

## ANALYSIS OF ARTICLES PUBLISHED IN THE JOURNAL OF THE KOREAN ASTRONOMICAL SOCIETY FROM 1968 TO 2021

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**Abstract:** This study presents the characteristics of publications in the Journal of Korean Astronomy Society (JKAS) from 1968 to 2021. JKAS has published 763 research articles over the past 54 years. In addition, 376 proceedings were also published with research articles. There were slight increases and decreases in the number of articles published in JKAS in the 1990s and 2000s, and in 2015 there was the highest recorded number of articles published for a given year. Since then, the number of articles has tended to decrease each year, up to and including the most recent period (2020–2021), which includes the Coronavirus pandemic. However, since theory centered research is primarily conducted without being swayed by society and policies, and that the proportion of authors belonging to educational institutions, such as universities, is high, the future direction of JKAS is encouraging. There are also positive developments including sustained researchers affiliated with international institutions at greater than approximately 23%, as well as improvements in the impact factor. Therefore, it is important to not be deterred by the decreasing trends of the quantitative aspect, but to respond positively by determining a future roadmap.

**Key words:** history and philosophy of astronomy — sociology of astronomy — publications, bibliography

### 1. INTRODUCTION

The Korean Astronomical Society (KAS) was founded at Seoul National University on March 21, 1965. At that time, Seoul National University began to produce students majoring in astronomy, and it had been a year since the Department of Space Physics was established at Sungkyunkwan University (February 1964). In 1967, the Department of Astronomy and Meteorology was established at Yonsei University, and new students were accepted in 1968. Therefore, when the Journal of the Korean Astronomical Society (JKAS) was launched in December 1968, three years after the founding of KAS, there were only a few astronomers in Korea. Publishing a journal under these circumstances would not have been an easy task. Therefore, the publishing of JKAS is regarded as a courageous decision and an event that has enabled significant progress for Korean astronomy.

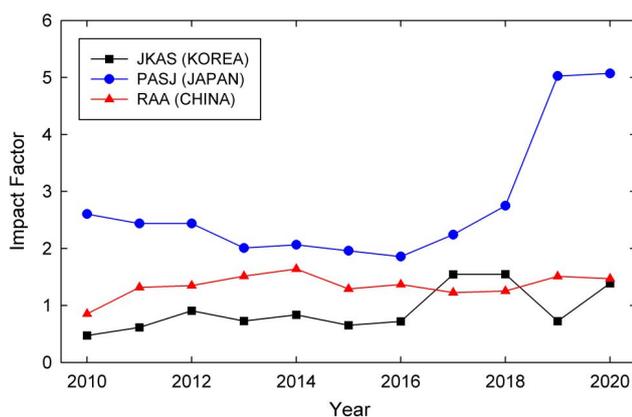
The 15th International Astronomical Union (IAU) General Assembly was held in Sydney, Australia, for approximately 10 days, from August 21 to 30, 1973. At this general meeting, KAS was approved for membership and it became an official member state of the IAU. In the following year, 1974, the National Astronomical Observatory of Korea was established, and the scope of KAS activities expanded. In the summer of 1996, the IAU Asia-Pacific regional meeting was hosted by

KAS. Institutions (both educational and research) from 24 countries participated. At this time, the conference proceedings were included in the journal as a special issue, and with these processes and results, JKAS prepared for the challenge of being accredited by the Korea Research Foundation (KRF; now Korea Citation Index or KCI). However, despite the hard work of the journal committee, JKAS instead became a candidate journal for the KRF accreditation in 1998. The fact that it became a candidate journal instead of a fully accredited journal was disappointing for its members. In 2002, the journal passed its first round of nominations, and it was selected as an accredited journal in 2003.<sup>1</sup> After selection as a KRF accredited journal, efforts were made to register it as an internationally accredited journal, and in 2007 it was selected as an SCIE journal by Thomson Reuters (now Clarivate).

The Journal of Astronomy and Space Science (established in 1984, JASS), another journal published by an astronomy-related society based in Korea, became a KRF candidate journal in 1999, a KRF accredited journal in 2001, and was included in Scopus and ESCI (Emerging Sources Citation Index; produced by Clarivate) in 2011 and 2017 respectively. It took approximately 16 years for JASS to be selected for ESCI after it achieved its status as a KRF-accredited journal (Jeon

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**Figure 1.** The impact factor (2010–2020) of JKAS (Korea, black line), PASJ (Japan, blue line), and RAA (China, red line).

& Kim 2019). However, JKAS took approximately four years to be selected as an SCI(E) from becoming a KRF-accredited journal. Despite JKAS being accredited later than JASS in Korea, it was accredited sooner internationally.

Astronomy journals with offices in Japan and China, which, together with Korea, are representative countries of East Asia, were investigated to examine the current position and influence of JKAS. Figure 1 shows the impact factor (IF) for a given year of journals with offices in Korea, Japan, and China. Publications of the Astronomical Society of Japan (PASJ), which is a publication issued by the Japanese Astronomical Society, was founded in 1949 and has been maintained for more than 70 years. In 2010, it had an IF of 2.606, which slowly decreased to 1.859 in 2016 and then sharply increased again to 5.071 in 2020. Research in Astronomy and Astrophysics (RAA), which is published by the Chinese Astronomical Society and National Astronomical Observatories, was first published in 1981 under the name *Acta Astrophysica Sinica*. In 2001, as English writing became regulated, the name of the journal was changed to the *Chinese Journal of Astronomy and Astrophysics*. In 2009, the name of the journal was changed to RAA and continues to be maintained as of the writing of this paper. RAA had an IF of 0.856 in 2010, after which the IF rose to 1.640 in 2014 and decreased to 1.469 in 2020, with slight increases and decreases throughout. Korea’s JKAS had an IF of 0.474 in 2010; thereafter the IF was more than 1.5 in 2017 (1.545) and 2018 (1.549). In 2019 the IF declined sharply to 0.725, and in 2020 JKAS had an IF of 1.390. Looking at the top ten journals on astronomy according to their current IFs, the IF should be maintained at 5.5 or higher to be competitive with these journals. The IF of PASJ is close to that of the current top journals; whilst those of JKAS and RAA are considerably lower. It is also important to note that RAA typically had a higher IF than JKAS, and these two journals exhibited, on average, a difference in IF of more than 0.5 over the past 10 years. This difference means that although JKAS has been regis-

tered as an international journal for 15 years, it is still influenced by unstable factors. Fortunately, given the journal’s rapidly increasing IF over the past three years, it can be said that JKAS has the potential to become a top journal. Therefore, to realize this possibility, it is necessary to determine the unstable factors related to JKAS to move the journal forward.

Studies on the characteristics of journals have been carried out in various fields. In relation to journals in the field of astronomy, there are cases in which articles published in PASA (Publications of the Astronomical Society of Australia), PASJ (Publications of the Astronomical Society of Japan), PASP (Publications of the Astronomical Society of the Pacific), and JASS (Journal of Astronomy and Space Sciences) have been analyzed (Mohan & Rajgoli 2017; Jeon & Kim 2019; Mohan & Kumbar 2020). In particular, they have mainly focused on the distribution of articles per year or the number of authors per article and attempted to quantitatively analyze them (Abt 2007a,b; Jeon & Kim 2019).

No previous studies have quantitatively analyzed JKAS, though in August 1997 there was one case in which JKAS was briefly mentioned by Yonghee Kang, who was the president of KAS at the time, while explaining KAS in the magazine “Science and Technology” (Kang 1997). At that time, he revealed that advanced countries were pouring out enormous support for astronomy projects. He also asserted that astronomy in Korea could receive sufficient support from public opinion as a national research project. Today, 24 years later, large-scale projects in some fields related to astronomical space have been conducted. This includes projects like a space center that has been built, and Korean launch vehicles such as Naro (known as KSLV-I) and Nuri (known as KSLV-II) that have been developed, and make use of original technology. Therefore, it can be said that Kang’s remarks at the time were very meaningful assertions, and it shows how influential the role of KAS and the functions of JKAS were. In 2015, a 50-year history of KAS was published, and the history of JKAS was briefly explained.

To consider the future of JKAS, it is important to analyze the characteristics of articles published in journals. An analysis of research topics creates an understanding of which studies were important trends at different times, thus enabling the prediction of future trends. By examining the characteristics of the past, it will become feasible to set higher goals for the development of the journal. Therefore, a quantitative analysis of the journal will have a significant impact.

We collected all articles published in JKAS for a total of 54 years, from 1968 to 2021. Subsequently, a quantitative analysis was performed by creating a database of the collected articles. In this study, we examined three characteristic criteria: quantitative changes, the authors and affiliated institutions, and the word frequency of the abstracts included in the papers. In the case of word frequency, we utilized word clouds to perform visual analysis, which is a technique that has been actively used in the field of social sciences in

recent years. Finally, we conclude by making suggestions for the direction of JKAS based on the analysis of these characteristics.

## 2. METHOD

### 2.1. Data

Articles published in JKAS over 54 years, from 1968 to 2021, were collected. JKAS is divided into research, commentary, reviews, and proceedings, with samples from all categories collected for this study. The KAS website was used for the data collection, and the publication data present on the server can be viewed by anyone using a search service.<sup>2</sup> To efficiently classify and analyze these articles, we categorized and organized them according to specific criteria, which will be explained below.

### 2.2. Method

We partially referred to the methods described by Cho & Kim (2014) and Jeon & Kim (2019). Collected articles were classified and organized according to the following criteria: 1) volume, issue, and publication year of the article, with the issues being divided into general and special issues. 2) Name of author(s), affiliation, and country of affiliated institution. 3) Form of the article, i.e., research article, commentary article, review article, or proceeding. In this study, all articles except proceedings were analyzed. Of the 1,141 total articles, 763 articles were selected, with the remaining 378 articles being proceedings (see Section 3.1). 4) Words used in the entire abstract. The classified items were then quantitatively analyzed.

Author(s) were divided into major authors (first and corresponding authors) and co-authors. The number of authors was used to examine the number of publications and trends per major author and co-author.

Keyword analysis was performed using the collected abstracts. For this, a program was used to select the top 10 words with the highest frequency using the word-counter method. Words such as articles and conjunctions were excluded from the analysis and only nouns or verbs related to astronomical terms were extracted (such as observe, collect, analyze etc.). In addition, a word-cloud analysis technique was applied. This is a visualization technique that selects keywords and expresses them as images and is frequently used in the field of social sciences.

## 3. RESULT

### 3.1. Characteristics of Quantitative Variation

JKAS published 1,141 articles in approximately 54 years, from 1968 to 2021. The articles can be broadly divided into general and special issues. General issues can be further divided into research, commentary, reviews, and proceedings. The proceedings were similar to special issues and were published together with research articles without any separate classification. In

## ANALYSIS ON THE PHOTOMETRIC ORBIT OF DI PEGASI

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### ABSTRACT

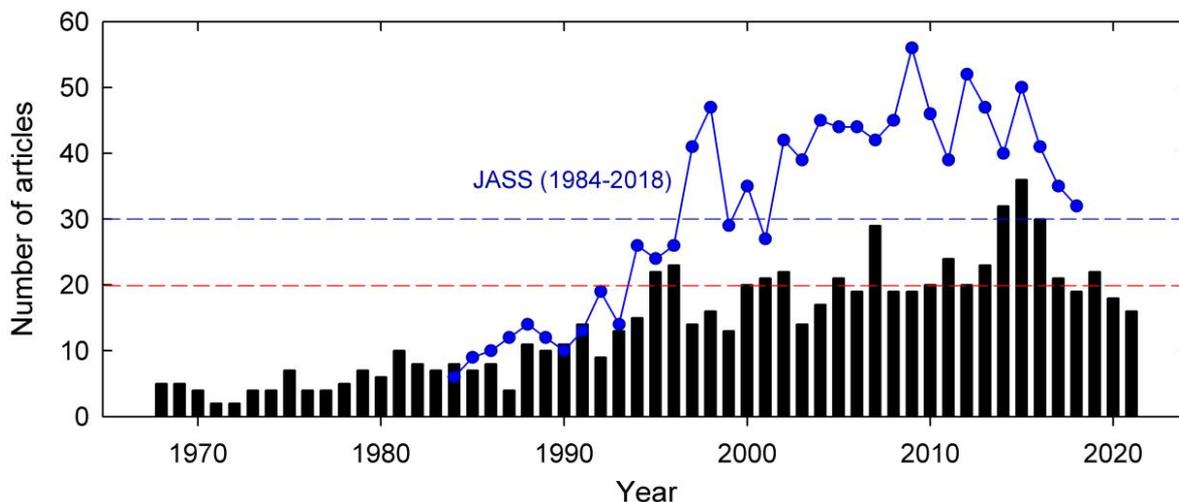
The photometric orbital elements of an Algol-type eclipsing variable, DI Pegasi, are derived by means of Fourier transforms from two-color photoelectric observations. The system shows a long term variation of its orbital period, which is interpreted as due to a continuing mass loss mechanism from the secondary component. Physical dimensions and a model of the system are also suggested here.

Figure 2. JKAS Volume 1, Issue 1, 1–18, 1968.

total, 231 proceedings were published in the special issues in 1996 (178), 2001 (32), and 2003 (21). Proceedings were confirmed to have been published for a total of three years, 2003, 2004, and 2005, which can be checked through the footnote and source at the end of the article. In 2003 (Volume 36), 14 proceedings were published in Issue 3. This issue consists of research presentations on the structure of galaxies at the Asia-Pacific Center for Theoretical Physics workshop. In 2004 (Volume 37), 19 proceedings were included in Issue 4. This issue consists of research presentations conducted at the 2nd Korea-Mexico Alliance Workshop. Issue 5 of 2004 (Volume 37) also included a total of 50 proceedings consisting of research presentations on the topics of cosmic rays and magnetic fields in large-scale structures, which were presented at the 3rd Korean Astrophysical Workshop. In 2005 (Volume 38), 64 proceedings were published in Issue 2. This issue consists of research presentations from the 6th East Asian Astronomy Meeting, which was held at Seoul National University in 2004. A total of 147 proceedings were published in combination with research articles over three years, from 2003 to 2005.

JKAS, Volume 1, Issue 1 began in 1968. Five articles were published in Volume 1, Issue 1, and the first article was a research article by researcher Kyong Chol Chou (1929–2010), who was a member of NASA at the time (Figure 2). Under the title of ‘Analysis on the Photometric Orbit of DI PEGASI,’ this study was based on photometric orbital elements, and it was written with Kitamura Masatosi, who was a researcher at the Tokyo Astronomical Observatory (Chou & Kitamura 1968). The publication of this article served as the initiation of JKAS. Interestingly, the first article in JASS Volume 1 (1984), Issue 1 is also an article by Chou (Chou 1984; Jeon & Kim 2019). The article published in JASS was a research article on the mechanical problems of projectiles. Chou served as a professor in the Department of Astronomy and Meteorology at Yonsei University and later founded the Department of Space Sciences at Kyung Hee University. In 1974, he served as the chairperson of the National Astronomical Observatory,

<sup>2</sup><http://jkas.kas.org/journal/archive.php>



**Figure 3.** The yearly distribution of the number of articles published in JKAS. The black bar graph shows the yearly distribution of the articles in JKAS, and the blue line graph shows the same for JASS, as identified by Jeon & Kim (2019).

when it was under the KAS initiative. In particular, he relayed the launch process of Apollo 11 (launched from Cape Kennedy on July 16, 1969) as a commentator in Korea. As such, it is significant that the first articles in the two journals that lead Korean astronomy were written by Chou, who is one of the most important figures in the history of modern and contemporary astronomy in Korea.

Figure 3 shows a histogram of the number of articles published per year. In this distribution, proceedings (378) were excluded from the number of articles. The distribution of articles was examined using the remaining 763 articles. Two articles were included both in 1971 and 1972, which was the period when the number of articles was at its lowest. The highest number of articles was published in 2015, with a total of 36 articles. In the figure, the red dotted line is a reference line indicating 20 published articles. In 1995, there were more than 20 articles published in a year for the first time, and it can be observed that there have been more than 20 articles published in a single year several times since then. Since 2015, which has the most articles published for a given year in JKAS history, the number of articles published per year has decreased and increased slightly; however, a sharp decrease can be observed in recent years up until the present (2021). We think that the cause of the decrease in the number of papers in the last two years (2020–2021) may be due to the Coronavirus pandemic.

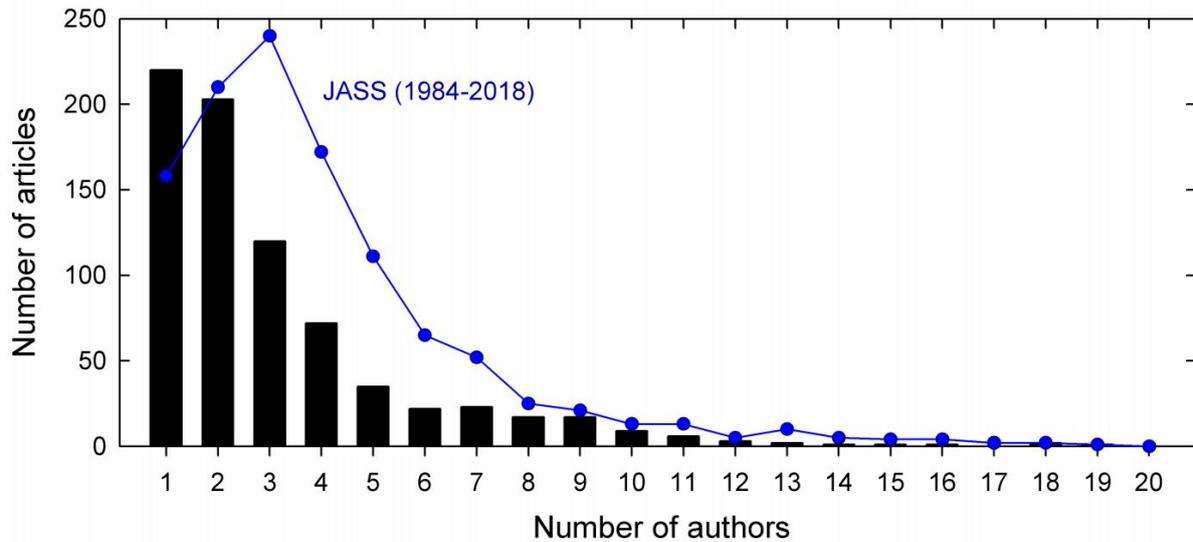
JASS has published more than 30 articles annually since 1997, 13 years since its foundation (1984). However, JKAS published more than 20 articles in 1995, 27 years after its foundation (1968), and it published more than 30 articles in one year for the first time in 2014, 47 years after its foundation (see Figure 3, the blue line). Thus, the quantitative growth rate of articles published in JKAS is relatively low compared with that of JASS.

Both Korean and English have been used since the first issue of JKAS. According to “The 50 Year History of the Korean Astronomical Society,” JKAS has solely published articles written in English since 1980 (Volume 13). However, according to our research, Korean articles have been published several times since 1980. In 1981 (Volume 14), one article was written in Korean. It was also confirmed that two articles in 2000 (Volume 33) and seven in 2001 (Volume 34) were written in Korean. Since 2002, no articles written in Korean have been published, and all articles have been written in English. Of the total 763 articles, 34 (4.5%) were written in the Korean language.

Jeon & Kim (2019) argued that the quantitative change in the number of articles published in JASS is correlated with the variation in the proportion of articles written in Korean. In JASS, from 1990 to 2009, the proportion of articles written in Korean was approximately 60%. After 2010, regulations were changed to restrict the use of the Korean language and so articles could only be submitted in English. During this period, the number of publications began to decrease. This declining trend indicates that articles written in English may become a factor that makes it difficult for domestic readers to access the journal (Jeon & Kim 2019).

In JKAS, only approximately 4.5% of all articles were written in Korean, and in particular, the use of English was higher compared with JASS, even in the period when both Korean and English were used. Even though JKAS has an office in Korea, the use of English can be a factor that causes accessibility issues for domestic readers. In addition, English writing has been adhered to since 2002; thus, we estimate that the growth rate of the quantitative variation of JKAS articles is relatively lower than that of JASS.

Because JKAS is an international journal with enhanced expertise in astronomy, it is natural that only articles written in English should be published therein.



**Figure 4.** Distribution of the number of articles according to the number of authors. The black bar graph shows the distribution of JKAS articles, and the blue line graph shows the distribution of JASS articles, as identified by Jeon & Kim (2019).

However, because the language barrier may cause difficulties regarding accessibility for domestic readers, it is necessary to devise a plan to secure domestic readers while maintaining the journal’s position as an international journal. This is essential for the long-term growth and development of JKAS and so an effective roadmap is required to mitigate these problems.

### 3.2. Analysis of Authors and Their Affiliations

Figure 4 shows the distribution of published articles according to the number of authors. Articles with a single author accounted for 218 out of 763 articles (28.6%), 203 articles had two authors (26.6%), and 120 articles had three authors (15.7%). The ratio of single authors accounted for the largest distribution, and as the number of authors increased, the distribution of published articles decreased. The article with the most authors is “OGLE-2017-BLG-1049: Another Giant Planet Microlensing Event,” which was published in Volume 53, Issue 6, 2020. A total of 58 people from 24 institutions in 10 countries were part of this publication, and it was found that the publication was the result of a large-scale research project that was aimed at exploring exoplanets through gravitational lenses (Kim et al. 2020).

In JASS, the proportion of articles with three authors was the highest at 21.6% (Jeon & Kim 2019). Looking at the characteristics of the research subjects of JASS, the ratio related to observation was the highest in the field of space astronomy, and the proportion of space environment and space technology articles gradually increased after the middle of 2000. Because observation and technology development research were the main topics of focus, there were many publications by those groups.

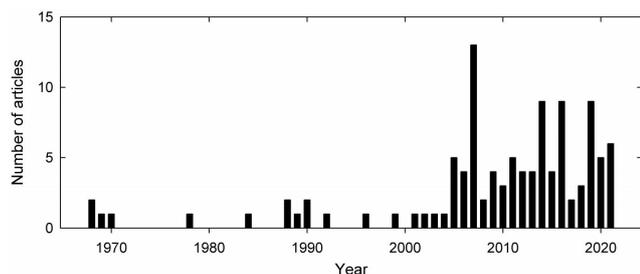
However, JKAS focuses on theoretical academic research on astrophysics. Therefore, it is presumed that

the proportion of studies by one or two authors would be relatively higher.

The main authors, i.e., the first or corresponding authors, were selected to identify the authors who contributed significantly to an article. A total of 368 major authors participated in the 763 articles. Among the 368 major authors, 240 (approximately 65.2%) were confirmed to have published in JKAS only once. This result is higher than that of JASS or JKES (Cho & Kim 2014; Jeon & Kim 2019). This means that there are relatively more one-time authors than returning authors. The fact that more than half (over 65%) of researchers publish only once in JKAS is a very important issue that must be addressed in the consideration of the future of JKAS.

It was found that only 128 (approximately 34.8%) of the 368 major authors published articles more than once. Fifteen major authors (4.1%) published articles more than 10 times in JKAS. The number of articles by the top five major authors is 102 (13.4%). Of course, if the articles in which they participated as co-authors were added, this proportion would increase. This is a meaningful result that shows that some authors consistently announce the results of their research activities in JKAS, even though over 65% of authors have only ever published once. However, the high proportion of these articles indicates that fluctuations in the quantitative and influential aspects of JKAS can be influenced by them; thus, this may present a risk from a long-term perspective. In the future, it will be necessary to improve the convenience for authors so that the rate of one-time publications can be lowered, and a plan should be devised to enable the continuous publication of articles from authors.

Figure 5 shows a histogram of the distribution of articles by authors (including co-authors) belonging



**Figure 5.** Yearly distribution of the number of articles by authors (including co-authors) belonging to international institutions.

to international institutions by year. Of the total of 763 articles, 109 were submitted by researchers from international institutions, and the participation rate was approximately 14.3%. The participation rate of authors from international institutions has increased since 2005, and the average participation rate over 15 years, from 2005 to 2021, is approximately 23.2%. This value is similar to the average foreign participation rate of journals listed in SCI(E) that are published in Korea (22%) (Cho & Kim 2014). However, there has been a decrease in the number of articles since 2015, which may affect the participation of researchers from international institutions in the future. Therefore, various measures must be taken to encourage the participation of international researchers.

The authors (including co-authors) of articles published in JKAS usually belong to one institution; however, some authors belong to more than one institution. Authors' affiliations included 361 institutions in 48 countries, both domestic and international. The institutions can be broadly divided into educational institutions (universities, astronomical observatories, or middle and high schools), research institutions, and industrial institutions. Most authors are researchers from educational and research institutions.

Table 1 summarizes the distribution of authors according to the nationality of their affiliated institution. Authors who participated in the 763 articles were counted, and duplicates were identified. The proportion of authors from institutions in Korea was the highest at 66.09%, followed by the United States (8.4%), Japan (7.06%), China (4.82%), and Taiwan (1.69%). Interestingly, these countries are closely related to Korea both economically and politically. In addition, it was found that there were institutions from various countries located on six continents, including Asia, Europe, Africa, North America, South America, and Oceania, which can be said to show the aspect of JKAS as an international journal.

Table 2 summarizes the distribution of authors by their affiliated institutions. Authors who participated in the 763 articles were counted, and duplicates were identified. Among the top 15 institutions, 10 are universities (educational institutions), and five are research institutions. The top 15 institutions comprise approxi-

**Table 1**  
Distribution ratio of authors according to the country of the authors' institution (top 15)

Rank	Country	Percentage [%]
1	Korea	66.09
2	USA	8.40
3	Japan	7.06
4	China	4.82
5	Taiwan	1.69
6	Egypt	1.51
7	India	1.28
8	Germany, Mexico	1.10
9	Italy	1.02
10	Russia	0.99
11	Australia	0.87
12	England, Ukraine	0.76
13	Canada, Poland	0.73
14	Spain	0.44
15	France	0.41

mately 65% of all authors' institutions. The institution with the highest proportion is Seoul National University, where approximately 16.6% of all authors belong. Recalling the fact that members of Seoul National University played an important role in the establishment of KAS and the founding of JKAS, it can be observed that Seoul National University has played a meaningful and important role in JKAS from the past to the present. Next, the Korea Astronomy and Space Science Institute (KASI) (15.9%) and the Korea Astronomical Observatory (5.1%), the predecessor of KASI, were the affiliations with the second and third highest number of authors. In other words, researchers belonging to Seoul National University, an educational institution, and KASI (including the Korea Astronomical Observatory), a research institution, account for more than one-third of the articles published in JKAS. Thus, the role of the authors' affiliation may be important in the quantitative aspect of the articles and the variation of impact factor. Therefore, in the future, the roadmap of JKAS should be devised in conjunction with these institutions.

In particular, the University of Science and Technology Graduate University (UST) first appeared as an author's affiliated institution in 2010, but in just ten years it has become an important institution of JKAS, accounting for approximately 3.3% of all authors. UST is a graduate school that was established by a coalition of government-funded research institutes in Korea. In addition, senior researchers from each center of KASI oversee the teaching of students. They also belong to UST as supervisors, and it is estimated that the size of UST has increased in a short period of time, owing to their relationship with KASI.

Five among these 15 institutions are foreign institutions. The 10th is the National Astronomical

**Table 2**  
Distribution of authors by affiliation

Rank	Institution	Country	Percentage [%]	
1	Seoul National University	Korea	16.61	University
2	Korea Astronomy and Space Science Institute	Korea	15.93	Institute
3	Korea Astronomical Observatory	Korea	5.07	Institute
4	Kyunghee University	Korea	4.74	University
5	University of Science and Technology	Korea	3.27	University
6	Pusan National University	Korea	2.79	University
7	Yonsei University	Korea	2.48	University
8	Chungnam National University, Kyungpook National University	Korea	2.26	University
9	Chungbuk National University	Korea	1.83	University
10	National Astronomical Observatory of Japan	Japan	1.72	Institute
11	Sejong University	Korea	1.44	University
12	Chinese Academy of Sciences	China	1.35	Institute
13	National Research Institute of Astronomy and Geophysics	Egypt	1.21	Institute
14	New Jersey Institute of Technology	USA	1.07	University
15	University of Tokyo	Japan	0.99	University

**Table 3**  
Top 10 frequency of words extracted from the abstracts of articles

	1	2	3	4	5	6	7	8	9	10
#1	cluster	orbital	cloud	tidal	term	obtain	SN <sup>5</sup>	data	Pleiades	gas
#2	model	star	light	galaxy	magnetic	velocity	classic	obs. <sup>2</sup>	field	galactic
#3	abu. <sup>1</sup>	cluster	star	par. <sup>3</sup>	globular	age	helium	umbral	period	mass
#4	star	cluster	halo	age	mass	NGC	disk	derive	color	model
#5	star	model	field	obs. <sup>2</sup>	source	density	galaxy	type	magnetic	temp. <sup>6</sup>
#6	star	mass	region	lumi. <sup>4</sup>	cloud	density	find	obs. <sup>2</sup>	field	disk
#7	star	cluster	galaxy	mass	cloud	line	NGC	density	region	field
#8	cluster	mass	line	star	data	shock	find	emission	solar	relation
#9	star	velocity	line	mass	CME	region	model	cluster	data	IRDC
#10	mass	obs. <sup>2</sup>	radio	star	galactic	galaxy	emission	stellar	data	cluster
#11	star	obs. <sup>2</sup>	data	solar	magnetic	time	radio	galaxy	mass	field

Abbreviation: <sup>1</sup>abundance, <sup>2</sup>observation, <sup>3</sup>parameter, <sup>4</sup>luminosity, <sup>5</sup>supernovae, <sup>6</sup>temperature. Here, #1 is the 1st period (1968–1970); #2 is the 2nd period (1971–1975); #3 is the 3rd period (1976–1980); #4 is the 4th period (1981–1985); #5 is the 5th period (1986–1990); #6 is the 6th period (1991–1995); #7 is the 7th period (1996–2000); #8 is the 8th period (2001–2005); #9 is the 9th (2006–2010); #10 is the 10th period (2011–2015); and #11 is the 11th period (2016–2021).

Observatory of Japan, the 12th is the Chinese Academy of Sciences, the 13th is Egypt’s National Research Institute of Astronomy and Geophysics, the 14th is the New Jersey Institute of Technology, and the 15th is the University of Tokyo.

### 3.3. Analysis of Word Frequency in Abstracts

#### 3.3.1. Word Frequency

The frequency trends of words were examined in the abstracts of the articles. Table 3 summarizes the top 10 words with the highest frequency in the abstracts for every five years (note, however, that the first period, 1968 to 1970, is a group of three years, and the last period, 2016 to 2021, is a group of six years). ‘Star’ is a high-order word that always appears. Subsequently, it was found that words such as ‘cluster’, ‘mass’, and

‘field’ were also frequently used. The frequent use of these words can be used as a distributional feature that reveals the character of JKAS. This is because research on stellar structure, evolution, and interstellar matter has continued from the earliest days of the journal to the present. This shows that JKAS primarily published academic research focused on astrophysical theory.

When looking at word frequencies from 1996 to 2015, ‘star’, ‘mass’, and ‘line’ have the highest frequencies. In addition, words such as ‘density’, ‘emission’, and ‘molecular cloud’ appeared more frequently than before. This suggests that studies on the structure and evolution of stars and galaxies were actively conducted during this period.

The Astrophysical Research Center for the Structure and Evolution of the Cosmos at Sejong University

began operating in 2002 (KAS 2004). In addition, the Center for the Exploration of the Origin of the Universe at Seoul National University started operating in 2008 (Im 2009), and the Center for Galaxy Evolution Research at Yonsei University started operating in 2010. The traces of research on the structure and evolution of stars and galaxies, shown by the frequency of words from 1996 to 2015, is indicative of the direction of the research centers formed around universities.

After 2006, abbreviated words, such as ‘coronal mass injection (CME)’ and ‘infrared dark cloud (IRDC)’ began to appear with high frequency. CME is a word related to the sun. It can be seen that the research nature of JASS has been replaced by topics related to the space environment since the mid-2000s (Jeon & Kim 2019). As such, research on the sun related to the space environment is considered to also be on the rise. This change in the trend of the overall research topics may have also affected JKAS. IRDC is related to cosmic evolution. The Spitzer Space Telescope, which is an infrared telescope, was launched in 2003 and so there may have been an increase in direct research related to Spitzer’s observations.

After 2010, the word ‘radio’ was mentioned with the highest frequency. This is presumed to be related to the Korean VLBI Network (KVN) project that has been conducted since 2000. The KVN is designed to perform effective observations by integrating the radio telescopes of Yonsei University, Ulsan University, and Tamna University. Such network construction and system development are achievements that enable precise observations and research. In particular, it provides effective data for research on galaxy formation and evolution. Against this background, the repeated use of the term ‘radio waves’ would have caused ‘radio’ to become a high-frequency word.

### 3.3.2. Word Cloud

From 1968 to 2021, the frequency of words in the abstract of articles was visualized and expressed using the word-cloud visualization technique (Jin 2017). The larger and bolder the word appears, the higher the frequency of the appearance of the word.

Figure 6 shows the word-cloud image of the 1st period (1968–1970). In the first period (1968–1970), ‘cluster’, ‘orbital’, ‘cloud’, and ‘tidal’ are identified to have high frequencies. Since JKAS was in its early days of publication, researchers from various fields published articles in the journal; therefore, the words that appear with high frequency also exhibit diversity.

Figure 7 shows the second period (1971–1975). In the 2nd period (1971–1975), ‘model’, ‘star’, ‘light’, and ‘galaxy’ appear prominently. From the perspective of astrophysics, theory-centered research tendencies are well expressed.

Figure 8 is an image of the word cloud of the 3rd period (1976–1980). In the 3rd period, words related to ‘globular’, ‘clusters’, ‘matter’, and the ‘sun’ are identified to have high frequencies.

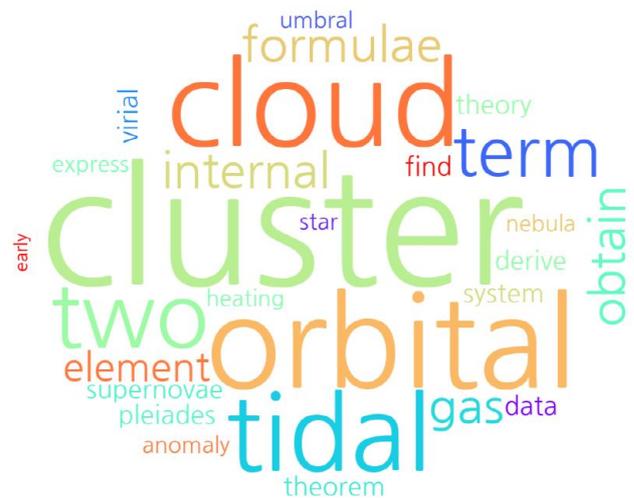


Figure 6. Word cloud of 1st period (1968–1970).

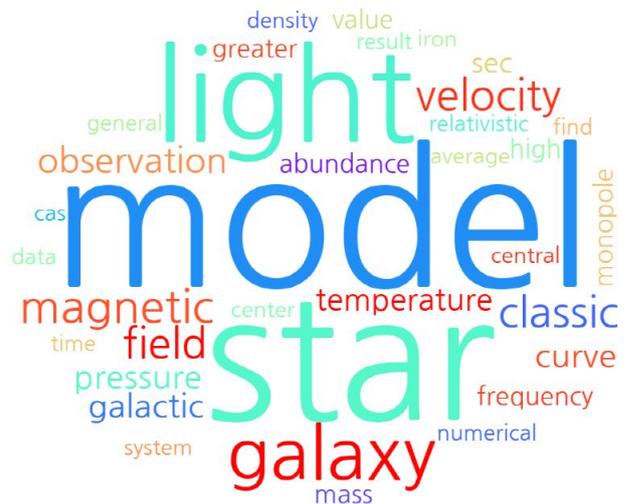


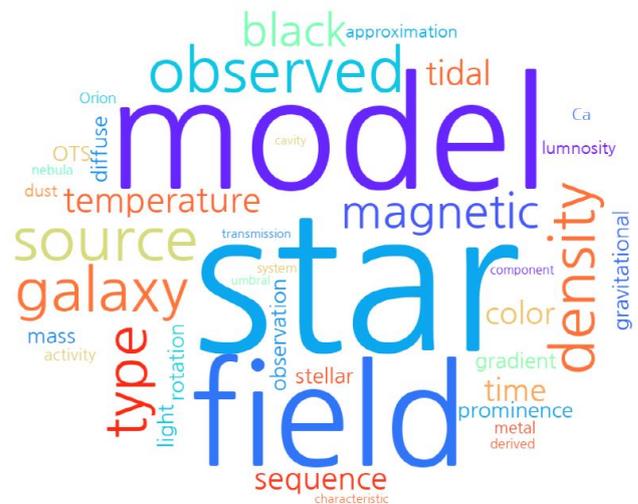
Figure 7. Word cloud of 2nd period (1971–1975).



Figure 8. Word cloud of 3rd period (1976–1980).



**Figure 9.** Word cloud of 4th period (1981–1985).



**Figure 10.** Word cloud of 5th period (1986–1990).

Figure 9 depicts the 4th period (1981–1985). In the 4th period, research on ‘clusters’ and ‘stars’ are the focus and references to the ‘disk’, ‘mass’, and ‘age’ are observed. It is presumed that there was an in-depth study on the evolution and structural models of galaxies. In addition, some words related to solar research, such as ‘IMF’, were seen.

Figure 10 shows the word-cloud image of the 5th period (1986–1990). In the fifth period, words related to ‘star’, ‘field’, and ‘model’ stand out. Also, words such as ‘magnetic’, ‘density’, ‘galaxy’, ‘observation’, and ‘type’ were identified to have high frequencies. As can be seen, some words are related to gravitational lenses.

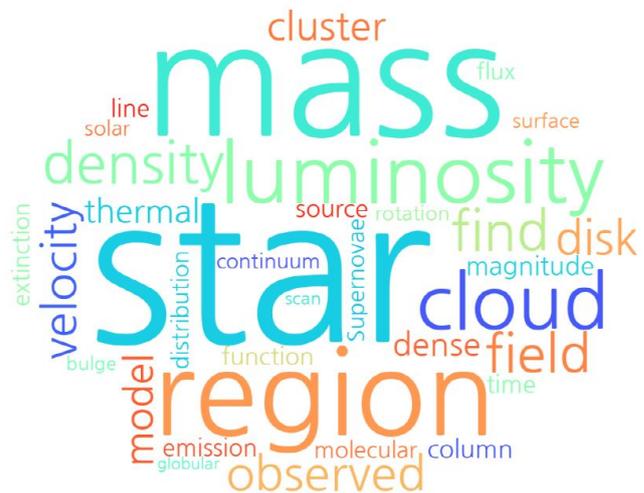
In the 6th period (1991–1995, see Figure 11), words related to galaxies and the stellar evolution were identified. It is assumed that mainly studies on stellar and galactic evolution were conducted during this period.

Figure 12 is the 7th period (1996–2000). In the 7th period, it is assumed that there were primarily ‘photometry’ and ‘solar’ studies.

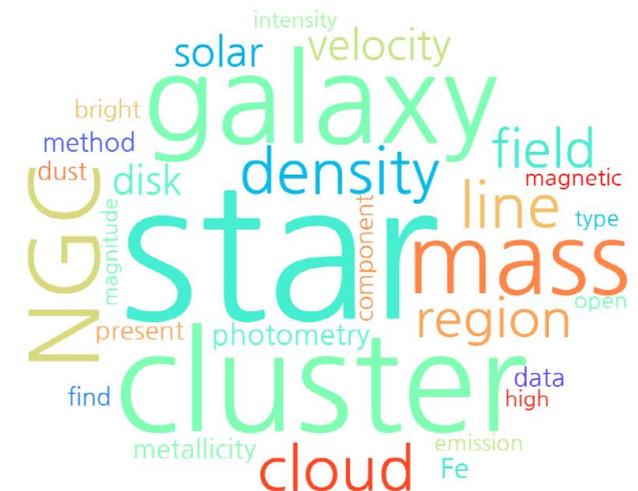
Figure 13 shows the word-cloud image of the 8th period (2001–2005). In the 8th period, studies on ‘clusters’ and ‘stars’ are observed, particularly in terms of ‘mass’ and ‘line’. It is assumed that there were in-depth studies on galaxy formation and evolution, which were likely related to the Space Structure and Evolution Research Center of Sejong University, which was established in 2002. It was also confirmed that the frequency of words related to the sun increased compared with the previous period.

In the 9th period (2006–2010, see Figure 14), words related to the study of stellar evolution and structure were observed. This may be related to the research center that the universities (see Section 3.3.1) started running. In addition, the frequencies of terms related to the sun, such as ‘CME’ and ‘magnetic field’, appear to be high.

Figure 15 shows the 10th period (2011–2015). In the 10th period, various terms were identified, such



**Figure 11.** Word cloud of 6th period (1991–1995).



**Figure 12.** Word cloud of 7th period (1996–2000).



JKAS has published 763 articles over the past 54 years. In addition, 229 proceedings assigned as special issues and 147 proceedings presented at a workshop were also published. After 1968, there were slight increases and decreases in the number of articles published in JKAS in the 1990s and 2000s, and in 2015, 36 articles were published, which is the highest recorded number of articles published in a given year as of the time of this study (it should be noted that the cause of the increase in articles is not clear, but it may have been a temporary increase). Since then, the number of articles has tended to decrease. However, we think that the cause of the decrease in the number of articles in the last two years (2020–2021) may be because of the Coronavirus pandemic. For this reason, the declining trend of articles may be temporary, but it is not clear if this will be the case. These factors may affect the quantitative variation of the articles and the change in the IF. Therefore, various defense measures should be devised for JKAS to increase the quantitative aspects and IF of the journal.

The distribution of articles published in JKAS shows that 28.6% of articles had single authors, 26.6% had two authors, and 15.7% had three authors. In addition, it was confirmed that 368 main authors participated in 763 articles, and 65.2% of these authors published in JKAS only once. These results demonstrate the need to encourage article publication.

The number of articles by the top five authors among the main authors was 102. This accounted for 13.4% of all articles. If this percentage expands to articles jointly involving these major authors, the proportion will increase. It is a potential risk factor for JKAS that the proportion of the total number of articles by the top five authors is more than 13.4%. This is because the mood and direction of JKAS can be changed by a small number of researchers, who produce a large proportion of the articles. Therefore, it is necessary to develop a plan to decrease the proportion of articles of the top major authors.

A total of 109 articles (14.3%) were submitted by authors from international institutions. Since 2005, the average participation rate of authors affiliated with international institutions has been 23.2%. JKAS was registered as an international journal in 2007 and has maintained its position until now. Considering these factors, having only 23.2% of all articles written by international authors is insufficient. Therefore, it is necessary to devise various methods to encourage the participation of researchers from foreign institutions. Thus, we propose an improvement of the article submission and review process. A concise submission process and a quick review process will encourage authors to submit their manuscripts. In addition, the manuscript review and editing processes should be strict. Articles published through this process will also contribute to increasing the IF.

Word-frequency analysis was performed by collecting abstracts written in all the articles. The frequency of words is primarily concentrated in relation to theory centers. This trend is associated with a high proportion

of single authors. It is also related to the tendency to focus on theory-based research instead of group research on large-scale projects. Thus, JKAS is not swayed by the government's science policy or social flow. That is, JKAS is still focused on the most basic research on astronomy. In particular, a high percentage of JKAS authors belong to educational institutions, such as universities or research institutes established within universities. In addition, Sejong University, Seoul National University, and Yonsei University have research centers on the structure and evolution of the universe. It would not be an exaggeration to say that this operation contributed to increasing Korea's astronomy research to an international level. JKAS needs to better reflect the characteristics of this trend in the future. In particular, it should be noted that the distribution of authors and the characteristics of research fields are highly relevant to educational institutions. Therefore, JKAS needs to establish a link with educational institutions in the future, and through active support for educational institutions, it may solidify its status as an international journal and seek the growth of its quantitative aspects and IF.

JKAS has experienced many trials in the process of publishing journals over the past 54 years (1968–2021). It experienced the failure of not being selected as an accredited Journal, and it was also selected as an international journal within a short period of time after being selected as an accredited Journal. Notably, it is something to be proud of that the journal has been maintained and published consistently for over half a century. Of course, considering that JKAS's influence index is low compared to Japan's PASJ and China's RAA, which are other East Asian countries, the aforementioned problems must be solved for JKAS to maintain its position as an international journal. However, since theory-centered research is primarily conducted without being swayed by society and policies, and that the proportion of authors belonging to educational institutions, such as universities, is high, the future direction of JKAS is encouraging. Therefore, it is necessary to not be deterred by the decreasing trends of the quantitative aspects and IF, but to respond positively by determining a future roadmap. By achieving this, it will be possible for JKAS to leap forward as a high-quality international journal. Looking at the development history of Korean astronomy since modern times, the achievements of KAS and JKAS have been notable. Therefore, we look forward to the future direction of the journal.

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