Introduction and Background of Establishment of Kanazawa University WPI

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WHAT IS WPI?

The World Premier International Research Center Initiative (WPI) [1, 2] is a program to create a world-class research site. It was launched by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan in FY 2007. This program aims to establish an open research center that will be a hub of the international Circulation of Talented Researchers where researchers from all over the world will gather to realize four missions: (1) Establish world-class research standards, (2) Create fusion-research fields, (3) Realize an international research environment, and (4) Reform the research organizations [1, 2]. The center must fulfill the following requirements: Have 70 or more researchers (critical mass of researchers), 7 or more international leading principal investigators (PIs), and of these, at least 30% of the researchers are from foreign countries, and the administrative and research support systems are all in English [1].

The support is intended for the concept of a research center in the field of basic research, and the scale of the support is up to 700 million yen annually for 10 years. However, considering the independence of the center, the scale of the support is gradually reduced after the mid-term assessment. The project assessment is conducted by a program committee consisting of Nobel laureates and prominent foreign researchers, and careful and meticulous follow-up is performed by the program director (PD) and program officer (PO), etc. Support expenses include personnel expenses, business promotion expenses, travel expenses, and facilities/equipment expenses. However, research project expenses are not supported because of the self-effort to obtain external funding [1]. Specifically, WPI is a program that aims for world-class research such as producing high-quality papers ranked in the top 1% of cited papers, creation of new research areas by combining different fields, performing system reform of universities and sciences, and deepening and strengthening international Circulation of Talented Researchers and cooperation between sites [1].

In the initial public call for WPI applications by MEXT in FY 2007, 33 applications were received. The following were selected: Tohoku University Advanced Institute for Materials Research (AIMR), University of Tokyo Kavli Institute for the Physics and Mathematics of the Universe (KavliIPMU), Kyoto University Institute for Integrated Cell-Material Sciences (iCeMS), Osaka University Immunology Frontier Research Center (IFReC), and National Institute for Materials Science (NIMS) International Center for Materials Nanoarchitectonics (MANA). In the second public call for applications in FY 2010, nine applications were received. The International Institute for Carbon-Neutral Energy Research (I^2CNER) of Kyushu University was selected. In the third public call for applications in FY 2012, nine applications were received. The following were selected: University of Tsukuba International Institute for Integrative Sleep Medicine (IIIS), Tokyo Institute of Technology Earth-Life Science Institute (ELSI), and Nagoya University Institute of Transformative Bio-Molecules (ITbM). In the fourth public call for applications in FY 2017, 15 applications were received. University of Tokyo International Research Center for

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Neurointelligence (IRCN) and Kanazawa University Nano Life Science Institute (NanoLSI) were selected. In the fifth public call for applications in FY 2018, 13 applications were received. Hokkaido University Institute for Chemical Reaction Design and Discovery (ICReDD) and Kyoto University Institute for the Advanced Study of Human Biology (ASHBi) were selected. As of FY 2019, 13 WPIs have been adopted [2]. As per my understanding, the next public call for applications is not yet decided. The five sites selected in FY 2007 reached the end of their support period and then have been selected for the WPI Academy as having realized outstanding research capabilities and internationalization alongside world-class research institutes and formed "visible research sites around the world" [1, 2].

From the following section, I will explain Kanazawa University WPI from planning to the present. At the time of planning/drafting the plan, I was in Osaka. Therefore, this part is hearsay. Further, due to the word limit of the journal, I have omitted the introduction of seminars for NanoLSI research, organization/operation, promotion of fusion research, support for foreign researchers, etc.

PLANNING AND DRAFTING OF PLAN FOR NanoLSI

Kanazawa University began planning and drafting the plan after receiving information that public recruitment for two new WPIs would be held in 2017. Prior to that time, to form a global research center, Kanazawa University had created several nuclei (fields) of research areas that were in a superior position in the University called the Transcendence Project. Research was promoted with the support of the University. The process in which these nuclei must be combined to file the application was discussed. The WPI research center concept consists of basic research, core research fields with world-leading research standards (producing high-quality papers such as papers with IF (Impact Factor) of 10 or more), and more than 7 world-leading PIs. In addition, research project expenses obtained by applying external funds at the time of application, and the goal to create a new research area with a high impact by fusing different fields.

In the case of Kanazawa University, there was only one project that fulfilled these conditions. Specifically, our application was based on the following two cores. One is "Bio-SPM (scanning probe microscope) nanometrology" of the Bio-AFM Frontier Research Center, and the other is the "Life Sciences" of the Cancer Research Institute of Kanazawa University. The former develops liquid SPM for biology such as high-speed liquid AFM, super-resolution frequency modulation AFM, and high-performance scanning ion conductance microscope (SICM). The latter has more than 50 years of history since its establishment in 1967, and it is the only national university research institute dedicated to cancer research. "Bio-SPM nanometrology" and "Life Sciences" dedicated to cancer research, "Supramolecular Chemistry", which develops molecular sensors that detect and operate specific molecules by attaching supramolecules to the tip of SPM probes, molecular machines, and supramolecules and drugs that detect metabolites, and "Mathematical and Computational Sciences" that perform SPM simulation and biomolecule simulation. The advertising slogan is "Seeing the appearance of biomolecules moving in liquid to elucidate the molecular mechanisms of life phenomena (One picture is worth a thousand words)." Specifically, the content is "To develop a probe microscope that can video capture the nano world, bring a leap to the field of life science by direct observation of biomolecules, and elucidate molecules, cells, and diseases at the nano level."

CHALLENGE TO ESTABLISH NanoLSI

As world-class PIs, a total of 16 PIs were organized: 3 in bio-SPM nanometrology, 7 in life sciences, 4 in supramolecular chemistry, and 2 in mathematical and computational sciences. Of these, 5 are foreign PIs and the foreign PI ratio is 31%. One is affiliated with Kanazawa University, and the other four live abroad. However, they have been conducting exchanges and joint research through the Transcendence Project and other activities, and their consent and cooperation for participation were smoothly obtained. In order to elucidate the disease, among the researchers involved in life science, in addition to PIs belonging to the Cancer Research Institute of Kanazawa University, PIs belonging to pharmacy and medical departments also participated. These 16 PIs also had a track record of obtaining external funding comparable to the WPI grant. The candidate for the site director was Professor Takeshi Fukuma, who was 40 years old at the time of the application. After the open call for participants in February 2017, Professor Fukuma sent me an email requesting my participation as a candidate for the head of the Administrative Department. I was glad to participate and heard that the framework of the project was already established. The research site was named the Nano Life Science Institute (NanoLSI) [3].

The deadline for acceptance for the first screening application was April 4, 2017. There were 15 applications, most of which were made by prominent universities and institutions/research institutes. Prof. Fukuma subsequently contacted and informed me that seven institutions, including Kanazawa University, had passed the first round of screening, and at the same time requested personal details as a candidate for the head of the Administrative Department for the second round of screening. I was subsequently contacted again and informed that four institutions, including Kanazawa University, passed the second document screening. A hearing was to be conducted on September 13 as previously announced, and requests for additional materials for the hearing had been made. Furthermore, there were questions in advance, and the deadline for responding was September 6. At the same time, long and intense meetings were held for the creation of an English language presentation for the hearing. I travelled from Osaka for presentation practice. The preliminary version of the presentation material was mostly completed on September 5, and subsequently, the final version was prepared after repeated revisions. In addition, possible questions were prepared and an English version of the questions and answers (Q&A) was prepared. The question and answer slides and the final presentation slides were merged to create slides for the hearing.

Members gathered in Tokyo the night before for the Kanazawa University hearing (third screening) conducted by the FY 2017 Program Committee at the Bachelor Hall. The hearing was held on September 13 from 11:00 a.m. to 11:45 a.m., and the presentation was for 20 minutes (given by the president and candidate for site director) and the question and answer session was for 25 minutes. I was informed that MEXT notified by phone and email that Kanazawa University was selected for WPI on September 15. The hearings were conducted with four organizations. Kanazawa University NanoLSI and University of Tokyo IRCN were selected. In addition, following the selection, the director was asked to prepare press release documents. MEXT also gave notice that the press release date was September 26. It was decided to hold a press conference at Kanazawa University on the day of the press release by MEXT. I too participated in the conference by means of a round day trip from Osaka. NanoLSI was established at Kanazawa University on October 6, 2017.

LAUNCH OF NanoLSI

The first task at NanoLSI was an urgent exchange of views on laboratory and room locations, equipment, and supplies purchased through the WPI grant. To accommodate WPI officials, it was decided that one of the 2200 m^2 buildings would be renovated and used as a building exclusively for WPI. The sixth floor (800 m^2) of another building would also be used exclusively for WPI. MEXT approved the budget for a new WPI building because some of the researchers could not be accommodated into the building due to space constraints. It was decided that the previous building would be used until completion of the new building. Eventually, a plan was created to accommodate NanoLSI researchers and administrative staff in both the Cancer Research Institute of Kanazawa University and the new WPI building to be built nearby.

The next task was the PI contract between NanoLSI and the four persons residing in foreign countries. Negotiations with Imperial College London (ICL) in the United Kingdom, where PIs were located, and the University of British Columbia (UBC) in Canada to establish NanoLSI satellites began. However, the negotiations have been difficult. In addition, visits were made to Tohoku University AIMR and Nagoya University ITbM to conduct interviews regarding WPI operations, inspect buildings, and learn about the use of WPI subsidies (e.g., facility/equipment expenses, operational expenses, personnel expenses). The WPI grant mainly covered personnel and operational expenses. In the first year, procedures to select and purchase common equipment needed for WPI were implemented. Moreover, Kanazawa University bore the human resource expenses for researchers who were affiliated with Kanazawa University at the time of application and staff members for administrative and research support. In addition, the first international public call for publications (November 26 to December 25, 2017) and the selection of postdoctoral researchers (specially appointed assistant professors) were conducted to increase the number of researchers to more than 70. Regarding the international recruitment of specially appointed assistant professors, there was a time limit deadline of the end of the fiscal year. Although papers were published in international journals such as Science and Nature, it did not gather sufficient publicity. As a result, the number of applicants and the level of applicants, especially the application of foreign researchers required to increase the ratio of foreign researchers to 30% or more, were unsatisfactory. In addition, due to time restrictions, the start of employment of many researchers was delayed into FY 2018.

At the same time, regular events and work related to WPI were initiated, and by the end of March 2019, the following events had occurred.

(1) The 23rd WPI Outreach Representative Meeting, held three times a year (first time of attendance by NanoLSI) was held on December 19, 2017.
(2) Visits to sites such as WPI's Ukawa PD and NanoLSI's Nakano PO, the NanoLSI representative, were held on January 15, 2018 for explanation of future plans, exchange of opinions, and inspection of the status of the sites.
(3) The joint symposium of all WPIs (the sixth WPI Science Symposium) held by the site on a rotating basis was held on February 11, 2018 at the National Museum of Emerging Science and Innovation.
(4) The first NanoLSI International Symposium was held at the National Museum of Emerging Science and Innovation from February 21 to 22, 2018 as the kick-off event.
(5) The Japan Society for the Promotion of Science (JSPS) requested a progress report for FY 2017 on April 4, 2018 and announced the submission deadline as May 22, 2018.
(6) The first WPI site visit (June 21 to 22, 2018) was held at Kanazawa University by working group (site working group) members [2] led by Nakano PO in charge of NanoLSI and PD Ukawa.

Furthermore, the following events were held:

(7) The second WPI Secretary-General's Meeting for information exchange at Kyushu University on September 6, 2018.
(8) The WPI Program Committee which provides individual status reports (hearings) from each WPI, from September 19 to 20, 2018 (NanoLSI was on September 20, from 13:05 to 13:35 hours).
(9) The second NanoLSI International Symposium on November 19, 2018 at a UK hotel near the ICL where a satellite was to be established.
(10) The seventh WPI Science Symposium was held at Nagoya University on December 27, 2018.
(11) Ukawa PD, Nakano PO and others' site visits on January 30, 2019.
(12) The first NanoLSI Advisory Conference was held at Kanazawa University from February 20 to 21, 2019.
(13) The third WPI Secretary-General's Meeting was held on March 13, 2019 in the JSPS meeting room.
(14) JSPS requested to create a progress report for FY 2018 on March 1 and announced the submission deadline as May 29, 2019.

Of particular importance at these WPI events is the meticulous follow-up [2]. The results of the site visit of (6) led to formal comments (site visit reports) over approximately a month, the WPI Program Committee responded to these comments (site visit reports) in individual status reports from each WPI at the WPI Program Committee of (8), and the results of the hearings at the Program Committee led to other comments (follow-up reports). At the PD/PO visit of (11), there were explanations of these comments (follow-up reports) and opinions exchanged, and responses to these comments will be made at the next site visit. Repeated follow-up events will lead to a 5-year interim assessment and a 10-year final assessment.

CURRENT STATUS OF KANAZAWA UNIVERSITY WPI (NanoLSI)

The number of NanoLSI researchers at the end of FY 2018 was 72, an increase of 23 researchers from 49 at the start of the project. The condition of "a total of 70 or more researchers" (critical mass of researchers) was satisfied in one and a half years. In addition, the number of foreign researchers increased from 14.3% (7 persons) at the start to 30.6% (22 persons) The condition of "30% or more foreign researchers" (international research environment) was satisfied in one and a half years. Further, the number of research support staff members increased from 8 at the start to 25 and the number of administrative staff also increased from 13 at the start to 24. Thus, the total number of persons forming the core of NanoLSI expanded from 70 to 121. The number of PIs remained at 16, but tenure-track young PIs (junior PIs) required for the promotion of the fusion-research field will be recruited from Kanazawa University for six new positions. Five will be hired based on interviews and one is already appointed. NanoLSI concluded an overseas satellite agreement with UBC in Canada, which has international PIs, in October 2018, and with ICL in the UK in January 2019. Furthermore, a joint research agreement was concluded in May 2018 with NIER RIKEN Center for Biosystems Dynamics Research (BDR) as a domestic

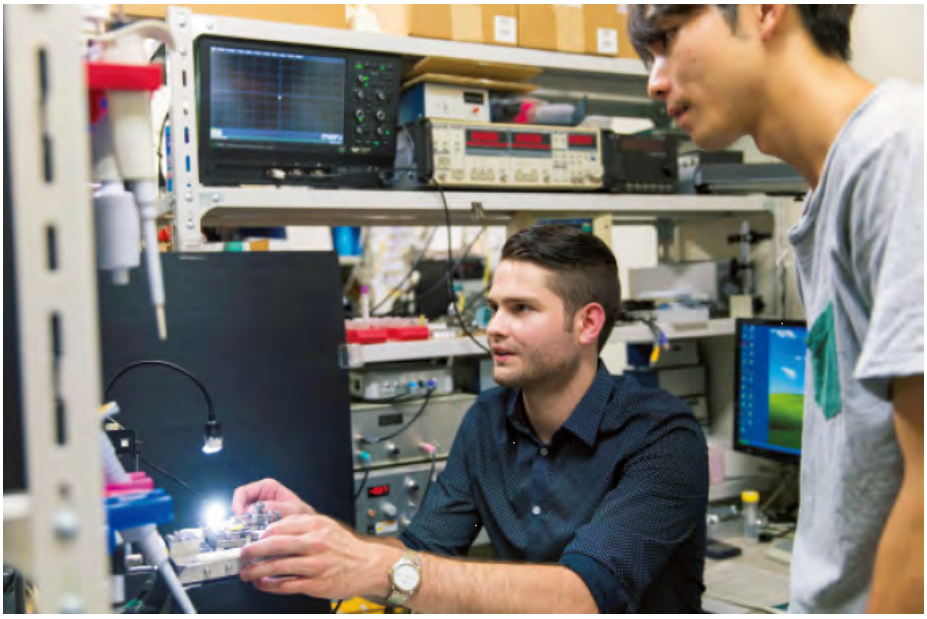

Fig. 1: Photograph of Bio AFM summer school practicum.

partner organization. The construction of a new building (6, 800 m^2) essential to accommodate NanoLSI members in one place and promote fusion research was approved by MEXT in FY 2018. The construction was initiated in FY 2019. Construction is scheduled to be completed in the fall of 2020.

NanoLSI aims to understand various life phenomena at the nano level by utilizing liquid Bio-SPM technology, and to establish the new research field of "nano (probe) life science." In order to expand the joint research network in Japan and overseas, this project has three Open Facility Programs, which are based on the high-speed atomic force microscopy (AFM), the super-resolution AFM, and the high-performance SICM, all with world's highest performance. The 1st one is the "Bio-SPM Collaborative Research" [3] program for external researchers and technicians, in which the applicants conduct research at the joint use facility (FY 2018 applications: 28 [11 from overseas]; selected including trial: 24 [8 from overseas]). The 2nd one is the "Bio-AFM Summer School (Figures 1 and 2)" [3] program for students and young researchers, which was established for the purpose of directly experiencing new possibilities by observing samples brought in by the successful applicants (FY 2018 applications: 23 countries, 71 persons; selected: 10 persons in Japan, 12 from overseas). As a result, in this program, applicants successfully visualized the nanodynamics of various biological systems such as nuclear pore complex [4], CRISPR-Cas9 [5], and human2-Cys peroxiredoxin II [6]. In addition, to increase the reputation of Bio-SPM and NanoLSI and publicize "nano (probe) life science" globally, the 3rd one, which is a "Fellowship Program" [3], has been introduced to accept prominent foreign researchers in various fields, including structural biology, and to promote international exchange (FY 2018 applications received: 21 applications; selected: 1).

Fig. 2: Photograph of Bio AFM summer school course.

We have also started internal recruitment of "fusion research promotion grants" to promote the fusion of four different research fields (i.e., nanometrology, supramolecular chemistry, mathematical and computational sciences, and life sciences) (31 applications in FY 2018; selected: 22 [including those with half the value]). The application for FY 2018 was focused on the fusion of two fields, but in the future, it is planned to realize the fusion of three to four fields to establish "nano (probe) life science". Additionally, to train the next generation of young researchers who will develop the results of NanoLSI, it is planned to launch the "Department of Nano Life Sciences" in Kanazawa University from 2020. In addition, we have introduced an excellent researcher allowance system to lead to the realization of a salary system in accordance with global standards.

The challenges for the future are to further improve the performance and functionality of Bio-SPM, observe the activity of biomolecules within and outside cells, and "elucidate molecules, cells, and diseases at the nano level."

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Seizo Morita, Professor Emeritus of Osaka University, was appointed as the director of the Administrative Department of NanoLSI, which was launched in October 2017. Seizo Morita retired at the end of FY 2018 due to chronic low back pain. He was awarded Medal of Honor with Purple Ribbon in 2011. He is vice Chairperson of the Foundation Advanced Technology Institute (http://www.ati.or.jp/index.html) and Program Officer of Advanced Measuring Technology of Japan Science and Technology Agency (JST).