

External Evaluation Committee

Review of the

Division of Science

National Astronomical Observatory of Japan

June 2023

1. Background

The National Astronomical Observatory of Japan (NAOJ) is a national joint-use research institution that aims to contribute to the scientific community, including universities, by producing internationally recognized scientific achievements.

NAOJ invited an External Evaluation Committee (EEC) to review the activities of the Division of Science (DoS) since its establishment in April 2019. The EEC was asked to make judgements on three broad questions: (i) Does the DoS produce or have a high possibility of producing science with high international research competitiveness? (ii) does it improve the research capabilities of universities? and, (iii) does it contribute to the development of young researcher human resources? In addition, it was asked to make suggestions for improving the future activities of the DoS.

During the external evaluation of the former Division of Theoretical Astronomy (DTA) in 2018, some concerns were raised regarding the relationship between NAOJ and the external community surrounding the former DTA. These concerns included the mobility of senior professors and associate professors to other institutions due to promotion, the balance of research fields and researcher types, and the negative impact of the dissolution of the DTA, which had contributed to theoretical astronomy in Japan for many years through joint utilization of the Center for Computational Astrophysics (CfCA), and its reorganization into the DoS.

This EEC recognizes that the activities of the DoS from 2019 to 2022 are the subject of evaluation, and it is not a direct evaluation of the follow-up measures taken in response to the issues raised during the external evaluation of the former DTA. Specifically, it should be noted that the DoS has many staff members who were newly appointed after the reorganization (10 out of 17 tenured faculty members), and some members who do not belong to the Rironkon (9 out of 17 members) may not be fully aware of the relationship with the community during the former DTA era or the requests from the Rironkon to the NAOJ executive office during the reorganization. Therefore, in this report the EEC focuses primarily on DoS activities since 2019 and limits its comments on the former DTA.

2. Introduction to the Review Process

The members of the EEC (see Appendix 1) worked closely with the Director of Research Coordination, Professor Motohara, and the Office of the Project Review Committee to define a detailed Project Review Plan (PRP). The PRP outlines the evaluation of two main categories: (1) The status of the founding objectives of the DoS, and (2) the response to the findings of the final review of the DTA.

To aid that evaluation, the EEC requested and received a detailed Review Data Package (RDP) as well as numerous statistics from the DoS and conducted an in-depth two-day visit to NAOJ on 2-3 March 2023. The paperwork requested and the on-site timetable are shown in Sections 4.1 and 4.2, respectively, of the PRP. The EEC felt it important to see and hear some of the science highlights, to speak with the NAOJ Director General Tsuneta and the Director of the DoS, Professor Ikoma, both of whom responded to a set of questions raised in advance by the EEC. In addition, the EEC held closed meetings with faculty, postdoctoral researchers, and PhD students as well as with international staff and students (see timetable in Appendix 2).

The papers and on-site meetings provide the basis for the judgements and recommendations of the EEC and it is very grateful to all those who participated in providing information, written and spoken.

3. Criteria for Evaluation

The PRP asked the EEC to consider 10 areas for evaluation, seven of which related to the Achievement of the Founding Objectives and three to the previous DTA review. We provide brief answers to each of these in this section.

3.1 Founding Objectives

3.1.1 Has the Division produced internationally outstanding research achievements in quality and quantity?

Based on the material provided to the EEC (evidence of around 600 publications, about 40 keynotes/invited talks, and around 20 prizes/awards), and on the scientific presentations and posters, the EEC concluded that the DoS was consistently producing high quality and impactful research. Most of the publications are world class and some are world leading. The Committee also noted that the DoS was extremely productive in the period under review, particularly given the constraints imposed on NAOJ by the Covid-19 pandemic. Since 2019 the number of papers almost doubled whilst researchers increased by 40%, the latter mostly through a larger number of postdocs and fellows. According to the feedback received during the evaluation process, each member of the DoS has made significant scientific contributions to the community by producing high-quality scientific results and conducting joint research with researchers outside the NAOJ.

3.1.2 Have research results been achieved through theory-observation collaborations?

The EEC noted the very high degree of such collaborations in most of the presentations on science highlights as well as in the poster presentations. This is an undoubted strength of the DoS, recognized by both staff and students in our conversations, and appears to have accelerated following the creation of the DoS. Nevertheless, such collaborations can always be reviewed and improved, and we return to this in our recommendations.

3.1.3 Have research results been achieved using large instruments and supercomputers in Japan and abroad, including those from NAOJ?

The creation of the DoS has clearly led to an increase in the collaborations between theorists and observers – in particular SUBARU and ALMA are key resources for DoS scientists – and there is excellent research underway with the CfCA. The committee also noted the involvement of DoS members on upcoming (Ariel, EUCLID and Nancy Grace Roman) and proposed (GLEX-PLUS and LAPYUTA) space missions. The use of large, cross-cutting facilities has greatly improved the quality and impact of research in the DoS.

3.1.4 Has the Division conducted research leading to delineating the direction in the future planning of astronomy and contributed to NAOJ's future planning from a scientific point of view?

This was a major topic for discussion between the EEC and the Director General, the Director of the DoS, and research leaders in the DoS. Overall, the EEC feels that the DoS is missing a coherent research strategy that aligns with both NAOJ and Japanese astronomical research more widely. One exception was in the presentation of Professor Tominaga (RA4) who outlined a research strategy within NAOJ (with theorists in CfCA) and observers (ADC, SUBARU, VLBI). He had started discussions on inter-divisional projects in time-domain/multi-messenger astronomy and had begun to think about long-term research strategies. He also noted that collaboration between theorists and observers in NAOJ as well as international collaborations were essential to keep their research at a world-class level.

The EEC discussed the issue of research strategy in detail with Professor Ikoma and noted that he is keen to form a Research Strategy Committee that would involve members external to NAOJ. The involvement of the wider Japanese astronomical community is vital to the ongoing success of NAOJ and the DoS. The EEC emphasises that the scientific autonomy of the DoS is vital to its success, and that the DoS's strategy should be shaped primarily by its members. However, it is also important for the DoS to listen to input from the wider community through a Research Strategy Committee or any other channels, which is likely to lead to a better strategy for the DoS and ultimately NAOJ.

3.1.5 Have graduate students and post-doctoral fellows from the Division been advancing their careers successfully?

The EEC held two closed meetings with students and postdocs and one meeting with international staff and students. The meetings with students and postdocs offered a very positive view of research in the DoS – easy access to experts from theory to computation to observations, plus expertise, for example in ALMA and SUBARU, in other parts of NAOJ; the colloquium programme was strong; and the parental leave system was commended. They felt that their research and future opportunities were enhanced by the synergistic approach to research in the Division.

There was also room for improvement. They wished to see a better balance between DoS colloquia and specialised meetings and an improvement in publicising internal seminars across NAOJ; in some areas a small number of students inhibited shared learning; opportunities for collaboration were difficult and depended on personal connections; and there was an urgent call for more space, a proper room in which to meet and talk/interact. The EEC heard one specific example of students working in a building under very physically uncomfortable conditions, crowded, no rest rooms and inadequate heating in winter.

3.1.6 Has the Division been acting as a hub for research by attracting proven researchers as visitors from Japan and abroad?

International researchers were very positive about their research environment, including supervision, computer support and opportunities for collaboration. Administrative support, including the help desk, was very helpful in finding accommodation but, in general, they recognised that the language barrier is still an issue. Some information was available in English but they noted that some forms were difficult to understand. The Japanese language course was very helpful, but some felt it could be held earlier in the year and some mentioned that notice of it had arrived so late that they were unable to attend. More flexibility in scheduling the language course, if it can be offered, will be greatly appreciated by the international members of the DoS (and probably the entire NAOJ).

Visits to NAOJ have been hindered greatly by restrictions due to the pandemic. Future numbers could be enhanced through workshops and conferences. It is suggested that more foreign staff and students could be attracted to NAOJ by a strengthened 5-year fellowship programme. A second suggestion is to grow formal international partnerships using links to Japanese scientists in foreign universities.

- 3.1.7 Have members from the Division been collaborating with researchers in Japan and abroad, including NAOJ's other projects, to create new sciences, thereby contributing to enhancing astronomy research activities in Japan?

Since the creation of the DoS, international collaborations have expanded and are strong and developing well. The Directorate produces world-class science and collaborates widely with international leaders. The evidence is clear that the DoS is a very collaborative environment and that many research papers are published with national and international scientists. Nevertheless, the EEC felt that collaborations with Japanese scientists were strong in some fields of research but weaker in others. While internal collaborations are strong, collaborations with Japanese scientists were mixed in terms of number and impact. The EEC felt that this was, in part, due to a lack of clarity in the mission of the DoS within NAOJ and on its understanding of its role as an 'inter-University Research Institute Corporation', in particular, on how it helps universities carry out astronomical research. Efforts should be made to strengthen engagement with the wider astronomical community in Japan to understand and support their research. We make recommendations on this point in Sect. 4.1.

3.2 Responses to the previous DTA review

The EEC recognised that the DoS is a different organisation from the DTA and that it has gone through the transition phase in a very successful manner. There had been clear progress in many areas raised by the DTA review, as outlined in the RDP. These include the appointment of international staff, the creation of two types of assistant professor, which Professor Ikoma had noted was already underway in the DoS, and an increase in theoretical staff. The provision of adequate high-performance computing and skilled computer experts is an ongoing and important issue for the quality of research undertaken in the DoS and will need ongoing monitoring.

Some issues remain, the most important of which is the need for adequate space for researchers and for research infrastructure. Indeed, this lack of space was identified in every meeting between the EEC and staff and students.

4. Recommendations

The EEC congratulates the DoS on its achievements during a challenging start-up period. Overall, the EEC recognizes the efforts of NAOJ to maintain a positive relationship with the external community and encourages the institution to continue to work towards further strengthening and improving its relationship with this community.

It is important, however, that the DoS seeks to form a long-term strategy that not only ensures that it will continue to deliver world-class science but one that will, in a spirit of collaboration, develop long-term relationships with and provide leadership to the Japanese astronomical community.

We make a number of recommendations and start with our two most important – the formation of a Science Advisory Committee and the issue of space.

4.1 Science Advisory Committee (SAC)

Based on the background presented, the EEC proposes the establishment of a Science Advisory Committee (SAC) as a mechanism to directly reflect the community's opinions in the activities and future plans of the DoS. When selecting members for the SAC, consideration should be given to balancing the fields of expertise.

The EEC suggests that the remit of the SAC could cover a number of topics such as post requirements and public solicitation, while taking into account the DoS's intentions. Additionally, the SAC could evaluate and consider the maintenance of diversity in research fields, the optimal composition of personnel, active personnel exchanges with outside institutions, and the appropriate placement of personnel within the DoS, in collaboration with other departments in the mid to long-term. However, the EEC also emphasises that the SAC should not in any way undermine the scientific autonomy of the DoS, and that the DoS's strategy should be shaped primarily by its members.

Specifically, the following points are proposed:

4.1.1 Formation of SAC

The EEC recognizes that the lack of a SAC for the DoS, similar to other projects and observatories, should be improved promptly. During the hearing, Director Ikoma stated that the executive branch is currently discussing the establishment of the SAC in the next fiscal year.

In the former DTA, there was an organisation similar to the SAC called the "Theory and Computation Committee", for which the Rironkon recommended members by election. Matters related to personnel transfers in the DTA and shared computer usage were reported and discussed at the Rironkon General Meeting and the Rironkon Management Meeting, and requests were conveyed directly from the members to the DTA. It may be beneficial to understand the historical context of the relationship between the community and the DTA when operating the DoS, such as the Rironkon's request letter to the NAOJ Executive Branch (March 2020).

The SAC and the DoS should not have a relationship of "evaluators" and "evaluated", but rather should collaborate to discuss how the DoS can contribute to the community as a science division of a university joint-use institution and reflect that in its operations.

4.1.2 Selection and Operation of SAC Members

In principle, the NAOJ Advisory Committee should serve as a bridge between the community and the organization. In reality, however, it is difficult to have specific discussions on individual cases due to a limited number of meetings and many deliberation items. The SAC will need to devise ways to have more substantial discussions.

In selecting SAC members, it is important to ensure that various fields are represented. However, it is not necessarily required to have one SAC member from each community. Membership of the SAC should be composed with consideration given to geographical location, university, gender,

age, etc., and with members having an understanding of the current state and issues of scientific research in the DoS and be able to engage in constructive discussions. Additionally, it is important to share the discussions in SAC with the community and receive feedback.

4.1.3 Demand for Positions and Open Recruitment

The benefit of the SAC is that, when the DoS sends a request for new positions to the NAOJ executive committee, proposals based on strategic and long-term planning discussed in SAC, and supported by the community, will be more convincing and increase the chances of success. Personnel demands with community support will result in a stronger proposal to the NAOJ executive committee.

Traditionally, the DoS has sent requests for new positions to the NAOJ executive committee, which were then approved at the advisory committee, and open recruitment was conducted with the recruitment document created by the DoS. The personnel selection committee was selected at the advisory committee, and both internal and external members were required. In the past open recruitment, the research field was not limited to a specific area and was advertised for "astronomy and related fields," and the discussion of the selection committee was not open to the public. As a result, the community could only anticipate the future of the DoS based on the "selection results." The selection committee was also not open to the public and had no responsibility for the selection results.

The EEC feels that there were not many opportunities for community input in this process, and it is hoped that a better method will be discussed in the SAC in the future.

4.1.4 Maintaining Diversity in Research Fields and Personnel Composition

The DoS is expected to promote cutting-edge research by covering a wide range of fields in astronomy and related areas, including theoretical, observational, and large-scale numerical methods, as well as observation wavelengths and target celestial bodies, through collaboration with universities and other projects both domestically and internationally. Therefore, efforts must be made to maintain diversity among members and research fields. The current open application method (as mentioned in the previous section) does not have a mechanism for receiving feedback from the community on maintaining diversity in research fields and optimizing the composition of different research areas. Thus, there is a potential concern that some fields may be biased towards areas with relatively more publications, influential researchers, members' intentions, or committee member preferences.

The external evaluation of the former DTA suggested the following proposals, which could be discussed in the SAC in the future:

“Establish subgroups within the DoS, such as theoretical astronomy groups, theoretical-observational collaboration groups, multi-wavelength observation collaboration groups, etc., to create a system that maintains an appropriate number of various types of researchers.

Consider balancing the placement of two types of positions, senior researchers who form groups with assistant professors who conduct research independently, to ensure a well-balanced composition.”

4.1.5 Personnel Exchange and Mobility

The DoS's important contribution to the community is not only to achieve scientific results and lead astronomical and astrophysical research in Japan, but also to serve as a starting point for the exchange of excellent personnel with universities and other institutions. The current tenured

positions in the DoS are relatively large compared to most university research laboratories in Japan, with six professors (+ one in selection), four associate professors, and seven assistant professors. The trend of these positions has a significant impact on the small community in Japan. Depending on the age composition and year of recruitment, there is a risk that the bias in certain fields will continue for a long time, making active personnel exchange essential.

In the former DTA, many members were aware of an “unwritten rule” to transfer to universities at an appropriate time, given the historical background and relationship with the theoretical community. In fact, there have been cases where professors, associate professors, and assistant professors have transferred to universities. Such movements helped maintain the vitality of the organization to some extent and contributed to the community.

However, ten of the seventeen tenure-track staff in the current DoS joined after its establishment. Therefore, it is not appropriate to evaluate personnel exchange in the past three years at this stage. Moreover, it may not be appropriate to expect the ‘unwritten rules’, or a sense of obligation to a particular community, that existed in the former DTA to continue in the DoS, which is a group of researchers with diverse backgrounds. Instead, specific initiatives and mechanisms are necessary to ensure active personnel exchange and SAC discussions are required.

4.1.6 Appropriate Personnel Placement within NAOJ

Personnel exchange should not only occur between NAOJ and universities but also between other projects within NAOJ. The DoS, which integrated several former research departments, can be a starting point for this. For example, it is possible to contribute to NAOJ's observational projects and joint-use activities at CfCA and the data center based on the research results of the Division or to transfer personnel who have achieved scientific results in observational projects to the DoS.

4.2 Space

Members of the Division, including students, are currently dispersed across several buildings on the Mitaka campus, and there are isolated researchers and students. The lack of infrastructure, such as a space for natural gatherings and daily discussions, as well as a guest space, which are essential for achieving research results, was pointed out repeatedly in interviews with students, postdoctoral researchers, and staff – indeed it was raised as a serious issue in all meetings, including those with Director General Tsuneta and Professor Ikoma. The DoS has grown rapidly since its creation and our expectation is that it will continue to grow. Unless this can be solved, the lack of suitable office and common spaces will prove a hindrance to the scientific impact of the DoS.

The space issue is a challenge not only for the DoS but for the entire NAOJ. In a hearing with the NAOJ Director, it was noted that the budget was tight due to other projects, but there seemed to be no particular short-term or long-term plans for the campus. Optimizing the design and operation of research spaces is crucial not only for the DoS but also for achieving excellent scientific results and should be given a high priority. Continuous consideration and budget requests should be made within NAOJ, including the space problem of the DoS. In the absence of a dedicated building for the DoS, the NAOJ should explore novel ways of creating additional space for it.

4.3 Commitment to Graduate Education

In general, excellent graduate students are essential to producing outstanding research results. The associate professors and professors in the DoS are concurrent faculty members of SOKENDAI

(list of faculty members: <https://guas-astronomy.jp/Supervisors/index.html>), and the adjunct faculty members at the University of Tokyo (Ikoma, Kokubo, Ouchi, Nakamura) can take University of Tokyo graduate students. Moreover, the DoS has a significantly larger number of concurrent faculty members than the student enrolment limit, so they have far fewer education-related duties (including entrance examination duties) than general university staff. In this sense, the DoS is in an advantageous environment compared to university and graduate-school teachers. Indeed, in the closed sessions, several students stated that they were very satisfied with the close contact with their supervisors and the collaborative nature of the DoS. Therefore, there seems to be no significant problems with the supervision of graduate students at the University of Tokyo and the DoS as it is currently operating. There was some dissatisfaction expressed by UT students concerning the lack of UT issues on the agenda of administrative meetings and on the lack of a proper colloquium series. There was also a comment that there is a difference in the financial support provided to graduate students at SOKENDAI and the University of Tokyo.

On the other hand, there are opportunities for growth in graduate student numbers. NAOJ should cooperate not only with SOKENDAI and the University of Tokyo but also utilize the Special Joint Usage Researcher (contract graduate student) system as a means of contributing to the community and ensuring diversity. It is recommended that the DoS collaborates with faculty members from other universities to instruct graduate students for a certain period and announce it widely to the community (in the former Theoretical Research Department, students from Kyoto University and Tohoku University also stayed as contract graduate students). According to <https://sci.nao.ac.jp/main/member>, there is at present only one student from a university other than the University of Tokyo and SOKENDAI among the Division's 24 students.

4.4 Internal Collaborations

The degree of internal collaboration was mentioned as a strength of the DoS by almost everyone. There was a feeling that this could be improved through a more structured approach to collaborative opportunities and to be less dependent on personal contacts. For example, through specialised workshops, or an ideas incubator. Once established, such activities could be offered to the wider community.

4.5 International Collaborations

If the DoS is to attract more international students and staff, it should provide a forum for those currently in place to suggest improvements to their campus experience. Small changes, for example the provision of IT information in English, can make a big difference. We also recommend that, using Japanese faculty working abroad, the DoS pursues formal international agreements and partnerships with foreign universities to attract international staff and students.

4.6 Research Budget

In our meetings, there were no significant complaints about the DoS budget allocated by NAOJ, indeed staff were generally very appreciative of the travel and research support they received. It is desirable that basic research expenses and competitive research expenses are regularly allocated from the internal budget to promote scientific research.

On the other hand, it is necessary to always be aware of opportunities to obtain competitive funds such as research grants. In particular, we recommend that DoS members should organize and apply for large-scale research grants in collaboration with researchers in universities and other institutes that lead new sciences in each field (such as the Grant-in-Aid for Transformative

Research Areas led by Murayama of IPMU), rather than the relatively small-scale items that university researchers can obtain, such as Basic B, C, and Challenge research.

4.7 Network Infrastructure

During our closed sessions, students and postdocs pointed out the following issues regarding the network and computer infrastructure. These are not limited to the DoS but have been NAOJ-wide problems identified previously. They have, however, become a significant obstacle to research activities and should be promptly addressed by the NAOJ executive:

1. NAOJ is not a member of eduroam <https://eduroam.org/>, which causes difficulties when conducting research activities or inviting researchers from other universities, including those from overseas.
2. When transferring from NAOJ to other institutions, the NAOJ email address assigned cannot be used immediately after transfer (and email cannot be forwarded). As a result, some people are forced to use email addresses such as Gmail. An email policy that 'encourages' individuals to use alternative addresses for scientific correspondence is not fit for purpose.
3. When transferring to other institutions, individuals are required to completely erase data on PCs and reinstall the OS, regardless of whether it is observation or theory-related data.

Regarding 1), if a research meeting including NAOJ members is held at another university, the university may have to take unnecessary measures, such as preparing Wi-Fi other than eduroam (or a guest eduroam account).

Regarding 2), there is a problem that important research communications are lost after transfer. Some universities have a permanent email address after transfer or graduation, and this should also be considered at NAOJ.

Regarding 3), there is a significant problem with research continuity. For example, CfCA's computational data can be moved outside of NAOJ through the network (if not, research cannot be conducted). It is therefore nonsensical to uniformly erase data with lower confidentiality on PCs.

4.8 Administrative Support

The DoS has grown appreciably since its creation and NAOJ should seek to increase the number of administrative staff to ensure adequate support for the DoS.

4.9 Equality, Diversity, and Inclusion

The EEC noted that the low numbers of female staff could result in too many requests for service duties for them.

Appendix 1: Members of the External Evaluation Committee

| Name | | Affiliation |
|---------------------------------------|------------|---|
| Dr. Aikawa, Yuri | | Professor at Graduate School of Science, The University of Tokyo |
| Dr. Ioka, Kunihito[†] | | Professor at Yukawa Institute for Theoretical Physics, Kyoto University; Member of Project Review Committee, NAOJ |
| Dr. Kawabata, Koji[†] | | Professor at Hiroshima Astrophysical Science Center, Hiroshima University; Member of Project Review Committee, NAOJ |
| Dr. Komatsu, Eiichiro | | Director at Max Planck Institute for Astrophysics, Germany |
| Dr. Millar, Thomas J | Chair | Professor at School of Mathematics and Physics, Queen's University Belfast, UK |
| Dr. Narita, Norio | | Professor at Graduate School of Arts and Sciences, The University of Tokyo |
| Dr. Wada, Keiichi | Vice Chair | Professor at Department of Science, Graduate School of Science and Engineering, Kagoshima University |

Appendix 2: Evaluation meeting timetable

| DAY 1 (2 March) | | DAY 2 (3 March) | |
|-----------------|--|-----------------|--|
| 9.30 | EEC (Closed) | 9.30 | EEC (Closed) |
| 10.00 | Director General (Closed) | 10.00 | Heads RA2 + science talks |
| 10.45 | Chair DoS (Closed) | 11.00 | Heads RA4 + science talks |
| 11.30 | Heads RA1 + science talks | 12.00 | EEC Lunch (Closed) |
| 12.30 | EEC Lunch (Closed) | 12.45 | Posters - all areas |
| 13.15 | Posters - all areas | 13.45 | Meeting staff, postdocs, students RA2, RA4 (Closed) |
| 14.15 | Heads RA3 + science talks | 14.45 | Chair DoS (Closed) |
| 15.15 | Meeting staff, postdocs, students RA1, RA3 (Closed) | 15.15 | EEC (Closed) |
| 16.15 | Meeting with international staff and students (Closed) | 16.00 | Feedback1 (Chair DoS and Full Professors) |
| 16.45 | EEC (Closed) | 16.30 | Feedback2 (all DoS staff and students) |
| 17.15 | End Day 1 | 17.00 | End Review |

RA1: Formation of Stars and Planets, Exoplanets

RA2: Galaxies, ISM, Protoplanetary Disks

RA3: Cosmology, Formation of Galaxies, Large Scale Structure

RA4: High Energy Astrophysics, Stellar Explosions