

[Kakenhi Essay]

February 2014 Issue

Grants Allow Research to Grow

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A “Pencil and Paper” Researcher

Since discovering the study of plasma physics in my university days and choosing theoretical research in that field as my specialty, I have continued to pursue my academic life as a “pencil and paper” researcher. To this day, I have continued with my habit of using up pencils until they are so short that they can no longer be sharpened with an electric pencil sharpener, and disposing of those stubs in small “memorial” jars I keep beside my desk. At a certain point, I make abrupt progress with my research in my head, but consolidating my thoughts into a tangible research project, applying for JSPS grant assistance, and organizing the results of that grant-funded research to put together my next project are also tasks I consider to be extremely important.

Although I may be a purely theoretical “pencil and paper” researcher, I cannot get by without grant assistance. Since I embarked on my work with the (reckless) desire to tackle problems I must solve rather than problems I can solve, finding suitable problems was a difficult task. If asked the reason why I need grants for this exercise, I would say I need them for travel expenses, first of all. In particular, it is essential that I observe experiments and identify or highlight new problems. To that end, I have to search for and find qualified experimentalists, visit their facilities, have them show me their research equipment, and discuss their research accomplishments. JSPS grant funding is instrumental in enabling me to design problems with my own ideas and insights.

In the course of my travels to research institutions worldwide, one thing I have learned is that I must set out on journeys aimed at finding individuals with whom I can communicate my ideas. Thanks to the good will of many individuals, I am fortunate in that I have had opportunities to know a number of research institutions worldwide and become acquainted with the amazing researchers they employ. I now have close ties to several such institutions, one of them being the Max-Planck-Institut für Plasmaphysik in Germany. My relationship

with that institution began during my graduate school career with an invitation to serve as a guest researcher. The Max-Planck-Institut became an inseparable element of a research life for someone supported by JSPS grant funding, daily strolls, and a taste for beer. In later years, I had the opportunity to invite the institute's former managing director, Professor Klaus Pinkau, to Kyushu University. On that occasion, Dr. Pinkau noted that because only a few people in this world shared his views, he had to make an effort to find them and that his travels for international exchange were for that purpose. That was an idea that also resonated with me.

### Applications Approved and Rejected

Reflecting on the applications I have submitted for new projects lasting from three to five years, I would say the occasions that applications failed to gain approval left the deepest impression on me. In the summer of 1987, I devised an entirely new theory for the H-mode transition of magnetically confined plasmas but my application for a project based on that idea did not immediately win acceptance. Discovered in 1982, the H-mode transition in magnetically confined plasmas is a phenomenon involving sudden constraints on motion near the plasma surface, thus facilitating an improved level of confinement. This discovery was an evangelical moment for research aimed at achieving nuclear fusion, but because it was a thorny problem, only a small number of people worldwide were then engaged in work to identify the related causal factors. In the summer of 1987, I was invited to the Max-Planck-Institut für Plasmaphysik, where the H-mode transition had been discovered. As I was interested in tackling problems that had to be solved, in the presence of the scientist that made that discovery, I announced (in a somewhat foolhardy fashion) that I would devise a theory of the H-mode transition phenomenon itself and began working on that task. After much effort and struggle, I succeeded in putting together a viable theory. I was aided in that endeavor by the strolls and beer I shared with my joint researchers. When I made a presentation on this research to members of the Physical Society of Japan, one professor openly scoffed that while he thought my ideas were interesting, he didn't accept them. I am not certain of any causal relationship but my application for JSPS grant assistance was not approved that year. Afterward, as more and more people comprehended and experimental physicists verified my theory, my applications for grant assistance were approved. My elaboration of this theory eventually earned commendations and awards including the Nishina Memorial Prize. That is perhaps why the grant application that was not accepted left an impression on me that has lasted to this day.

## The Shift in Research to Large-Scale, International Projects

Of course, I was also deeply moved whenever my applications for grant assistance were approved. I became a strong believer in the necessity of serious experimentation as my research moved forward. And, after my fashion of tackling problems that had to be solved, I was obsessed with the desire to find out what was actually going on within a turbulent plasma field. JSPS's grants-in-aid for scientific research were the key that would enable a theoretical "pencil and paper" researcher like me to submit proposals for (albeit with no vested interest in) research amounting to hundreds of millions of yen that would also include the stages of experimental verification. Under the sharp eye of application referees, I was allowed to carry out a proposed research project for which I applied for a Grant-in-Aid for Specially Promoted Research. As one outgrowth of that endeavor, I feel that I contributed to the formation of a new subfield: plasma turbulence physics. As I see it, the awards and commendations earned by my junior joint researchers fully attest to the success of this project. This turn of events presented me with the opportunity to launch the Itoh Project Prize: an award offered to doctoral degree students that have excelled in the field of plasma turbulence research within the European physics community. Winners of this award are invited to Kyushu University and given the opportunity to make a speech when they receive the prize. My motive was to create opportunities for young researchers to grow and win friends and supporters in Japan. This year will be the ninth for the Itoh Prize. All of the recipients thus far are now leading stellar careers within the global physics community.

## Research Allowed to Grow and Thrive

Beginning with my first research project which was awarded a Grant-in-Aid for Encouragement of Scientists to my most recent project which was awarded a Grant-in-Aid for Scientific Research (C), the walls of my research lab are lined with a series of reports on grant-funded research that involved me as project leader. The report I wrote in 1982 notes that study should be devoted to the transport phenomena induced by the instability and fluctuation of inhomogeneous plasmas with the parallel development of physics methodologies that can facilitate a systematic analysis of phenomena ranging from fluctuations to macroscopic plasmas. That enterprise eventually led to the aforementioned achievements. Practically every time I've submitted a proposal for a new project, I've embarked on a challenge that opens the door to new research frontiers and demands an ever-higher level of JSPS grant assistance. The grant assistance that I so immoderately sought time after time has allowed my research to grow and thrive. For that, I am deeply grateful.

## In the Shoes of Application Referees

These days, I find myself more frequently engaged in duties that play a supporting role to the JSPS grant program. Day after day, I find myself calling for expanded levels of grant funding. Each day is a day where I either “evaluate or am evaluated.” As I reflect on all the applications I have submitted for grant assistance—both those that were awarded grants and those that failed to pass muster under the keen scrutiny of the review process—I recognize the need to exercise great discernment in the review of applications.

