1. Outline of Research Activities

Hirohiko Tsujii, M.D., Ph. D.,
Executive Director for Research

(Outline of Research Activities)

You will see in the following pages that all the research activities at NIRS were performed successfully in the third year of the second Mid-term Plan. I would like to finish with heartfelt thanks for cooperation and advice given to us during FY 2008.
The National Institute of Radiological Sciences (NIRS) was reformed as an Independent Administrative Institution in April 2001, when the first Mid-term Plan was started. This Plan was successfully completed in March 2006. This fiscal year (April 2008- March 2009) is the third year of the second Mid-term Plan. The NIRS research directly supported by the Japanese Government consists of five fields; heavy charged particle therapy, molecular imaging, radiation protection, and radiation emergency medicine. The research activities of these fields have been carried out by four research centers and one fundamental technology center and are presented in detail in this report.

Judging from the achievements in FY 2008, including publications, presentations at scientific meetings, and collaborations with other institutes/groups, etc., it can be concluded that our research activities had been vigorous with much progress and successful achievements obtained. The number of original papers published reached 315, and many of them were published in international journals with good reputations. Furthermore, we had more than 152 proceedings presented at international or domestic scientific meetings, 553 oral presentations, and 60 patent applications. Collaborative studies and exchanges of researchers were also very active: 109 collaborative studies were carried out, 1502 researchers worked as visiting staff, and 366 students were accepted as trainees. This year we started the NIRS International Open Laboratory for the purpose of creating and maintaining favorable environments in which young scientists can engage in advanced research at an international level with the support of Distinguished Visiting Scientists in strategically important fields such as radiology, biology, physics, chemistry, and engineering, thus contributing to the Institution as a whole.

Using the Heavy Ion Medical Accelerator (HIMAC), cancer therapy has been conducted at the Research Center for Charged Particle Therapy. In FY 2008 a total of 684 patients (753 lesions) were treated. The total number of patients treated has reached 4,504 since 1994. The development of new types of irradiation techniques, such as the spot-scanning method for treatment of moving targets progressed successfully. We supported construction of the new charged particle facility at Gunma University, where treatment of the first patients will begin in March 2010. Basic biological studies were also conducted to obtain biological evidence useful for development of effective protocols for carbon ion radiotherapy. Other research achievements included development of novel irradiation techniques, improvement of therapeutic and diagnostic procedures, research on radiation effects for improvement of radiation therapy, etc.

In the Molecular Imaging Research Center consisting of four groups, understanding of the mechanism of brain function and cancer pathology progressed and uses of this knowledge in clinical applications were carried out, mainly by positron emission tomography (PET). The achievements included PET studies on mesothelioma and hypoxic tumors as well as PET imaging of cancer neovascularization using 64Cu-labeled RGD peptide. In a molecular neuro-imaging study, remarkable progress on PET imaging and potential efficacy for treatment of Alzheimer’s disease was made. Development of advanced measuring techniques including the OpenPET continued with much progress as well as development of a new depth-of-interaction (DOI) PET detector.

The researches on radiation protection and emergency medicine, an important mission of our institute since its establishment, have been carried out in two centers. These centers also played a role as a national hub for collaboration with international organizations including the International Atomic Energy Agency (IAEA), International Commission on Radiation Protection, United Nations Scientific Committee on Atomic Radiation, World Health Organization, and so on.

The Research Center for Radiation Protection was established to provide a scientific basis for radiation protection and safety. The research done here has focused on the health effects of low dose radiation, levels of natural radiation, and radiation effects on environment (non-human biota). Toward this goal, radiation exposures from various sources were measured, dose-effect relationships for various endpoints were examined, and the mechanisms underlying the effects were investigated. The Research Center disseminated the outcome to promote public understanding of radiation effects and encourage the enactment of more reasonable regulations concerning the use of radiation. The scope of these activities is not limited to Japan. The Research Center has been designated by the IAEA as "Collaborating Centre for Biological Effects of Low Dose Radiation".

The NIRS has been positioned as a national center for radiation emergency medical preparedness in the nuclear disaster prevention system established by the Japanese Government. The Research Center for Radiation Emergency Medicine is assumed to perform the role of a specialized radiation emergency hospital and provide advanced radiation emergency medicine. In this scheme, the Center conducted various studies and investigations, continuously organized the radiation emergency medicine system on standby in Japan as well as maintained the facilities and devices for emergencies. It also carried out activities to maintain and enhance or strengthen the emergency preparedness system required to fulfill its role as the
tertiary radiation emergency hospital by establishing three nation-wide network councils for medicine, chromosome analysis as bio-dosimetry, and physical dosimetry.

The Fundamental Technology Center was established to support various studies of NIRS with advanced fundamental technology. It also carried out some developmental researches including on a single particle irradiation system to cells, a neutron irradiation device for animal experiments, and a radiation measurement apparatus for cosmic rays.

Some other research programs were also continued or newly started with the support of funding agencies including the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Ministry of Economy, Trade and Industry, the Ministry of Environment, and so on.

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