.024	0.057	0.033	−0.017	0.004	−0.072	0.081	−0.033
dθ		−0.400	0.194	0.063	−0.148	−0.089	0.045	−0.010	0.189	−0.214	0.087
CSF = dθ/dε (Observed Value)		−2.645	−2.649	−2.603	−2.605	−2.668	−2.694	−2.670	−2.617	−2.625	−2.657
CSF = -R^3/(h*e^2) (Expected Value)		−2.764	−2.598	−2.612	−2.625	−2.727	−2.664	−2.676	−2.607	−2.710	−2.619
% Error		4.336	1.941	0.337	0.755	2.172	1.098	0.215	0.372	3.119	1.451

Table 16: Journal of Earth System Science.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	59	66	88	106	121	140	127	143	135	131	235
Total citation (TC)	996	1108	1204	1473	1503	1163	1026	799	649	322	266
H-core citation (HC)	324	289	361	441	361	225	256	169	144	49	25
Net excess citation (EC)	672	819	843	1032	1142	938	770	630	505	273	241
ε=Sqrt(EC/TC) (FET)	0.821	0.860	0.837	0.837	0.872	0.898	0.866	0.888	0.882	0.921	0.952
θ=Sqrt(HC/EC) (FHE)	0.694	0.594	0.654	0.654	0.562	0.490	0.577	0.518	0.534	0.424	0.322
dε		0.038	−0.023	0.000	0.035	0.026	−0.032	0.022	−0.006	0.039	0.031
dθ		−0.100	0.060	−0.001	−0.091	−0.072	0.087	−0.059	0.016	−0.110	−0.102
CSF = dθ/dε (Observed Value)		−2.616	−2.626	−2.608	−2.640	−2.745	−2.733	−2.709	−2.743	−2.854	−3.269
CSF = -R^3/(h*e^2) (Expected Value)		−2.649	−2.608	−2.609	−2.685	−2.819	−2.668	−2.758	−2.728	−3.024	−3.600
% Error		1.230	0.668	0.005	1.701	2.616	2.473	1.781	0.525	5.619	9.200

Table 17: Journal of Medical Physics.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	40	38	35	37	35	41	40	44	45	40	40
Total citation (TC)	418	624	292	301	279	270	174	161	161	48	10
H-core citation (HC)	121	100	100	64	81	100	49	49	36	16	1
Net excess citation (EC)	297	524	192	237	198	170	125	112	125	32	9
ε=Sqrt(EC/TC) (FET)	0.843	0.916	0.811	0.887	0.842	0.793	0.848	0.834	0.881	0.816	0.949
θ=Sqrt(HC/EC) (FHE)	0.638	0.437	0.722	0.520	0.640	0.767	0.626	0.661	0.537	0.707	0.333
dε		0.073	−0.105	0.076	−0.045	−0.049	0.054	−0.014	0.047	−0.065	0.132
dθ		−0.201	0.285	−0.202	0.120	0.127	−0.141	0.035	−0.125	0.170	−0.374
CSF = dθ/dε (Observed Value)		−2.743	−2.700	−2.642	−2.670	−2.603	−2.604	−2.613	−2.651	−2.637	−2.828
CSF = -R^3/(h*e^2) (Expected Value)		−2.975	−2.599	−2.754	−2.615	−2.610	−2.623	−2.606	−2.724	−2.598	−3.514
% Error		7.806	3.898	4.062	2.109	0.263	0.712	0.299	2.688	1.499	19.525

Table 18: Journal of Scientific and Industrial Research.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	114	103	106	76	81	101	94	76	14	36	10
Total citation (TC)	2002	1447	857	492	496	607	287	207	52	62	19
H-core citation (HC)	484	324	225	144	100	121	49	49	25	16	4
Net excess citation (EC)	1518	1123	632	348	396	486	238	158	27	46	15
ε=Sqrt(EC/TC) (FET)	0.871	0.881	0.859	0.841	0.894	0.895	0.911	0.874	0.721	0.861	0.889
θ=Sqrt(HC/EC) (FHE)	0.565	0.537	0.597	0.643	0.503	0.499	0.454	0.557	0.962	0.590	0.516
dε		0.010	−0.022	−0.018	0.053	0.001	0.016	−0.037	−0.153	0.141	0.027
dθ		−0.028	0.060	0.047	−0.141	−0.004	−0.045	0.103	0.405	−0.372	−0.073
CSF = dθ/dε (Observed Value)		−2.702	−2.681	−2.628	−2.681	−2.793	−2.854	−2.789	−2.648	−2.646	−2.701
CSF = -R^3/(h*e^2) (Expected Value)		−2.723	−2.646	−2.613	−2.790	−2.797	−2.918	−2.693	−2.778	−2.653	−2.761
% Error		0.780	1.305	0.567	3.899	0.142	2.202	3.584	4.668	0.277	2.169

Table 19: Journal of Vibrational Engineering and Technologies.

	2014	2015	2016	2017	2018	2019
No. of papers	18	57	60	60	49	91
Total citation (TC)	50	241	136	101	90	122
H-core citation (HC)	25	64	25	25	25	25
Net excess citation (EC)	25	177	111	76	65	97
ε=Sqrt(EC/TC) (FET)	0.707	0.857	0.903	0.867	0.850	0.892
θ=Sqrt(HC/EC) (FHE)	1.000	0.601	0.475	0.574	0.620	0.508
dε		0.150	0.046	−0.036	−0.018	0.042
dθ		−0.399	−0.127	0.099	0.047	−0.113
CSF = dθ/dε (Observed Value)		−2.660	−2.730	−2.751	−2.647	−2.689
CSF = -R^3/(h*e^2) (Expected Value)		−2.642	−2.858	−2.671	−2.627	−2.778
% Error		0.670	4.481	2.992	0.763	3.218

Table 20: Pramana - Journal of Physics.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	178	222	188	234	174	213	191	237	184	170	201
Total citation (TC)	1260	1268	1093	1161	1205	582	748	899	818	628	591
H-core citation (HC)	289	289	289	324	324	81	144	144	169	121	121
Net excess citation (EC)	971	979	804	837	881	501	604	755	649	507	470
ε=Sqrt(EC/TC) (FET)	0.878	0.879	0.858	0.849	0.855	0.928	0.899	0.916	0.891	0.899	0.892
θ=Sqrt(HC/EC) (FHE)	0.546	0.543	0.600	0.622	0.606	0.402	0.488	0.437	0.510	0.489	0.507
dε		0.001	−0.021	−0.009	0.006	0.073	−0.029	0.018	−0.026	0.008	−0.007
dθ		−0.002	0.056	0.023	−0.016	−0.204	0.086	−0.052	0.074	−0.022	0.019
CSF = dθ/dε (Observed Value)		−2.711	−2.675	−2.634	−2.632	−2.809	−2.951	−2.893	−2.864	−2.797	−2.800
CSF = -R^3/(h*e^2) (Expected Value)		−2.713	−2.644	−2.626	−2.638	−3.114	−2.823	−2.975	−2.773	−2.822	−2.779
% Error		0.065	1.185	0.327	0.235	9.797	4.555	2.746	3.280	0.893	0.751

Table 21: Proceedings of the Indian National Science Academy.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	21	23	33	63	30	89	108	128	55	71	46
Total citation (TC)	51	77	39	236	40	467	180	249	100	51	23
H-core citation (HC)	25	16	9	81	16	144	49	64	25	9	4
Net excess citation (EC)	26	61	30	155	24	323	131	185	75	42	19
ε=Sqrt(EC/TC) (FET)	0.714	0.890	0.877	0.810	0.775	0.832	0.853	0.862	0.866	0.907	0.909
θ=Sqrt(HC/EC) (FHE)	0.981	0.512	0.548	0.723	0.816	0.668	0.612	0.588	0.577	0.463	0.459
dε		0.176	−0.013	−0.067	−0.036	0.057	0.021	0.009	0.004	0.041	0.001
dθ		−0.468	0.036	0.175	0.094	−0.149	−0.056	−0.023	−0.011	−0.114	−0.004
CSF = dθ/dε (Observed Value)		−2.661	−2.736	−2.629	−2.613	−2.608	−2.616	−2.644	−2.661	−2.760	−2.897
CSF = -R^3/(h*e^2) (Expected Value)		−2.769	−2.706	−2.599	−2.635	−2.604	−2.634	−2.655	−2.667	−2.891	−2.903
% Error		3.916	1.103	1.147	0.850	0.160	0.656	0.420	0.226	4.508	0.211

Table 22: Proceedings of the National Academy of Sciences India Section A - Physical Sciences.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of papers	49	42	40	38	13	68	61	64	83	70	82
Total citation (TC)	64	85	39	174	26	352	227	285	296	168	231
H-core citation (HC)	16	25	16	49	4	144	64	81	81	36	36
Net excess citation (EC)	48	60	23	125	22	208	163	204	215	132	195
ε=Sqrt(EC/TC) (FET)	0.866	0.840	0.768	0.848	0.920	0.769	0.847	0.846	0.852	0.886	0.919
θ=Sqrt(HC/EC) (FHE)	0.577	0.645	0.834	0.626	0.426	0.832	0.627	0.630	0.614	0.522	0.430
dε		−0.026	−0.072	0.080	0.072	−0.151	0.079	−0.001	0.006	0.034	0.032
dθ		0.068	0.189	−0.208	−0.200	0.406	−0.205	0.004	−0.016	−0.092	−0.093
CSF = dθ/dε (Observed Value)		−2.635	−2.611	−2.612	−2.763	−2.684	−2.611	−2.622	−2.626	−2.682	−2.859
CSF = -R^3/(h*e^2) (Expected Value)		−2.612	−2.647	−2.623	−3.013	−2.646	−2.623	−2.621	−2.632	−2.749	−3.001
% Error		0.892	1.376	0.442	8.313	1.425	0.444	0.042	0.222	2.461	4.718