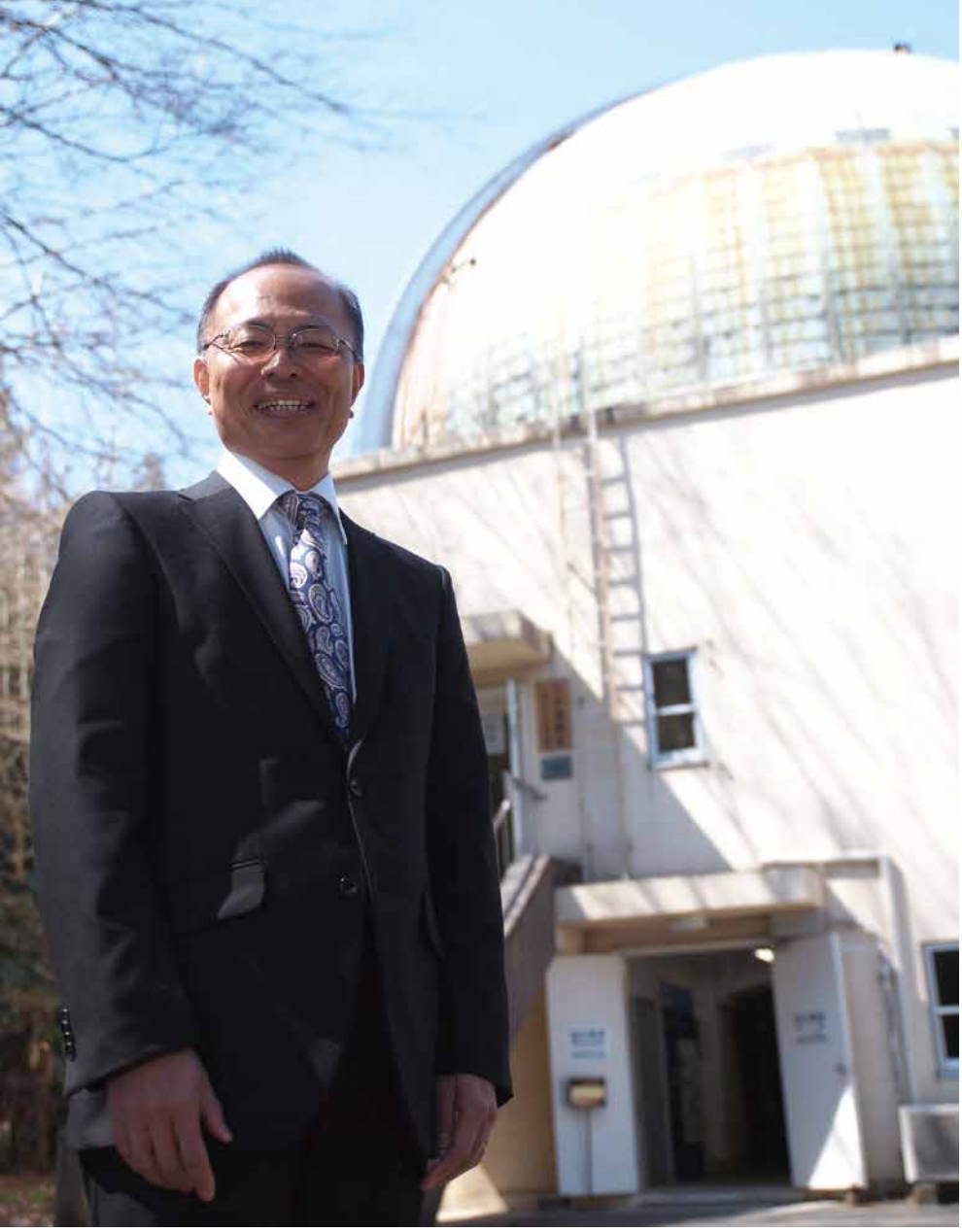

PREFACE

Masahiko HAYASHI
Director General of NAOJ

It is my pleasure to present the Annual Report of the National Astronomical Observatory of Japan for fiscal year 2013.

In fiscal year 2013, Japan started work to create TMT. TMT is a 30m diameter optical-infrared telescope being constructed on Mauna Kea on Hawai`i Island by 5 countries including Japan, the United States of America (University of California, California Institute of Technology, the National Science Foundation), the People's Republic of China, the Republic of India, and Canada. Overall construction is scheduled to begin in 2014. But Japan had the good fortune to have its construction budget approved before the other nations. Japan bears responsibility for the most critical components, including the body of the telescope and production of the nearly 600 segments for the primary mirror. The Master Agreement establishing the fundamentals needed for the 5 nations to move forward with construction was completed and in July I signed it on behalf of the NAOJ. The search for signs of life in the Universe is one of the stated major targets for TMT. This statement sounds like a dream, but I am confident the day is approaching when it will be a reality.

ALMA is continuing commissioning (the process of confirming and adjusting those complicated devices one by one) while carrying out Cycle 1 observations. Also, results from the Cycle 0 trial observations have started to be released. ALMA has over 100 times more sensitive than previous millimeter/submillimeter band radio telescopes. I understood this mathematically, but when I saw the actual data and realized what that really means, I was amazed. The resolving power approaches 0.1 arc-seconds, equivalent to the sharp images taken with the Hubble Space Telescope or the Subaru Telescope using adaptive optics.

Thanks to this overwhelming sensitivity and resolution, ALMA can zealously observe objects in the distant Universe. Thinking back to when I was a graduate student, CCD cameras were being mounted on the 3−4m diameter optical telescopes in the world and observing the Universe out to a redshift of 3 (11.5 billion light-years.) Seeing those observations, I thought it was a world that Japan could never attain through any means. Even using the Nobeyama 45-m Radio Telescope, detecting carbon-monoxide spectral lines from nearby galaxies required an exposure time of about 1 hour per pointing. But today with the Subaru Telescope, we can see the redshift 7 Universe (12.9 billion light-years away) and ALMA promises to detect even farther galaxies. I feel that we have truly entered a new generation of astronomy.

ALMA is producing interesting results in the field of planetary system formation. One of the surprises we've learned is that the dust which becomes the material for planets is localized inside protoplanetary disks (gas disks.) The biggest problem in modern planetary system formation theory is how dust grains on the order of 1 micron in size amalgamate up to planetesimals on the order of several kilometers in size. It is very difficult for dust grains to collect and form planetesimals in the case where the dust particles are scattered around the star in the same formation as the gas disk. But if just the dust grains are localized at areas within the gas disk, it becomes especially easy for planetesimals to form. This is a very interesting result.

In addition, test observations with the ultra-wide-field prime focus camera (Hyper Suprime-cam) have finished at the Subaru Telescope and the Strategic Observation Program has been assigned 300 nights over the next 5 years. This camera's survey speed (=limiting magnitude x area of the field of view) is over 10 times greater than previous surveys. Thanks to this camera, the Subaru Telescope's observations will be the world's forerunners without question, until LSST (America's Large Synoptic Survey Telescope) becomes operational in the mid 2020's. Observations with this camera will elucidate the large-scale distribution of dark matter in the Universe. It should be able to constrain the characteristics of dark matter and dark energy in the quest to understand the evolution of the large-scale structure of the Universe.

Noteworthy FY 2013 results, in addition to those mentioned above, are cited below. First, through years of observations by Mizusawa VLBI Observatory's VERA Project measuring the rotation of the galaxy with greater accuracy than before, we learned that the galactic rotation velocity in the vicinity of the Sun is about 10% faster than previous estimates. This shows that the Milky Way's mass (dark matter) is about 20% larger than was previously thought. Also, using the Subaru Telescope's high contrast camera HiCIAO the extra-solar planet survey project succeeded in the direct imaging of an exoplanet with 4 times the mass of Jupiter (a Second Jupiter.) It was determined that with TMT we should be able to take a direct image of an Earthlike planet and analyze its atmospheric composition.

In other matters deserving mention, I want to point out the completion of the career path for technical staff. This has been an issue since before the NAOJ was established; there have not been suitable high level positions in technical fields, or people have not been appointed to them. Now, technical staff can select the new career path, taking proper advantage of the freedom of the personnel system which increased when we incorporated.

With the Subaru Telescope, NAOJ established its first overseas research facility. After that, ALMA proceeded through cooperation with Europe and the Americas. In the world of astronomy, this was the first instance of this level of international collaboration. I think the fact that as one of the members of this kind of international collaboration NAOJ participates as a principal partner shows that, even from an international viewpoint, Japanese astronomy has attained leading-edge status.

But I don't believe that the internationalization of Japanese university research institutions, NAOJ included, has reached a sufficient level yet. An environment where faculty who don't speak Japanese can comfortably conduct research has not been adequately prepared. Even at NAOJ foreign research appointments are actively proceeding, but I feel that to be seen by the world as a true international open astronomy research facility, internationalization is required in every aspect, including the Administration Department. Similar problems also arise with attempts to increase the number of women faculty members. I feel we must reexamine the entire NAOJ, or even up to the level of the National Institutes of Natural Sciences, to address these issues.

Masahiko HAYASHI
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