

KAKENHI ESSAY SERIES No. 28 (May.2011)

**Grants-in-Aid That Supported the Development of Hi-Tech
Astronomical Instruments**

By **Masanori Iye**
**Director of Research Coordination and Professor, National
Astronomical Observatory of Japan**



How I came to apply for a Grant-in-Aid

I believe it was seeing photographs of spiral galaxies in a book when I was in elementary school that set me on my path as an astronomer. I went on to earn a doctoral degree through my theoretical research on gravitational instability, which holds the secret to the amazing spiral structure of these galaxies. To verify the characteristics of the spiral patterns predicted by my theories, from the time I was a graduate student I carried out observations at the Okayama Astrophysical Observatory and KISO Observatory. I remember how greatly impressed I was the first time I observed galaxies through a 188cm aperture telescope. However, I realized in a few years that these domestic telescopes are not competitive to world leading ones.

Several years after promoted as a tenure research associate, I spent a year as a visiting astronomer at Cambridge University to carry out theoretical research. Interestingly, theorists of my same generation whom I had discussions with at Cambridge are now leading forefront projects in Europe, UK, USA, and Canada. In the following year, I was given the chance to stay in Munich as a guest researcher at the European Southern Observatory (ESO). I wrote four observation proposals to use a newly commissioning instrument, and was selected for three of them. As a result, I was able to spend a month at the La Silla Observatory in Chile, as its first observer. Under starry skies, I was able to capture breathtaking images with a CCD camera of this instrument. It was that particular night when I was convinced that the era for developing photographic plates in a darkroom was coming to an end.

Building a CCD camera with my first Grant-in-Aid

After returning to Japan in 1984, though just a fledgling researcher I rashly applied for a Grant-in-Aid under the category General Scientific Research A. Surprisingly, I was accepted for the grant in the amount I requested: ¥29.6 million. A year later, I finished developing my liquid-nitrogen cooled CCD camera and made my first observation with it using a 188cm telescope. Though the camera had worked just prior, no image was produced. It appeared that the CCD chip at the heart of device had been damaged by an electrostatic charge. I sank into low spirits that night, thinking that my life as a researcher had ended. In the following month, I managed to repair the camera and used it to re-challenge the photo shoot. This time, the faintest star detected on CCD was 23rd magnitude, two magnitudes fainter than the 21st magnitude that had previously been recorded on photographic emulsion plates. In Japan, that marked the beginning of the CCD era in astronomical observation.

Since then, I was lucky to receive 12 consecutive Grant-in-Aid funded projects for 27 years. Though some did not yield the kind of results that satisfied me, my work was greatly, even immensely supported by Grants-in-Aid.

Developing a hi-tech goggle for Subaru Telescope

Using a Specially Promoted Research grant from FY 2002 and Scientific Research (S) grant from FY 2007, we carried out over a 10-year period a series of development to build a laser-guide adaptive optics system that would increase by ten times the power of the Subaru Telescope. Altogether, ¥784 million in Grants-in-Aid was invested to develop key components and integrate them into a system with the help of about ten highly gifted colleagues. The deformable mirror designed by us was developed by a French company, and the laser-launching 50cm telescope was manufactured by an Italian company. The solid-state sum-frequency wave laser, photonic crystal fiber and micro-lens array were jointly developed by RIKEN and other domestic manufacturers. The members of our group designed and assembled the various optical components, such as a wavefront sensor employing 188 avalanche photodiodes, while also designing and developing the control electronics and software.

Our observational research, which was advanced in parallel with instrument development, yielded world-record results over a 4-year period from FY 2006. We were able to discover the theretofore farthest galaxy in the universe at 12.9 billion light years away. Though it may be said that this rock we threw at elucidating the early history of the universe hit the target as planned—we were also very lucky.

Developing and commissioning this first-in-the-world device did not always go as initially planned. One unanticipated predicament we found ourselves in happened when trying to transport the instrument to Hawaii. During the course of research, the National Astronomical Observatory was reorganized as an inter-university research institute, and an application had been made for extending the Subaru Telescope's tax exemption in the US, but not yet approved. Without it, we'd have to pay customs in an amount of about ¥10 million. We didn't have such a large amount of money available, nor did we want to set a disadvantageous precedent for the Subaru Telescope by paying the tax. As it was the first year that Grants-in-Aid were allowed to be carried over into the next fiscal year, we applied for permission to carry our grant over so as to postpone the transport of the device while awaiting the tax-exemption approval. Not wanting to cause trouble for intermediaries in applying for the grant extension, I used personal reasons for requesting the carryover, though they weren't the real ones. After considerable clamor, the processing of the extension was completed. In April, I quickly visited the embassy in Washington and petitioned for the expedited processing of the Subaru Telescope's tax-exemption application. Then, on the very last day(!) of the allowed transport period, the tax exemption was approved. Looking back, it was a thrilling tightrope that we walked. However, the efforts made by the team paid off in developing and commissioning the laser guide adaptive optics system, which for less than a 2% added investment strengthened the resolving power of the ¥40-billion telescope by ten times.

Evolving Grants-in-Aid

Grants-in-Aid must be used within the parameters of an array of rules. In the early 1990s, the amount of grant funding that could be used for international travel was still small while expense-item barriers to domestic travel were high. Limits were also placed on the grant support that could be given to the international travel of graduate students; and with various other obstacles in the way of using grants overseas, there were many cases when the system was inadequate for advancing international scientific research. Chairing the International Cooperation Committee for Astronomy in the Science Council of Japan, over a period of three years we gathered requests from frontline researchers on ways to improve the grant system and compiled them into a report titled "Enhancing the Support System for International Joint Observational Activities in Astronomy-related Fields," and released it in 1998. Looking back at the contents of that report, I'm impressed that almost all of the points needing improvement have now been accomplished. MEXT and JSPS have reflected voices from the field in enhancing the Grants-in-Aid system.

For three years from FY 2006, I was given the opportunity to serve as a senior program officer in JSPS's Research Center for Science Systems. Continuous communication between JSPS's competent staff and the Center's researchers, who were capable of clearly conveying needs from the field, accelerated the speed of Grant-in-Aid system enhancement.

Against the national calamity caused by the Great East Japan Earthquake, it is my hope that Japan will be able to leap forward by steadfastly advancing science, technology, and education.