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Grants-in-Aid: Foster Parent of My Optical Communication Research

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Without Grants-in-Aid for Scientific Research of JSPS, my research wouldn't have existed. The bonds between my research and the Grant-in-Aid program has been truly firm: Grants-in-Aid have 1) been parent that fostered my optical communication research; 2) helped compile and disseminate Japan's noteworthy technologies (DB-JET); and 3) promoted certainly national scientific research.

1. Conception and Realization of a Dynamic Single Mode Laser (DSM Laser) for Ultrafast and Long distance Optical Fiber Communications

After completing my doctoral studies at Tokyo Institute of Technology in 1960, I was appointed as a research associate of Tokyo Institute of Technology. As a graduate student I had felt that there were speed limits in microwave communication, which was major communication tool at those days. I, therefore, set about on research to realize optical communication, which had the potential of several thousand times more higher transmission speed. At that time, optical communication was yet an unexplored field of research. At Tokyo Tech, I was allowed to set my own research goals though still a fledgling researcher standing on the starting blocks of a long process. The university endowed my research with an excellent environment, but without sufficient funding to exploit it. After becoming an associate professor in 1961, I was give my own lab along with some amount of research funding, but that still left me a long way from pursuing my research objectives in earnest.

Fortunately, I was able to receive support from Grants-in-Aid for scientific research in 1966, which encouraged me greatly. From that point, we started to make progress in our research, blessed as I was with the collaboration of colleagues, both senior researchers and gifted graduate students. Even then, however, it took about 10 years to fully equip the lab. Thereafter, it was without pause that I received an inflow of Grants-in-Aid. In 1971, I secured a Grant-in-Aid for our research on pioneering the integrated laser. In 1972, I conceived a concept of semiconductor laser with stable single wavelength operation under

real environment, later to be called a dynamic single mode laser, DSM laser for short, while searching for principles to make it operational. That was thought to be a key device to realizing ultrahigh speed and long distance optical fiber communications. To move my research forward, I succeeded in developing an integrated laser and, from that, a dynamic single-mode laser.

In 1974, I came up with the concept for a resonator that could shift the phase 180 degrees between two distributed reflectors and, so doing, elucidated the principle of the dynamic single-mode laser in widely use today. Then from 1977, I received a Grant-in-Aid for Priority-area Research to advance my work on the project of optical waveguide electronics, followed up with Grant-in-Aid for Specially Promoted Research in 1979. Advancing my research in collaboration with industry, for the first time in the world I realized the room-temperature continuous-wave operation of a GaInAsP/InP semiconductor laser at 1.5μm wavelength region needed for long-distance optical fiber communications. Around that time, I built a clean room with support from Grants-in-Aid and the university, and I was advancing our work at the university with what could be called facilities of the highest world academic standard.

The phase-shifted DFB laser, as a type of DSM Laser, we reported developing in 1984 is currently used widely as the essential standard laser for ultrahigh speed and long distance optical fiber communications. The wavelength tunable laser, as another type of DSM laser, I proposed in 1983 would be applied to wavelength multiplexed optical transmission. These technologies were in practice by industry: 1.5μm band long distance optical fiber communication was deployed over land in around 1987 and via transoceanic submarine cable in 1992, in industries respectively. Thereafter, they became familiar as basic technologies for developing the Internet. Side Mode Suppression Ratio (SMSR), a term we coined to express the singularity of the dynamic single-mode laser, later became widely used within the international electronic standard term.

I was very fortunate to have been able to pursue this research during a transitional period when new fields of science were being created and applied. I was doubly fortunate to have done so with robust financial support from Grants-in-Aid, which allowed me to pioneer and expand the frontiers of optical communications. Having participated in the development of this science and technology from its inception, I have very much enjoyed watching its advance and transform society. In 1989, I was appointed president of the Tokyo Institute of Technology, so as custom dictated at the time, I restrained myself from

applying for any more Grants-in-Aid for my own research activities.

II. Creation and Dissemination of the Database on Noteworthy Japanese Contributions to Electrical Technology

In the postwar period, various new technical creations and innovations raised Japan's technology to a world level. The Database on Noteworthy Japanese Contributions to Electrical Technology (DB-JET), nicknamed the "Digital Electric Museum," was created to archive and disseminate these milestone technologies to the junior and public, including the world. Started in 2003, DB-JET has been in operation for seven years. Its operation is supported by grants I applied for under three Grant-in-Aid categories: Publication of Research Results, Scientific Research, and Priority-area Research. Currently, the database archives some 1,250 technologies reported by the five scientific societies listed below. It operates over the network of the National Institute of Informatics (http://www.dbjet.jp/).

Institute of Image Information and Television Engineers
Illuminating Engineering Institute of Japan
Information Processing Society of Japan
Institute of Electronics, Information and Communication Engineers
Institute of Electrical Engineers of Japan

The database's technical content is derived from technology-related awards issued by the five societies each year, respectively, and described using the certificate of commendations. From this year, the database is open to disseminate noteworthy electric technology in three categories; for junior high school boy and girls to make interest on these technologies; for domestic professionals; and an English version for international interest.

III. Expanding Grants-in-Aid

I had for long years received marvelous support from Grants-in-Aid for conducting my own research. In 2003, as a chairperson of the Science and Technology Council, Ministry of Education, Science and Culture, I became keenly interested in national system of research funding, including how Grants-in-Aid were being used to create a high quality education and research environment in universities. Despite the immense efforts of administrators and others involved, the level of financial support provided by the government for

university research is a lower percentage of GDP than other OECD countries. This, it is pointed out, creates an obstacle to enhancing the international competitive circumstance of universities. It is my sincere hope that the government willing to expand its Grants-in-Aid and other government-allocated research funding to reach OECD level.