Recommendation

Japanese Master Plan of Large Research Projects

—— A Table of 43 Selected Projects ——

17 March 2010

Science Council of Japan

Committee for Scientific Community

Subcommittee for Large Research Projects

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Introduction

The Science Council of Japan (SCJ) officially announced the “Japanese Master Plan of Large Research Projects” for the first time on 17 March 2010. Such a Master Plan based on proposals from the science communities will play essential roles: to show the direction of science to the public, to promote cutting-edge science, and to strengthen and broaden the base of Japanese science.

We present here the English version of its essence, “A Table of 43 Selected Projects”.

The SCJ Master Plan

The “Japanese Master Plan of Large Research Projects” is a 150 page recommendation prepared by the Subcommittee for Large Research Projects organized in the SCJ, including 43 projects selected from 7 fields of science: Humanities and Social Sciences; Life Sciences; Energy, Environmental and Earth Sciences; Material and Analytical Sciences; Physical Sciences and Engineering; Space Sciences; and Information Sciences.

Working Process

The Subcommittee for Large Research Projects was established in March 2009 following the 2007 SCJ report “Direction and Promotion of Large Projects in Basic Sciences”. The mission of the subcommittee was to produce the first master plan of large research projects in Japan selected from the proposals from all fields of science based on discussions and selection in wide communities of scientists. An Announcement of Opportunities was sent to 206 universities and research institutes covering all Japanese major research organizations, and as a

result, 285 proposals were sent back to the subcommittee. It reviewed all proposals based on discussions in the 30 committees of fields of specialties, and finally selected 43 proposals based on the selection criteria (see below). The edited recommendation with the master list was sent to the SCJ council members for comments and also sent to the Committee for Scientific Community for review. Then the final version was submitted to the SCJ Executive Board in February 2010.

Two Categories of Large Research Projects

In this process we divided the large research projects into two categories:
A. “Large Research Facility Projects”, and
B. “Large Scale Research Projects”.
The category A is a project that aims to construct a large research facility, which is essential to accomplish its scientific goals. The typical cases are big accelerators, big telescopes etc. The Category B is a project to organize many scientists in specific fields for a long period to establish a database, research network, resource center, etc., which widely supports the related communities and strengthens the research in related fields as a whole. The category B is a new concept of large research projects formally proposed in this recommendation for the first time. The Announcement of Opportunities was made separately for each category showing the definitions and detailed selection criteria. The total budget of the two categories is set to be over 10 billion yen and over several billion yen each, which is a difficult level to implement with the existing funding mechanisms in Japan.

Content of the Master Plan Recommendation

The Master Plan Recommendation consists of 1. Background and Purpose, 2. Definition, Needs and Significance of Large Research Facility Projects, 3. Definition, Needs and Significance of Large Scale Research Projects, 4. Selection Criteria of Large Research Projects, 5. Working Process of the Master Plan, 6. Proposals to Promote Large Research Projects, and 7. Conclusion. A Table of the 43 Selected Projects with important information, and Explanations of the individual 43 Projects (two pages each) follows. The English version of the whole recommendation is under preparation.

Outlook

1. The Master Plan Recommendation was sent to all related governmental organizations and research organizations. Some of the 43 projects in the Master Plan were discussed for actual promotion and budgets were allocated to some of them. For example, the following four projects will start in 2010 using the "Promotion of Cutting-Edge Research Program Fund" of the Ministry of Education, Culture, Sports, Science and Technology:

   "Web for Integrated Studies of the Human Mind (WISH) "

   "High Magnetic Field Collaboratory: High Field Facilities in the Next Generation"

   "Exploring Physics beyond the Current Particle Theory with Super B-Factory"

   "Large-scale Cryogenic Gravitational Wave Telescope Project"

   Also, the following five projects in the Master Plan will also start partially in 2010:

   "Establishment of an Animal Genetic Engineering Consortium for Cutting Edge Medical Research"

   "Research Center for Drug Discovery"

   "Deciphering the History of the Earth and Life and Exploration of Subsurface Deep Biosphere"

   "Materials and Life Science with High Intensity Neutron and Muon Beams"

   "National Academic Cloud Computing Facility for High-Performance Computing and Shared Scientific Databases"

   The SCJ will keep and strengthen close contact and cooperation with the related funding agencies to follow up on the Master Plan.

2. The SCJ will continuously review and update the Master Plan. As this was the first attempt for such a master plan of large research projects, we will implement minor changes to the Master Plan 1st version within one year, i.e. in 2011, taking into account the recent status. Then, the Master Plan 2nd version will come up in 2012. Afterwards, we expect to have new version every three years.

The members of the Subcommittee for Large Research Projects

Chairperson	Yasuhiro Iwasawa	(Council member of Section III)	Chemistry
Vice-chairperson	Matori Yamamoto	(Council member of Section I)	Anthropology
Secretary	Norio Kaifu	(Council member of Section III)	Astronomy
Secretary	Tetsuo Nagano	(Member)	Pharmaceutical Science
	Kotaro Suzumura	(Council member of Section I)	Economics
	Toshio Yamagishi	(Council member of Section I)	Psychology
	Makoto Asashima	(Council member of Section II)	Biology
	Shoji Nagamiya	(Council member of Section III)	Physics
	Shinichiro Ohgaki	(Council member of Section III)	Environmental Engineering
	Asahiko Taira	(Council member of Section III)	Earth and Planetary Science
	Takashi Gojobori	(Member)	Biology

Japanese Master Plan of Large Research Projects

Humanities and Social Sciences

cate-gory *note 1	project name	financial requirement (1billion yen)	project duration	project summary	expected outcome	international collaboration level *note 2	degree of development
B	Global Integration of Regional Knowledge Resources and its Intercommunity Platform	Development cost: 2. Annual operating costs: 0.7 (Total cost: 9).	2010 to 2019 (Develop-ment period: 2010 to 2014. Operating period: 2015 to 2019.)	The objectives of the project are to collect, digitize and structure available regional knowledge resources including historical documents and maps; and to construct and continuously run the intercommunity platform for acquiring, managing and retrieving resource information. The project will further enhance the considerable development of area studies.	The project facilitates multilayered, multidimensional understanding and policy making for solving regional problems; and it also supports regional information development in developing countries.	d) The platform will have important and unique characteristics in that it can deal with multiple languages, various place names, calendars and ambiguities. The project sets up a “regional knowledge hub” of area studies institutions, archives, and libraries worldwide especially in East Asia and Southeast Asia. It promotes collaborative research and exchange between such hubs in order to contribute to technical transfer and capacity building.	The project was proposed as a recommendation by the Science Council of Japan in 2008, and is being promoted by the Consortium of Regional Studies and the Collaborative Organization of Geography Associations.

B	Integrated Database of Classical Japanese Texts in the Pre-Meiji Period	Initial investment: 2. Annual operating costs: 19 (split over 10 years).	2011 to 2021	At present, there is no system in place for making use of the classic historical texts that form the core of Japanese culture. To remedy this situation, the project proposes the compilation of a new database. While taking into consideration legal issues involving copy and publishing rights, and developing new codes for the display of kanji characters, the database will be compiled with links to bibliographies, images of original manuscripts and transliterated texts. Also, it will be made available to the public.	The preparation of a comprehensive index covering all domains of Japanese culture will further enable the compilation of a large-scale Japanese dictionary, bringing Japan up to par with other countries in this respect. This will contribute greatly to the international dissemination of Japanese culture.	**d)** Japan will play a central role in the development of a new kanji code system. Toward this end a request for support has already been made to researchers of Japanese studies from six foreign countries.	The project has received the endorsement and full support from a number of academic societies and universities involved in Japanese studies in addition to the Committee on Languages and Literatures in the Science Council of Japan. The accumulated resources of relevant data at the National Institute of Japanese Literature allow this project to be undertaken immediately.
B	Web for the Integrated Studies of the Human Mind (WISH project)	Initial investment: 1.6. Annual budget: 0.9. Total budget: 7.	2011to 2016	The WISH project aims to establish, within six years, a unique institute in Japan for promoting advanced and integrated studies of the human mind. To achieve its goal, the project will facilitate collaboration among multiple disciplines to examine the human mind from a broad perspective including neural, social, evolutionary, developmental, and cultural factors, while also extending a bridge to the social sciences.	The WISH project will examine the mental mechanisms that produce empathy, cooperation, reciprocity, mutual trust, and a sense of justice. It will also provide guidelines for national policies to deal with mental health issues faced by modern societies.	**d)** The WISH project will bring together eight international research institutions to form a tight web of collaboration, including unique contributions from Japan in areas such as primatology.	The WISH project was created through a long-running discussion that began in 2005 within the Science Council of Japan. The establishment of this kind of research network has already been strongly recommended by the SCJ 2010 agenda.

*note 1 A: large research facility project, B: large scale research project

*note 2 International Collaboration Level: **a)** jointly led collaboration, **b)** domestically led collaboration, **c)** foreign led collaboration, **d)** research level international collaboration/cooperation, **e)** other

Life Sciences

cate-gory *note 1	project name	financial requirement (1billion yen)	project duration	project summary	expected outcome	international collaboration level *note 2	degree of development
B	Establishment of the research center/network of the environmental adaptation strategy based on the next-generation genome science	Budget of Construction; Investment budgets of first fiscal year: 8. Management budget per year for the period of 10 years: 1.	2010 to 2019	Living things have the capacity to adapt in extreme environments (hot spring, frozen snow bottom, desert, deep sea) other than the environment at normal temperature. Based on the next-generation genome sciences, the molecular mechanisms of the environmental adaptation are analyzed using the super sequencer, and the intellectual resources obtained through the analysis are used for solving problems in the global environment, food, and medical care.	The adaptation mechanism to various environments by creatures is elucidated through genome science, and the findings will be applied to production of bioenergy, and climate change tolerant crops, and the development of medicine and drugs based on eukaryotic structure biology.	Japan has taken part in many international scientific research genome projects including The Human Genome Project. This project has focused on many animals such as Oryzias latipes and Ascidiacea Nielsen, and plants such as Oryza sativa, Arabiodopsis thaliana, Physcomitrella patens and algae. However, this project did not study the entire DNA found in human cells; some heterochromatic areas remain un-sequenced, as do genome sequences of eukaryotic extremophiles. Japan is the most advanced nation in fundamental studies and the application of biodiversity including extremophiles based on genome science.	Each community playing a key role in the plan has already established the base of the element technology necessary for promoting next-generation genome science about model organisms and the extremophiles. Thus, an early start of the actual work is possible if an agreement among the members of Committee for Basic Biology on role sharing is built.
B	Integrative Biological Network for Monitoring and Data Integration and Analysis of Biodiversity	5.6	2010 to 2019	Development of ecosystem/biodiversity indicators for monitoring of biodiversity hotspots and methods to integrate and to analyze wide-range/long-term monitoring data. Assessments and predictions on effects of climate change, eutrophication, and biological invasions based on the integrative understanding of complicated dynamic systems.	Enhancing basic and integrative scientific understanding on biodiversity hotspots and providing ecological knowledge socially required for their conservation and sustainable use.	d) Standardization of observation and database construction are in close collaboration through the network of ILTER(International Long-term Ecological Research)	Planned through deliberations of the Science Council of Japan Committee for Integrative Biology, based on the results of activities of the "long-term ecosystem monitoring network" and others. Several new sites (such as for primeval basin containing primeval natural systems) are planned to be established by using unused facilities in underpopulated areas.

B	Establishment of an Animal Genetic Engineering Consortium for Cutting Edge Medical Research	Initial investment: 7. Annual operating costs: 9 (split over 10 years).	Initial investment period: 2010 to 2013. Operational period: 2014 to 2019.	Since aberrant gene function relates to many illnesses, elucidation of gene function is tied directly to drug discovery. The use of genetically-engineered animals is the most effective means to elucidate gene function. A consortium of four universities will serve as centers to systematically create, analyze and provide genetically-engineered animals in order to facilitate their use.	Qualitative progress of Japanese medical research and development of novel therapeutic drugs through creation, analysis and provision of genetically-engineered animals by the consortium and accepting requests from the research community.	d) International collaboration between labs is common. Of the 10,000 genetically engineered mouse lines that have been constructed, 14% were created in Japan, which is a huge contribution.	Creation of genetically engineered animals is an urgent key task for a broad range of disciplines such as medicine, immunology and laboratory animal science. Exploratory research project has started in 2009 at the University of Tokyo, Osaka University, and Kumamoto University.
B	Establishing a Cutting-edge International Research Center Aiming for the Integrated Development of Glycoscience	Budget of initial investment (first and second fiscal year): 3.11. Management budget per year for the period of 7 years: 8.88.	Period for establish-ment (partly for operation): 2010 to 2011. Period for operation: 2012 to 2016.	Establishment of a cutting-edge international research center for the integrated development of structure analyses and functional analyses, two pivotal cores of glycoscience. In particular, through a combination of the remarkable results from mass spectrometry and NMR with the results from world-leading glycogene and knockout studies, a contribution to finding solutions to various medical and biological issues is expected.	The integrated development of analyses on structures and functions of complex carbohydrates enables generation of a systematic Glyco-Atlas and achievement of advancements in glycoscience. Consequently, this will lead to further understanding of diseases and pathogenesis, as well as to the development of Drug Discovery Science.	b) Japanese scientists have cloned 60% of known glyco-genes and are world-wide leaders in the field of glycoscience. International cooperation: Joint meetings of the Japanese, American Consortia and NIH for Glycomics. Standardization of N-glycan analyses and fostering the development of young scientists by HUPO (Human Proteome Organization) and the JSPS Asian Consortium meeting.	JSCR (Japanese Society of Carbohydrate Research) and JCGG (Japan Consortium for Glycobiology and Glycotechnology) have long been discussing the establishment of a cutting-edge research center, and their proposal has obtained strong approval and support from the community. The quality of the research technology is extremely high, and a cooperative network is well established.

B	Center to accrue medical knowledge: development of infrastructure for informatics and research resources	Total investment: 45 (Initial investment for construction: 15. Annual operating cost; 3.).	Construction: 2011. Operation: 2012 to 2020.	Establishment of new research center with a twofold function: a “translational research platform” to accelerate development and commercialization of research outcomes, and a “clinical information platform” to accumulate and analyze clinical data nationwide. This will “accrue medical knowledge” which will result in a smooth transition of research outcomes from basic research to clinical medicine and vice versa.	This center greatly contributes to the advancement of medical research through prompt commercialization of innovative pharmaceuticals and medical devices in parallel with development of new therapeutic approaches through epidemiological analysis of accumulated clinical data.	d) Collaborate with other countries in projects for developing nationwide clinical databases and projects for international harmonization of clinical research and reviewing process.	Several projects on translational research have already been launched and there is an increasing need to develop infrastructure for promoting translational research between academic, medical, and industrial communities in Japan. Also, there has been in-depth discussion on the direction for national clinical databases in academic societies concerning medical informatics. Therefore, this plan is highly feasible.
B	Research center for medical genomics	Initial investment: 12. Annual operating cost: 2.	Construction: 2010. Operation: 2011 to 2015.	At the research center, by applying new technologies of massively parallel sequencing, a ″personal genome-based medical practice,″ where the optimal diagnosis and decisions for the best treatment will be made based on the personal genome, will be realized. This will lead to advances in the quality of medical care.	The optimal health care including prevention of diseases will be realized. The achievement is expected to make the personal genome-based medicine as standardized medicine, which leads to various ripple effects to broad areas of medical practice.	d) Translation of the massively parallel sequencing and genome-informatics into clinical practice will revolutionary realize a new paradigm of ″personal genome-based medicine″. To accomplish this aim, international collaborative activities focusing on diversity of disease susceptibility genes depending on ethnic background will be essential, and, furthermore, international collaborative activities to standardize the ″personal genome-based medicine″ will be required.	Research community of genomics research in Japan is preparing the ″reference sequence of Japanese individuals″ and aiming to establish a research consortium combining medical genetics, sequencing and genome infomatics, which will be the important infrastructure of personal genome-based medicine initiatives.

B	Center for development of next generation high-performance magnetic resonance imaging	Total budget：15. Operating costs：5.	Construction : 2011. Development and operation: 2011 to 2015.	Development of MRI apparatus with ultra high field magnet, operating software, and analytical methods are needed to further improve their performance. Building research centers is essential to develop and operate state-of-the-arts over 10 Tesla MRI for clinical science and to facilitate multidisciplinary researches.	Ultra high field MRI will dramatically increase detectability for minute pathological changes of structure and function in vivo. This information will be essential for the very early diagnosis of cardiac disease, dementia, and cancer.	d) Nearly 40 ultra high field MRI for human use are deployed in the world, whereas only one is built in Japan. Building MRI research centers will facilitate international collaboration.	Many countries push forward to building ultra high field MRI centers and 7Tesla MRI has been rapidly deployed in many sites in the past few years. Urgent development of research centers are needed in Japan.
B	Research Center for Drug Discovery	Initial investment: 9. Operating cost: 1/yr.	2010 to 2020	The progress in life science has deepened the understanding of disease and brought drug discovery to the attention of academic researchers. However there is no substantial infrastructure for drug discovery in Japanese academia. Thus, establishment of a center to support the drug discovery research is needed.	The research center enables full-scale research of drug discovery from hit finding to the stage of preclinical study, which has a significant effect on pharmaceutical education, cultivation of bio-venture companies, and development of drugs for rare diseases.	d) Information exchanging and mutual visits are made between NIH Molecular Libraries Program and Japan. Release of collected data within Japan through PubChem is under consideration.	A part of the infrastructure has been set up by a national project. Based on the remarkable results of the project, the proposal from the research community for the full-scale infrastructure and its continuous operation was made.
B	Establishment of Metabolome Research Center	Initial investment: 5. Operating cost: 1.8/yr.	2010 to 2020	In order to dramatically develop and popularize metabolome research through which all metabolites are comprehensively analyzed, establishment of Metabolome Research Center, where metabolite analysis, chemical substance collection, and database construction are carried out, is proposed.	Identification of disease specific metabolic pathway, discovery of pathogenic mechanism, finding of disease-related biomarker, early diagnosis, prognosis of therapeutic effect and development of new drugs.	d) Japanese Conference on Biochemistry of Lipid, LIPID MAPS Consortium in USA and European Lipidmix Consortium have been constructing their own lipid data base, and these three groups organized “the International Lipid Classification and Nomenclature Committee” and established a “Comprehensive Classification System for Lipids” under the committee.	Metabolome analysis, collection of standard chemicals and construction of database have partly started. The research community has agreed to establish an integrated center.

B	Formation of Research Center for Green-innovation	Budget of Construction; Investment budget of first fiscal year: 7.5. Management budget per year for the period of 7 years: 25/yr.	2010 to 2016	Permanent research center project includes; 1) Construction of high level large scale experimental field, breeding farm, and a research center for next-generation plant and insect resources; 2) Construction of Bio-refinery system of cellulosic resources for low carbon society, and 3) Formation of multi-category research center advancing the improvement and restoration of the atmosphere-water-soil environments for a greening society.	1) Development of the biotechnology of genetically modified organisms with high quality, high yield and environmental resistance. 2) Construction and extension of adaptable technology for low carbon society, epochal technology for improvement and remediation of environment, and agricultural engineering concerned biotechnology.	**d)** Establishment and extension of 1) the innovation technique on the genetically modified organism, 2)adaptation technique for low carbon society and 3)environmental control technique under outdoor and indoor conditions	Although a mutual agreement in the Committees of Agriculture and Food Science of the Science Council of Japan has been reached, mutual regulation among the three fields involved and multi sections is needed. Decision of general framework enables examination and promotion of a concrete plan.
B	Formation of research center for food functions and scientific verification system	Initial investment: 1. Annual expense: 1.	Initial investment: 2011 to 2013. Annual expense: 2011 to 2020.	To establish scientific verification systems for multiple food functions, a research center needs to be formed, where the in vitro and in vivo evaluation of food functions, dynamic analysis of food components in the digestive tract, and search for food substances with novel functions will be performed.	On the basis of the concept "Food and medicine are isogenic", systems to evaluate scientifically the validity of health-promoting foods will be established. This will contribute to the development of the industries associated with food and health.	**e)** Collaborative research programs with EU, Pacific rim, and Asian countries have already started, although they are still in small scale collaborations. Japan is expected to play the leading role in this research field.	This proposal has been drafted with repeated examination at JST-workshops, committee meetings in SCJ, and so on. Preparation of the basic technologies required for important elements of the verification systems is already making progress.

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Energy, Environmental and Earth Sciences

cate-gory *note 1	project name	financial requirement (1billion yen)	project duration	project summary	expected outcome	international collaboration level *note 2	degree of development
A	Demonstration of steady-state high-performance fusion plasma	LHD; Capital investment: 12.3. Operational cost: 72.1. JT-60SA; Capital investment (Japanese allotment): 21.7. Operational cost: 3.44 (additional costs for disassembl-ing and rebuilding of the present facilities are required).	LHD; Modification and operation: 2010 to 2021. JT-60SA; Construction : 2007 to 2015, Operation: 2015 to 2017.	Demonstration of steady-state operation of high-temperature high-density plasmas is indispensable to realization of fusion energy. Performance maximization of the Large Helical Device (LHD), which is a helical system originated in Japan, and the JT-60 Super Advanced (JT-60SA) tokamak project provides complementarity to the burning plasma experiment by ITER.	This project will establish a control scheme for high-performance plasmas and accelerate the creation of a new physical paradigm for the understanding of nonlinear/multi-hierarchy phenomena, simulation science, material science, and so on.	LHD: **d)**, JT60SA: **a)** LHD is based on a concept that originated in Japan and hosts a large number of international collaborations by extending the role of an inter-university research organization worldwide. JT-60SA is being built in Japan under the Agreement between the Goverment of Japan and EURATOM for the Joint Implementation of the Broader Approach Activities in the Field of Fusion Energy Research.	This project is supported through discussions in the Japan Society of Plasma and Fusion Research, the Fusion Network etc., and has been approved as a priority project in the Basic Plan Special Committee of the Council for Science and Technology, MEXT. The project is in preparation and partially being executed.
B	Development Program of HTGR (High Temperature Gas-cooled Reactor) Hydrogen Production System using HTTR (High Temperature engineering Test Reactor)	Experimental expense: 3.25.	2010 to 2016	Proposition of a prototype HTGR system with a hydrogen production system by thermo-chemical process. The system will lead to expanded use of nuclear and hydrogen energy to solve the global environmental problem. This is enabled through R&D on science technologies such as material, chemical reaction and so on.	The demonstration of a large-scale system converting nuclear energy to a chemical one as hydrogen can expand the nuclear application, which is presently limited to power generation.	**d)** International collaboration: International Forum of Generation IV Nuclear Energy Systems, bilateral and multilateral collaborations. The HTTR reactor outlet coolant temperature is 950 degrees Celsius, which is the highest of all nuclear reactors in the world.	The working group of nuclear heat application in the Japan Atomic Industrial Forum is appealing to the Japanese government to define the HTGR hydrogen production system as a promising system for reducing CO2 emission and promotes public enlightenment.

B	Solar Quest Project (International Research Center for Global Energy and Environmental Technologies)	Equipment cost: 1. Administra-tive cost: 8.6.	2007 to 2014	Comprehensive study that includes hybrid renewable energy technologies based on solar power, wind power and biomass, energy storage/transport technology, and environmental risk reduction technology such as anti-pandemic measures against viral infections, with existing research organizations at the core.	The development of new sciences as well as demonstration of our nation's scientific initiative toward establishment of a sustainable society through active international expansion.	**d)** Active collaborations such as the conclusion of agreements with US and European related organizations are being planned. This project aims to give Japan an internationally competitive edge in the mid-term and long-term periods through the establishment of international standardization based on our country's solar power generation/photocatalyst technology.	With high expectations from the academic community, key projects centering on the wide-scale dissemination of solar power generation and increasing the amount of renewable energy usage towards greenhouse gas reduction are now in progress.
B	Research Network on 'Non-equilibrium and Extreme State Plasmas'	Instruments: 6.3. Operation: 2.	2010 to 2019	This project advances united plasma physics that covers expanding frontiers (e.g., fusion, high energy density, nano-bio), i.e., non-equilibrium and extreme state plasmas, via a large-scale collaborative network. This project accelerates fusion and creation of new materials.	This project focuses on establishing unified physics of nonequilibrium plasmas. This project promotes our understanding of plasmas in nature and nature itself and of fusion plasmas decisively.	**d)** International collaborative research has been enthusiastically promoted via a number of academic agreements and international laboratories (such as LIA (Laboratoire International Associé) 336, and ICHEDS (International Collaboration for High Energy Density Science) supported by JSPS).	This plan was proposed based on the achievements of a collaboration of core groups, and on discussions at a society meeting and a network meeting. The research impacts were also discussed and supported by researchers at community symposiums.
A	Construction of a satellite earth observation system	400-500 (Operation: 150)	GCOM-W: 2011; ALOS-2, EarthCARE, GPM: 2013; ALOS-E, GCOM-C1: 2014 to launch.	Construction of a satellite earth observation system for global water cycle, climate change and detailed Earth surface measurements. The system provides the global monitoring data useful for coping with the global warming and environmental problems.	The system is designed to provided long-term global data sets of the Earth's climate changes and surface environments, which are indispensable for assessment of model predictions of environmental problems.	**a)** CEOS and GCOS international frameworks, NASA and ESA joint missions.	The plan has been reviewed periodically by the Science Forum and Space Activity Commission.

A,B	Coordinated observational, experimental and modeling projects for the prediction of the Earth's environmental changes	62.1 (operation: 41.8)	Development and preparation: until 2011 to 2013. Full operation: from 2015.	Comprehensive measurements, experiments, and predictions of the variability of the geospace and the Earth surface system including oceans, lakes and atmosphere. The project tries to develop a model of the Earth system where the human activity is deeply involved.	Acquisition of three dimensional data of the Earth's surface system including the geospace and understanding of their dynamics. It improves the prediction accuracy of the Earth's future climate and extreme environmental events.	**d)** Cooperation with IUGG organizations, NSF, NOAA, Hadley Centre for Climate Prediction and Research, Indonesian organizations etc.	The research basis is mature. Discussion has been made by the Scientific Advisory Board of JACCO and SCJ Earth and Planetary Science Committee.
A	Geodynamics and geohazard research programs utilizing state of the art technologies	Initial investment (including the major modification of D/V Chikyu): 40. Operational cost: 40–60/year.	2012 to 2023 (R&D for the first two years. Construction for the second two years and operation thereafter.)	Establishment of a new geodynamic theory of plate subduction zone, especially focusing on understanding crustal evolution, earthquake mechanics and volcanic activity. Coordination of frontier technologies such as deep drilling, crustal imaging using high-energy particles, high-resolution seismic profiling and ocean observatory network systems will be implemented.	New geodynamic theory beyond plate tectonics not only advances our knowledge of how the Earth's interior works, but also contributes to geohazards mitigation and carbon storage technology providing further foundation for our sustainability.	**d)** Chikyu has been used for Integrated Ocean Drilling Program (IODP) together with other drilling platforms provided by the USA and Europe. Chikyu is a unique scientific vessel capable of drilling 7km below the deep-sea floor. The plan for the use of Chikyu has been discussed in the international science advisory body of IODP.	Drilling into deep targets has been intensively discussed in IODP and a site survey plan has been proposed. Initial installation of a submarine cable network has been initiated and a feasibility study of high-energy particle geophysics has been completed. Experience has been gained for high-resolution seismic reflection and refraction coordination. Overall planning has been discussed in the Japan Drilling Earth Science Consortium.

B	Deciphering the history of the Earth and life and exploration of subsurface deep biosphere	Initial investment: 30. Operational cost: 5/year.	Construction of research system and nodes in the first three years: 2012 to 2014. Field research, drilling campaigns, material analyses, experiments, and modeling will be done during the rest of the decade.	Understanding of the entire history of linkage and interaction between life and the Earth through application of modern technologies. Evolution of life on the Earth strongly affected the geochemical cycles of such element as carbon and nitrogen, thus has influenced the changes in the Earth's surface environment. Special attention will be given to the role of deep subsurface biosphere in the geochemical cycles.	1. Understanding of the history of relationship between life and the Earth and evolution of geochemical cycles. 2. Exploration of material cycles in deep subsurface biosphere and its application to carbon capture and storage (CCS).	**d)** Deep subsurface biosphere research has been discussed within the framework of Integrated Ocean Drilling Program(IODP) and the first international drilling cruise is planned in 2010. A larger–scale future plan was discussed in 2009. Several individual projects have been discussed and implemented within the framework of the International Continental Drilling Projects (ICDP) for the study of the evolution of life and the Earth, although the planning for further integration needs to be discussed.	The study of the evolution of life and the Earth stands at the level of individual proposals from various major institutions and further discussion among the community is required for the integration and refinement. The research on deep subsurface biosphere has been actively taking place in several institutions and feasibility plans were already developed with rapidly accumulating data and experimental techniques.

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Material and Analytical Sciences

cate-gory *note 1	project name	financial requirement (1billion yen)	project duration	project summary	expected outcome	international collaboration level *note 2	degree of development
A	Materials and Life Science with High Intensity Neutron and Muon Beams	Construction cost: 20. Running cost: 2/yr.	Construction : 2010 to 2021. Operation: 2010–.	Upgrading of the existing neutron and muon beamlines and construction of the next generation beamlines at the Materials and Life Science Facility (MLF) of J-PARC to provide powerful research tools.	High intensity beams of neutrons and muons should open up a new horizon of materials science and life science.	d) J-PARC MLF plays its part as a world research hub together with its counterparts in the US and Europe.	Planning has been worked out through discussions by the responsible organizations: J-PARC Center, JAEA and KEK, and the J-PARC User Committee representing the user community.
A	Synchrotron Radiation Science in the Future	Construction cost: 48. Running cost: 7.5/yr.	Construction Phase I; 2012 to 2014. Phase II; 2017 to 2019. Operation: 2014 to 2019.	Installation of ultra-high brilliance soft X-ray light source in collaboration with the Super-KEK Project (KEK-X Project) and installation of a storage ring type X-ray light source with diffraction limited emittance by renovation of the SPring-8 (SPring-8 II Project).	Elucidation of local crystal structures and local electronic structures by nano-beam probes, reinforcement of a wide range of science and technology enabled by synchrotron radiation, and pioneering of new applications, including industrial applications.	d) Promotion of photon science in collaboration with the leading synchrotron light source facilities in US, Europe and Asia.	This plan for the future has been worked out as a result of discussion among the synchrotron facilities and their users, in the Japanese Society for Synchrotron Radiation Research and the Synchrotron Radiation Light Science Joint Symposium.
A	High Magnetic Field Collaboratory-High Field Facilities in the Next Generation	Construction cost: 30. Running cost: 3/yr.	Construction Phase: 2011 to 2014. DC: 2011 to 2015. Operation: 2011 to 2016.	Implementation of the network of the leading high magnetic field facilities in Japan (High Magnetic Field Collaboration) and promotion of joint-use and collaborative research utilizing both pulsed and steady magnetic fields.	By furnishing the high magnetic field experimental environments, developments in materials sciences including the discovery of new material phases and ripple effects to other fields such as functional materials and life sciences, are expected.	d) The Collaboration plays its part as a world research hub together with its counterparts in the US and Europe.	The planning has been worked out as a result of discussions in the high magnetic field research community (High Magnetic Field Forum). Promotion of high magnetic field science and nurturing of talents are persued by coordinated activities of the facilities each with own function and role.

B	Laboratory Network for New Materials Development	Initial cost: 5. Running cost: 0.5/yr.	Construction : 2011 to 2012. Operation: 2011–.	Implementation of the network of joint-use and collaborative research organizations in the field of materials science in order to support such activities as the search for new materials, preparation of high quality samples, structural analysis, and materials characterization. Promotion of new materials research by sorting and providing the relevant information on new materials.	Expansion of condensed matter research by coordinated programs of materials development, which is complementary to the research using big experimental facilities, and which leads to establishment of Japan's predominance in this field.	**e)** Japan is leading the world in the development of new materials. High quality samples provided by the Japanese team very often hold the key to international collaborative research.	The basic idea is based on the report published by the 17th-term Science Council of Japan. A more concrete plan should be worked out by the community with an eye on the evolution of the new scheme of joint-use and collaborative research hubs inaugurated in FY2010.

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Physical Sciences and Engineering

cate-gory *note 1	project name	financial requirement (1billion yen)	project duration	project summary	expected outcome	international collaboration level *note 2	degree of development
A	Exploring Physics beyond Today's Particle Theory with a Super B-Factory	Construction: 35. Operation: 7/year.	Construction: 2010 to 2013. Operation: 2013 to 2020.	To upgrade the KEK B-Factory accelerator by increasing the luminosity by a factor of 40. The project aims to investigate the mystery of matter-anti-matter asymmetry in the universe and to unveil the fundamental laws of nature by reproducing, in the laboratory, the state of the very early, hot and dense universe.	It will provide clear understanding of the reason why the anti-matter universe does not exist and reveal the nature and origin of dark matter. It will help discover the yet-unknown laws of nature that govern the evolution of the universe.	b) More than 30 foreign institutions from the US, Europe, Asia and Australia are involved in the project.	This is a top priority item of the high energy physics community. A part of the project has already been funded.
A	Revealing the Origin of Matter with an Upgraded J-PARC	Construction: 38. Operation: 2.5/year.	Construction: 2010 to 2014. Operation: 2015 to 2019.	Increasing the intensity of the main ring proton accelerator and corresponding upgrade of the neutrino beamline. Expanding the experimental hall to accommodate a variety of particle/nuclear experiments.	Investigate the evolution as well as origin of matter in the universe.	b) More than 62 institutions from 12 foreign countries are involved.	The upgrade of the main ring is a top priority of particle physics community and the expansion of the hadron experimental hall is a top priority of nuclear physics community.
A	World Research Center for the International Linear Collider	Construction: 670. Operation: 20/year.	Construction: 2015 to 2024. Operation: 2025 to 2034.	A proposed electron-positron collider, the international Linear Collider (ILC), will answer the questions about what the universe is made of and what is the dynamics that the vacuum follows. Planning, designing, funding and building will require global, multi-national collaboration.	It will explain the origin of mass and probe the theories beyond today's particle theory, such as the super-symmetric theory and the theory of extra dimensions. It will also enable us to discover new particles and new phenomena.	a) Global organization, including US, European and Asian counties, is being envisioned.	The particle physics community considers ILC as a top priority project on the energy frontier after Large Hadron Collider.

A	Nucleon Decay and Neutrino Oscillation Experiments with Large Advanced Detectors	Construction: 50–75. Operation: 2/year.	Construction: 2014 to 2020. Operation: 2021 to 2035.	Advance neutrino physics/astronomy and search for nucleon decays using a large water Cherenkov detector that is approximately 20 times larger in volume than Super Kamiokande and/or a large liquid argon detector.	It would discover the particle–antiparticle asymmetry (CP asymmetry) in the lepton sector by shooting a muon neutrino beam from J–PARC to the advanced large neutrino detector. It will also probe the grand unified theories by searching for nucleon decays.	**b)** This project builds up on the legacy of Super Kamiokande with a large number of international institutions.	A high priority will be considered by both particle and cosmic ray physics communities if the on–going long baseline neutrino (J–PARC to Kamioka T2K) experiment obtains the expected results.
A	Exploring the Frontiers of Nuclear Physics with an Advanced Radio Isotope Beam Factory	Construction: 15. Operation: 4/year.	Construction: 2013 to 2016. Operation: 2017–.	Upgrade the ion generation system of the Radio Isotope Beam Factory (RIBF) at RIKEN. RIBF enables us to investigate the lifetimes, masses, radii, shapes and other properties of unknown unstable nuclei.	Epoch–making discoveries are expected through the study of strange shaped nuclei such as halo and banana–shaped nuclei.	**b)** Currently, RIKEN RIBF is running ahead of its competitors world–wide. Many international teams are working in the RI–Beam Factory.	The RIBF upgrade plan has been endorsed by Japanese nuclear physics community. The major R&D required for the upgrade already has been completed.
B	Network of Computational Facilities for Basic Sciences	Annual budget: 4.1.	2010 to 2020	Six research institutions in the field of computational physics and chemistry form an interdisciplinary research network for advancing computational basic science through strategic and collaborative use of the Japanese Next Generation Supercomputer and the supercomputer facilities provided by the member institutions.	Advancement in computational basic science is expected through the formation of a multi–layered supercomputer infrastructure necessary for supporting various stages of research.	**d)** The leadership in this field is severely contested among the USA, Europe and Japan. Asian countries are rapidly coming up to the competitive level.	The formation of a network is already advanced in the respective fields of materials research, and of astrophysics and particle physics. Unifying the two networks to one for basic science is the next task.

A	Large-scale Cryogenic Gravitational Wave Telescope (LCGT) project	Construction: 15.5. Operation: 0.432/year.	Construction: 2011 to 2015. Commission-ing: 2016 to 2017. Observation: 2018- (Longer than 10 years).	This project aims at the world's first detection of the gravitational wave signal directly, using a super high sensitivity laser interferometer. In order to achieve the sensitivity to reach as far as 700 million light-years' distance, the detector will be placed underground and cryogenic mirrors will be adopted for the first time in the world.	The theory of general relativity under a strong gravitational field will be tested, and the dynamic nature of space-time will be unlocked. A brand new research field of gravitational wave astronomy will be pioneered by the international collaborations with detectors located worldwide.	**d)** Based on the original idea of cryogenic mirrors and utilizing a unique quiet underground site, the detector will be built under the Japanese leadership. At the same time, the LCGT will play an important role in the international community by exchanging advanced technologies and by joining the worldwide simultaneous observations as an indispensable partner.	The project is ready to start construction based on systematic development since the mid-1990's. There are worldwide endorsements to support the LCGT project, including those by the Gravitational Wave International Committee and by the Astronomy and Astrophysics subcommittee of the Science Council of Japan.
A	Thirty Meter Telescope (TMT) project	Construction cost: 130. Operation cost: 5/yr (Japan plans to contribute at about 25% level for both of construction and operation).	Construction: 2012 to 2020. Operation: 2018- .	By constructing an optical infrared telescope with a 30m diameter segmented aperture primary mirror on Mauna Kea, Hawaii, we will open a new frontier of the universe. Dark matter, dark energy, black holes, the early universe, and exo-solar planets, especially in habitable zones, will be studied extensively with higher sensitivity and resolution.	Unraveling the history of the early universe and the search for Earth-like planets will bring us revolutionary changes in our view on the origin about the universe and life. Development of adaptive optics technology will bring innovations in the medical and industrial applications.	**a)** TMT is an international project. Japan's contribution, with its technology and scientific expertise around the Subaru Telescope is essential.	The community of astronomers in Japan shares a complete agreement that the TMT is the highest priority project after ALMA. Many recommendations for the TMT have been issued. Construction can get started as soon as the financial support is secured from the expected partner countries.
A	Square Kilometer Array Project	Construction: 200. Operation: 20/yr (planned Japanese contribution: 10% each).	2013 to 2022. Construction: 2017-. Early phase operation: 2023-. Full operation: 30 years.	An international large radio interferometer with collecting area of 1 km2. The SKA covers a frequency range of 0.1 – 25 GHz, complementary to that of ALMA. The SKA observations with high sensitivity, a wide field of view, and high resolution will provide us with opportunities to address to long-standing and basic astrophysical problems.	The SKA aims to push forward the cutting-edge sciences like astrobiology by searching for large organic molecules in dark clouds and star forming regions, detection of gravitational waves and tests of general relativity, the origin and evolution of the cosmic magnetic field, cosmic re-ionization, and formation of the first objects in the early universe. A huge amount of digital technology development will be made.	**c)** Construction by an international consortium. Japanese contribution to the SKA is planned to be at the level of 10% of the total budget for the construction and operation.	An international committee has been established for coordinating and organizing the SKA construction project. Japan is participating in the committee as an observer. In Europe, USA, Australia, and South Africa, planning and construction of prototype systems (called SKA path finders) are in progress. The decision of the SKA construction site is due in the year of 2013.

B	Promotion of Leading Research toward Effective Utilization of Multidisciplinary Nuclear Science and Technology	Initial investment: 6. Maintenance cost: 3.8 (10 years).	2010 to 2019	Establishment of a center of excellence to grow and promote multidisciplinary nuclear science and technology with collaborative use of important research resources (as for example, reactors and accelerators). Efficient utilization of nuclear power and radiation provides solutions to maintain, sustain and even to improve development of human society, leading to improved quality of life for all.	To accelerate the accumulation of basic and fundamental knowledge necessary for the safe and effective utilization of nuclear energy, including the development of material science and the Boron Neutron Capture Therapy study (BNCT), which benefits society as well as human resource cultivation.	**d)** International collaborative researches are being promoted under academic agreements with foreign institutions.	The world's first accelerator driven subcritical reactor (ADSR) experiment has been conducted with the combination of an actual reactor core and a proton accelerator. In addition, the BNCT study has been intensively conducted at the world's largest scale. The progress of multidisciplinary nuclear science and technology is centered on these two research areas, and is strongly supported by several academic societies, as well as by university organizations such as the Council for Nuclear Energy Research and Education in Universities.
B	Project for Developing Researches of High Energy Density Science	Total budget: 9 (Initial investment: 8.4. Operation: 0.6.).	Construction : 2011 to 2013. Academic Research: 2014 to 2016.	Pioneering relativistic plasma physics and nonlinear quantum electrodynamics by attainment of ultra-high intensity will be attained with a newly developed sub-exawatt (10^18 W) laser. Establishment of the global center of excellence for high field science aiming at the frontier of high energy density physics with the use of high power lasers.	Exploration of the frontier of high energy density physics including; laser-driven particle acceleration under deeply relativistic regimes, extremely-bright radiation from an accretion of pseudo-black holes, validation of the vacuum polarization effect, and realization of metallic hydrogen. Advanced laser technologies for exawatt lasers will be established.	**d)** International collaborations on high energy density science have been extensively carried out. In the last three years, 7 countries and 12 institutions have participated in these collaborations. Several-orders of magnitude stronger than previously attained, the world-highest field will be realized. Absolute synchronization of the new laser with GEKKO-XII for laser-driven implosion is available.	The project has been planned by the members of the steering committee and the collaboration committee of the Institute of Laser Engineering (ILE), Osaka University. Extensive discussions are made in a new community organized with ILE collaboration researchers. Elemental technologies for the sub-exawatt laser have already been developed. R&Ds for implementation of them into the new system are required.

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Space Sciences

cate-gory *note 1	project name	financial requirement (1billion yen)	project duration	project summary	expected outcome	international collaboration level *note 2	degree of development
A	Space Infrared Telescope for Cosmology and Astrophysics (SPICA) Project	Production: 33. Operation cost: 0.56/year.	Construction : 2011 to 2018. Operation: 2018 to 2023.	An Infrared Space Observatory aiming to reveal history of the universe "from Big Bang to Emergence of Life". Superior sensitivity in the infrared will be achieved by a 3-m class, large aperture telescope cooled down to 6K. This is an international cooperation mission led by Japan with significant contribution from Europe.	Scientific achievements: Clarification of key problems in modern astronomy, such as the (1) Drama of the birth of galaxies, (2) Recipe of planetary systems, (3) Circulation of materials in the universe. Technical achievements: Development of strategic technologies for space missions, such as mechanical cryocoolers.	b) International infrared space observatory led by Japan. Substantial contribution from Europe. Collaborations with the USA and Korea are under discussion.	Mission study and technology R&D program conducted by researcher's community for more than a decade / Official status in JAXA as a pre-project / Assessment Study has been done both in Japan and in Europe. The mission is aimed to be put into an official project in FY2011 under the collaboration between Japan and Europe.
A	New X-ray Astronomy Satellite : ASTRO-H Project	Production: 16.7. Operation etc: 0.4/yr.	Construction : 2009 to 2013, First Term Operation: 2013 to 2016.	An X-ray observatory aiming to uncover the dynamic evolution of the universe and understand the energy concentration process. Capable of high-resolution X-ray spectroscopy and wide energy coverage from 0.3 keV to 600 keV. Observes the motion of high temperature gas in clusters of galaxies, and clarifies super-massive black holes growing behind a thick interstellar medium.	First measurement of hot gas motion in clusters of galaxies to trace its kinetic energy. Hard X-ray imaging of super massive black holes to understand its growth and role for galaxy formation.	b) International X-ray observatory lead by Japan. Substantial contribution from NASA. Collaboration with top institutions overseas. Data will be open to the world community.	X-ray community gives maximum support. More than 150 research staff across 25 public and private universities make tremendous efforts. SAC evaluates that the project is ready for development phase in January 2010).

A	Simultaneous Multi-scale Observations in the Earth's Magnetosphere (SCOPE) Project	Production: 18.5. Operation: 0.4/year.	Construction : 2011 to 2017. Operation: from 2018.	Simultaneous multi-scale and in-situ observations of the space plasma will be carried out by a set of satellites in formation. By this mission observational foundations of magnetohydrodynamics will be provided for understanding the coupling process between the large-scale dynamics and the microphysics that is the key for understanding how the cosmic plasma behaves.	The dynamic behavior of the geo-magnetospheric plasma will be revealed based on the simultaneous and multi-scale in-situ observations. This understanding will be utilized to build up a universal framework of cosmic plasma physics.	**b)** This project will be performed by Japan (as a primary partner), and Canada. European countries and U.S.A. are also considering cooperation.	The mission proposal submitted by the space plasma community WG was endorsed in the Mission Definition Review by ISAS's Steering Committee for Space Science (January 2009). Technical preparation review will be conducted together with Canada in 2011. Studies of inter-satellite communication technology etc. are underway.
A	Space Exploration Program Aiming for the Research of Solar System Evolution	Production: 65. Ground-based equipments: 0.6. Operation: 2.1/year.	Operation: 2011 to 2017 (Consists of multiple projects; details are shown in the text).	A combination of solar system exploration projects such as a lunar landing mission, sample return from small bodies and planetary missions. The aim is to study the formation and history of the solar system, with emphasis on understanding the earth and life in the context of evolution of solar system and other planetary systems.	Studies of the birth and evolution of the solar system, for example (1) detection and analysis of water and organic materials of small bodies, and (2) study of the structure and evolution of the moon will tremendously improve our understanding of the earth and life on it.	Lunar exploration: **b)** It is under discussion in the international political framework with the U.S. and Europe. Sample return from small bodies: **d)** Discussion about scientific collaboration with USA .and European scientists is lead by Japanese scientists.	Lunar exploration project is at the conceptual design stage and technological development has almost been completed. Sample return proj ect from minor bodies is at the design phase. Each related community has expressed support for each project.

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Information Sciences

cate-gory *note 1	project name	financial requirement (1billion yen)	project duration	project summary	expected outcome	international collaboration level *note 2	degree of development
B	National Academic Cloud Computing Facility for High-Performance Computing and Shared Scientific Databases	Annual budget: 1/ year.	Operation period : 2011-.	1) Deployment of computing and storage resources for cutting-edge cloud computing. 2) Development of software and human resources for the promotion of scientific research by strengthening the shared distributed information infrastructure.	This project will expand a new scientific methodology called "e-Science" and international research collaboration by providing shared computing resources for academic institutions.	**e)** The network behind the cloud is equipped with several leading technologies in the world. Several international collaborations with Internet2 in the US, TEIN in EU and so on are underway.	The plan was made based on the discussion in the informatics committee of the Science Council of Japan. This project is positioned as the upper level of the SINET4 which will be deployed in 2011.
A	Large-scale Virtualized Network Test bed	Construction : 15. Annual operation budget: 12/year.	Construction and deployment: 2012 to 2015. Operation and experiment: 2016 to 2017.	Construction of revolutionary ultra large-scale network test beds over which the validity of R&D outcomes in various ICT technologies for network science, cloud computing, information security, large-scale sensor networks, and the like are to be verified.	New ICT technologies to realize a new paradigm of network infrastructure platform with Japan originated innovations are to be created and to be used globally.	**d)** Current network test beds are connected to US and Asian countries, and various experiments with foreign organizations are being done over the test beds.	The R&D community to utilize current small scale network test beds has already established and has enough experience to facilitate and operate those network test beds, and then the proposed plan can be started smoothly.

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