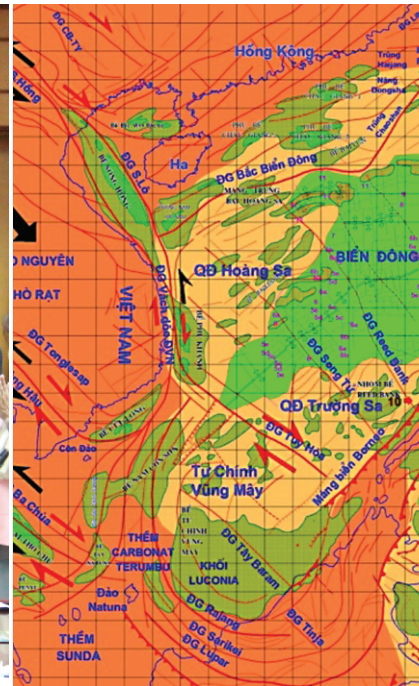




VIETNAM ACADEMY OF SCIENCE AND TECHNOLOGY



ANNUAL REPORT 2015



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ABBREVIATIONS LIST

GUST	Graduate University of Science and Technology
ISI	Institute for Scientific Information
IT	Information Technology
LIDAR	Light Detection And Ranging
MOST	Ministry of Science and Technology
MoU	Memorandum of Understanding
NAFOSTED	National Foundation for Science and Technology Development
NGO	Non - Governmental Organization
ODA	Official Development Assistance
SCI	Science Citation Index
SCI-E	Science Citation Index Expanded
VAST	Vietnam Academy of Science and Technology
VNMN	Vietnam National Museum of Nature
VNSC	Vietnam National Satellite Center
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific

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A MESSAGE FROM THE PRESIDENT

In continuation of promoting the role of the largest science and technology institution in the country, the VAST successfully implemented the important tasks assigned by the Prime Minister and the tasks of the national key programs for science and technology such as the fundamental research program, the science and technology program for socio-economic development in Tay Nguyen region (Tay Nguyen 3 program), the science and technology program for space, the project of construction of Vietnam's nature museum and the project of strengthening the earthquake observation network for earthquake and tsunami warning in Vietnam. Also, VAST continued successful implementation of the key projects with urgent and advanced applications to economic development and national security.

The strengths of the fundamental research are confirmed once more illustrated by an increase in the number of international publications of 5.6%, among which the number of articles in ISI journals rose by 12.4% compared to that in the previous year. Numerous works have been published in journals with high impact factors. The number of fundamental research projects approved for the first period of 2015 by National Foundation for Science and Technology Development (NAFOSTED) is 24.2%



of the total number of projects in the whole country. The number of patents and utility solutions is increased by 27.7% compared to 2014. During 2015, the scientists of VAST published 30 monographs.

With increasing success, the gap between scientific research and society's needs has been

Mission

The Vietnam Academy of Science and Technology (VAST) is a government agency, earlier known as Vietnam Academy of Science, established in 1975 by Decree 118/CP dated 20 May 1975 and issued by the former Council of the Vietnam Government. The VAST is committed to

- carrying out basic research in natural sciences and technology development ;
- providing objective grounds for science and technology management, for shaping policies, strategies and plans for socio-economic development;
- training high quality human resources for science and technology.

Vision

The VAST aspires to be a leading national multidisciplinary research center for science and technology with world class standards recognized both regionally and internationally, to fulfil its roles and responsibilities in driving scientific, technological and social development of Vietnam and its global integration.

bridged. The transfer of scientific knowledge, innovative technologies and the general deployment of scientific applications has shown its value to numerous aspects of life as reflected through a variety of relevant application-oriented projects which are being deployed in large scales across multiple provinces, cities and ministries. Scientists are increasingly interested and active in technology application and deployment, attracting considerable local investments and production facilities. In particular, the institutes of VAST made use of the strength of their highly qualified human resources and expertise to evaluate many important projects for the country's economy assigned by the Government, such as the hydroelectric power plant project "Song Tranh 2", regional tectonic investigation of nuclear power plant in NinhThuan province, etc.

Implementations of investment projects in 2015 are all well-targeted, sticking approved projects, ensuring the governmental regulations. The completed projects were handed over immediately to use and promote efficiency.

VAST has established 03 Centers of Excellence for fundamental research in the fields of mathematics, physics and chemistry. These centers have started to implement national tasks. Furthermore, two Type-2 UNESCO International Centers for mathematics and physics proposed by VAST have been approved

by UNESCO and are now operating under its auspices. The VAST's Graduate University of Science and Technology (GUST) was put into operation and admitted the first students in 2015.

VAST is continuing to strengthen and expand international cooperation relations on scientific research in the region and in the world, having new partners, new forms of cooperation and new research areas such as space, energy, investment advice and high-quality training. The program for young scientists continues to be deployed, aiming at issuing concrete policies to support young scientists, who are working at VAST, as well as to attract outstanding scientists to join VAST.

The year 2015 was closed with encouraging achievements, paving the premise for a new period with many guidelines and policies for the new goals. The year 2016 will certainly be a pivotal year for the new developments of VAST.



Prof. Academician Chau Van Minh
President of Vietnam Academy of Science and Technology

Directorate of VAST



President
Professor Academician
Chau Van Minh



Vice-President
Professor Doctor of Science
Nguyen Dinh Cong



Vice-President
Professor Doctor of Science
Duong Ngoc Hai



Vice-President
Associate Professor Doctor
Phan Van Kiem

HUMAN RESOURCE

More than 4000

Staff members

2513 Permanent staff members

204 Professors and Associate Professors

792 Doctors and Doctors of Science

911 Masters of Science

ORGANIZATIONAL CHART



- Units established by Government
- Units established by VAST President

SOME HISTORICAL IMAGES



10th anniversary of the establishment of VAST



General Vo Nguyen Giap visited the Institute of Physics



15th anniversary of the establishment of VAST



Prime Minister Pham Van Dong visited VAST (1981)



Prime Minister Nguyen Tan Dung visited VAST (2009)



General Secretary Nong Duc Manh visited VAST (2002)

VAST 40 YEAR ANNIVERSARY

Over the past 40 years, VAST has rapidly developed in every field, both in terms of staff potential and facilities, as well as affirming its position and providing contributions to natural sciences in Vietnam and around the world. Promoting the advantages of a leading multidisciplinary research institute in natural sciences and technology, the academy has completed the assigned tasks commissioned by the Party and the State to serve socio-economic development, and ensure national security and defense. It has been governing multiple programmes, investigation projects and general research on natural resources, natural conditions and environment to provide scientific bases for making plans on socio-economic development in Vietnam and its territories.

The VAST holds an important role as a leading center in the field of basic research, applied research in advanced technology such as nano-technology, biotechnology, new material technologies, remote sensing technologies and space technology. It is the leading unit nationwide in terms of international publications meeting ISI standards, with an increase in publications over the past five years by 29% and accounting for 40-45% of the international publications of the country in natural sciences. Nearly 9,300 scientific publications of VAST, including 3,100 international publications with over 2,000 works meeting ISI standards, hundreds of monographs, patents and inventions. In addition, three journals published by VAST in the field of Maths and nano-technology have been



Acad Chau Van Minh, President of VAST made a speech at the VAST 40 years Anniversary ceremony (20/05/2015)

listed in the international Scopus list and others are striving to meet IST standards in the future.

The academy's success in mastering Vietnam's first earth observation satellite VNREDSat-1 was marked by the second anniversary of the satellite's launch to orbit and effectively operating its purpose to serve socio-economic development, national security and defense. Related has been the successful manufacture of the super small satellite PicoDragon which operates in space and transmits signals to the ground. Other success includes the production of iron ore, sponge iron and steel from red mud on an industrial scale with the over 200 tons of production tests, this not only contributes to solve environmental pollution but also brings great socio-economic effectiveness.

With the role as the leading scientific research agency of the country, associating scientific research with human resource training, the academy has become a cradle of post-graduate training in Vietnam in the field of natural sciences. The 19 institutes under VAST were assigned to train doctors and masters by the Prime Minister,

INTRODUCTION ■

with the annual training of 400 PhD and MA students. In 2014, the Graduate University of Science and Technology of the VAST was established by the Prime Minister to open a new period for the academy to promote high-quality science staff training in natural sciences in Vietnam.

To strengthen research potential, the academy attaches special attention to developing international cooperation in science and technology. The academy signed cooperation agreements with more than 30 international organizations, scientific research agencies and major universities around the world.

With these and other achievements over the past 40 years, the VAST has been awarded the second-class Independence Medal in 1995, the first-class Independence Medal in 2000 and the Ho Chi Minh Medal in 2010. Many institutes and key groups



Deputy Prime Minister Vu Duc Dam made a speech at the VAST 40 years Anniversary ceremony (20/05/2015)

from the VAST were presented to Independence and Labour Medals, Certificates of Merit of the Prime Minister, several Ta Quang Buu awards for their outstanding achievements in scientific work and for their contributions in building socialism and national protection.

THE MILESTONE IN HISTORY

1975	The establishment of the National Centre for Scientific Research of Vietnam. The Government appointed Acad. Tran Dai Nghia as the first Director of the NCSR of Vietnam.
1983	Acad. Nguyen Van Hieu was appointed as successor Director
1993	The establishment of the National Centre for Natural Science and Technology on the basis of the National Centre for Scientific Research of Vietnam
1994	Acad. Dang Vu Minh was appointed as Director
2004	National Centre for Scientific Research of Vietnam was renamed to the Vietnamese Academy of Science and Technology
2008	Acad. Chau Van Minh was appointed as President
2012	The Government issued Resolution regulating the functions, tasks, powers and the organizational structure of the Vietnam Academy of Science and Technology

SOME ACTIVITIES TO CELEBRATE THE VAST 40TH ANNIVERSARY

The VAST 40th anniversary exhibition



Ribbon-cutting opening



Stall for posters and exhibits

SOME ACTIVITIES TO CELEBRATE THE VAST 40TH ANNIVERSARY



Exhibits from the Vietnam National Museum of Nature



Exhibition stall of the Institute of Geophysics



Products of the Natural science and Tecnology Pubishing House



Medical products and dietary supplements



Seminar on applied research and technology development



The VAST 40 Anniversary workshop



The section on Information Technology – Automation – Space technology



The section on Material Science



The section on Biodiversity and Bio-active Substances



The section on Environment and Energy



The section on Basic Research in Mathematics and Physics



The section on Biotechnology



The section on Marine Science and Technology



The section on Earth Sciences

2015 IN NUMBERS

434	Science and technology projects and tasks at different levels with the total financial funding of more than 316 billion VND;
323	NAFOSTED Basic Research Projects, accounting for about 30% of the total basic research projects of the country (2010 - 2015);
26	ODA projects (08) and NGO projects (18) with total funding of 448.7 billion VND;
2.197	Scientific publications, of which 588 were articles in ISI journals, an increase of 12.4% compared to 2014;
18	Patents (11) and Utility Models (7);
190	New species of plants and animals discovered by VAST experts;
30	New books published;
506	PhD students in 19 research institutes, and 265 Master students;
109	Observation stations in 15 research institutes located throughout the 35 provinces and cities;
825	Science and technology contracts with a total cost in 2015 of over 200 billion (up nearly 25% compared to 2014).

RESULTS HIGHLIGHTS IN 2015

In 2015, the Vietnam Academy of Science and Technology has obtained many valuable research results in Science and Technology on specific directions. A number of main highlights are listed below:

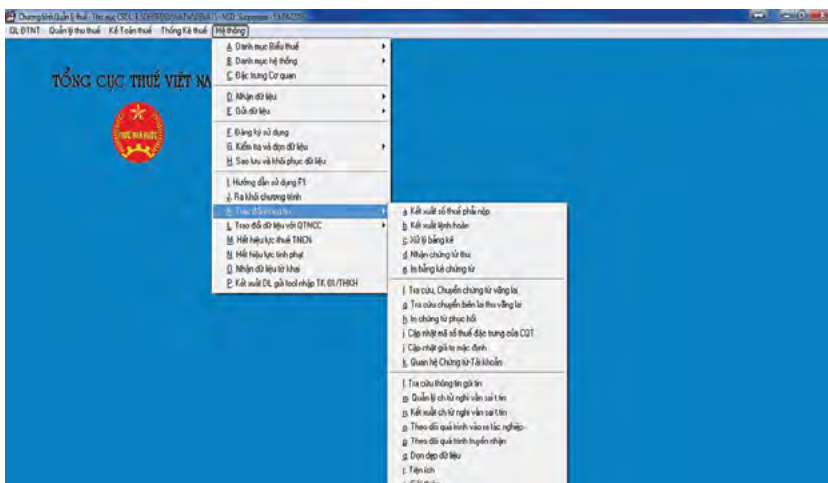
In the field of Information technology, Electronics, Automation, Aerospace technology:

Environmental monitoring systems hosted on a cloud platform, via WIMAX 4G telecommunications networks has been developed;

The design and manufacture of a wrist equipment to support Vietnamese reading for visually disadvantaged.

The research, design and manufacture of an integrated control system for mobile robots.

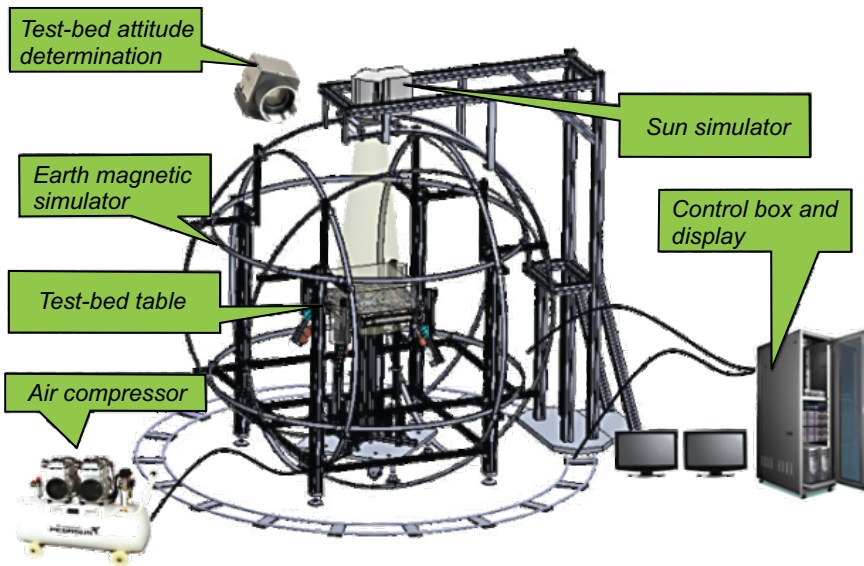
After multiple years of research and rigorous testing, in 2015, the tax management software of the Institute of Information Technology was put into use at 500 Tax Departments through out the country.



Main display of the tax management software



Intelligent control system for mobile robots



Simulation system for small satellite determination and control

Field of Mathematics

In the field of Mathematics: Prof. Nguyen Dong Yen and Assoc. Prof. Pham Hoang Hiep of the Institute of Mathematics have been awarded two of the four Ta Quang Buu prizes for outstanding scientific works for year 2015.



Prof., Dr Nguyen Dong Yen (second form the left) and Asoc. Prof., Dr. Pham Hoang Hiep (second from the right) receiving the Ta Quang Buu 2015 prize for the works in fundamental rearch.

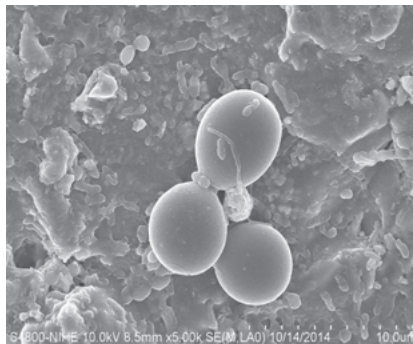
In the field of Biotechnology and Biodiversity

In 2015, researchers of the Vietnam Academy of Science and technology have discovered 190 new species, including 112 new species to the world and 78 new species for Vietnam. In 2015, for the first time in Vietnam, the Institute of Biotechnology has sequenced and analyzed genome data of the heterotrophic microalgae species endemic to PQ6.

Of special attention in 2015, the Prime Minister has assigned to implement larger tasks in the field of biotechnology, namely: to set up a project on the Inspection of Center martyrs DNA missing information; to set up a project on key laboratories for dioxin research; a project to develop multiple centers for food safety analysis; and finally, the planning of a project on a Northern Center for National Biotechnology sciences by Decision 1670/QĐ-TTg dated 09/28/2015 of the Prime Minister.



Biofilm forming microorganism product after drying to the humidity of 15 %



Biofilm forming microorganisms adhered on rice bran (x 5.000 times)



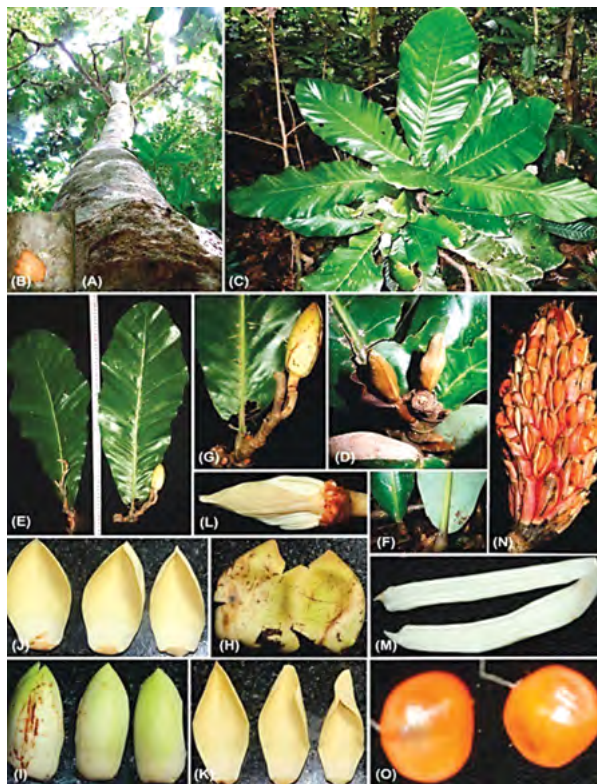
Oil contaminated wastewater treatment technology by using biofilm forming microorganism product in 300 litre/cycle module

Biofilm forming microorganism product to treat oil polluted wastewater (Institute of Biotechnology)



The recombinant human IL-2 was designed and produced by Institute of Biotechnology (IBT, VAST) and manufactured at The Company for Vaccine and Biological Production No.1 (Vabiotech)

190 new species of plants and animals discovered by VAST experts in 2015.



Magnolia tiepii



Magnolia lamdongensis

In the field of physics, mechanics, materials science

The VAST has successfully developed and manufactured technologies for an automatic unmanned helicopter in collaboration with Belarus. The automatic unmanned helicopter was tested in practice with many premium features. The helicopter was demonstrated at the Techmart fair and plans are made for commercial exploitation. Along with the flight radius of the automatic unmanned helicopter of 4000 km in distance, its ability to undertake up to 35-hour long journeys, the production technology of the automatic unmanned helicopter mastered by VAST will be applied in many related fields.

The Center for Materials Damage Assessment – COMFA of the Institute of Materials Science has successfully developed techniques to assess the component status of industry equipment which allows response assessment for safety operations. Furthermore, technologies for manufacturing hard-alloy, characterized by a high toughness of an WC-Co and WC-Ni system, have been developed and used for an industrial rock drill, tested successfully at Deo Ca - Khanh Hoa Tunnel. Findings have also been beneficial for the development of kinetic energy penetrator projectiles in the military. These drills have been successfully tested for the first time in Vietnam with quality equivalent to that of the advanced industrial countries. Bullet core 85 mm anti-tank guns had fired test results through 40Cr steel plate 130mm thick, exceeding the standards and objectives set.



The cooperation between the Institute of Applied Physics and Scientific Instrument (VAST) and the A.V. Luikov Heat and Mass Transfer Institute (NASB) on materials for unmanned airplane

Presidents of the VAST and the Academy of Belarus inspect the unmanned aircraft Pelican - VB01



The WC-Co and WC-Ni hard alloys with high hardness, high fracture toughness are used for fabrication of rock drill bits and the kinetic project of anti-tank weapon



In the field of Chemistry, Environment and Energy:

Over the past year, studies in Chemistry and Environmental sciences have achieved results in research and application. This has been marked by numerous international publications, registration of intellectual properties and multiple products of Science and technology have been successfully tested and put into practice.



*BIOGLUCUMIN
Techmart certificate
Vietnam 2015 of MOST*



Functional food VEDA-K+



Hudavil Hud-5



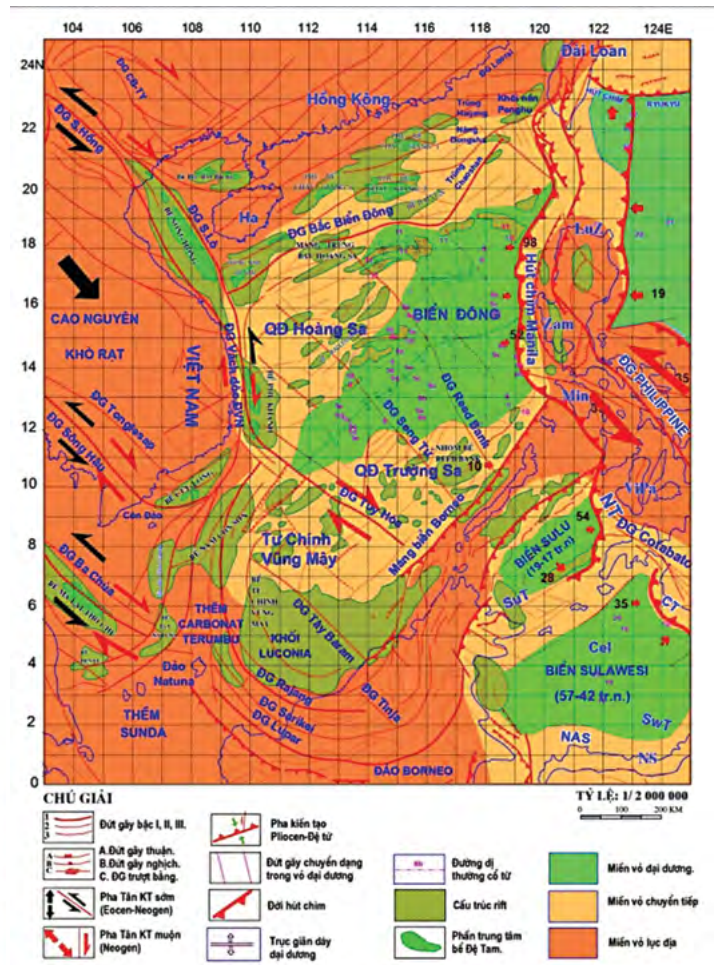
Anaerobic wastewater treatment systems (IC - Internal Circulation)



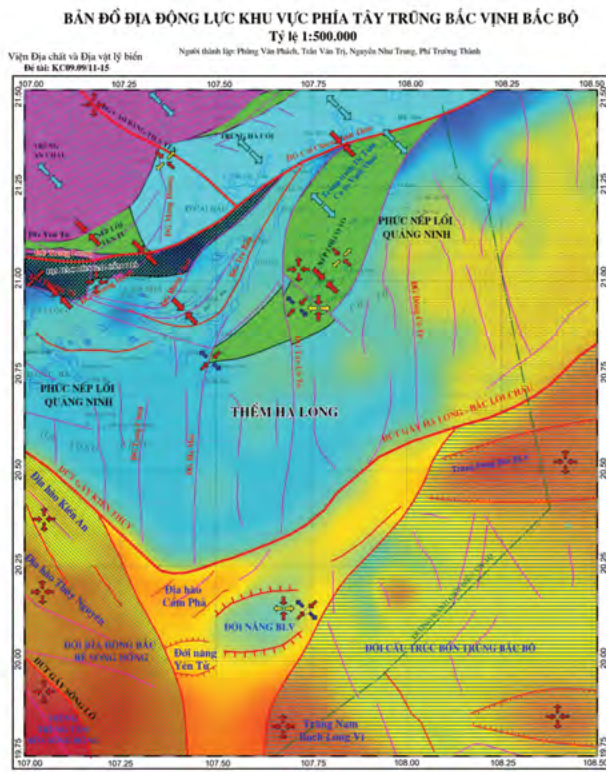
Ecological engineering module in Hoa Binh Xanh farm

Field of earth sciences, marine science and technology:

In 2015, for the first time the VAST has mapped the tectonic structure and geodynamic in the East Sea and the adjacent mainland at a scale of 1: 1,000,000 - accurately reflecting the tectonic structure elements in the East Sea. These results contribute to more efficient exploitation of marine resources and contribute to affirm Vietnam national sea sovereignty.



Map of tectonic Structure and Geodynamics of East Vietnam sea and adjacent area. Scale 1:1.000.000 (Institute of Marine Geology and Geophysics 2015)

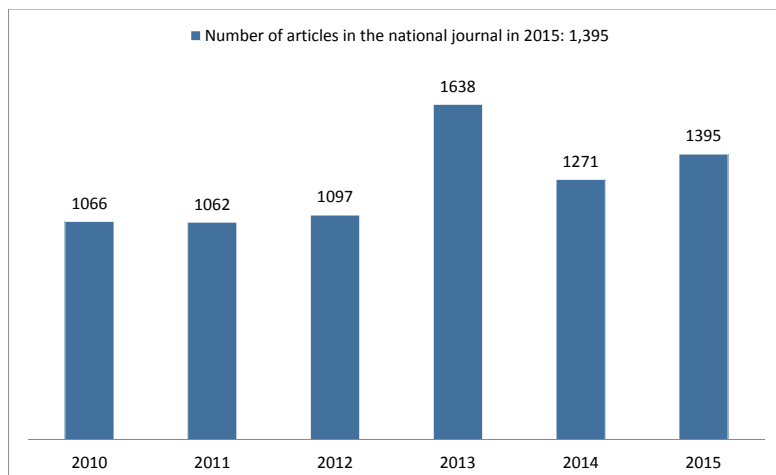
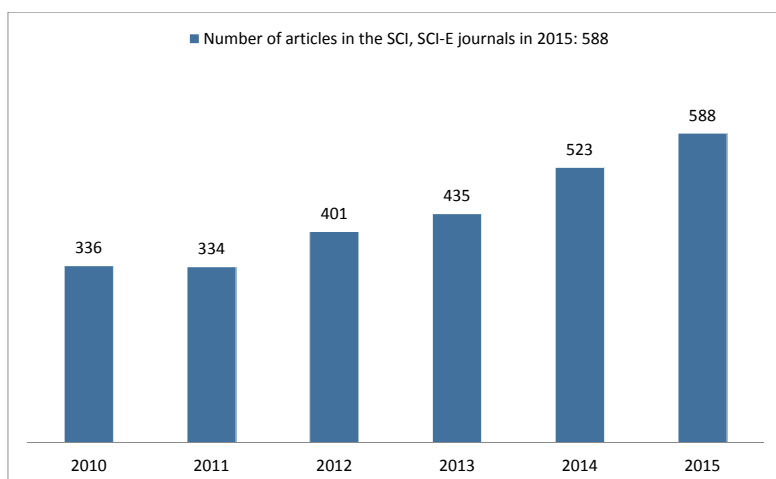
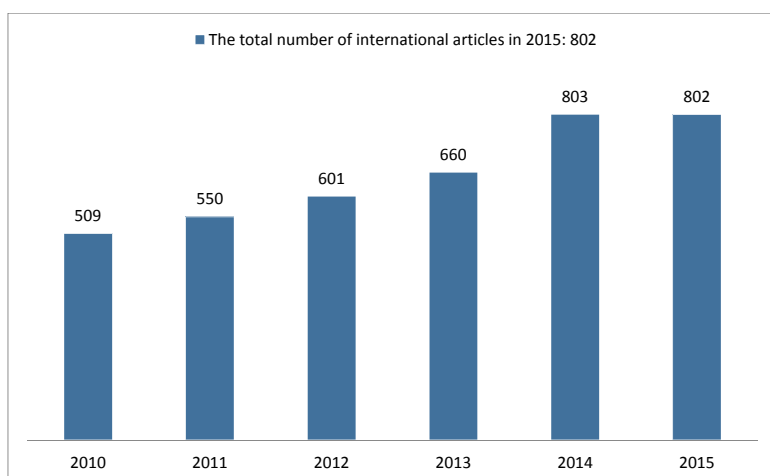


Map tectonic structure – geodynamics of the northern part of the Gulf of Tonkin, scale 1: 500.000 (Institute of Marine Geology and Geophysics 2015)

FUNDAMENTAL RESEARCH

In 2015, the VAST published a total of 2197 scientific works, an increase of 5.6% compared to 2014. The total number of international articles in 2015 was 802 articles, equivalent to 2014. The number of articles published in prestigious international journals with ISI standards (SCI and SCI-E) has increased to 588, which is 12.4% higher than in 2014. Among these, 82 articles (19% of the total number of ISI-listed publications) has been the effort of collaboration between different institutes within the VAST. Total registration of intellectual property has been 18 certificates, including 11 patents, an increase of 27% compared to 2014. In 2015, VAST has published 30 monographs, a significant increase compared to 2014.

In the period 2010 - 2015, the VAST has received funding for a total of 323 basic research projects from NAFOSTED, accounting for about 30% of the country's research projects.



Research results published in the past 06 year of VAST

Fundamental research in Mathematics

Prof. Dr. Sc. Le Tuan Hoa

Director of the Institute of Mathematics

The Institute of Mathematics (IMH) has 103 members (78 permanent positions and 25 short-term positions). Among the 88 researchers (71 permanent positions and 17 short-term positions) there are 22 full professors, 15 associated professors and 20 PhD tenures.

In 2015, the IMH has published 74 peer-reviewed science articles in international journals. Among them, 28 papers were published in SCI journals and 30 papers in SCI-E journals. These numbers are better than those of 2014 (the corresponding numbers are respectively; 54 – 23- 24).

One of the major highlights of 2015 has been the granted Award of the Ta Quang Buu Prize to Prof. Nguyen Dong Yen for his publication “A class of linear generalized equations” in SIAM Journal on Optimization (jointly with N T Qui) and the Award of the Ta QuangBuu Prize for young scientists to Assoc. Prof. Pham Hoang Hiep for his publication “A sharp lower bound for the log canonical threshold” in Acta Mathematica (jointly with J.P. Demailly). The Ta QuangBuu Prize was established by the Ministry of Science and Technology in 2014. Each year it is awarded to a maximum of four scientists who are working in Vietnam and have excellent publications regarding natural sciences and technology in top journals over the past five years.

In addition, Dr. Doan Thai Son and Dr. Hoang Le Truong were recognized by the VAST as “Excellent Young Scientists” of the VAST. This year the annual award has been organized for



Prof. H. Hironaka (Fields medal 1970, second from left) at the France-Japan-Vietnam symposium on singularities

the first time and, in total, six 6 young scientists of the VAST have received this honor.

The IMH has 26 research projects supported by the National Foundation for Science and Technology Development (NAFOSTED), among them were 20 newly granted projects in 2015.

During the past year, six PhD students have successfully defended their PhD theses and eight new PhD students have joined the IMH. In total, 41 master students completed their study and six students of the International Master Program were accepted by French universities for the M2 study under their grants.

The IMH organized or co-organized 06 international workshops, 02 international schools and 08 other workshops. The year 2015 marked 45 years of the establishment of the IMH as well as 40 years of VAST. Many scientific and public activities were organized to welcome these events.

A highlight with regard to international relations has been the successful implementation of the agreement for the creation of the International Associated Laboratory (LIAForMath Vietnam) between the CNRS (France) and VAST which started in 2011 with the aim to promote bilateral cooperation in the field of Mathematics. In particular, thanks to this agreement, many French professors have been able to come and teach M1 students at the International Master Program of the IMH, and many students of that program received grants for M2 and afterwards also PhD studies in France. Based on the achievements of this LIA, the agreement was extended by CNRS and VAST for another period of four years (2015 to 2018).

Members of the IMH made 64 scientific visits abroad; most of these (58 visits) were fully supported by institutions overseas. The institute received 20 foreign visitors (this does not include speakers and participants of workshops).

A final noteworthy highlight of 2015 has been the preparation of a project for the establishment of the International Centre for Postgraduate Studies and Research in Mathematics (ICPoSRem) as an UNESCO center



Discussion with Prof. C. Villani (Fields medal 2010, first from left)

(category 2). This project was first proposed by the Ministry of Science and Technology (MOST), and then supported by VAST. An expert group of specialists of the IMH has intensively worked with specialists from Institute of Physics, VAST, MOST and the Vietnam National Commission in collaboration for the UNESCO project as well as a similar project regarding the establishment of an International Center for Physics. As a result, in November 2015, both centers have been successfully accepted by the UNESCO

General Assembly as category-2 UNESCO centers. On behalf of the Vietnamese Government, the MOST will sign an agreement with UNESCO about the establishment of these two centers within VAST in the first half of 2016. The international Master and PhD programs of ICPoSReM will be carried out mainly by faculty members of the IMH. This will be a new opportunity for the development of the IMH in the following years.



Vietnam delegation for the establishment of UNESCO centers of category 2 in Paris, October 2015

Fundamental research in Physics

Prof. Dr. Le Hong Khiem
Director of the Institute of Physics

Introduction

The Institute of Physics belongs to the Vietnam Academy of Science and Technology. The Institute of Physics was established by the Government under the Prime Minister's Decision No.25/CP dated as February 5th, 1969. So far the Institute has an history of 46 years. By the end of 2015, the Institute of Physics has a staff of 180 members, including 06 full professors, 09 associate professors and 48 PhD tenures.

The Institute of Physics is a multi-disciplinary, comprehensive research and development institute responsible for both fundamental and applied physics in the country. The principle tasks of the institute are: carrying out fundamental research in all fields of physics, including theoretical physics, condensed matter physics, nuclear physics, environmental physics, applied physics among other fields. Its mission is to ensure a high level of physical sciences in both fundamental and applied research nationally as well as developing co-operative relations on scientific and technological research and production and designing and manufacturing scientific equipments. Other key objectives include the transfer of new technologies, the establishment of the nucleus of an advanced graduate program in physics, and to work with other universities of the country in creating a top level physics graduate curriculum. Finally, establishing fruitful international collaborations in the field of physical sciences and providing a forum for scientific contact between Vietnamese physicists and their colleagues around the world are important responsibilities of the institute.

Nowadays, there are six centers that belong to the Institute of Physics, including; the center for

theoretical physics, the center of computational physics, the center of quantum and electronics, the center for nuclear physics, the center of environmental physics and the center of engineering physics. Among them, the first four centers are related to the field of basic research. In this report an overview of the main research directions in the field of fundamental research is given.

Main Research Directions in the field of Fundamental Physics

The principle activities of the Institute of Physics are oriented towards scientific research in theoretical and experimental physics.

The main research topics at the Center for Theoretical Physics and the Center for Computational Physics

One of the most important centers of the Institute of Physics is the Center for Theoretical Physics. The Center for Theoretical Physics was founded in 1982 based on the Department of Theoretical Physics of Institute of Physics, Vietnamese Academy of Science. The main aim of the Center is to carry out foremost research in the fields of theoretical physics and train young researchers within this field. The Center for Theoretical Physics is purely dedicated to theoretical research, however in a wide range of topics regarding modern theoretical physics. The Center for Theoretical Physics is a renown national research center, which conducts a wide range of fundamental research in mathematical physics, particle physics and condensed matter physics. At the Center for Theoretical Physics, theoretical investigations in quantum field theory, high energy physics, quantum mechanics have a long and successful history in many respects. At the same time there have been important strides in understanding the physics of condensed matter systems, as well as in the development of theoretical soft matter physics.

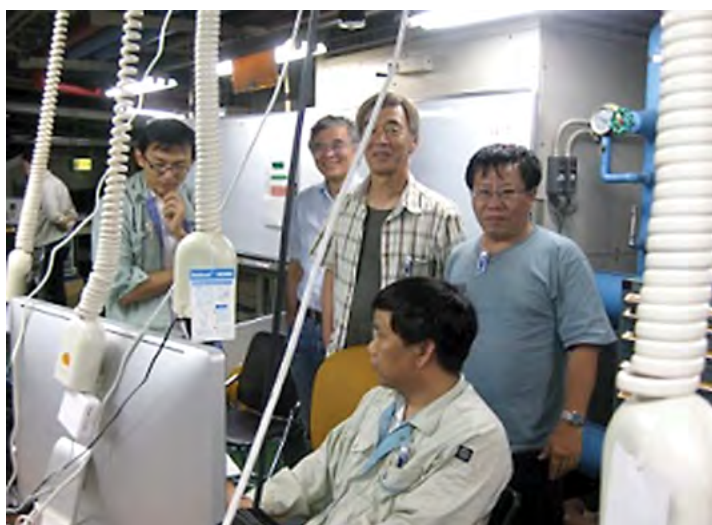
Recently, the Center for Theoretical Physics was divided into two sub-centers, namely: the Center for Theoretical Physics and the Center for Computational Physics. In general, their activities are very similar, however with distinct focus areas. At present, the main research topics carried out at the Center for Theoretical Physics and the Center for Computational Physics are listed as following:

- Particle Physics and Cosmology: Phenomenology of Particle Physics: Beyond Standard Models, Super-symmetric Models, Gauge-Higgs Unification, Extra Dimensions.
- Mathematical and High Energy Physics: Mathematical physics: Gauge theory and gravitation, quantum groups, integrable systems, Standard model and beyond, measurements at the LHC (with the ATLAS collaboration), B physics and CP violation.
- Strongly correlated electron systems, Quantum materials: Phase transitions in some complex systems, Magnetic phases in two-dimensional frustrated lattices, Correlated electron materials, Emergent phenomena and quantum criticality, Topological phases, Quantum dots and nano structures.
- Quantum Information: Quantum computation, entanglement, quantum state transfer.
- Nano Physics: Electronic structures of molecules and nano systems, Quantum transport in graphene and semiconductor nano structures, Design of nano electronic devices.
- Physics of Bio and Complex Systems: Graphene and carbon nanotubes, DNA and biosensors, Econophysics, Phase transition in complex systems, Structures and dynamics of silica glass.
- Statistical and Biological Physics: Protein folding, Protein aggregation and amyloid form, Stretching of proteins and DNAs, Biological membranes, Protein interaction networks, DNA toroids.

The main research topics at the Center for Quantum Electronics

The third important center of the Institute of Physics is a Center for Quantum Electronics. Photonics and Quantum Electronics are about lasers and how laser light is used. The center for Quantum Electronics of the Institute of Physics was established on December 18th, 1997 based on important work of the researchers of the optics laboratory. Nowadays, the center for quantum electronics has become a well-known center working in the field of quantum electronics not only within the Vietnam Academy of Science and Technology but also nation-wide. The goal of this center is to explore fundamental aspects of quantum mechanics, as well as work towards future photonic quantum technologies. Research in the department covers a diverse range of topics. In the center, peoples grow organic photonic materials, and study them using spectroscopy, in many cases with ultrafast lasers.

Active areas of experimental research of the center are studies and research related to optics, photonics, modern laser spectroscopy, physics and technology of coherent light sources, interaction between laser light and materials, electronics and communication



Experiment of the Institute of Physics at the Research Center of Nuclear Physics of Osaka University

technology, biophysics and medical physics as well as photonic and electronic materials. Currently the center is focusing on the following topics: spin and exciton dynamics, nano-scale structures, optoelectronic devices, and nonlinear optical pulse propagation. Specialized courses are offered bi-annually, including Quantum Electronics, Laser Principles, Nonlinear Optics, Semiconductor Physics, Solid State Physics, and Optics. Many projects of fundamental research and application at national level are on-going. International conferences on optics, photonics and spectroscopy are organized bi-annually.

The main research topics at the Center of Nuclear Physics

The Center for Nuclear Physics is another important center within the Institute of Physics and carries our fundamental research in the field of nuclear physics. The center was founded in 1987 on the foundations of the Department of Nuclear Physics within the Institute of Physics. It is possible to say that the Center for Nuclear Physics has really began its fundamental researches in the field of nuclear physics after the Institute of Physics was equipped with particle accelerators, such as the 14 MeV neutron generator NA-3C (1974), the electron accelerator Microtron MT-17 (1982) and a dedicated spectrometer system (scintillator detector, semi-conductor gamma detector, X-ray detector, multichannel amplitude analyzer,...). At that time, those were the first accelerators in Southeast Asia. Some of the main research directions have been deployed as nuclear reactions and nuclear data for neutron of 14 MeV and photon at maximum energy of 15 MeV, as well as analysis research on neutron activation, on photon and X-ray fluorescence.

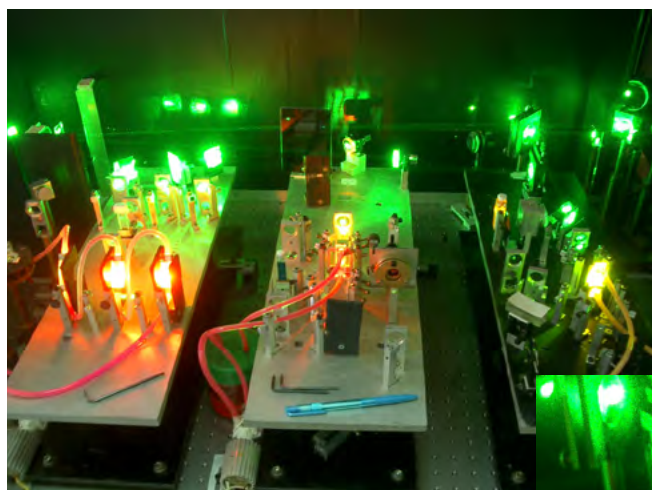
Fundamental research in the field of nuclear physics basically requires modern equipments and a huge research budget. At present, these requirements are very difficult to satisfy because the country is still developing. International cooperation is a major enabler to increase capacity to conduct fundamental research in the

field of nuclear physics. Being aware of these opportunities, Center for Nuclear Physics has actively cooperated with the famous nuclear research institutes around the world. At present, the Center for Nuclear Physics has collaborated effectively with several advanced laboratories such as the Joint Institute for Nuclear Research in Dubna (Russian Federation), the Institute for Physical and Chemical Research RIKEN (Japan), Center for Nuclear Study of the University of Tokyo (Japan), Research Center for Nuclear Physics of Osaka University, POHANG Accelerator Center (South Korea), the Institute for Nuclear Physics in Orsay (France) and the Synchrotron Light Research Institute (Thailand).

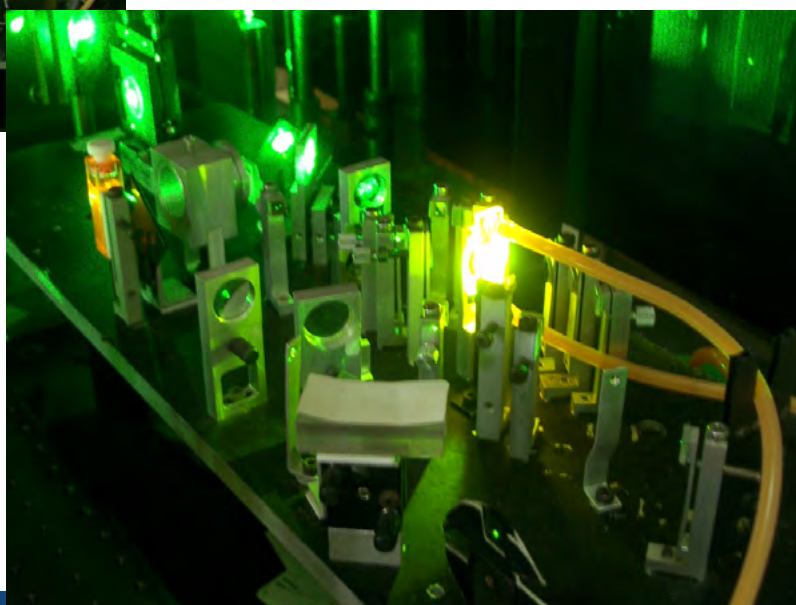
Currently, the following main research subjects have been focus areas of researchers of the Center for Nuclear Physics:

- Study of photonuclear reactions based on electron accelerators.
- Study of nuclear reactions caused by radioisotope and stable isotope beams based on particle accelerators.
- Study of nuclear reactions induced by neutrons from isotopic sources, accelerators and nuclear reactors.
- Study of nuclear structures based on particle accelerators.
- Nuclear spectroscopy and nuclear data.
- Nuclear electronics, instruments and accelerator techniques.
- Simulation of physics experiments and programming for data analysis.

Over the years scientists of the Center for Nuclear Physics have gained several results which have played significant and acknowledged role in experimental nuclear physics in the country. Several scientific papers have been published in prestigious international journals on nuclear physics. At the national level, the members of the center are leading scientific projects of key importance.



The 500fs dye laser system



The picosecond visible laser system

Achievements

According to a number of indicators, the Institute of Physics is one of the top-quality scientific research institutes of Vietnam Academy of Science and Technology. The quality and quantity of scientific production places it among the Vietnam's most successful research centers. In the field of fundamental research, the Institute of Physics has received numerous outstanding achievements. For years continuously, the Institute of Physics is among the institutes of the Vietnam Academy of Science and Technology that publish the most scientific papers. Every year, high-quality peer-reviewed papers are published by the researchers of the Institute. The yearly average of international publications, including those in SCI and SCOPUS-listed journals, fluctuates around 100 manuscripts per year. In some selected research areas such as theoretical physics, nuclear physics, quantum electronic, the Institute of Physics has achieved the highest expertise nationwide. In the coming years, the mission of the Institute of Physics is to be the leading organization for fundamental research in physics in the country.

IT-ELECTRONICS-AUTOMATION AND SPACE TECHNOLOGY

Prof. Dr. Sc. Duong Ngoc Hai
Chairman of Scientific Council

Information technology

Hedge algebra

To strengthen the foundation of fuzzy logic against some weakness, the Institute of Information Technology establishes the theoretical foundation of hedge algebra and its application to IT and automation fields.

Fuzzy logic targets linguistic variables and the operators by which we can manipulate and reason about these linguistic variables to deal with practical problems. Fuzzy logic is a form of multi-valued logic in which the truth values of variables may be any real number between 0 and 1. By contrast, in Boolean logic, the truth values of variables may only be 0 or 1. Furthermore, when linguistic variables are used, these degrees may be managed by "membership" functions. However, because there does not exist any formal mechanism based on which the evaluation of membership functions could be established, traditional approach in fuzzy logic with respect to membership functions is purely intuitive.

Hedge algebra is a mathematical model

Tax Management Information Systems for Branches

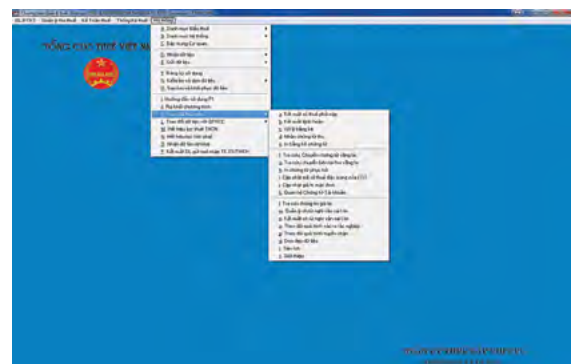
District-level Tax Management Information Systems are business software which are developed and deployed at all district-level Tax Departments. Its main objective is to manage all tax-related activities of these offices and forward the aggregated report to the General Taxation Office for each pre-defined period in a fiscal year. The main functions of this software are as follows: Taxpayers' information management; Manage tax declaration; Manage tax entries (collection and payment); Tax accounting and tax statistical collection; Export tax entries for management purposes of higher levels (The Provincial Tax Department).

With the ultimate aims of improving management

structured on pre-defined linguistic orders among language domains of variables and its theoretical foundation is built upon axiomatic logic. With these principles, hedge algebra is expected to overcome the disadvantages inherent to fuzzy logics. Rather than replacing fuzzy logic, hedge algebra is expected as an extension on top of fuzzy logic to deal with scientific and technological issues: Hedge algebra is a solid theory about processing fuzzy linguistic information in a different way (more refined) from fuzzy logic; Formal theory of hedge algebra and its methodologies are sound; The application of this theory could be in classification and regression problems which are often practical, especially many macro-level state socio-economy policies at the Ministry of Investment and Planning.

With its solid theory and potential application, in 2015 hedge algebra-related research has been published in international scientific journals: 2 SCIs and 1 SCI-E articles.

capabilities, information transparency and decision support in the sector, the system has been an essential and effective tool for taxation management personnel in every department for the past 25 years. In 2015, turnover from upgrade and deployment activities of this software is about four billions VND. During this period, this software is upgraded for new requirements in the current tax reform process.



Applications of computational physics methods and software tools in research of quantum materials, biological polymers, nuclear radiation and astronomy

In 2013-2015, the Institute of Physics has experimentally used the High Performance Computing Cluster - newly built in Vietnam Academy of Science and Technology - for research in quantum materials, biological polymers, nuclear radiation and astronomy. Each research direction has benefitted from specific studies and computations on the High Performance Computing Cluster in order to obtain qualified and significant research results. In addition, these studies have served to test the capacity of the High Performance Computing Cluster at Vietnam Academy of Science and Technology for research applications.

The quantum materials research direction has conducted studies on the essential phases in theoretical models for quantum materials. This research has resulted in the modification and development of open source LISA codes of the dynamic mean field theory for the investigation of three-component correlation problems in quantum simulations of multi-component correlated materials. The obtained results show that the High Performance Computing Cluster of Vietnam Academy of Science and Technology is completely appropriate and compatible with studies of multi-component correlations.

The biopolymer research direction has successfully applied various methods of molecular dynamics simulation, Monte Carlo simulation and advanced sampling techniques for coarse grained models in studies of biopolymer systems such as the studies of the phase diagram of the ground states of DNA condensates, the effects of ribosomal exit tunnels on folding of nascent proteins, and the effects of macromolecular crowding on protein folding.

In the computational astrophysics direction, research has been carried out on the radiative

transfer problem coupled with the realistic hydrodynamic simulations of circum-stellar envelopes around evolved stars. We used the open-source hydrodynamic simulation code 'Athena' to simulate the mass loss process and the influence of binary companions on the structure of the circumstellar envelopes. We carried out simulations to determine the structure and physical properties of the envelope such as the kinematics, spatial distribution of gas density and temperature and also the influence of binary companions. We also performed the molecular excitation and radiative transfer calculations in circum-stellar envelopes and the circum-nuclear disks around the center of galaxies. The results for the molecules CO and HCN in the circum-nuclear disk of nearby starburst galaxy M51 have been published in the internationally renowned The Astrophysical Journal.

In the field of nuclear physics, gamma detection by spectrometer has been calculated. The Monte-Carlo method has been applied to solve several problems which frequently exist in experimental nuclear physics. The following specific problems have been studied: Calculation of detection efficiency of high-purity germanium detectors by Monte-Carlo methods and the simulation of gamma-ray transportation by Monte-Carlo methods. These calculations have been applied for designing a device for density variation measurement of the concrete layers of newly constructed highways using backscattered gamma-rays. The results of these studies were published in 2 articles and 1 monograph.

The final results of the project named "Application of calculation methods and calculating facilities for studying quantum materials, bio-polymers, nuclear radiation and astrophysics are: 01 monograph was written, 03 scientific papers were published in international journals, 02 mastetheseses have been finalized and contribute to the supervision of 01 PhD thesis.

Electronics and automation

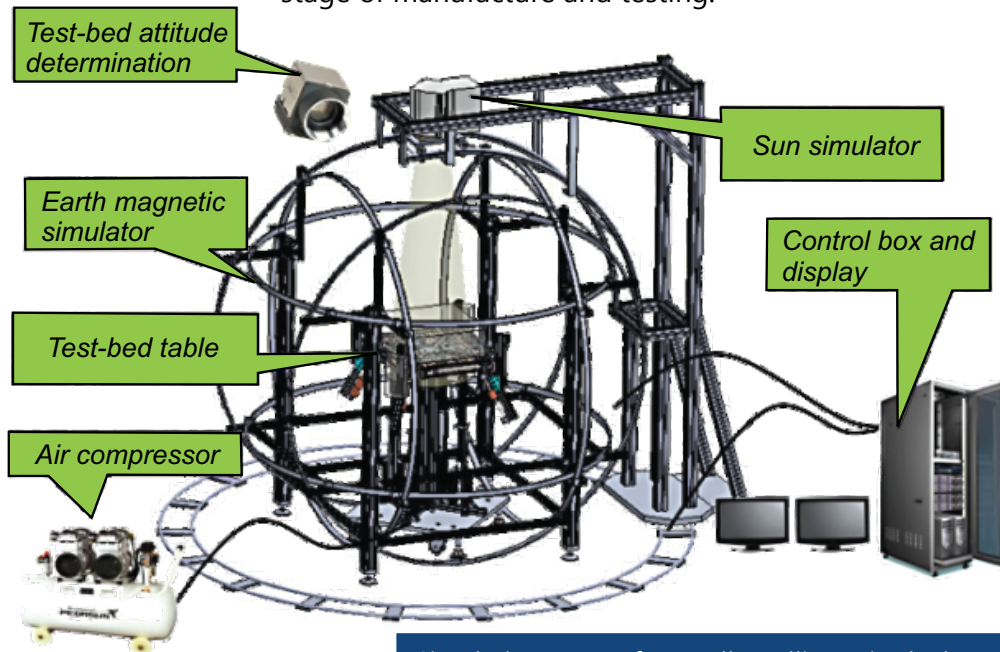
Another achievement of the Institute of Physics in the direction of electronics, informatics and automation should be mentioned. We have successfully designed and integrated a two-dimensional nano-positioning stage within the framework of a VAST-funded technology development project. This flexure nano-positioning stage has a resolution of 10 nm and a displacement range of 20 micrometers. The displacement of the stage is actuated with piezostacks integrated with high precision

position sensors. The actuators are controlled through high-voltage large-bandwidth amplifiers with digital signal from the FPGA and high-resolution 12-bit DAC. The FPGA control board connection to the main computer is made through an USB port. The FPGA board can also control the photon counting module when the nano-positioning stage is integrated with single nano-particle measurement setup. We have successfully used our nano-positioning stage to obtain fluorescence images of single quantum dot nano-particles and single dye molecules.

Space Technology

Research and application

In 2015, VAST continued to act as the leading organization of the National Research Program on Space Science and Technology in the period 2012 – 2015 with 26 projects under 3 main topics: applied research, scientific research and basic research. Some institutes of VAST implemented many projects under space technology application, satellite image application (VNREDSat-1's imagery) on many areas nation-wide to serve the monitoring of natural disaster, agriculture, geographical mapping, et cetera. The technology-oriented project on the high-precision simulation systems for small satellite attitude determination and control is now in the finishing stage of manufacture and testing.



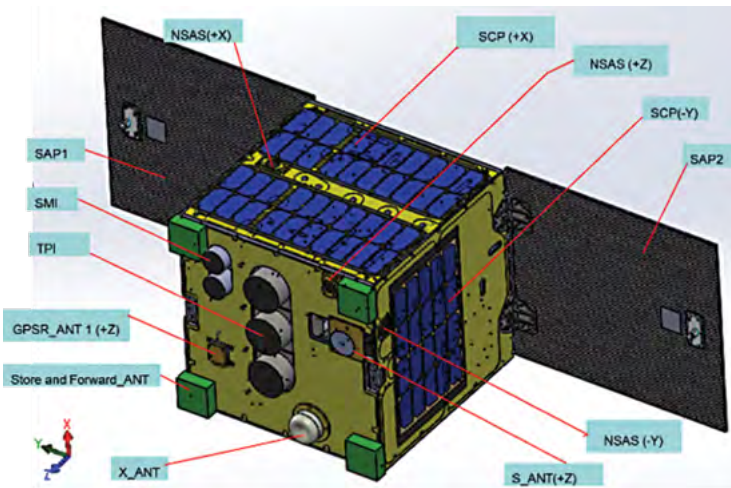
Simulation system for small satellite attitude determination and control

Technical Infrastructure Development

Vietnam Space Center Project backed by Japanese ODA investment is actively being implemented. In 2015, the Project was completed and handed over all categories of grounding and has started to construct works of the North area in Hoa Lac High-tech park, the Center for supporting human resource development and technology transfer at 18 Hoang Quoc Viet, Hanoi, purchasing facilities for observatories and planetariums in Hoa Lac and Nha Trang.

In addition, the project is also preparing the

bidding package of designing – manufacturing, launching and transferring satellite technology of the LOTUSat-1. Furthermore, eleven students of Batch-1 of the basic training course for Master of Satellite Technology have graduated and returned to work in the Vietnam National Satellite Center (VNSC). The students of Batch-2 and Batch-3 (24 students) are continuing to study in universities in Japan. In addition to the master’s program, the students are also engaged in manufacturing and practicing on 50kg MicroDragon Satellite which is tasked to observe marine watercolors to assess environmental quality of coastal water with the aim to serve social-economic development.



MicroDragon satellite is being developed by students of VNSC



The students of VNSC in Japan attended the official acceptance of the MicroDragon satellite design

■ PRIORITY DIRECTIONS IN SCIENTIFIC RESEARCH AND TECHNOLOGY DEVELOPMENT

The status of VNREDSat-1

- Until 11/2015, the satellite VNREDSat-1 has been operated safely by engineers of the Center for satellite control and utilization (of Space Technology Institute – STI). In total, more than 42,000 image scenes have been captured (about 50% for each MS and PAN), of which about 23,000 of the captured scenes of Vietnam’s territories have been used for effective application for socio-economic development and security assurance.

- In 2015, through the international cooperation between VAST and UNESCAP, the VNREDSat-1 has captured numerous scenes of disasters in the region. Consequently, these images have been sent to those countries for disaster relief management, such as: VNREDSat-1 images of the

Earthquake of Kathmandu (Nepal) (4/5/2015); and VNREDSat-1 images of the forest fires at Pateros, Washington, USA (27/08/2015).



VNREDSat-1 images of the Earthquake of Kathmandu, Nepal (04/05/2015)

- In September 2015, at the office of the Ministry of Agriculture and Rural Development (MARD), the signing ceremony of the Memorandum of Understanding (MOU) has occurred between 3 sides: VAST-JAXA-DWR (DWR - Directorate of Water Resource – MARD). The MOU content is about cooperation using satellite imagery and remote sensing for disaster management in Vietnam, in which JAXA and VAST are technical supporters and the DWR – a key end-user.



The signing ceremony of MOU between 3 sides: VAST-JAXA-DWR, MARD

- For implementation of this MOU, in October 2015, under the supervision of VAST, the Space Technology Institute (STI) has registered to be the member of the Sentinel Asia project – a network of Asia to share satellite imagery and support disaster reduction efforts in the region. In this regards, VAST requested the STI as the main responsible agent to provide VNREDSat imagery for these purposes (Data Provider Node – DPN) and receive satellite images from Sentinel Asia when disasters occur in the region as well as in Vietnam.

- The Advanced Center of Remote Sensing Technology and Geo-Information System (ACRG) is established within the STI, VAST.

- In cooperation with France and Belgium, the VAST is going to conduct feasibility studies for further development of the VNREDSat-1 (an optical and very high resolution satellite) and the VNREDSat-2B (hyperspectral).

International Cooperation

VAST and VNSC has actively continued to participate in international organizations such as the Committee on Earth Observation Satellites (CEOS), the Group on Earth Observation (GEO), the International Astronautical Federation (IAF), the International Academy of Astronautics (IAA) amongst others.

VAST also has participated in many international activities such as 31st Space Symposium in America, Asia-Pacific Regional Space Agency Forum (APRSF 2015) in Indonesia, Vietnam – US 2nd Dialogue on Space Technology, Vietnam – Russia Cooperation Workshop on satellite image application et cetera. On 1/9/2015, VAST, Japan Aerospace Exploration Agency (JAXA) and the Water Resource Directorate of the Ministry of

Agriculture and Rural Development signed the cooperation agreement on space technology applications in natural disaster mitigation and prevention. Furthermore, the VAST is preparing to sign cooperation agreement with the Centre National d’Etudes Spatiales (CNES) and in preliminary negotiations regarding cooperation in the field of satellite imagery with partners from Israel, Canada and the USA.

On December 9th, 2015, VAST and National Aeronautics and Space Administration (NASA) signed the cooperation agreement on the GLOBE Program in order to disseminate knowledge on space to school pupils and teachers. VAST also worked with French partners on technical issues for the VNREDSat-1 project, coordinating with the Embassy of Belgium in Vietnam and other partners of Belgium to start VNREDSat-2B Project.



Vietnam – US 2nd Dialogue on Space Technology



VNSC engineers test MicroDragon satellite at Kyushu university

BIOTECHNOLOGY

Prof. Dr. Truong Nam Hai
Chairman of the Scientific Council

In 2015, major achievements in the field of biotechnology within the VAST have been:

Evaluation of the projects completed in 2014

Five projects have been completed in 2014 which have been evaluated by the VAST scientific committee. These finalized and evaluated projects include:

- The Project "Study of sweet miraculin protein expression in transgenic tomato plants", which has been conducted by Assoc. Prof. Dr. Chu Hoang Ha of the Institute of Biotechnology.
- The Project "Production study of nanoparticle antigen capable of triggering immune response", conducted by project leader Assoc. Prof. Dr. Le Quang Huan of the Institute of Biotechnology.

- The Project "Study the production of recombinant L-asparaginase to inhibit cancer cell line and treatment of acute lymphoblastic leukemia", conducted by project leader Assoc. Prof. Dr. Quyen Dinh Thi of the Institute of Biotechnology.

- The Project "Creating and studying recombinant Baculovirus strains carrying influenza virus antigen gene for new generation vaccine production" conducted by the project leader Dr. Dong Van Quyen of the Institute of Biotechnology.

- The Project "Identification of gene mutations for diagnosis of congenital hereditary hearing impairment in children" conducted by project leader Assoc. Prof. Dr. Nong Van Hai of the Institute of Genome Research.

The new projects

The VAST Scientific Committee has approved 05 new projects for 2016-2017, including;

The project "Sequencing of plastid genom of gensing Ngoc Linh (*Panax vietnamensis*)" lead by Ass. Prof. Dr. Nong Van Hai of the Institute of Genome Research.

The project "Transgenic soybean plants resistant to some adverse conditions of the environment" lead by Ass. Prof. Dr. Chu Hoang Ha of the Institute of Biotechnology.

The project "Transgenic maize rich in

carotenoid" lead by Ass. Prof. Dr. Nguyen Duc Thanh of the Institute of Biotechnology.

The project "Application of hydroponic techniques for amplification of Lan brocade (*Anoectochilus formosanus* Hayata) in large scale in Da Lat, Lam Dong" lead by Dr. Phan Xuan Huyen of the Tay Nguyen Institute of Scientific research.

The project "Production of mycelial biomass and exopolysaccharide in submerged cultivation of medicinal mushroom *Cordyceps* sp. for development of functional foods" lead by Dr. Bui Van Ngoc of the Institute of Biotechnology.

Achievements

1) The research on “the expression of aryl hydrocarbon receptor (AHR) in peripheral blood of dioxin-exposed people” led by Dr. Nguyen Trung Nam, Institute of Biotechnology.

During the Vietnam War, many central and southern regions of Vietnam have been exposed to herbicides containing dioxin. Previous studies revealed that some locations such as Danang and Bien Hoa airports still heavily contaminated with toxic chemicals such as TCDD. In Vietnam, there have been numerous research projects on the effects of dioxin on the environment and humans. Recently, several scientific reports have demonstrated that the expression changes of aryl hydrocarbon receptor (Ahr), known as the dioxin receptor, under stimuli triggered by dioxin or ligands, regulate responses of the immune system as well as the development of inflammatory disorders such as inflammation and auto-immunity in vitro and in animal models. The current study of the changes of Ahr expression in the blood of dioxin-exposed people will propose to use Ahr as a molecular marker for the initial screening of dioxin exposure. Additionally, studies of the relationship between the Ahr expression, Ahr-regulated cytokines and the frequency of diseases in dioxin-exposed people is very important in helping to identify the mechanism of Ahr-mediated diseases as well as to suggest therapeutics for treating the diseases caused by dioxin through Ahr signaling pathway.

Peripheral blood samples were collected from the dioxin-exposed and healthy people. Red blood cells from peripheral blood were removed by centrifugation. Total RNA was extracted by Trizol method and quantified

by spectrophotometer Nanodrop Lite. cDNA was synthesized from total RNA using cDNA Synthesis Kit First Strand Kit. Real-time PCR reaction with specific primers for Ahr and cytokines was performed on LightCycler - using DNA kits FastStar LightCycler SYBR GREENI MasterPLUS. The Ct value of the samples was determined by software LightCycler 4.0. The levels of gene expression between samples were compared according to $2^{-\Delta\Delta Ct}$ method. The statistic analysis of the correlation between changes of expression of Ahr, cytokines and the frequency of dioxin-mediated diseases were conducted by specific softwares.

By analyzing blood samples from 30 dioxin-exposed people and 30 healthy people using real-time PCR technique, we found that the expression of Ahr in dioxin-exposed people is almost 14-time higher than that in healthy people. The expression of inflammatory cytokines such as IL-1, IL-6 and TNF- α has increased significantly in dioxin-exposed people compared to that in healthy people.

Taken together, Ahr can be recommended to use as an initial marker for screening dioxin-exposed people. However, the analysis of Ahr expression is on-going with larger sample size to get more reliable statistics. The relationship between increased expression of Ahr, inflammatory cytokines, and the frequency of diseases such as inflammation and autoimmunity in dioxin-exposed people is also being investigated.

2) The research on “Formulation of functionalized PLGA–PEG nanoparticles loaded docetaxel for targeted cancer cell with HER2 overexpression” led by Ass. Prof. Dr. Le Quang Huan, Institute of Biotechnology.

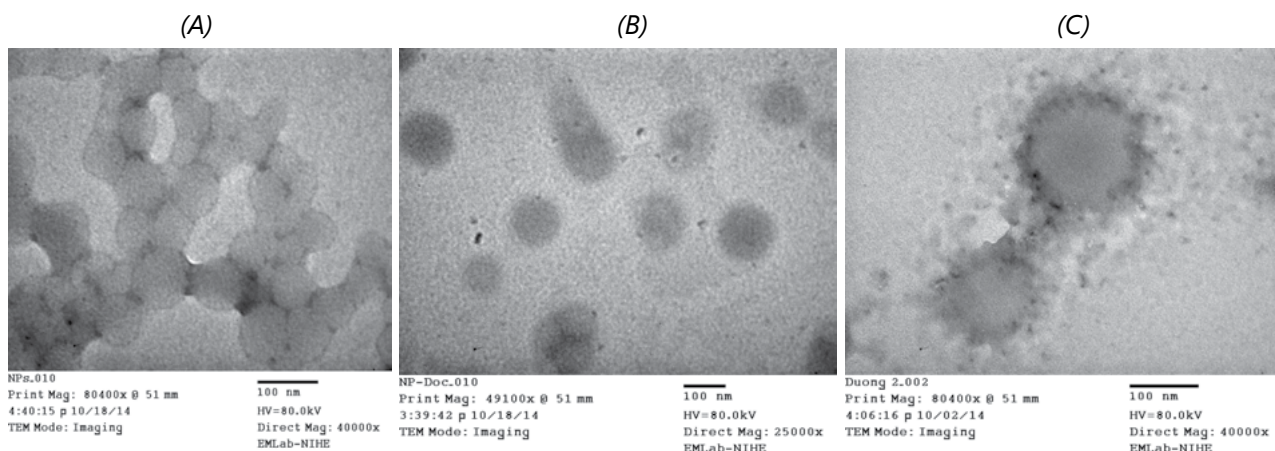
Cancer treatment can be considered as one of the most challenging problems in pharmaceutical science and medicine today. "Chemotherapy" is one of the main treatments used today, but in addition the ability to kill or inhibit cancer cells, this therapy can also cause side effects such as hair loss, lack blood and liver toxicity, kidney toxicity. How to increase treatment efficiency and reduces the side effects of the drug? The researchers have demonstrated that the problem can be solved by constructing nano-scale drug delivery system to target the cancer cells, then drugs only affect cancer cells and does not affect normal cells. To contribute to research in this direction, the PLGA-PEG system carries docetaxel targeting HER2 (scFv-PEG-PLGA-Doc/nanoparticle formulations) had been constructed. HER2 is a cell proliferation factor but overexpressed on the surface of some types of cancer, such as breast cancer, gastric cancer, ovarian cancer, colon cancer, lung cancer, cervical cancer et cetera.

Multicellular BT474 and HCT116 tumor spheroids were developed using the hanging

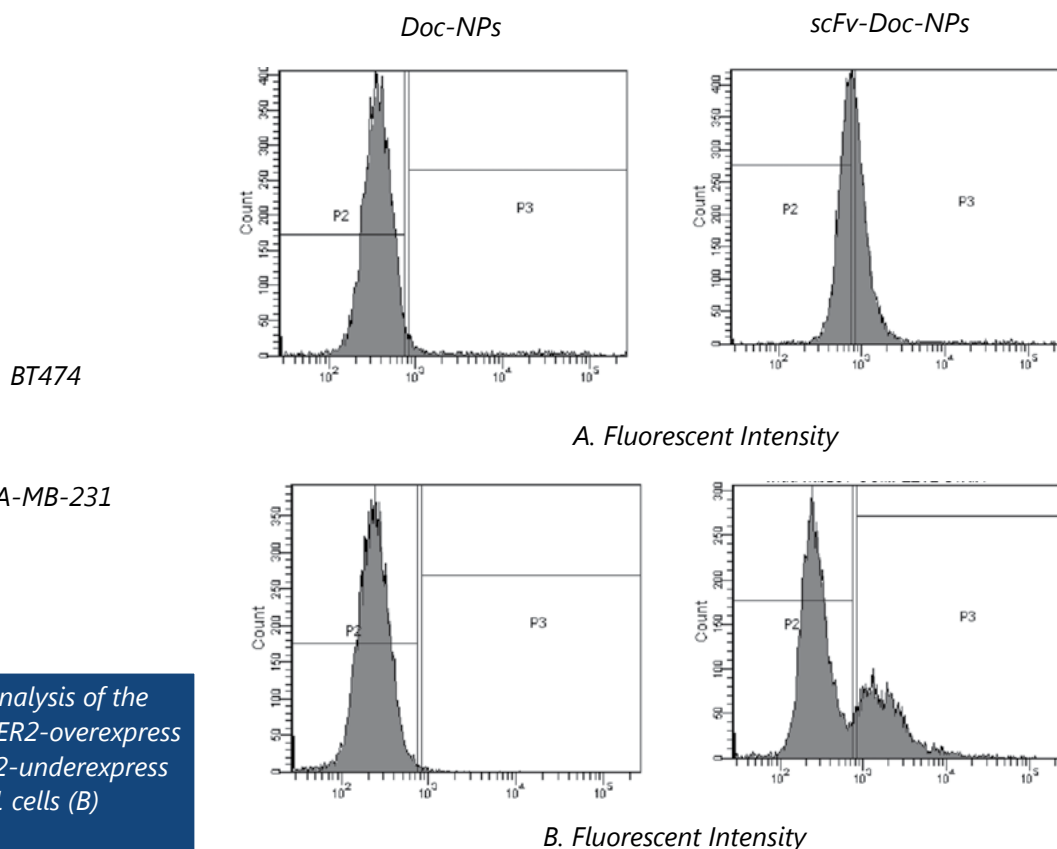
drop method and, consequently, cytotoxicity of nanoparticle formulations have been examined. Permeability and cellular uptake of the nanoparticle formulations in three-dimensional BT474 spheroids were evaluated at various intervals using confocal fluorescence scanning microscopy.

As shown in Figure 1, the monoclonal antibody targeted nanoparticles were larger at 135 ± 9 nm. Transmission electron microscopy showed that the nanoparticles and targeted nanoparticles were spherical and rather homogeneous in size. The zeta potential of the nanoparticles and scFv ligand-targeted nanoparticles was -24 ± 0.3 mV and -32 ± 1 mV, respectively. The encapsulation efficiency in this study is 83%.

The binding ability of scFv-Doc-PLGA-PEG to the HER2-overexpressing cells were evaluated by flow cytometric analysis of HER2-overexpressing cells - BT474 and HER2 underexpressing cells - MDA-MB-231. The results (Figure 2) demonstrated that scFv-Doc-NPS has a stronger binding affinity on BT474 cell lines than MDA-MB-231 cell lines.



TEM images of the PLGA-PEG (A), Doc-PLGA-PEG (B), scFv-Doc-PLGA-PEG (C) nanoparticles.



Flow cytometric analysis of the binding activity of HER2-overexpress BT474 (A) and HER2-underexpress MDA-MB-231 cells (B)

Evaluation of nanoparticles on 3D model - Spheroid had shown that docetaxel loaded PLGA-PEG nanoparticles combined with scFv molecules has improved the permeability, inhibition of receptor HER2, and cell cytotoxicity in experimental models of 2D and 3D on HER2 overexpressing cells. Thus, these promising cancer drug delivery systems should be continued for further preclinical tests in vivo in development of derivatives in cancer treatment.

Whole genome sequencing of Vietnamese heterotrophic marine microalga *Schizochytrium mangrovei* PQ6.

The heterotrophic marine microalga *Schizochytrium mangrovei* PQ6, which was isolated in 2006-2008 at Phu Quoc Island, Kien Giang province, synthesizes large amounts of polyunsaturated fatty acids (PUFAs) with possible food and fuel applications. Therefore, the project "Genome Sequencing of heterotrophic marine microalga *Schizochytrium mangrovei* PQ6 of Vietnam" was carried out basing on state of the art facilities including three phases: Characterizing biological pathway synthesizing lipid and fatty acid; studying and applying next generation sequencing; studying bioinformatics

to assembly, predict and annotating the genome and transcriptome of PQ6.

In order to determine key enzymes and regulators of fatty acid and lipid metabolism in *S. mangrovei* PQ6, samples were collected at the lag phase (1st day), logarithmic phase (3rd day), and stationary phase (5th day) in cultivation. The cell growth, total lipid contents, and DHA contents of this strain rapidly increased on day 1 in cultivation and reached their maximum levels on day 5. The total lipid contents in cultivation were $20.89 \pm 2.38\%$, $28.45 \pm 1.33\%$, and $33.20 \pm 1.25\%$ of DCW on days

■ PRIORITY DIRECTIONS IN SCIENTIFIC RESEARCH AND TECHNOLOGY DEVELOPMENT

1, 3, and 5, respectively, and decreased to $29.65 \pm 1.47\%$ of DCW on days 6. The DHA content increased 2.56-fold (123.15 mg/g DCW) and 2.83-fold (135.91 mg/g DCW) on days 3 and 5, respectively, compared to that on day 1 (48.07 mg/g DCW).

After quality controlling, 51767972 (95.5%) reads were assembled into 7710 and 7181 de novo contigs by using Velvet and Edena, respectively. The N50 index was 47528 in Velvet and 35414 in Edena. The longest contig produced by Velvet was 193.6 kb while the one produced by Edena was 189.4 kb. Estimated genome size by Velvet and Edena were 60.1 Mb and 60.9 Mb, respectively. After merging two sets of contig, the final genome size was reduced to 59.29 Mb with 2601 contigs; the longest contigs was 320.5 kb.

Total genes predicted by two methods of ad initio and evidence-based were 4,128. The genes similar with the NCBI NR database were 3,970, in which 2,383 genes were categorized in Gene Ontology. The genes were held against the KEGG database, leading to the discovery of 16 genes associated to fatty acid biosynthesis. The result is consistent with our transcriptomic analysis of *S. mangrovei* PQ6. We also estimated the genome size of mitochondria in PQ6 was about 31 kb, consisting of 40 genes. The complete database of the draft genome of PQ6

is in construction and the gen browser could be found at <http://pq6.ibt.ac.vn> (password required).

Extracted mRNA of *S. mangrovei* PQ6 from day 1, day 3 and day 5 were sequenced and assembled. 30782 unigenes were predicted before being annotated with BLAST+. Afterwards, the function annotation and gene expression analysis were carried out. 9101 (29.57%) could be annotated with BLAST+ hit information. The function annotation of PQ6 indicated that 3082 unigenes were in biological processes, 3585 unigenes were in molecular functions and 1848 unigenes were cellular components. The gene expression analysis has identified 1007 unigenes with distinguished expression for each growth and development stage. The key enzymes participated in 3 metabolism pathways for PUFAs fatty acid biosynthesis had been also discovered.

This study has not only shown details about the genome and transcriptome of *S. mangrovei* PQ6 but, in addition, has provided tools for in-depth analysis into their molecular biology. More importantly, bioinformatic tools have been applied skillfully and effectively to achieve significant results. Bioinformatic approaches will have significant contribution in the near future when the next generation sequencing is more accurate and more affordable.

The software visualizing components and genomic functions of the heterotrophic microalgae *hizochytriummangrovei* PQ6



MATERIALS SCIENCE

**Prof. Acad. Nguyen Van Hieu,
Chairman of the Scientific Council**

Special metallic materials

In this field, the key achievement was the successful application of a hot isostatic pressing technique for the development and production of metal-based composites oriented towards applications in the civil and defense industries. The successfully fabricated WC-Co alloys are characterized by high hardness and high fracture toughness. These alloys have been used for the fabrication of rock drill bits and field tests show

that the lifespan of tested rock drills were the same in comparison of those that are produced by the developed countries. In addition, WC-Ni hard alloys have been fabricated by using a hot isostatic pressing technique. These alloys have been used for production of kinetic projector of anti-tank weapons.

The WC-Co and WC-Ni hard alloys with high hardness, high fracture toughness are used for fabrication of rock drill bits and the kinetic project of anti-tank weapon



Carbon nanostructure materials

- CNTs nanofluids for heat dissipation in high power electronic devices were successfully fabricated. Experimental results for computer processors (Intel Pentium IV, Intel Corei5) and high power LED (450 W LED floodlight, 100 W LED street light) showed that the temperature of the electronic components decreased about 3-5oC. We have submitted 01 patent application at the National Office of Intellectual

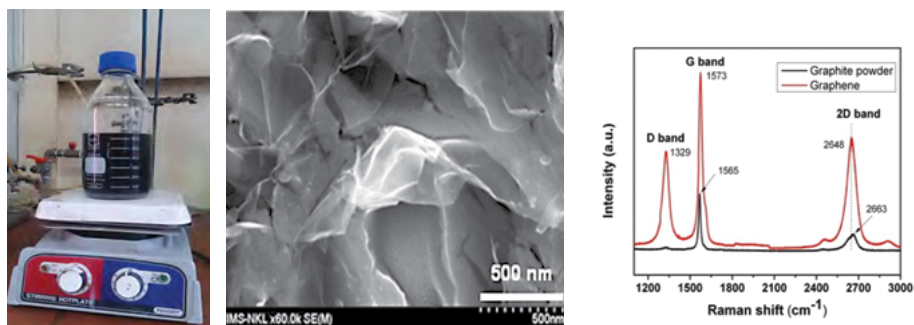
Property of Vietnam, and continue perfecting 01 patent application and 01 useful solutions for license of invention in 2016.

- Successfully fabricated graphene films with one to multiple layer thickness on copper substrates have been achieved by CVD methods. Some applications based on this graphene film are relevant to electrochemistry and field effect sensors to detect the amount of glucose, cholesterol, atrazine among others.



The 100W LED streetlight using CNTs nanofluid for heat dissipation

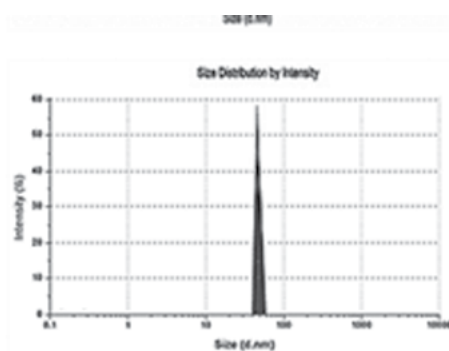
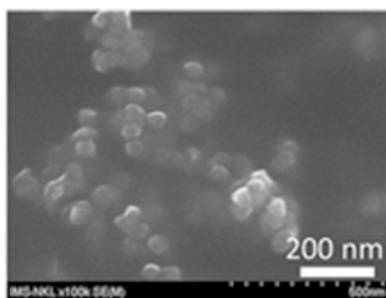
- Successfully fabricated graphene and graphite oxide materials have been achieved by plasma-assisted electrochemical exfoliation methods.



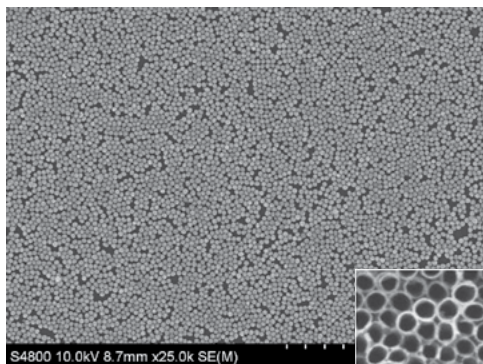
(a) Image of graphene powder well dispersed in water, (b) SEM image and (c) Raman spectra of graphene powder.

Drug delivery

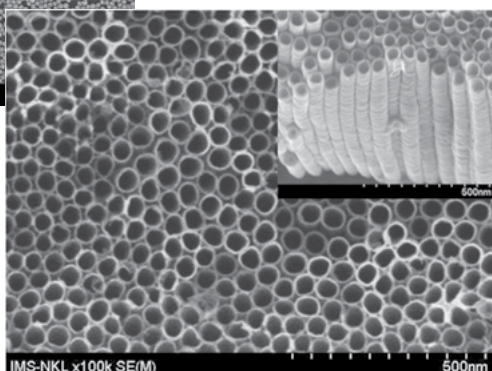
- Setting up a process of preparing Drug delivery nanosystems (DDNSs) based on biocompatible and biodegradable polymer as the carrier and Curcumin and Paclitaxel loaded Fe₃O₄ NPs as the core for the goal of diagnosis and treatment of cancer. These DDNSs were biologically tested to evaluate their ability of fluorescence labeling, improving the Magnetic Resonance Imaging (MRI) contrast and killing cancer cells by chemotherapy or hyperthermia. The results show that these DDNSs can effectively facilitate uptake into the tumor spheroids.



FESEM images of (Curcumin+Paclitaxel) NPs. NPs were spherical, small and homogeneous in size, which were about 15 – 20 NM



SEM images of SiO₂ balls and TiO₂ nanotubes



- Successfully fabricated the surface enhancement Raman scattering (SERS) substrates based on Au(Ag) NPs two-dimensional arrays which are constructed of uniform-size Au(Ag) NP with regular inter-particle gaps by using different templates (TiO₂ nanotubes, SiO₂ balls,...) and studied their surface enhancement Raman scattering effects. These SERS substrates are used to fabricate biosensors for detecting serious diseases.

Quantum dots (QDs)

Successfully synthesized highly luminescent core/shell QDs of II-VI semiconductor with various structures (such as type-I and type-II quantum structures) are studied for its luminescent mechanisms as well as the role/

contribution of photons in optical transitions in these QDs for applications such as bio-medical fluorescent labels and as light-emitters/absorbers in advanced opto-electronic devices, including the solar cell and light emitting devices,...).

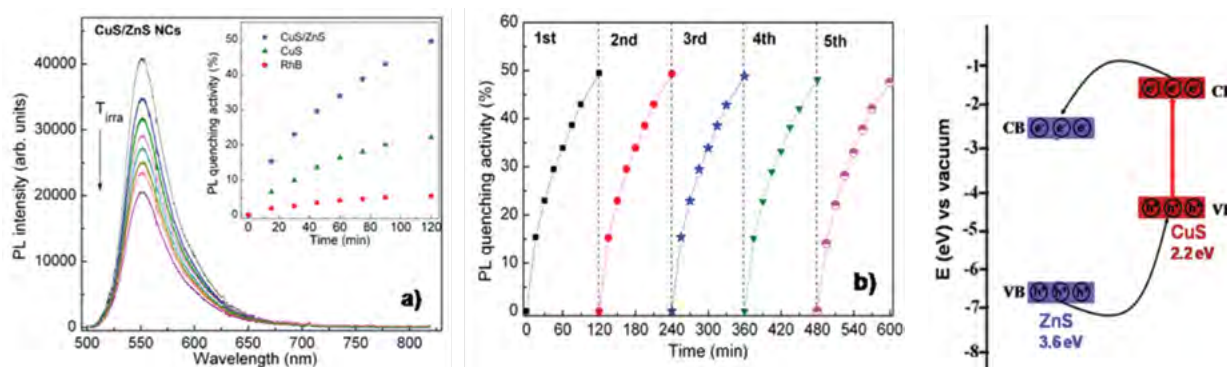


Photograph of CdSe/ZnS QDs in n-hexane (a); CdTe/CdS QDs in water (b); InP/ZnS QDs in n-hexane; and CuInS₂/ZnS QDs in n-hexane (d).

Photocatalytic materials

• Scientists of the Vietnam Academy of Science and Technology have developed the appropriate/reasonable technologies to synthesize the photocatalysts based on copper compounds (such as CuS(Se), Cu₂O, CuO and CuS(Se)/ZnS; CuO/TiO₂, CuO/ZnO core/shell)

and have studied the optoelectronic processes as well as the dynamics of the photocatalytic reaction for pollutant treatment and H₂ production applications. Currently, the stages of synthesis and study of potential applications of transition metal sulfide or selenide (MS(Se)_x with M = Mo, W) for converting energy are initiated.



a) PL spectra of RhB aqueous solution in presence of CuS/ZnS core/shell photocatalysts under visible light irradiation. Inset shows the comparison of photocatalytic activities of CuS and CuS/ZnS core/shell NCs for the photocatalytic decolorization of RhB at different irradiation times; b) Recycling of CuS/ZnS core/shell NCs in photocatalytic degradation of RhB.

PEMFC fuel cell

Completed the synthesis process of catalysts Pt/C having high catalytic activity and durability for PEMFC. Synthesized catalytic materials Pt/C with Pt content of 20% wt. have a particle size of 2-3 nm of which an evenly distributed surface of carbon and electrochemical materials attained an ESA of 120m²/ g Pt.

- Successfully synthesized alloy catalytic materials PtNi/C. The Pt1Ni1/C catalyst material has a particle size of about 4-8nm and are highly suitable for oxygen reduction reactions in PEMFC.

- Fabricated and evaluated the MEA membrane electrode properties with catalytic materials Pt/C 20% wt, the results indicate that the maximum power density reached is approximately 640mW/ cm². Designed, manufactured, assembled, and tested a PEMFC stack with power ~ 20W.



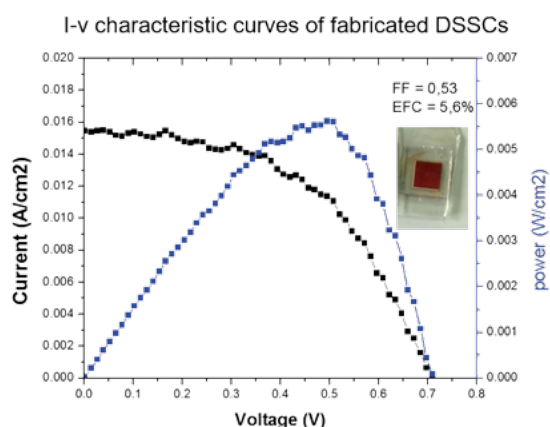
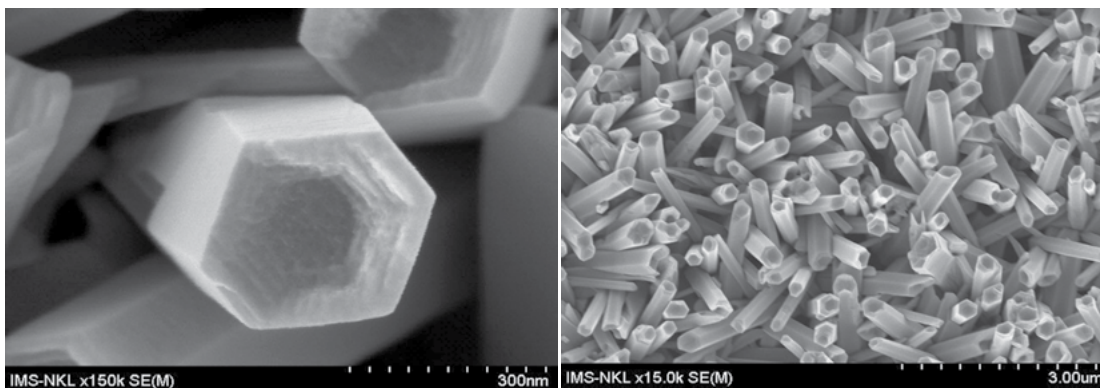
PEMFC stack, power ~ 20W

Solar cells based on nanostructure metal oxide semiconductor compounds

Scientists of the Vietnam Academy of Science and Technology have investigated and developed various methods, for example vacuum evaporation, electrochemical and hydrothermal techniques, to

produce TiO₂, ZnO nanostructure thin films with different morphologies (such as nanoparticle, nanowire and nanotube forms) on transparent conductive substrates including FTO, ITO and PET. Applications can prove fruitful for the fabrication of nanostructure solar cells and other components.

SEM images of ZnO nano rods film synthesized by hydrothermal method



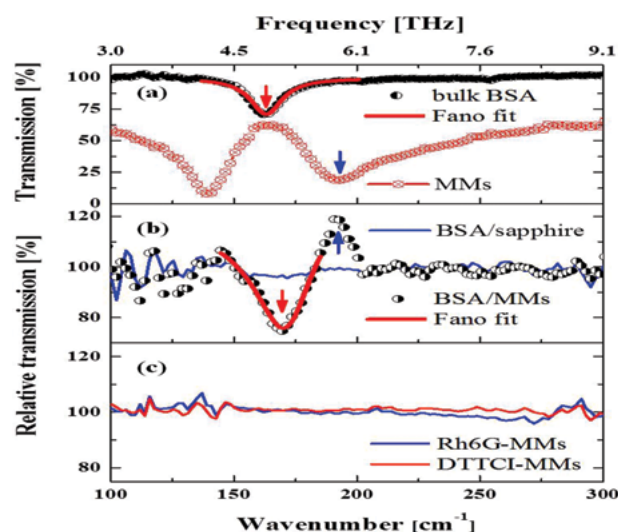
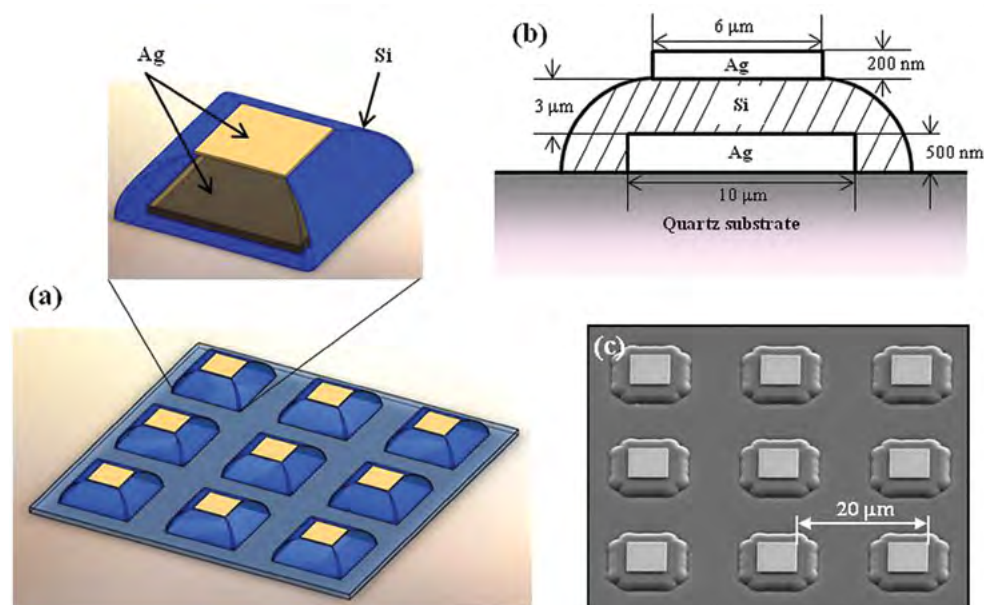
- By using the vacuum deposition technique combined with thermal treatment, gold nanoparticles dispersed on TiO₂ nanostructure thin films as well as other substrates have been successfully synthesized. The properties of the plasmonic effect in these materials have been investigated and applied for making plasmonic solar cells and improving the photocatalytic properties of nanostructure materials TiO₂, ZnO.

Metamaterials

Systematically constructed fabrication technology of negative refractive index and perfect absorption ($A \sim 100\%$) metamaterials (MMs) with symmetric structure and various operating bandwidths from MHz to THz for application purposes in antenna. The

fabrication process is highly stable and repeatable.

Successfully designed and fabricated MMs working at THz frequencies. The application purpose in biological sensor fabrication has been studied recently on bovine serum albumin (BSA) and received a high sensitivity device.



Fabricated MMs sample working at THz frequencies for application in bio-sensor

Magnetic materials

Structure, magnetic properties and magnetic-cooling effect of Heusler alloys (Ni-Mn-Sn, Ni-Co-Mn-Al...) and rapidly quenched alloys (La-Fe-Co-Si, Pr-Nd-Fe...) were investigated. The structural transformation, magnetic phase transitions and magnetic properties are very sensitive to composition (concentration of Sn, Mn, Co, Si...) and fabrication conditions (quenching rate, annealing conditions...). The alloys with high refrigerant capacity $RC > 80 \text{ J.kg}^{-1}$ (in magnetic field change $\Delta H = 1.2 \text{ T}$) have been fabricated. The magnetic-cooling effect of some alloys was tested. The obtained results show the applicability of these alloy systems in magnetic refrigeration technology.

Materials applied in radiation dosimetry

Studies of materials such as: K₂GdF₅ and K₂YF₅ doped with Dy, Pr, Sm, Tb rare earths and the process of screening a material K₂GdF₅ doped with Tb ion, which can be used for radiation dosimetry and especially the neutron dosimeter. This material has thermoluminescent characteristics such as: high luminescence intensity, appropriate peak temperature, and good absorption of radiation doses. It can be applied in radiation dosimetry. These are the new materials fabricated by the solid state reaction methods. This technology can produce large amounts with relatively low-cost dosimeter comparable to the ones currently available in Vietnam.



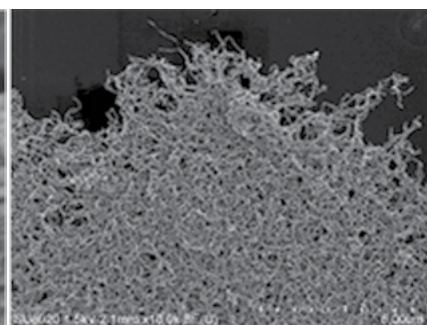
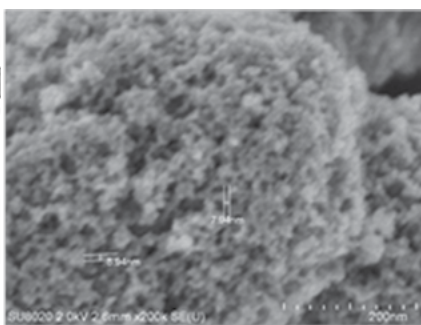
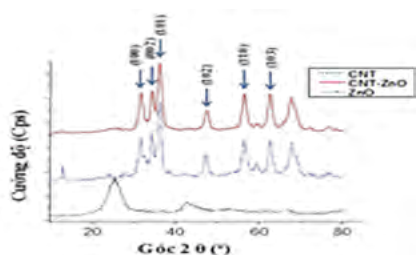
CNTs of application in protective coatings preparation

• Reparation of weather durability and solar reflective insulation waterborne coating systems: The effect of the pigments (TiO₂, Fe₂O₃) and IR reflecting particles (hollow ceramic microspheres (VCR), calcium silicate) to the solar reflecting properties of coating materials has been studied. The IR reflectivity of the coatings (in the range from 750 to 1400 nm) was > 84%. After 1200 hours of accelerated weathering tests under conditions of 08 hrs UV irradiation at 60°C following by 04 hrs of water condensation at 50°C, the appearance of the coating had not changed significantly, its IR reflectivity (in the range from 750 -1400 nm) remained at a high level (> 84%). The exterior surface temperature of concrete coated with

the solar reflective coating system was on average 9 degrees lower in comparison to an uncoated concrete surface.

• Research and manufacture of a coating system using modified carbon nanotubes combined with nano-additives, applied for protection of structural steel used in marine atmospheric environments.

The nanocomposites CNT/ZnO were prepared by deposited nano-particles ZnO on CNT. The performance of the reaction to form ZnO is about 74-77%. The ZnO particle size is about 8–9 NM. The ZnO has a wurtzite crystal structure. Initial results show that CNT/ZnO is well dispersed in the polymer coatings (not clustered), thereby improving the mechanical, anti-corrosion properties and UV resistance. Incorporation of 1% CNT in zinc-rich coating increases the mechanical and anti-corrosion properties.



X-ray diffraction of CNT, ZnO and CNT/ZnO

SEM images of ZnO nanoparticles

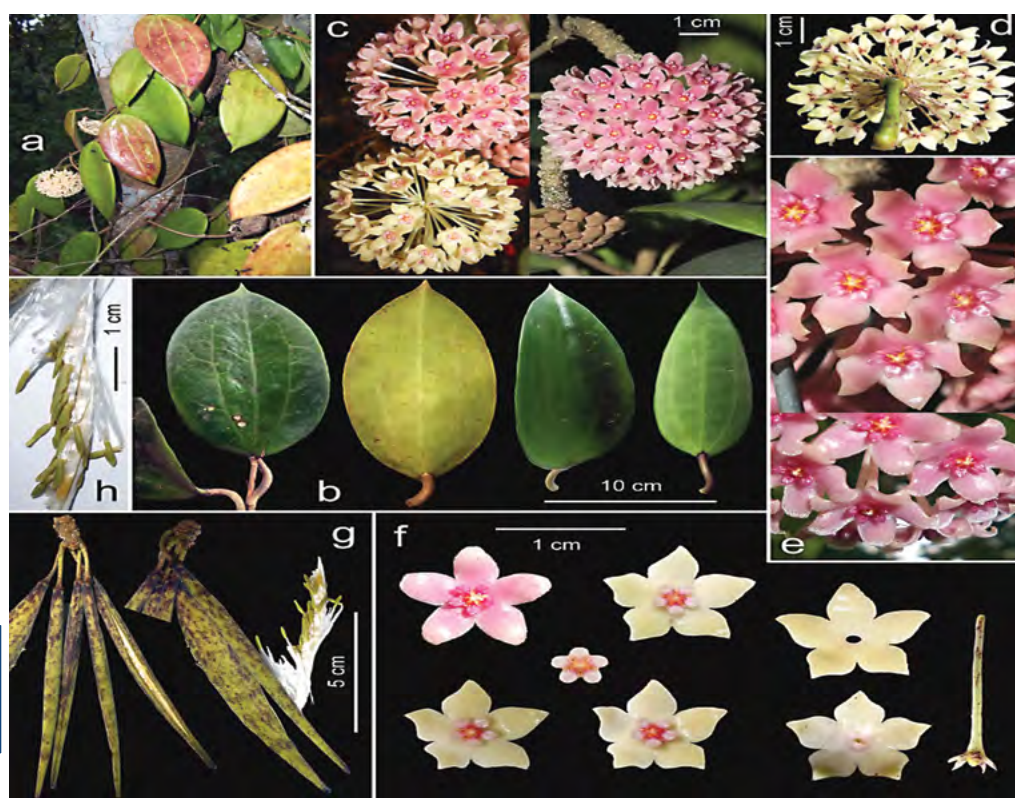
SEM images of CNT/ZnO nanoparticles

BIODIVERSITY AND BIOLOGICAL ACTIVE SUBSTANCES

Prof. Dr. Sc. Tran Van Sung
Vice-Chairman of the Scientific Council

Research highlight in 2015

The botanists of the VAST have discovered and published 13 new high plant species for the world plant kingdom and 7 new species for Vietnam flora; 50 new animal species for the world and 24 new species for Vietnam (the IEBR).



(Hoya hanhiae V.T.Pham et Aver) – new species for the world

(Binthuanomon vinhtan) – new species for the world



Two new snake species



Parafimbrios gen.nov.
(photo Patrick David)



Isanophis gen. nov.
(photo Alexandre Teynié)

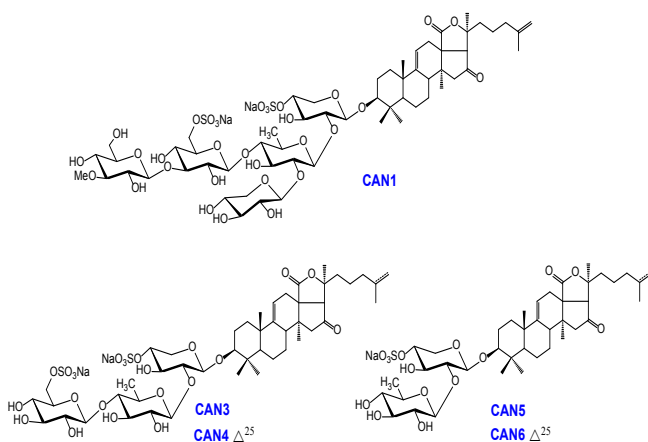
The project team TN3/T09 investigating the biodiversity in the genuational Garden Bidoup – Nui Ba has discovered and published regarding one new plant genus and 5 new plant species for the world and 4 new plant species for Vietnamese flora. Furthermore, one mushroom (Năm lỗ Drewes: *Phallus drewesia* Desgardin et B.a.Perry) has been registered as a new one for Vietnam and Asia (Institute of South Vietnam Ecology).

The IEBR had 96 SCI/SCI- E listed publications.

The institute of marine biochemistry has isolated 49 new compounds with steroide, biscembranoide, diterpenoide, sesquiterpenoide, holothurine, asterosaponine, polyhydroxysteroid glucoside skeletons. The institute issued the functional food product Linstata from the extract of marine stars and Linh chi mushroom. They have published 60 articles in the SCI/SCI – E list and have registered 02 patents.



Functional Linstata



New isolated compounds from *Cercodemas anceps*

The institute of natural product chemistry submitted 2 functional food products: VEDA-K+ for enhancement of the body health and resistance from fatty acids, lipids of corals;

BIOGLUCUMIN derived from mushroom for supporting the treatment of cancer patients. This product received the price of the International Techmart 2015 in Vietnam.



Functional food
VEDA-K+

BIOGLUCUMIN
Techmart certificate
Vietnam 2015 of MOST



EARTH SCIENCES

Assoc. Prof. Dr. Sc. Tran Trong Hoa
Chairman of the Scientific Council

General information

The 2015 scientific report of the Earth Science includes achievements in geological science and technology that have been acquired by the Institute of Geological Sciences (IGS), the Institute of Geography (IG), the Institute of Geophysics (IGP), the Institute of Resources Geography in Ho Chi Minh City (HCM-IRG), and by other institutions within the Vietnam Academy of Science and Technology (VAST).

Science and Technology Projects

In 2015, the above listed Institutes completed 30 State-level science-technology projects, including 05 independent, 01 international collaboration under the protocol, 15 from Key Science and Technology Programs (e.g. 04 of KC08 and 08 of TN3) and 05 funded by the National Foundation of Science and Technology Development (NAFOSTED), including 02 instant-duty projects, 02 of fundamental investigation and 01 of the Environmental Protection Program.

Also completed are 07 VAST-assigned projects/duties, which include 01 geoscience prioritized project, 04 independent young-researcher projects, 02 VAST-President assigned projects, and 03 duties conducted under collaboration with central or provincial authorities.

The Geoscientists have also completed 57 basic research topics, 29 young-researcher support projects and a number of science-technology contracts.

In the year of 2015, the geoscience block continued to carry out 15 national science and technology projects, among these 02 are independent, 03 are Key Science & Technology Programs (TN3 and Space), 09 are funded by NAFOSTED (fundamental research, application oriented, instant duty), and 01 is of basic investigation. Ongoing VAST-funded projects include 01 key duty, 09 belonged to 07-prioritized orientations, 02 young-research independent tasks, 04 international collaborative projects and 02 VAST-president assigned duties. Besides, a number of science-technology contracts that have been implemented are expected to complete in 2016.

Publications:

In 2015, 118 research articles were published by the four Geo-Institutes, including 24 in SCI and SCIE journals, 19 in international ISSN journals, the rest were published in VAST-based journals and others. Four monographs were printed, including one by Springer Publishing. A number of papers submitted to domestic and international workshop/conferences were published elsewhere.

International Collaboration:

During the past year, Agreements on International Scientific Collaboration were signed and implemented with the (Japan) Space Environment Group, the National Institute of Information and Communications Technology (NICT) on land survey and staff training; the University of Kyushu (Space Environment Research Center) for study of the association of sun atmosphere – magnetic atmosphere – ionosphere – (earth) atmosphere by monitoring global Sq flow systems; with the University of Nagoya to study historic floods recorded in basin sediments elsewhere in Vietnam in order to mitigate flooding hazards in southeast Asia; with the Institute of Earth Sciences, Academia Sinica (Taiwan) to study earthquakes and crustal structure in northern Vietnam; with the Institute of Theory of earthquake predictions and geophysical mathematics, Russian Academy of Sciences (RAS) to study earthquake and earthquake hazard prediction; with the Institute of Geology and Geophysics (RAS, Siberian branch) for study of precious metals (such as gold, indium) in NE Vietnam. In addition, a number of Memoranda of understanding on science and technology collaboration with many foreign universities were signed.

The pronounced achievements:

Basic research in geosciences:

NAFOSTED- funded fundamental research projects have achieved new age and compositional results of Permian – Triassic and Cenozoic magmatic formations in northern, central and western highland regions as well as along the coastline terrains. These achievements contribute to essential information for the correction, revision and publication of Vietnam geological map at 1:1000,000 scale (inland and sea) supervised by the Vietnam General Department of Geology and Minerals. The results have been promptly reported in several ISI journals and updated in Springer monograph ‘Intraplate magmatism and Metallogeny in North Vietnam’.

Scientific research and technology-based research for natural hazard prevention and mitigation:

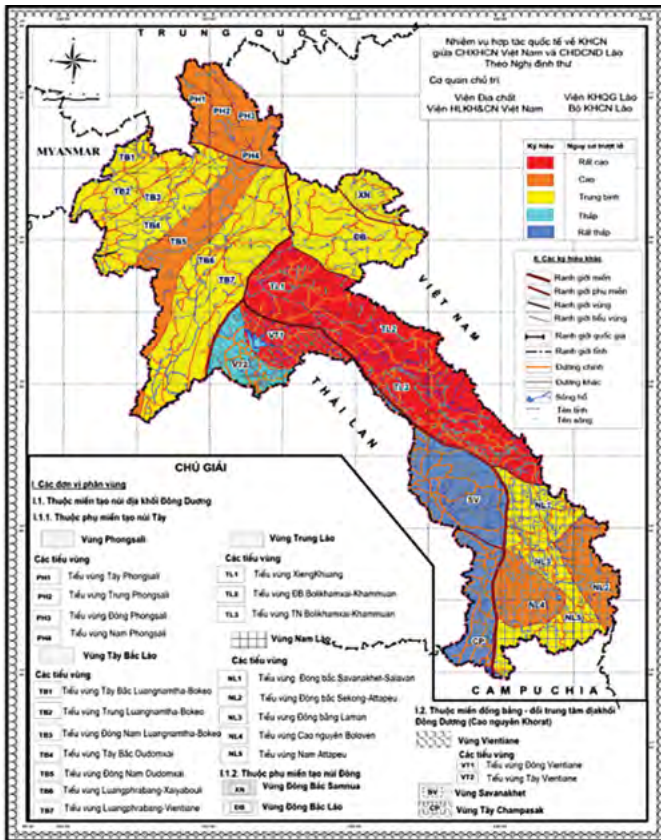
The following achievements have been obtained:

- Maps of hazard types (typhoon, drought, flood, landslide, flash flood, mud-flood, coastline erosion, earthquakes) frequently occurring in inland Vietnam; the completion of a synthetic map of natural hazard warnings and a map of hazard distribution and classification of Vietnam, which will subsequently be published as atlas at scale of 1:1000,000 (Fig. 1) and 1:3000,000, both in hard-copy and digital online forms. The data are open for updates (map upgrades), easy to use, and aim to serve hazard management instantly as well as and support land-use management for both local and central decision-making administrations. The above achievements are acquired from the project of ‘additional research, construction and publication of 2000-to-present natural hazard maps of Vietnam’ (Proj. KC08./11-15).
- A set of environmental hazard maps of Laos People’s Democratic Republic in 1:1000,000 scale summarizing the basic characteristics, rules of occurrence and development of major natural hazards reported with accompanying supportive database and mitigation measures. The results are viewed as important science-technology basics to support land use management and hazard prevention for the socio-economic

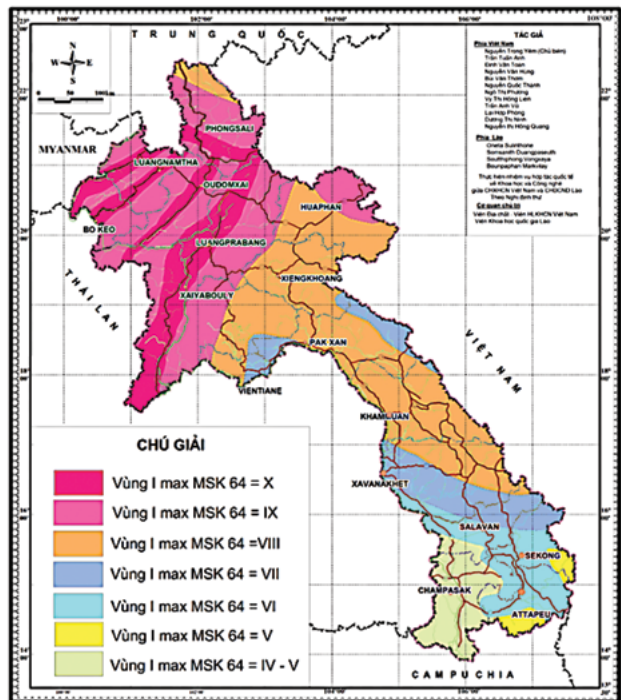
■ PRIORITY DIRECTIONS IN SCIENTIFIC RESEARCH AND TECHNOLOGY DEVELOPMENT

development of Laos PDR. The project has also helped to train 04 geoscientists to serve as core researchers at the Institute of Earth Sciences under the Ministry of Science and Technology of Laos to serve as experts in the field of basic geosciences, hazard management

in general, and earthquake and landslide disasters in particular. This was an international collaboration under the protocol between Laos PDR and Vietnam supervised by Prof. Nguyen Trong Yem.



A set of environmental hazard maps of Laos people's Democratic Republic in 1:1000,000 scale



Research on enhancing capacity of rational use of natural resources

- Discovery and determination of a new type of potential nano- and micro-sized gold-sulfide mineralization disseminated in an arsenopyrite and pyrite ore in northwestern mountainous provinces: (i) Au-As in coal-bearing sediments and silicic volcanic associations; (ii) Au-As-Sb in mafic intrusive magmas. Aside from the industrial perspective evaluation of these ore types, an ore mining, gold-extraction

technology has been developed for practical application.

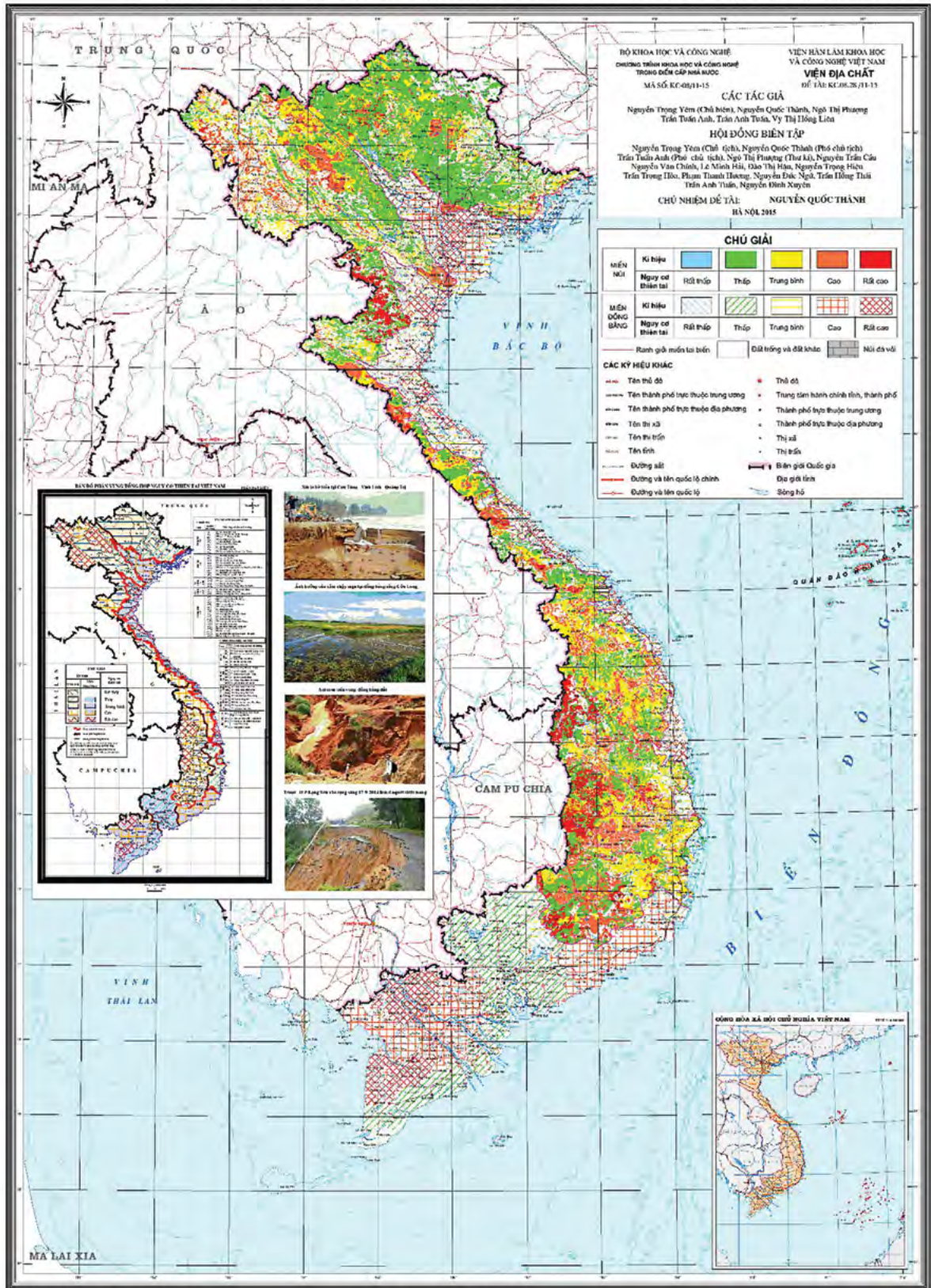
- Implementation and determination of physical parameters of Bang geo-thermal basin (Quang Binh province) as a thermal resource providing foundation for planning of exploitation and effective use this clean energy. A ground thermal monitoring apparatus was successfully installed and an air conditioning system using ground thermal pumping techniques was also applied.

- Map of potential solar energy of Vietnam based on satellite data as a result of international collaboration between the Institute of Geophysics and the University of Silparkorm (Thailand). The map of the potential solar energy distribution in Vietnam was constructed based on satellite digital cloud images acquired by MTSAT at space resolution of 3x3 km. The map may be used in planning and development of nation-wide solar radiation energy.
- The discovery and preliminary estimation of 'black sand' (ilmenite-bearing) resources in the coastline area of Tra Vinh province and the proposal on mining and exploitation; the research revealed distribution regulation, concentration, quality and reservoir of ilmenite-bearing sand at 08 important sites along Tra Vinh's coastline. The findings serve as a scientific basis for coastline resource and environment management and protection. The findings also illustrate important contributions of applied geomorphology- sedimentation that have recently been developed at the Institute of Resources Geography in Ho Chi Minh City. This project was PI by Dr. Nguyen Van Lap.

Technology development in natural resource study

- The Global Positioning System (GPS) on Android mobile devices like smartphones or tablets has been applied successfully in checking the quality of forest survey and inventory data in 25 provinces under the General forest survey and inventory project of Vietnam for the period 2012 – 2016. Maps of forest status and management have been transformed from the VN2000 coordinate system to the WGS84 UTM and converted to format mbtiles and later transferred to mobile devices. Tracking software Locus has been used in Offline mode with GPS on. System setup by that way has been used in fieldwork to check accuracy of forest status and coincidence between management attributes of forest parcel and field. This new technology has been used in all survey groups at the same time in the field. Way points and information about checked forest parcels are updated online to support monitoring capabilities of the headquarter - located within the Institute of Geography – to track the progress of fieldworks. This technology is helpful to detect errors in forest mapping and to timely inform the surveying group to check, correct and/or update results.
- An algorithm of automated classification of land cover by the Landsat 8 OLI data has been successfully developed. This algorithm is based on the decomposition of multispectral satellite imagery to components of the same simplified spectral patterns (SSP). Land cover types associated with SSP are consistent in both time and space. A database of SSP has been developed by visual interpretation and used further for automated classification. A land cover map of Vietnam has been developed using this algorithm. 33 Landsat 8 OLI scenes collected during 2013 and 2014 were used as input data for land cover mapping. The legend of the land cover map consists of 7 classes; water, wetlands, forest, shrublands, grasslands, developed land and barren lands. This is the first time a detailed land cover map of Vietnam has been developed in such detail and spatial extent. Although the work is still in its preliminary phase, it points out a new direction of application of multi-temporal and multi-spectral satellite image data to monitor the environment and natural resources of entire Vietnam, not only in macro scale but in scale 1:100,000 as well.

BẢN ĐỒ TỔNG HỢP CẢNH BÁO NGUY CƠ THIÊN TAI VIỆT NAM PHẦN ĐẤT LIỀN



The General Natural Hazard Map of Vietnam

MARINE SCIENCES AND TECHNOLOGY

Assoc. Prof. Dr. Sc. Nguyen Van Cu
Chairman of the Scientific Council

In 2015, scientists of the Vietnam Academy of Science and Technology (VAST) have completed six State Projects under the program “Research on Science and Technology for marine-islands management and marine economic development”. The projects implemented by specialized institutes under the management of VAST have successfully completed tasks on time with high quality.

In addition to, VAST also hosted four international cooperation projects under the Vietnam-US protocol and a protocol mission with China.

In 2015, Scientific Council on Marine Science and Technology has assessed the study results of five VAST’s projects. The completed projects have achieved their objectives with products that have high scientific and practical value. Here are some of the outstanding results:

- A map of the Tectonic Structure and the Geodynamics of the East Vietnam Sea and adjacent area, scale 1:1,000,000, has been established with basic content regarding geological structures and the evolutionary history of the East Vietnam Sea in the Cenozoic. This map is highly relevant for mineral deposits and national security.
- A map of the Tectonic Structure and the Geodynamics of the Northern Tonkin Gulf region, scale 1:500,000, which has identified 8 major structural units in the North of Tonkin Gulf region, including: two structural floor units in Paleogene structure, two structural floor units in Mesozoic structure and four units in Cenozoic structure; and has identified six tectonic phases in this region. This is an important basis for preliminary investigation, exploration and evaluation of geological – mineral resources,

geo-hazard predictions, decision-making support for planning and sustainable use of resources and environmental protection in this study area.

- For the first time, a profile of 50 off-coast islands (with area > 1 sq. km) located in the Tonkin Bay have been mapped in terms of position, resources and natural and social-economic conditions. The newly updated data and information content is meaningful for marine economic development and the protection of national sovereignty.
- Based on the study results of the Quaternary sedimentary evolution at Tuy Hoa – Nha Trang coastal zone in corresponding to periods of climate change and sea level fluctuation, the Project has evaluated the evolutionary trend of geomorphology and sedimentation associated with recent climate and sea level changes. The project contributes to re-establishing a sedimentational evolutionary history in this area corresponding to glacial and interglacial periods in the Quaternary.
- The Project of Research on biological characteristics of some symbiotic bacteria on a sponge in the marine area of Hai Van – Son Cha (Thua Thien Hue Province) has collected 34 sea sponge samples and isolated 9600 sticky bacteria strains, 9960 symbiotic bacteria strains, 360 actinomycetes and 940 sticky symbiotic actinomycetes, 1710 sticky fungi strains and 1462 strains of symbiotic.... The biochemical properties and format of selected micro-organisms have been studied.
- The Project of artificial propagation and cultivation experiments of a number of seaweeds (Sargassum) in coastal regions has been

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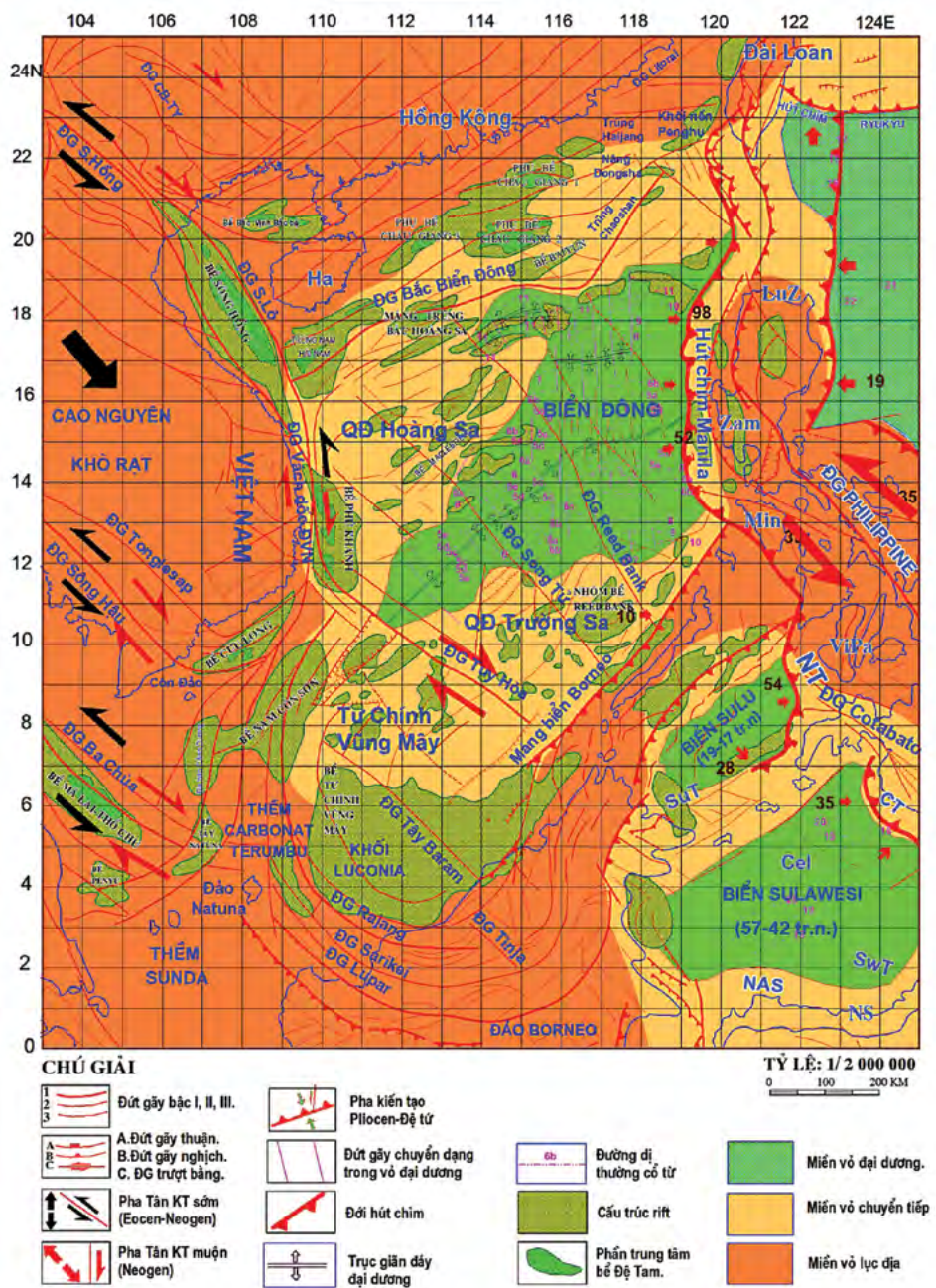
completed. Phases of the project include the procedure of Sargassum cultivating, from the propagation procedure by zygote to cultivation and finally the harvest of biomass in the sea. The study has registered patents, utility solutions: "Sargassum propagation procedure by zygote".

Under the leadership and assistance of VAST, the Scientific Council on Marine Science and Technology has successfully organized a scientific conference to mark the 40th anniversary of the establishment of VAST.

Subcommittee on Marine Science and Technology has attracted a large number of scientists in and outside VAST. The subcommittee was divided into three groups: Marine Geology and Mineral Resources; Biology and Biotechnology; and Oceanography and Marine Environment. The Subcommittee has a total of 107 scientific reports, including 29 reports of marine geology, geophysics and geography, 34 reports of biology, 41 reports of oceanography, marine environmental and management and other issues. Particularly, there are two reports of scientists

from Pacific Oceanological Institute of the Russian Academy of Sciences. In total, 36 good quality reports were selected and submitted to the President of VAST for permission to publish in the Journal of Marine Science and Technology.

In 2016, the field of Marine Science and Technology will implement 06 transition projects from 2015 and 06 projects in the period 2016 to 2017.



Map of Tectonic Structure and Geodynamics of East Vietnam Sea and adjacent area, scale 1:1,000,000 (Constructed at Institute of Marine Geology and Geophysics, 2015).

ENVIRONMENT AND ENERGY

Assoc. Prof. Dr. Vu Duc Loi
Secretary of the Scientific Council

2015 Project Execution and Achievement Report

In 2015, the environment and energy division has carried out 09 projects in which four are transitional and the other five are new openings. The total budget is 2200million VND, 1200million VND for transitional projects and 1000million VND for new ones. All projects were chaired and operated properly according to the plan. The projects focus on the following research areas: waste treatment technologies, wastewater treatment by advanced technologies and materials such as nanotechnology, oxidation combined with bio-reaction on membrane bioreactor (MBR),. This research particularly focuses on the recovery, utilization and re-use of essential elements in wastewater, such as N and P to produce slow release fertilizer.

Research that has been conducted includes a study to design and produce an equipment system combining electro-oxidation with membrane bioreactor (MBR) to treat water sources that are contaminated by pesticides to conform environmental regulation QCVN 40:2011/BTNMT. Some new materials had been studied and produced such as Ag-bentonite composite and Ag-silica which have anti-fungi ability on *Fusarium oxysporium*, *Rhizoctonia solani*, *Colletotrichum* even in low dosage and therefore have potential to be used to minimize the prevalence of pesticides causing environmental pollution. Furthermore, some nanomaterials which have potential to inhibit the growth of microalgae have been produced and selected to provide the scientific foundation for the application of processing flower blossoming in cyanobacteria in fresh water. Additionally, a technological process has been successfully built to recover N (ammonium) and

P (phosphate) in urine as Struvite precipitate to produce slow release fertilizer.

In the field of energy, the projects focus on research of new renewable energy sources and resolving the issues of power transmission. As a result, appropriate technologies and experimental models for stable and high performance of power generation by sea wave energy have been identified. In addition, methods and software to identify the location of underground cable incidents with high accuracy were built in order to reduce power interruption periods as well as operation and repair costs of a medium-voltage grid operator.

The project "Building a model of production and application of useful microbiological products to treat odors in the poultry breeding farms" was executed by the Institute of Environmental Technology which successfully issued the process of using a Sagi Bio-1 microbiological product as poultry bedding material and deployed 02 models using the Sagi Bio-1 microbiological product to treat poultry bedding material for egg laying hens and chicken feed. The results have shown that the product is effective to reduce the stench arising in the barn, NH₃ and H₂S gas concentrations are lower than the levels allowed under QCVN01-15/2010/BNNPTNT, the density of the groups of pathogenic microorganisms such as *E. coli*, *Salmonella* and mold are lower in comparison to the barns which did not apply Sagi Bio-1 from 10²-10⁴ CFU/g.

The project "Research and application of advanced technologies which are suitable for the Vietnamese context to treat the environmental pollution combined with the re-use of waste from pig breeding farms" which was executed by the Institute of Environmental Technology has studied and built a wastewater treatment system according to ABR technology

■ PRIORITY DIRECTIONS IN SCIENTIFIC RESEARCH AND TECHNOLOGY DEVELOPMENT

that can quickly treat COD at pilot level of 30 m³/day. COD treatment efficiency reached 70-80% when the load was 4-4.5 kg COD/m³/day. TSS treatment efficiency was 83% and a fast anaerobic process has been introduced for the treatment of wastewater from pig breeding farms and for the treatment of S, N in biogas.

The project "Research on catalytic cracking processes for new FCC catalyst systems to produce bio-gasoline (Bio-20) from bio-

oil (derived from agro-forestry waste) and residual oil" - which was executed by the Institute of Chemistry - has successfully studied technological processes to manufacture a new cracking catalyst (FCC catalysts modified by HZSM-5). These processes achieve high activity for cracking oil mixtures (20% biodiesel and 80% of Bach Ho oil sludge) to generate a bio-gasoline (Bio-20) which is equivalent to the quality of commercial gasoline.



Microbiological product for treatment of environment in livestock breeding farm Sagi Bio1



Anaerobic treatment system in Green Peace Camp

2016 Project Development Outlook

In 2016, the environment and energy division will carry out 4 new projects, the new opening projects include:

1. VAST07.01/16-17. Research the treatment of landfill leachate by electrochemical flocculation combined with bio-filters.
2. VAST07.02/16-17. Research the treatment of herbicides (Paraquat) and sterilize domestic water in rural and mountain areas by TiO₂ photocatalysts.
3. VAST07.03/16-17. Research the treatment of heavy metal pollution in agricultural soil by plants in lead recycling Dong Mai village, Van Lam district, Hung Yen province.
4. VAST07.04/16-17. Establishment of method and software accessing the reliability of power supply considering the role or renewable energy sources and fuel for the power plants in Vietnam.

RESULTS 2015

According to the planning system of the national government, the year 2015 is the final year of the five year plan (2010-2015), and hence the master plan and major programs which belong to the field of science and technology are scheduled for finalization in 2015. In addition, numerous projects of the Vietnam Academy of Science and Technology (VAST) are conducted in cooperation with local, provincial, ministries and pilot projects, or funded by smaller budgets, are often designed to run over the course of two years. Hence, these projects are not affected strongly by the five year planning periods, with the exception of budget sharing for urgent projects and overlapping themes. The number of projects approved in the year 2015 was significantly higher than in previous years leading to a greater number of works carried out by the Department of Application and Development Technology (DADT) compared to previous years.

Main results of the Department in 2015 are:

Consultancy for the President of the VAST about the Application and the Development of Technology

In 2015, the DADT managed 26 projects cooperated with the local provinces, 09 pilot projects and 03 ordered projects (targeted to finish in 2015 and 2016). The department organized the scientific board to qualify 06 cooperative projects, 06 pilot project which were finalized in 2014.

The outstanding results of the projects completed in 2015 include:

The cooperation project between Vietnam Academy of Science and Technology and the People's Committee of Lam Dong province to "Build Documentation of World Biosphere reserves of Bidoup - Nui Ba", The documentation have been submitted to UNESCO (ICC/MAB) and Bidoup has been recognized as a World Biosphere Reserve.

The pilot project "Research on the use of chemicals to extract phytosterols from soybean industrial waste for the purpose of soybean oil refinement to produce anti-cholesterol supplements" with project code VAST.SXTN.07/13-14. Products derived from this project - "An Mach Vuong reduces

cholesterol" were Certificated as supplement by the Department of Hygiene and Food Safety (Ministry of Health) "number 4417/2014/ATTP-XNCB" on March 28th, 2014.

The pilot project "Improvement and application of technologies conserving semen, for the artificial insemination of dogs, aimed to develop a high quality professional of flock of dogs for security and defense" with project code VAST.SXTN.02/13-14. After 02 years of implementation on Berger, Labrador, Cocker genius at the Police Department of management, training and the use of animals (C69), the project has produced and preserved 1175 samples of highly motile frozen semen, producing 175 dogs. The price of imported dog ranges from 8000-10.000 USD compared dogs of project which cost about 750 USD.

Further professional duties conducted include: Evaluation of new proposals: Supervision of the financial regulations enforcement; Assessment of the midterm results of projects; The interdiction of guidelines and support for the head of projects and related institutes; And the organization of the evaluation projects.

Scientific advice, technology evaluation as required by provincial authorities and companies

In 2015, the DADT has consulted the President of VAST regarding the establishment of scientific boards for the evaluation of mining technologies at the request of the Lao Cai province, the evaluation of new scientific ideas relevant to societal needs and the monitoring and investigation of explanations for spontaneous combustions in Tam Nong District, Phu Tho Province.

Comments on the law documents, regulation of Government

The DADT has correctly performed all the executive directions delegated by the the Government in the field of the Application and Development Technologies. The Department has guided units of the Academy to achieve timely implementation of government documents. Furthermore, the department has implemented all the regulations and requirements of VAST for administration management. Fruitful cooperation with the State Audit Office of Vietnam has streamlined achievements to carry out the works in 2015 at the VAST.

The development of cooperation with ministries and local provincial authorities

The DADT consulted and organized the signing ceremony between VAST and Hai Phong City, Logistics Academy (Ministry of Public Security) and the Hanel Company.

With the authorization of the VAST's President, the DADT has worked with 10 local DOSTs. The highlight results include: People's Committee of Quang Ninh Province has announced to welcome close participation with the VAST, i.e. to maintain relationships with the VAST institutions to build the proposals and submit the provincial key objectives in December, 2015. The People's Committee of Long An Province agreed to implement some projects to promote organic agricultural and environment protection projects. The People's Committee of Ho Chi Minh City has requested professional departments to coordinate with VAST to build the proposal for "Research on the scientific base to develop the Can Gio coastal economic zone" which is scheduled to be completed in June, 2016.

The Department has collaborated with the Directorate of Fisheries to draft a project to "Study and Apply scientific knowledge and technologies for the exploitation and development of sustainable fisheries" which is planned for the period 2016-2020 and this document was submitted to the Minister of Agriculture and Rural Development.

The DADT contracted the National Office of Intellectual Property of Vietnam for deployment of the project "Improving the organization and management of intellectual property activities within the Vietnam Academy of Science and Technology".

The Department has motivated and supported scientists and institution with the preparations for the proposal for the "Vietnam Inclusive Innovation Project" commissioned by the Ministry of Planning and Investment.

The contracts of VAST in 2015 showed: A total of 755 contracts have been signed, 2015's budget for those was 177 billion and 548 million Vietnam Dong. Those economic contracts are preconditions for the technology transfer of VAST.

Strengthening the promotion of technology and the implementation of the research results of the Academy.

The Department of Technology application and Deployment has organized a series of events of promoting and introducing the results of research and technological progress of VAST, including: Workshop on "Policies to promote commercialization of intellectual property at VAST" was held on 27/01/2015 at Nha Trang; Workshop on "Promoting commercialization intellectual property of VAST" dated 03/27/2015 in the Ho Chi Minh city; Workshop on "Promoting commercialization intellectual property of VAST" dated 13/07/2015 in Hanoi.

At the International Techmart fair in Hanoi 2015, the Department organized 17 showrooms for the VAST to exhibit and introduce outstanding products of VAST and its institutes. In total, 15 institutes participated Techmart 2015.

In October 2015, the Department organized an exhibition of scientific and technological progress in the VAST office, based at 18 Hoang Quoc Viet, Cau Giay, Ha Noi and a seminar on applied and technology development. The event attracted many staff and numerous television, radio agencies to report.

Difficulties

In the process of implementing key tasks in the year 2015, the Department has encountered the following difficulties:

In general, there are two types of funding sources for cooperation projects. Each of the funds has different examination times and approval procedures. The VAST funded projects requires an early evaluation and funding is provided further in advance as compared to provincial funding parties. Hence, the final approval of project is usually slower than planned.

A number of projects with high applicability in the field of basic scientific mapping, GIS and Remote Sensing require complete investment to operate however the local capacity and human resources of relevant implementing parties, at times, do not match the project, hence these projects remain in proposal phase.

In the field of Health and Medicine, the production protocols need clinical tests and registered by authority, normally the registration can take from 06 months up to one year, and this time has not been accounted for within the project duration, therefore projects are forced to extend the time.

Registration of Intellectual Property Rights

VAST has registered 25 intellectual property, including 14 patents, over the course of 2015. The number of intellectual property certificates in 2015 has increased from 2014 (09) and 2013 (10).



Delegates witness the signing of technological contract at Techmart 2015 (01/10/2015)

Plan for 2016

The department plans to undertake the following tasks in 2016:

- Continue to manage the projects and organized the boards to evaluate the projects finishing in 2015; Midterm checking the 2015-2016 projects, Perform tasks assigned by the VAST President.
- Prepare a signed memorandum for scientific and technological cooperation with Binh Dinh province and re-sign the outdated agreement, review the works relating to the cooperation agreement.
- Promote the research results of VAST and facilitate potential transfer to local company and local provincial authorities.
- Promote to secure intellectual property certifications. The ambition for 2016 is to increase the number of intellectual property certificates of the VAST to over 20.
- Build a regulation management system of the applications technology projects

Techmart 2015



VAST President and agencies' leaders visited VAST stalls at Techmart



VAST President visited the stall of the Institute of Natural Products Chemistry



Visiting the stall of the Institute of Applied Physics and Scientific Instrument

TECHNOLOGY APPLICATION AND DEPLOYMENT ■

Some activities on technology transfer in 2015



Prof. Duong Ngoc Hai speaking at a workshop on commercialization of intellectual property (13/07/2015)



Signing ceremony of science and technology cooperation between Hai Phong People Committee and VAST for 2015 – 2020 period (11/05/2015)



The signing on market research and the commercialization of products, inventions, patents between VAST and Hanel (12/02/2015)



International workshop at the Vietnam National Commission for UNESCO, the Ministry of Foreign Affairs (31/03/2015)

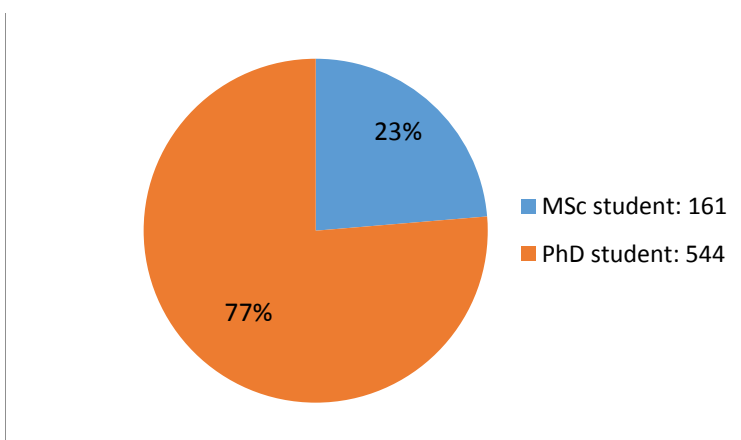
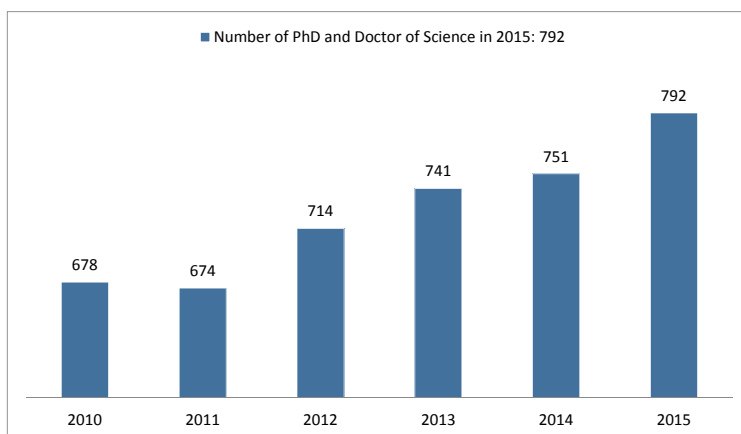
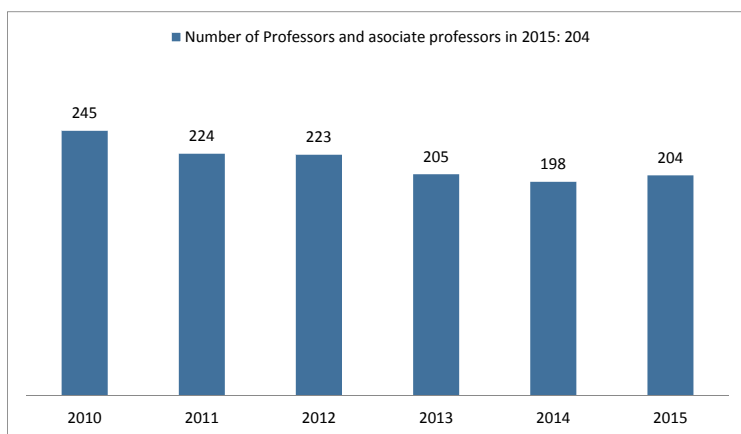
The President of ICC/MAB session knocks the hammer to adopt the decision on recognising Langbiang world biosphere reserve (09/06/2015)



Waste water treatment system at Da Nang Hospital Nurses

Results of postgraduate training achieved in 2015

The postgraduate training activities of VAST marked a new stage in 2015. Eighteen postgraduate bases of institutes are moved and unified in management by the VAST. As of December, 2015, the VAST has had the Institute of Mathematics and Graduate of Science and Technology (GUST) licensed by Ministry of Training and Education to open a doctoral course. Currently, the VAST is completing the organizational structure and hand-over of the PhD students from the Institutes. From the intakes of 2015, the GUST has accepted 147 admissions including 02 PhD admissions for the 911-program. On 10/30/2015, the Prime Minister signed Decision No. 1844 / QD-TTg which supplements 4854 million VND from the fund for education and training of the governmental budget in 2015 to ensure the operation of the GUST. The GUST currently has a total of 519 regular PhD students and 25 PhD students under the 911-Program and 161 Master students.



Postgraduate education of VAST is divided into 02 types; Master and Doctoral courses. The master courses in specialized institutes are in collaboration with several universities. These specialized institutes having master's course are Institute of Physics, Institute of Mathematics, Institute of Ecology and Biological Resources, Institute of Chemistry and the Institute of Mechanics.

High level qualification scientific staff of VAST



Percentage number of postgraduate students 2015



Human Resource training activities

The training and retraining to improve quality and professional qualifications for public officials and employees always receives the attention and guidance of Leadership from the Vietnam Academy of Science and Technology. In 2015, the Academy has sent numerous relevant staff members to participate in the training and re-training in different areas, including:

- + Dispatched 10 leaders to attend the state administrative management senior official class (2015-2016) with part-time study load, organized by the Training Center for Politics of the Party Executive Committee of Central Agencies and coordinated by the Ho Chi Minh National Academy of Politics and Public Administration.
- + Dispatched 19 leaders to attend the state administrative management senior official class (2014-2015) with full-time study load, organized by the Training Center for Politics of the Party Executive Committee of Central Agencies and coordinated by the Ho Chi Minh National Academy of Politics and Public Administration.

+ Dispatched 02 leaders to attend the state administrative management senior official class (2014-2016) with part-time study load, organized by the Training Center for Politics of the Party Executive Committee of Central Agencies and coordinated by the Ho Chi Minh National Academy of Politics and Public Administration in HCM city.

+ Dispatched 57 leaders to attend the state administrative management senior official class, organized by University of Home Affairs and dispatched many other officers to be trained in professional activities and management skills.

+ Dispatched 51 leaders to attend the state administrative management Junior official class, organized by University of Home Affairs and dispatched many other officers to be trained in professional activities and management skills.

In 2015, VAST send many others to different courses on bidding, training in new policies and to keep up-to-date on scientific and technological developments et cetera.



Launching ceremony of Graduate University of Science and Technology

INTERNATIONAL COOPERATION ACTIVITIES

Assoc.Prof.Dr. Ninh Khac Ban, Director of International Cooperation Department



Main international partners of VAST

In 2015, under the direction of the leaders of the Vietnam Academy of Science & Technology (VAST), international cooperation activities continued to be enhanced with many achievements that have been gained under the target goals. Many international workshops and conferences were held by the VAST, which contributed to bringing together scientists to share experiences on research as well as to envision directions for cooperation in the future. The VAST also organized many delegations led by VAST leaders abroad to negotiate, sign the cooperation agreements, and develop collaboration activities in science and technology. The year 2015 was remarkable for several important events such as the signing of agreement for cooperation in the GLOBE program between VAST and NASA according to the recommendation of the Vietnam Government and the official approval of UNESCO for the establishment of two International Centers for Mathematics and Physics.

In total, there were 15 outgoing delegations led by the President and the Vice-Presidents of the VAST to foreign institutions. The most important delegations worth mentioning were the delegations led by the VAST's President Acad. Chau Van Minh to the Lao Ministry of Natural Resources and Environment, to the French Ministry of Finance and Space Corporations to implement the next phase of the VNREDSat-1 project, to the Russian Foundation for Basic Research and the National Academy of Sciences of Belarus to develop and strengthen the bilateral cooperation activities in the period of 2015-2020. The VAST's Vice President Prof. Duong Ngoc Hai led delegations to the University of Trento, the Italian National Research Council, and the Austrian Institute of Technology. The

VAST's Vice President Prof. Nguyen Dinh Cong led delegations accompanied by representatives from Ministries of Vietnam to the Smithsonian Institution and the US Museum of Natural History. These visits focused on negotiations, signing of cooperation agreements on research, training and education as well as promoting research and technology transfer projects.

In 2015, the VAST has received more than 40 international delegations from academies, scientific agencies and research centers all over the world such as the delegations led by the President of National Academy of Sciences of Belarus, the President of Czech Academy of Sciences, the Ministry of Foreign Trade of French Republic, the US Department of Navy, the Strategic Research Committee for Agriculture, Forestry and Fisheries of Japan, the Duma Executive Committee of Russian Federation, etc. Many other delegations have also been welcomed to research institutes of the VAST for talks on cooperation opportunities, signing of agreements, and participation in international scientific workshops, conferences and training courses.

In 2015, the VAST signed 12 cooperation arrangements with international partners and delegated VAST's institutes to sign 19 scientific cooperation documents with foreign partners. The VAST spent over 400.000 USD for the annual membership fees to international organizations such as Dubna, IIASA, AUF, APCTP, IUGG and PSA. The VAST also sent representatives to attend the annual meeting at Dubna, the NMO's council meeting of IIASA, and 13 scientists have enrolled in Dubna for long-term training and another 10 scientists have proceeded for short-term training. The VAST successfully organized the 7th VAST – AIST Workshop "Cooperation in Research: Assessment and Orientation for the Future" and 35 other international workshops/ conferences that were held by the VAST's research institutes. The topics of these workshops, conferences and training courses have focused on the areas of space technology, earth science, nanotechnology, environmental technology, biotechnology, ecology,

physics, information technology, renewable energy, disaster prevention, chemistry and oceanography.

In 2015, the VAST continued implementing ODA projects such as the project "Building the Vietnam Space Center" (ODA from Japan Government), the VNREDSat-1 (ODA from French Government), and working with the partners from France and Belgium on technical issues to prepare for the second phase of the projects VNREDSat 2 and VNREDSat-2B. The VAST also completed the documents applied for the project "Enhancing capacity on scientific research and technology development for scientists of National Academy of Sciences of Lao" and continued mobilizing ODA for the project "Establishment of the Vietnam – Japan Center for Advanced Technology." Especially, the VAST has negotiated with the Far Eastern Branch – Russian Academy of Sciences (FEBRAS) and obtained permission from Vietnamese authority to start the program "The 5th East Sea research survey by Academician Oparin Ship" in 2016. The VAST implemented 25 joint research projects in the period 2015-2016, 01 joint research project with JSPS in 2014-2016, and launched new 27 joint research projects in 2016-2017. The VAST has finished the closing procedures for 15 of the 19 VAST-level projects in the period 2013-2014 and those of the period 2014-2015 at Institute level, as well as conducting the mid-term evaluation of projects in the period 2015-2016. The VAST has approved 27 new projects to be carried out in the period 2016-2017. These projects resulted in 02 patents, 25 publications in international journals, 30 articles published in national journals and workshop proceedings and contributed to the training of 08 PhDs, 05 doctors and 06 masters of science.

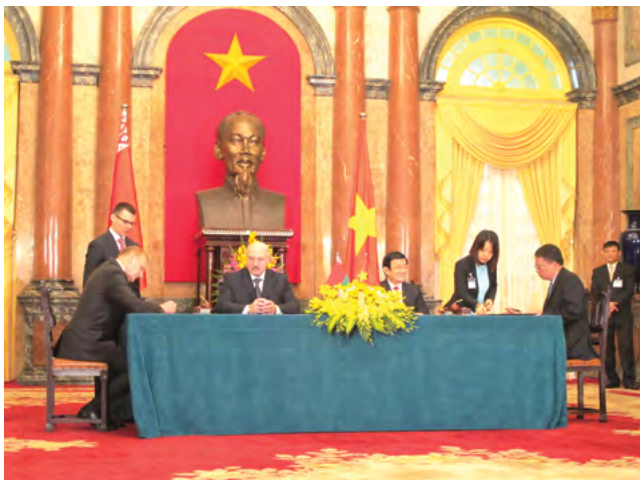
In order to promote the international integration on science and technology and to raise the VAST's position in the world science and technology landscape, in 2016 the VAST plans to implement the following international cooperation activities:

INTERNATIONAL COOPERATIVE ACTIVITIES ■

- To take an active lead in international integration and enhance VAST's position in the region and in the world by focusing on developing cooperation programs in oceanography, space, biodiversity, environment, climate change, renewable energy, information technology, biotechnology, physics, nuclear science and new materials.
- To coordinate with the Ministry of Foreign Affairs, Ministry of Planning and Investment to mobilize the ODA from Japan Government for the project "Establishment of the Vietnam – Japan Center for Advanced Technology"; to continue discussions with partners from France and Belgium to formulate the projects VNREDSat-2 and VNREDSat-2B to be submitted to Vietnam

Government for approval; to get the approval for starting the project "Enhancing capacity on scientific research and technology for scientists of the National Academy of Sciences of Lao PDR."

- To carry out the 5th survey of the East Sea in collaboration with FEBRAS; to organize the workshop for the 10th anniversary of cooperation and review the joint research results with the Russian Foundation for Basic Research; to organize the conference on S&T and Innovation with the Network of Academy of ASEAN; to continue implementing the activities coming forth from signed agreements with foreign partners such as the scheme of cooperation development between VAST-NASB in the period 2016-2020 and the Globe program with NASA.

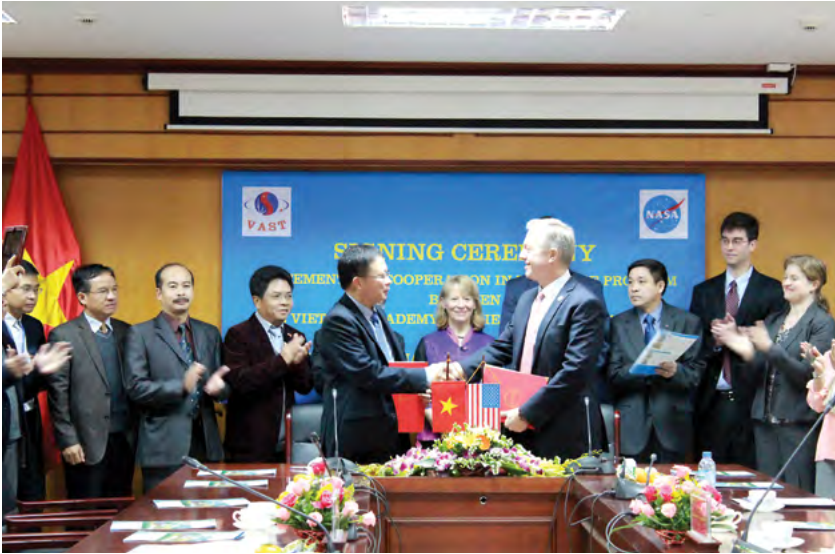


Acad. Chau Van Minh, the President of VAST and Acad. V.G. Gusakov, President of NASB signed the Cooperation Development agreement between VAST and NASB.



Acad. Chau Van Minh welcomed the delegation of Mr. Luskov Denis Vladimirovich, Vice-President of the Space Administration of the Russian Federation

■ INTERNATIONAL COOPERATIVE ACTIVITIES



Signing ceremony of Agreement for Cooperation in the GLOBE program between VAST and NASA (19/12/2015)



The 7th VAST – AIST Workshop in Vietnam (12/11/2015)



Prof. Tetsuo Asana, President of JAIST (Japan) visits VAST (21/12/2015)

INTERNATIONAL COOPERATIVE ACTIVITIES ■



VAST's delegation at the RFBR



Signing the Minutes of Meeting between VAST and NASB (28/10/2015)

The meeting between the NASB, the VAST, Deputy Minister of Industry and Trade and Vietnamese ambassador

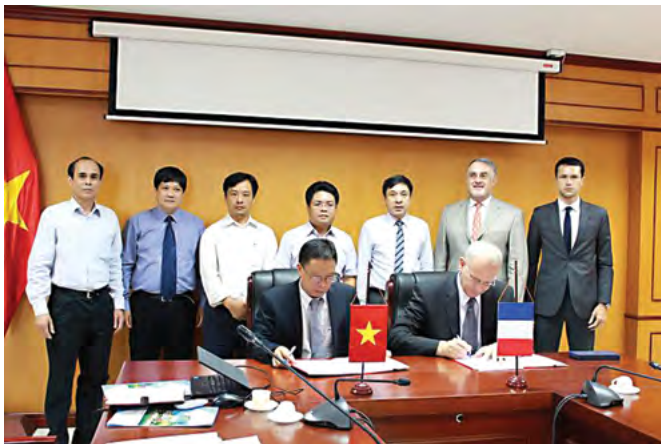


Acad. Chau Van Minh presents an award to Mr. Daito Michio, Economic Counsellor to the Japanese Embassy in Vietnam (17/09/2015)

■ INTERNATIONAL COOPERATIVE ACTIVITIES



President of VAST and his delegation at the meeting with CNES's President (23/07/2015)



Signing of the Minutes of Meeting by VAST and CNES's President (23/07/2015)

Acad. Chau Van Minh, President of VAST presents the Medal to Mr. Bruno Angelet, the former Ambassador of Belgium in Vietnam (27/07/2015)



Signing ceremony of the agreement in natural resources and environment between VAST and Ministry of Natural Resources and Environment of Lao PDR (24/03/2015)

General information on the 2015 assigned investment plan:

1) 339.5 billion state budget development capital, including 01 billion for preparation of the investment capital and 338.5 billion as project implementation capital; Government bonds: 285 billion and foreign capital: 250 billion VND (satellite projects ODA).

- Ending 02 Projects: Developing facilities for the Marine Environment and Resources Institute and expanding the Museum of Oceanography in Hai Phong Phase 1: 7.413 billion VND; Component Project part of the National Specimen Collection Project part of the National Museum of Nature Project: 23 billion VND.

- Counter-capital for ODA: 23 billion VND Government budget, 285 billion VND Government Bond and 250 billion VND foreign investments.

- Budget for 07 transitional projects: 174.087 billion VND;

- Budget for ground-breaking of 06 (Science and Technology) projects: 93.5 billion VND and 01 (Resources & Environment) project: 10 billion VND.

- Budget for Education and Training: 30 billion VND (payment capital for Training Center Project).

2) Capital for repairing – small-scale construction: 18 billion for 23 items, among which there are 19 projects transitioning from 2014: 17.867 billion; 5 new items in 2015: 2.133 billion.



Institute of Applied Material Science (IAMS)

Infrastructure development highlights

Research facility for the Institute of Applied Material Science (IAMS), 6 stories building, total floor area of 5078 m², expected to be delivered and put to use at the beginning of 2016. The building will ensure that the IAMS will have a modern, stable and long-term facility for research and working; contribute to free the facility at 01 Mac Dinh Chi to start the reconstruction of 01 Mac Dinh Chi according to the planning up to 2030.

- The research facilities of the Space Technology Institute and Institute of Marine Bio-chemistry are in the final completion phase, and will be completed and delivered mid-2016 on the condition of sufficient funding (solid building, total floor area ~9000 m²)

■ INVESTMENT TO STRENGTHEN RESEARCH CAPABILITIES AND TECHNOLOGY DEPLOYMENT



Space Technology Institute - Institute of Marine Bio chemistry



Vast's Incubation center

- VAST Incubation Center has completed all the structures and floors and surrounding walls, and is moving on to finishing works, and will be completed and delivered in 2016 with sufficient funding.

The completion and application of the research facilities of the Space Technology Institute and the Institute of Marine Bio-chemistry is important: besides facilitating the activities of the Institutes themselves, they also contributes to the completion of the Plan

for construction and development of research area at 18 Hoang Quoc Viet, contributing to VAST Project to attract young scientists.

4) Completed, delivered and put into use are two new research facilities for the Center of Science and Technology of Tay Bac in Phu Tho and the Center of Science and Technology in Quang Tri. With this support the two organizations no longer need to rent offices.



The construction of the Center of Science and Technology of Tay Bac in Van Phu, Viet Tri City

- Total land area: 2839 m²; 1.207,6m² leveled
- 1 storey building: 248 m².

Center of Science and Technology in Dong Ha, Quang Tri:

- Total land area: 5300 m²; 1.207,6m² leveled
- 2 storey building: 248 m².



- Completed the request for land, compensating and clearing 5 ha in Buon Ma Thuat City to build the test-site for Earth-observation satellites and to build the Center for Science and Technology in Buon Ma Thuat.

• In addition:

- Completed the reconstruction of a storage building into office space and delivered to the Central Institute for Scientific Research at 32 Huynh Thuc Khang, Hue City. With the support, temporary working facilities for the Institute are

secured during the construction of a new facility from 2015 to 2020.

- Completed the infrastructure (private road, electrical system) to put into use the VAST's Mechanical – Electronic Workshop in Co Nhue.

■ INVESTMENT TO STRENGTHEN RESEARCH CAPABILITIES AND TECHNOLOGY DEPLOYMENT

Progress on ODA projects:

At the moment, VAST is carrying out 01 ODA project, namely; The Vietnam Space Center Project, the Project has been completed and delivered in terms of Project Component I – which encompasses the preparation of the 11 ha construction site at Hoa Lac Hi-tech Park (using counter capital); The construction of the Center for human resource development and technology transfer at 18 Hoang Quoc Viet is still ongoing. At present, the construction of items in the North Area of Hoa Lac Hi-tech Park has commenced (using counter-capital, 125 billion VND); The preparation of a bid for the contract for Designing, Developing and Launching the number 01 satellite (ODA); A number of 11 (additional) staff members have been dispatched to attend the 2nd training term and 14 staff members to the 3rd training term, at master's level, at several Japanese Universities.

Strengthening equipment

In 2015, VAST spent 251,000 million funding for the strengthening of research equipment, which it intended to invest 221,300 million for 10 projects at the Academy key level (71,300 million for 03 transitional projects and 150,000 million for 07 newly commenced projects), and the rest for other projects including 07 foregoing projects (18,095 million, including 01 project for retail equipment), 08 projects opened new (10,285 million, of which 04 projects for retail equipment) and a portion of funds for the maintenance of large equipment, shared by a number of units (1,320 million). Synthesis of the implementation of the project as follows:

The project to complete the procurement in 2015 was 25/25 with the ability to disburse 100%.

The project that has ended before 2015 has been granted acceptance by the Academy.

Number of projects approved before 2015 ends but must extend notes due 2015 to be granted funding for 03 projects, including:

The Project "Strengthening laboratory equipment

applied mechanics" of the Institute of Mechanics and Applied Informatics (Total investment: 6,000 million, implemented from 2011);

The Project "Strengthening Workshop equipment Mechanical Engineering - Electronics" Centre for High technology Development (Total investment: 30,000 million, implemented from 2012);

The Retail equipment Project "Investment debut device for research impact assessment of the marine environment to reliability and longevity of concrete materials" of the Institute of Mechanics (Total investment: 990 million, the implementation from 2014);

Overall, the projects to enhance equipment were deployed in 2015 as planned; the bidding and the selection of contractors all complied with regulations. The projects were selected based on units matching the target user, necessary for professional activities. All the projects are accepted in terms of evaluation board effectiveness, achieving the objectives of the project, resulting in well-working equipment and meeting the needs of scientific research. This indicates a proper investment policy and practice of the VAST.



In 2015, 04 National Key Laboratories at VAST have implemented the two nationally independent projects of science and technology and 21 scientific themes according to the function of the key laboratories. The Key Laboratory of gene technology has one project, 08 scientific themes of which 03 are finishing in 2015. The Key Laboratory of materials and electronic components has 05 scientific themes; The Key Laboratory of plant cell technology has one project and 05 scientific themes; The Key Laboratory of network technology and multimedia has 03 scientific themes. All projects and scientific themes have been performed according to the approved plan with compulsory components, namely: scientific content, time schedule and registered products. Funding in 2015 to support the activities of the four key laboratories at VAST was 6.575 million. It is 635 million the higher than in 2014.

The 04 Key Laboratories at VAST to ensure the performed functions are open labs, where the implementation of a variety of projects and tasks at all levels. All key laboratories at VAST have been managed and have effectively used the available budgets and facilities, thereby contributing to the functions and tasks of the key laboratories and host institute.

Although the economic situation of Vietnam remains challenging, the key laboratory of plant cell technology has signed many contracts for application deployment in the fields of activity of the Institute. Total funding of the signed contracts is approximately 08 billion; the members of the relevant lab participate actively and report the results

of basic research and application development in several national and international workshops.

In general, the projects of scientific and technological research are carried out in the key laboratories of the VAST according to predefined planning. The devices of the key laboratories have been exploited effectively. Some equipments are operating with very high frequency such as scanning electron microscope (FE-SEM), X-ray diffraction system, Raman scattering system, and some systems of measurement equipment for research optical properties of material (measured fluorescence absorption system). Other equipments were mining with low frequency boost attention being exploited, for research and collaborative research.

The projects carried out in Key Labs in 2015

No	Key Lab name	Type of project	frequency	special	gene conservation	Nafosted	cooperation	VAST
2	Materials and Electronic components		5	1		5		
3	Network technology and multimedia		3			3		16
4	Plant cell technology		5					5
Total			21	6	1	9	3	21

The articles published in Key Labs in 2015

No	Key Lab name	Article	SCI	SCIE	ISSN	VAST1	VAST2	other
2	Materials and Electronic components		12					
3	Network technology and multimedia							
4	Plant cell technology				1		15	1
Total								

Training in Key Labs in 2015

No	Key Lab name	Level	Dortor	Master	Bachelor
2	Materials and Electronic components				
3	Network technology and multimedia		8		
4	Plant cell technology		6	4	18
Total			58	75	80

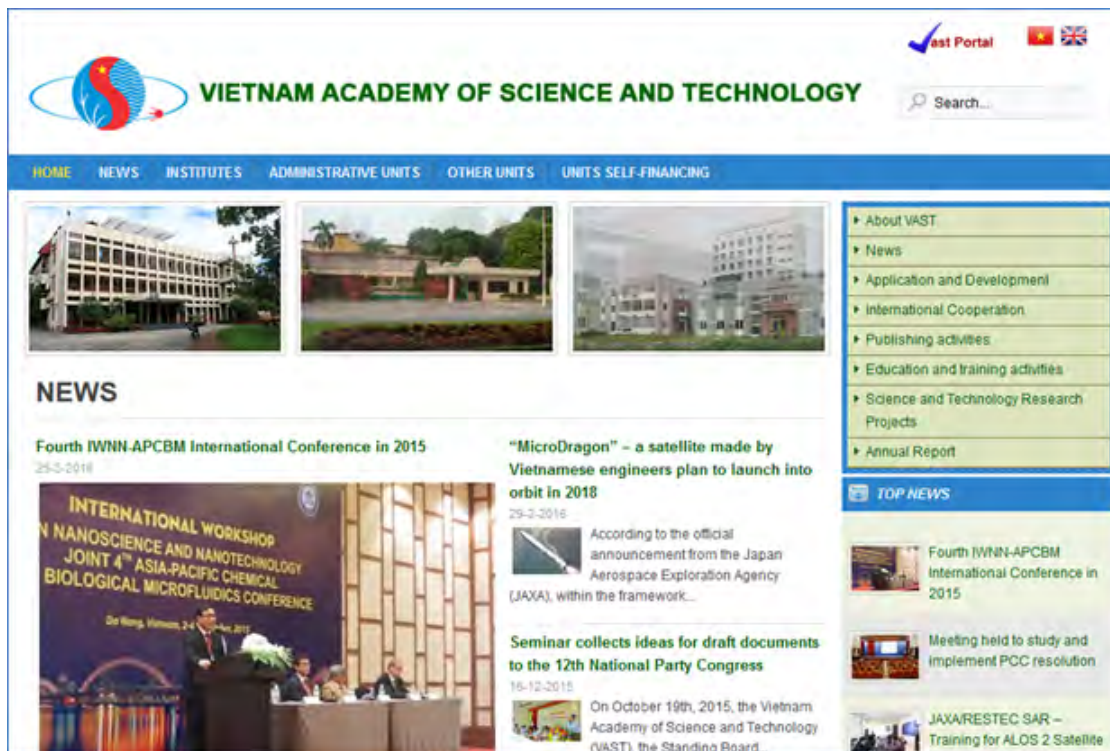
Some key results

1. The Key Laboratory of Gene Technology implemented one project: "Research on the production of recombinant Interleukin-3 and interleukin-11 with high quality for medical use (treatment)" (2012 - 2015), Principle investigator: Prof. Dr. Truong Nam Hai of the Institute of Biotechnology. The amino acid sequence of the first 15 amino acids of N terminus of recombinant protein IL11 was identified. The method to eliminate the heat in the product was optimized. The participating scientists were successful in the creation of a formula for the product.

2. The Key Laboratory of Plant Cell Technology conducted one project "The development of technologies for the production of biomass and root cells in vitro Ngoc Linh ginseng" (2012-2015), funding in 2015 has been 200 million. Dr. Nguyen Huu Ho of the Institute of Tropical Biology has been the principal supervisor. The roots uncertainty, hair roots of *Panax vietnamensis* Ha et Grushv. were successfully grown in the bioreactors with gas supply (03 litres, 05 liters and 10 liters).

OPERATION OF THE VAST'S WEBSITE

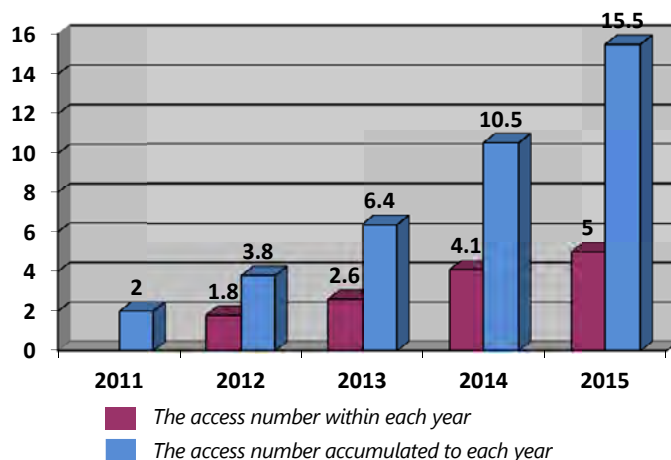
The official information channel of VAST on the internet is the website located at <http://www.vast.ac.vn>. This is an official and reference information source for external media agencies regarding activities and events related to the VAST.



The homepage of the VAST website at <http://www.vast.ac.vn/en/>

The VAST's website in Vietnamese

By the end of 2015, the access number of VAST's website in Vietnamese was more than 15 million (compared to nearly 10 million visits in 2014), reflecting the growing intention of readers for VAST and confirming the important position of the VAST's website among the scientific information webpages in Vietnam.



The access number to VAST's website in Vietnamese in recent years

(unit: million visits)

The statistics of articles posted on the VAST’s website in Vietnamese in 2015

News articles		Total Posts	Percentage
News & Events	News related to VAST’s activities	73	22,46%
	News related to the subordinate units	32	9,84%
	News related to Organization and Personnel	15	4,62%
	News related to technology applications and deployment	20	6,15%
	News related to international cooperation	28	8,62%
	Announcements	39	12,00%
Science news	VNREDSat-1 Newsletter	21	6,46%
	Domestic science news <i>(100% from the VAST’s scientists)</i>	82	25,23%
	International Science News	15	4,62%
Total		325	100%

The VAST’s website in English

- Number of visitors: by the end of 2015 is 1.617.108 (compared to 1,036,976 in 2014).
- Monthly hits: more 41,000 visits (compared to 38 000 in 2014).
- Daily hits: is more 1,300 (compared to 1,200 in 2014).
- The number of articles is 315, of which 45 articles have been updated regarding the science and technology news and activities of the VAST.
- The total number of final reports of the completed projects in 2015 is 98 among which the information of 86 projects have been put onto the VAST’s website in English.

Scientific Information and Electronic library activities

The Institute of Scientific Information (ISI) is a focal point in the science and technology information for the VAST. The VAST’s library hosted in ISI provides researchers with a traditional library and electronic library services. ISI supports many services including disseminating information of VAST’s outstanding scientific and technological achievements; providing scientific information and intellectual property information; collecting, archiving and preserving scientific and technological documentation; researching the Vietnamese calendar; researching, analyzing, synthesizing scientific and technological information to support the research and forecast of scientific development within the VAST.

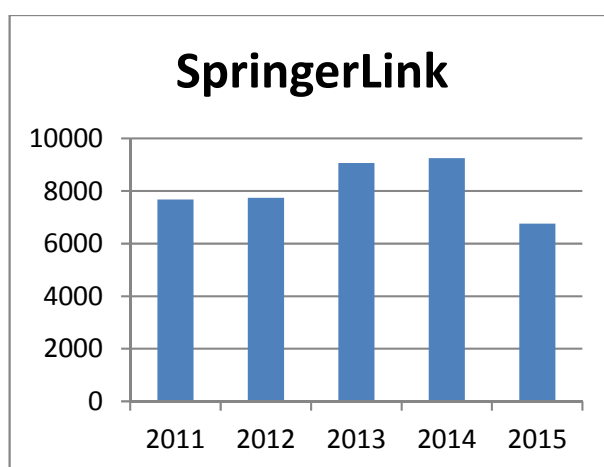
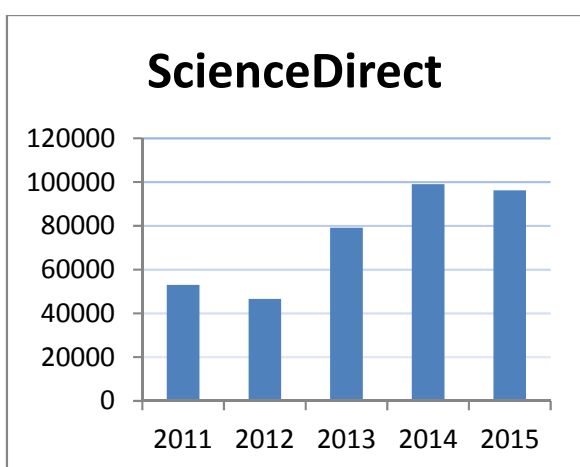


Visitors and participants in the workshop and Exhibition on Vietnam Book Day 21/04/2015

The number of downloaded papers from different publishers in recent years

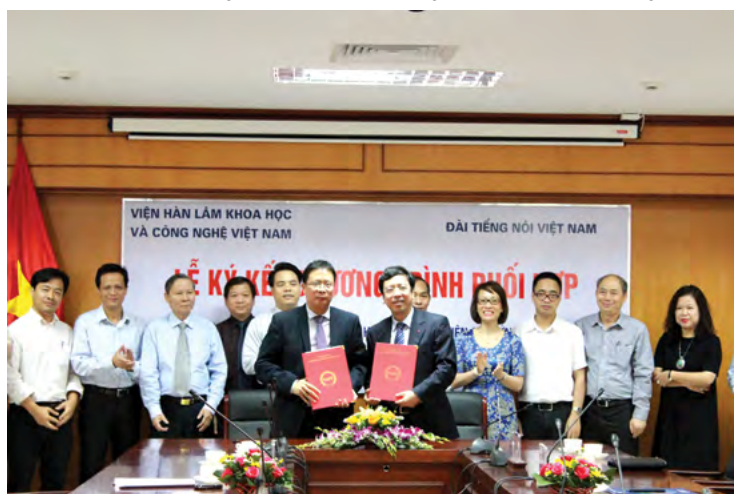
	ScienceDirect	SpringerLink	ACS	APS	AIP	IOP
2011	53018	7680	2406	204	10	5038
2012	46575	7749	6184	809	103	523
2013	79096	9068	6381	1878	156	898
2014	99093	9249	4997	1390	534	734
2015	96213	6759	4413	1547	364	824

Chart of number of articles downloaded for two most downloaded packages



- Continuing the implementation of the project of purchasing foreign scientific and technological magazines for the period 2014 to 2016 of VAST by equipping for the library with a huge number of foreign online electronic journals, for example: buying access right to foreign electronic scientific and technological journals in 2015: the ScienceDirect database includes more than 2000 journal titles in the field of science and technology; 38 ACS journal titles; 11 AIP journals; 7 APS journals; 66 IOP journal titles and the ProquestCentral database; equipping libraries in Hanoi and Ho Chi Minh City with Latin and Russian scientific and technological magazines.

- Promoting the Digital Library (<http://elib.isivast.org.vn>). Reviewing, updating and granting access accounts for all researchers in VAST. Currently, CSI has granted more than 2300 accounts for researchers and 19 static IP addresses to 35 subordinated units of VAST. By the end of 2015, there had been more than 100,000 full-text articles downloaded to serve scientific research activities.



The signing ceremony of a cooperation program on research and application of science and technology dissemination on the mass media VOV (21/04/2015)

SCIENTIFIC PUBLISHING WITHIN THE VIETNAM ACADEMY OF SCIENCE AND TECHNOLOGY (VAST)

Msc. Tran Van Sac

Director, Publishing House for Science and Technology (PST)

The communication and propagation of scientific information, study results and technological deployment of scientific knowledge is of key importance for every research institute. It can take form in publications, including scientific journals, monographic books, reference books, postgraduate and advanced textbooks et cetera. Publishing is one of the annual science and technology activities of all scientific and technological

organizations. The Vietnam Academy of Science and Technology (VAST) with its large team of scientists have governed many national projects of high importance and impact. Annually, hundreds of books are published and thousands of articles are published in 12 journals specialized for science and technology, and hundreds of articles are published in international journals with increasing quality by scientists of VAST.

Publishing in scientific and technological journals

Currently, VAST is publishing 12 journals specialized for science and technology. These are widely-read journals recognized and licensed by the government. Several journals have been upgraded from being published in Vietnamese into English such as Vietnam Journal of Mathematics, Vietnam Journal of Mechanics, Communications in Physics and Advances in Natural Sciences: NanoSciences and Nanotechnology, and the Journal of Acta Mathematica Vietnamica. Other journals are also upgraded in quality, both in terms of content and form, and in quantity and the frequency of publication editions to approach the regional and international standards. Therefore, it increasingly meets the demand of publishing works, scientific study results of national and international scientists.

The editorial boards of the journals consist of leading scientists in universities, academies and institutes nationwide. The number of foreign scientists makes up more 50% of total member of editorial boards of journals such as the Vietnam Journal of Mathematics, Advances in Natural Sciences: NanoSciences and Nanotechnology and the Journal of Acta Mathematica Vietnamica.

Articles published in the journals have to meet the requirements of scientific value, have to be details and follow copyright regulations of the State, and the regulations of the editorial boards. Normally, an article must undergo strict assessment, evaluation, editing and review to ensure its scientific quality and other requirements of the editorial boards before it can be finally published.

After upgrading the quality according to the approved projects and published in accordance with the international standards by SPRINGER and IOP, several journals have made it in to the index of ISI (International Standard) and Scopus (Regional Standard), including the Journal of Advances in Natural Sciences: Nano Sciences and Nanotechnology for the former, and the Vietnam Journal of Mathematics and Journal of Acta Mathematica Vienamica for the latter. All journals are published online and the number and accessed frequently. To indicate, the Journal of Advances in Natural Sciences: Nano Sciences and Nanotechnology, has been accessed with over 140,000 downloads (with key articles being downloaded at nearly 500 times per month). On average, the download rate of articles has been around 286 times per month. Numerous customers have shown interest in ordering printed works. The other of journals are implementing key projects to promote the remaining 6 out of 9 journals to obtain the SCOPUS standards.

Publishing scientific works in the form of books

In addition to publishing periodical scientific journals, the VAST schedules an annual special fund for publishing scientific works in the form of books.

Monographic Book Volumes have continued to be published, with a classification in 04 major fields:

- Monographs within the field of technology and technological developments
- Monographs within the field of natural resources and the environment of Vietnam
- Monographs within the field of sea and marine technology
- Textbooks for training graduate and postgraduate education.

The editorial boards were set up according to their relevant fields.

The monographs are selected and published covering the results of one field of science and/or technology by the author or the co-authors after many years of research. It offers a summarization of his/her/their works; they were enhanced to theory in the higher range and highly appreciated in the term of science by scientists and managers. Their form is presented consistently, printed with high quality and solemnity. After publication, the PST distributes the editions to the required addresses. According to the plan, a set number of book will be published which ranges between 5-10 books per year. In 2015, a total of 08 monograph books have been published.

The PST has continued to publish books about the Vietnamese Sea - Islands which are a predominant field of VAST. These books were commissioned by the State. By the end of 2015, 40 books have been published in fields related to the sea and islands of Vietnam. Through the assessments of scientists and other readers, it has high scientific value and is very useful in popularizing and improving people's knowledge about the marine sector, contributing to National Sea Strategies up to 2020.

- In 2015, PST registered the publishing plans 42 times for 74 books, issued the publishing decisions for publications in accordance with its principles and objectives in accordance with State agencies. There have been no errors in published publications in 2015.

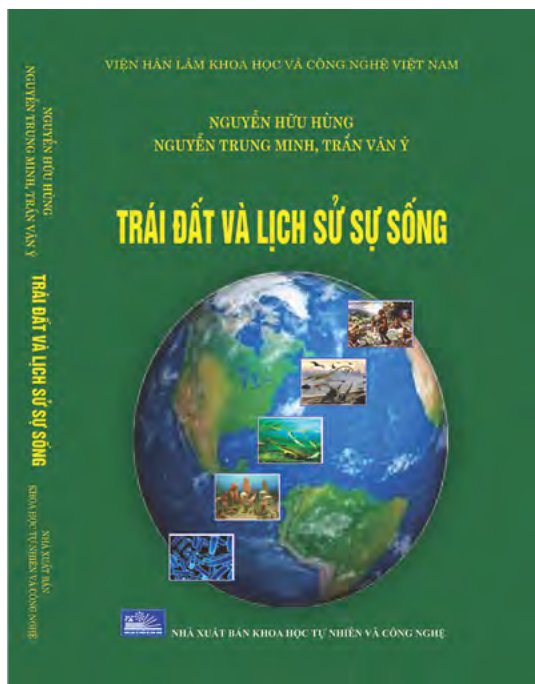
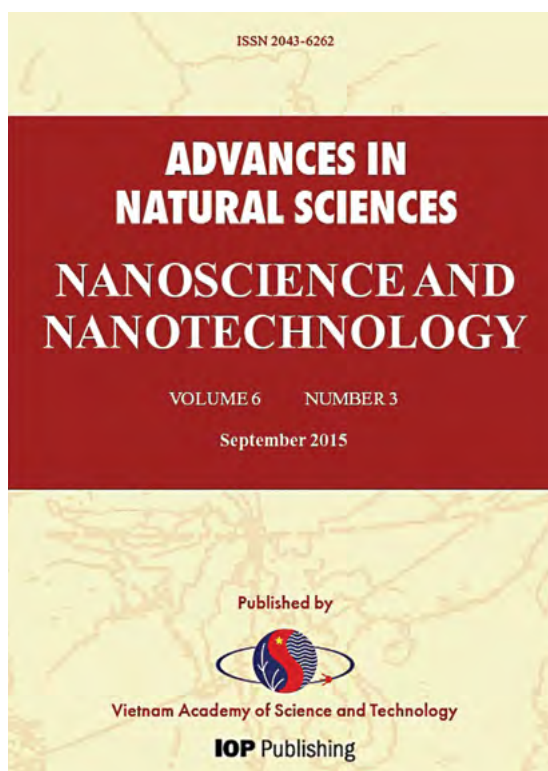
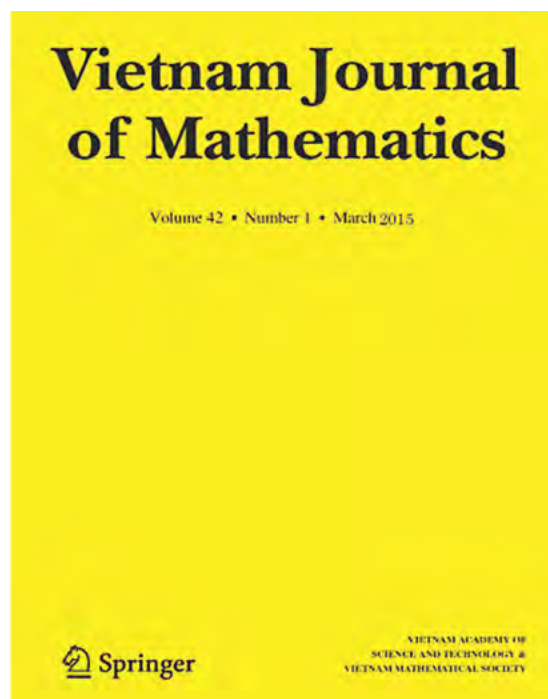
- In July 2014, the PST became a member of The Publisher International Linking Association, Inc ("PILA"). Therefore, to be a PILA member, all journals are to be issued and listed with the DOI index, including the collections of proceedings books. When publishing proceedings, PST has published online - thereby contributing to promoting the scientific value and integration for publications.

- PST continued to participate in Vietnam Book Awards and won the high prizes: These books are "Earthquake Tsunami", by author Prof. Dr Bui Cong Que; "Atlas of Vietnam Insects", by the author Dr. Nguyen Xuan Thanh, Prof. Doctor of Science. Vu Quang Con won Silver Prize with his interesting book about "Vietnam Geomorphology" by Prof. Le Duc An and Uong Dinh Khanh won the Third Prize with "Vietnam Birds Identification" by Nguyen Manh Hung - thereby winning the Consolation Prize. "Phong hóa Nhiệt đới ẩm ở Việt Nam" by Nguyen Duc Pho won the Bronze Prize.

Orientation of publishing activities in 2015 and the following years

- Maintaining the publication of 12 specialized journals with incremental improvement in content, form and print quality.
- Continuing to implement the signed agreements with SPINGER and IOP Publishers on the publishing 3 journals: Vietnam Journal of Mathematics; Journal of Advances in Natural Sciences: NanoSciences and Nanotechnology and Journal of Acta Mathematica Vietnamica under the international standards and aim to achieve and maintain ISI standards.
- Implementing the approved projects for 9 journals on upgrading to get the regional standard in 2018.
- Strengthening the leaders and Editorial Boards of journals to streamline orientation with the participation of foreign scientists for successful implementation of the ambitions to upgrade journals by 2018.
- Continuing to publish monographs in the Monographic Book volumes following the strengths of the VAST.

- Participating in the publication of books per commission of the State for the National Bookcase, especially in fields where VAST is apparently strong such as books on sea and islands, natural resources and environment, and basic research



MUSEUM ACTIVITIES

VIETNAM NATIONAL MUSEUM OF NATURE'S INITIAL SUCCESSSES

Assoc. Prof. Dr. Nguyen Trung Minh
Director, Vietnam National Museum of Nature

Vietnam National Museum of Nature (VNMN) was officially established under Decision No. 305/QĐ-KHCN of President of Vietnam Academy of Science and Technology. One month later, Prime Minister issued Decision No. 86/2006/QĐ-TTg dated on 20/4/2006 approving "the overall planning of the Vietnam Natural museum system up to 2020". This has been an important turning point for Vietnam National Museum of Nature in particular and the Vietnam Natural Museum Systems in general. The phrase "Natural Museum" appeared and was presented in popular culture and the society and its communities for the first time.

After nearly 10 years of establishment, the VNMN has made remarkable progress. In 2015, VNMN made achievements in emulation to celebrate the 40th anniversary of foundation of VAST.

Although VNMN is a young scientific and technological unit, in 2015, VNMN assigned to perform 26 tasks, projects of all levels. As a result, the museum published 117 works and monographs in prestige magazines both nationally as well as abroad - including 52 international articles (10 articles in journals listed as SCI, 29 articles in journals of the SCI-Expanded list (reaching 1.31 SCI, SCI-E/1 researcher, ranking 2nd in the VAST) and 13 other articles in

magazines listed with ISSN /ISBN, 25 articles in national journals published by VAST, 39 articles published in other journals, 01 monograph and 01 copyright certificate.

The museum staff has published 34 new species for science: including 13 species of animals, 21 species of plants.

Vietnam National Museum also manages the project "Building a Specimen Collection on Vietnam Nature", which was officially implemented this year. In addition to the implemented component projects in 2015, 06 new component projects of building a specimen collection are also implemented by 06 Institutes including: Institute of Ecology and Biological Resources, Institute of Geology, Institute of marine resources and the environment, Institute of Oceanography, Institute of Ecology in South and VNMN.



Organism evolution
exhibition Room

*Organism evolution
exhibition Room*



The activities of the museum, as part of the public service sector, include the need to meet the demands of visitors, community education and gaining experience for building museum expositions in the future. In May 2014, The “Organism Evolution Exhibition Room” was opened and put into operation. From November 1st 2014 to October 31st 2015, the room received about 40,769 visitors; (including primary, secondary and high school) and students accounted for 41.73%; preschool accounted for 33.56%, the others accounted for 24.71%. Besides, the museum also guides the students to visit and study in conjunction with the participation of experts and research staff of the VNMN.



*Organism evolution
exhibition Room*

VNMN regularly organizes communication activities such as activities for the International Museum Day (the 18th of May) with the theme in 2015 of the "Museum for a Sustainable Society"; the meeting for correspondent, journalists on the occasion of Vietnam Revolutionary Journalism Day, on June 20th, 2015, to express thanks to journalists who have accompanied, supported Vietnam National Museum of Nature in the development; Organize exhibitions to introduce and make public to the "Organism Evolution Exhibition Room" in Hue City, Tuyen Quang and Hai Phong city.

VNMN photographed, edited and printed the photo panels serving for temporary display, introduced the Organism Evolution Exhibition Room, bringing beautiful photos and images of nature as well as the activities of the room posted on the web to introduce and make public for VNMN.

VNMN participated in Techmart exhibition 2015 in Hanoi and exhibition for scientific products display held by VAST to celebrate the 40th anniversary of establishment of VAST.

The museum also collaborated with television and news agencies to gain publicity for the room "Organism Evolution exhibition Room" via: VTV, VOV, Hanoi Television, Vietnam News Agency, Tien Phong Newspapers, Tia Sang Magazines, Nhan Dan Newspapers, Rainbow Magazine among others.

One of the tasks assigned by the Prime Minister is to collect annual specimens according to the Text No. 611/TTg-NN dated on July 15th, 2007 on supporting for specimen collection of VNMN which was implemented seriously. In 2015, VNMN

implemented 22 specimens' admissions from 9 authorities and local people including 37 dead animals: tiger, forest cat, monkey among others, including 2482.8 kg of elephant ivory, 2.93 kg of rhinoceros horn and 08 horned Gaur. The museums erected 01 horse bear specimens. The museum pretreated and put into storage a total of 15 skins, 20 skeletons, has determined the scientific name for 04 remaining samples by DNA-methods, and has collected 29 specimens of geological and paleontological times (21 rock specimens and 08 paleontology specimens) from Yen Bai, Nha Trang, Nghe An and Quang Binh.



Ursur thibetanus

VNMN is a national museum, the leading unit in the Vietnam national museum system planned under Decision No. 86/2006/ QGD- TTg dated 20/4/2006 signed by the Prime Minister. According to the decision, the Prime Minister assigned the Institute of Science and Technology of Vietnam (at present, the VAST) to govern and coordinate with ministries, branches, localities and relevant agencies to implement the objectives of the plan. The former Institute of Science and Technology of Vietnam (at present, the VAST) issued the Decision No.2233/QD-KHCNVN dated on 21/11/2006 assigning VNMN to coordinate the relevant agencies to perform the tasks. The VNMN demonstrated its role as one of the 06 national museums. In fact, it is the leading museum in the system of 10 local museums and 02 outdoor exhibition zones (botanical gardens, zoological gardens). The museum counseled and supported museum membership in the system, such as the Northwest Museum of Nature, the Central Coast Museum, the Highlands Nature Museum in Lam Dong, the Museum of Vietnam Forest Resources, the Oceanographic Museum in Do Son, the Nha Trang Oceanography Museum and the Biology Museum of the Vietnam National University. In 2015, the VNMN successfully organized an annual seminar on the "Coordination in building Natural Museum in the Vietnam Natural Museum System at Hue.

Since its establishment, the Museum identified strategies and plans to develop Museum term 1 (estimated 10 years) and focused on implementation in order to build the museum early. The Leaders of VNMN perseveringly follow up the entire strategies and plans to complete the tasks.

This is a project that lasts for several years, in February 2001, the project of building VNMN completed a pre-feasibility study and was

submitted to Institute of Science and Technology of Vietnam (now is the VAST), and was approved under the Text. No. 1147/CP-KG dated on 25/09/2002 of the Prime Minister. Many scientists, managers and the leading experts in various fields of biology, earth science, and heritage have contributed to its success with great effort.

Regarding the location, the project was submitted and had applied for building locations. Since 1999, Hanoi city has suggested some locations for the project like in Xuan La, Tay Ho - Hanoi My Dinh- Hanoi, Ha Tay et cetera.

The project "Building Vietnam National Museum of Nature" is now at the preparatory stage, the current location selected for project construction has been agreed upon and is applying for its licenses and permits, rate 1/500 at Quoc Oai Ecology zone, with the areas of 32 ha. The project was adopted in terms of the investment policy at the Text No. 86/TTg-KGVX dated on 19/01/2015 by the Prime Minister on the investment policy of the project for the VNMN. The project has been granted the planning permission No. 1637/GPQH used for the construction investment project dated on 27/4/2015 of Hanoi Planning and Architecture Department. Currently, the project has been submitted for approval and appraisal of the medium-term plans 2016-2020 of capital for components project 1: Preparing the ground for construction of the project Vietnam National Museum of Nature Phase I (2016-2020).

To develop the research orientation and nature conservation, VNMN developed the project "Centre for Natural Resource Conservation of Vietnam and animal, plant rescue". The project consists of two components: Component Project 1: Develop infrastructure for Vietnam natural conservation resources centers and animal, plant rescue; and Component Project 2: Roads to connect with infrastructure of the Central.

The project had been valued funds and approved for implementation in the period 2016-2020.

In terms of international cooperation activities, so far, VNMN has signed a total of 42 Memorandum of Understanding with foreign organizations, research institutes, museums and universities of 18 countries. In 2015, VNMN received 14 foreign delegations, designated 25 VNMN officials to work and study abroad. In 2015, VNMN completed procedures that allow the training of 02 doctoral staffs in Japan and Germany, and 01 master training enrollment in Australia, at present, 03 VNMN officials are under doctoral training abroad.

In terms of postgraduate education, the VNMN staff participated in lecturing activities at many universities, training institutions, and has supervised for numerous bachelors, masters, doctoral degrees.

In 2015, the Museum completed some projects and conducted some projects of building potential of science and technology in order to build the facilities and equipment for VNMN staff. Annually, Vietnam National Museum of Nature assessed the efficiency of appliances, with usage regulations for large appliances, and special training of the staff for running these facilities.

Overall, in 2015, VNMN completed the assigned plans. The projects have been completed without delay. Despite the difficulties in 2015, the project "Building the



Masturus lanceolatus

National Specimens Collection on Vietnam Nature" has been implemented, and "The Organism Evolution Exhibition Room" stays open to draw a large public. The project "Building Vietnam National Museum of Nature "is being promoted for early implementation. In 2015, VNMN received the competition flag given by VAST. After nearly 10 years of establishment, the VNMN has gradually developed its position and has been put into operation to contribute to the propagation and education on Vietnam's nature to people in the nation and worldwide.

MUSEUM OF OCEANOGRAPHY

The Museum of Oceanography is one of the top-10 most-visited museums in Vietnam. During a visit to the museum, visitors can explore the amazing ocean world through over 20.000 specimens of more than 4.000 species from marine and fresh waters.

In 2015, the museum received 353.830 visitors; collected 6 large specimens for its collection, including 3 guitar fishes (1.2 – 1.3 m), a hammer head shark (2.7 m), an eagle ray (0.9 m) and an exceptional guitar fish (3.1 m and 195 kg) from Ca Mau province; handled 5 shark and guitar fishes specimens; evaluated and identified turtle and giant clam specimens for the Inspector of the Khanh Hoa provincial Department of Agriculture and the Rural Development and Khanh Hoa Public Security. Moreover, the Museum had digitalized data of over 5.000 specimens for searching and accessing specimen information.

In response to Sea Festival 2015, the museum opened an area of 450 m² to display the theme “Knowledge on and love for the sea together” with following topics: Marine science for national economical development and protection of sovereignty, Marine animals in stamps, Natural and Man-made disasters, Marine biodiversity and cultural aspects. The themed exhibition has attracted many visitors.

During the Vietnam – Thailand workshop in November 2015 at the Chulalongkorn University (Thailand), the Museum had a chance to present posters introducing Vietnamese marine culture.



*Museum of Oceanography
Some images of Museum of
Oceanography*



Orientations and plans for the year 2016

2016 is the first year of the (National / Governmental) five-year plan (2016-2020). It is the year for the Resolution deployment of the 12th Party National Congress, and also for the Resolution deployment of 7th VAST Party Congress. Based on the actual situation and resources, some major directions of the 2016 plans of VAST are as follows;

Continue to keep abreast the development planning of VAST up to 2020 with the vision until 2030, which was approved by Prime Minister, and by best using of the available manpower and the budget, which was funded by the government for 2016.

Strive to successfully implement the 2016 plan, paving the firm foundation for excellently completing the plans stipulated for the 2016-2020 period, to meet the country's requirements for the development stages, exchanges and deeper integration in all fields.

Increase the number of scientific publications with international standards; Improve the quality of products in different science and technology missions; Strengthen technology incubators, the application of science and technology to production and practice, and gain intellectual property; Strengthen activities in information services and publication of scientific results to enhance the quality of VAST magazines/journals; Promote activities of 02 International Centers of Type 2 for Mathematics and Physics, under the auspices of UNESCO and 03 Advanced Centers; Promote training and put the University of Science and Technology into effective operation.

Continue implementing big projects such as the satellite and space projects, projects for earthquake observation network, project tsunami warning in Vietnam; project "Collection of national specimens and planning museum systems", project "Science and technology for

social-economic development in Tay-Nguyen region" (Tay-Nguyen 3 project), project Building High-technology Zone of VAST in Hoa Lac. Improving the effectiveness for 04 national key laboratories; And the implementation of the 'national Physics program 2020' project.

Concentrate on steering the key tasks at VAST's level, especially those on strengthening research facilities, which have been supported and financed by different ministries, and set up key tasks for the future; Put the projects into highly effective operation.

Focused on Governmental construction of a number of major projects: The Project regarding the Advanced Center Vietnam - Japan in Hoa Lac; the Ocean Research Ship project; the projects on the Planning in biotechnology development for 2020, the projects on the basic research in chemistry, life science, earth science and marine science and technology.

Implementation of the projects of investment in basic construction which were carried out from 2015 and the projects that are newly commenced in 2016; Continue the establishment of material facilities in order to create a new face suitable to the position of a leading national scientific authority; Focus on building and gradually implementing the medium-term investment plan for the period 2016-2020.

Continue the young scientists program, deploying the project for construction of a technology incubation of VAST based on the stipulated time schedule in order to provide accommodation for young scientists in next few years.

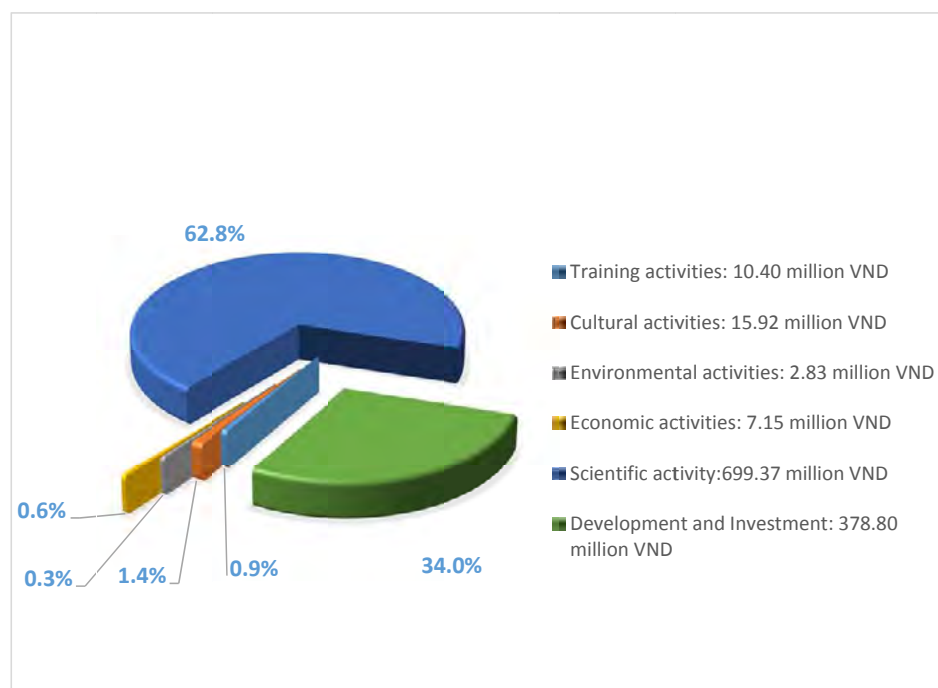
Continue the management of innovation, enhance checking and monitoring the budget implementation, the deployment of science and technology projects at all levels, the projects of basic construction investment: Economically and efficiently use equipment and work area for each unit in VAST; Accelerate completion of settlement report in the unit.

■ ORIENTATIONS AND PLANS FOR THE YEAR 2016

The Prime Minister and the Ministry of Finance have decided to allocate an amount of 1,210.4 billion VND as the 2016 governmental budget of VAST, among which 511 billion VND is for development investment, 699.4 billion for recurrent expenditure.

VAST has worked with all its units on the 2015 plan, has prepared a scheme to distribute the 2016 budget and is ready to present the budget distribution scheme to the ministries before 31/12/2015, in accordance with regulations.

Expenditure estimates for 2016 VAST's budget



Unit: million VND

Content	Year 2015 (*)	Year 2016 (**)
I. Expenditure on investment	589,500	511,000
II. Recurrent expenditure	849,549.248	699,370
1- Expenses for science and technology:	821,529.248	663,070
* National level projects	131,820	37,543
* VAST operating expenses, Ministerial level projects	689,709.248	625,527
2- Expenses for education and training	6,730	10,400
3- Expenses for economics	5,500	7,150
4- Expenses for environment (including clean water program)	3,490	2,830
5- Expenses for culture	12,650	15,920
Total	1,469,049.248	1,250,370

(*) Data as of the end of 2015

(**) First data delivery in 2016

The total state budget revenue estimates in 2016 compared to 2015

SOME IMPORTANT STATISTICS ■

Number of basic research projects of the VAST in the 2010-2015 period (*)

No	Sponsored field	The total number of newly opened projects						Total
		2010	2011	2012	2013	2014	2015	
1	Mathematics	1	24	1	2	17	1	46
2	Information and Computer science	0	3	2	2	2	0	9
3	Physical	12	23	12	15	16	1	79
4	Chemistry	19	10	17	15	11	3	75
5	Earth sciences	8	5	2	3	5	1	24
6	Life sciences	17	16					33
	- Bio-agriculture			11	12	10	1	34
	- Biomedical			3	5	2	1	11
7	Mechanics	2	4	1	3	2	0	12
Total		59	85	49	57	65	8	323

Source: NAFOSTED. Number of projects approved by year.

Table of statistics for scientific publications, patents, utility solutions for the 2010-2015 period (*)

No	Statistics Category	2010	2011	2012	2013	2014	2015
A	Total number of scientific publications (1+2+3+4+5)	1.575	1.612	1.698	2.298	2.074	2.197
B	Number of publications in international journals (1+2+3+4)	509	550	601	660	803	802
C	Number of publications in SCI, SCI-E journals (1+2)	336	334	401	435	523	588
1	Number of publications in SCI journals	247	209	258	282	298	317
2	Number of publications in SCI-E journals	89	125	143	153	225	271
3	Number of publications in international journals with ISSN/ISBN codes (2015 only count the number of articles for journals ISSN)	173	216	200	225	246	176
4	Number of publications in 3 VAST-1 journals (VAST SCOPUS)					34	38
5	Number of publications in national magazines	1.066	1.062	1.097	1.638	1.271	1.395
6	Number of patents	9	7	7	7	3	11
7	Number of utility solutions	1	4	5	6	10	7

(*) Statistics taken for the period : 01/12/previous year - 30/11/following year

Statistics of scientific publications, intellectual properties of VAST in 2015 (*)
(Sorted by total number of publications in SCI and SCI- E journals)

No	Name	Numbers of articles in International journals					Numbers of articles in local journals			IP		Book	
		ISI			VAST Scopus ^(***)	ISSN/ISBN	Total	VAST ^(****)	Other	Total	Patents		Utility Models
		Total	SCI	SCI-E									
1	Institute of Ecology & Biological Resources	96	31	65		37	133	28	94	122			4
2	Institute of Materials Science	68	57	11	15	11	94	55	13	68	1	3	1
3	Institute of Marine Biochemistry	60	25	35		10	70	76	14	90	2		
4	Institute of Mathematics	58	28	30	11	5	74						
5	Vietnam National Museum of Nature	39	10	29		13	52	23	39	62			1
6	Institute of Physics	35	34	1	2	21	58	7	36	43	1		2
7	Institute of Biotechnology	31	8	23	1	7	39	73	59	132	2	2	2
8	Institute of Chemistry	31	27	4	2	6	39	110	38	148	1		
9	Institute of Natural Products Chemistry	22	15	7	1	5	28	40	15	55	2		2
10	Institute of Mechanics	19	8	11		4	23	8	18	26			
11	Institute of Chemical Technology	15	7	8	4	2	21	11	3	14			
12	Institute of Environmental Technology	13	8	5	2	6	21	11	27	38	1	1	3
13	Institute of Applied Materials Science	13	8	5	1		14	23	8	31			2
14	Nha Trang Institute of Technology Research & Application	13	10	3		2	15	21	13	34			1
15	Institute of Information Technology	11	3	8		8	19	6	2	8			
16	Institute of Oceanography	10	4	6		9	19	17	51	68			1
17	Institute for Tropical Technology	8	5	3		3	11	64	3	67		1	
18	Institute of Genome Research	8	5	3		1	9	14	5	19			
19	Southern Institute of Ecology	8	4	4		3	11	3		3			
20	Institute of Tropical Biology	8	1	7		7	15	43	24	67			
21	Institute of Marine Environment & Resources	8	3	5		5	13	19	19	38			6
22	Institute of Geophysics	7	3	4		3	10	9	5	14			
23	Ho Chi Minh City Institute of Physics	7	7				7	1	6	7			
24	Institute of Geological Sciences	6	3	3			6	14	25	39			1
25	Tay Nguyen Institute of Scientific Research	6	2	4			6	26	3	29			1
26	Institute for Marine Geology & Geophysics	4	3	1		4	8	26	47	73			1
27	Institute of Applied Physics & Sci. Instruments	4	3	1	1		5	3	7	10			
28	Graduate University of Science and Technology	3	2	1			3	2		2			
29	Institute of Geography	2	1	1		4	6	12	11	23			2
30	Mien Trung Institute of Scientific Research	2	2			2	4	8	6	14			
31	Centre for High Technology Development	2	2			1	3	4	12	16	1		1
32	Vietnam National Satellite Center	2	2				2	3	5	8			
33	Space Technology Institute	2		2		2	4	2	2	4			
34	Hochiminh city Institute of Resources Geography	1		1			1		7	7			
35	Institute of Applied Informatics & Mechanics	1		1		1	2		12	12			
36	Publishing House for Natural Science and Technology							9		9			
37	Institute of Energy Science					3	3		3	3			
Total (**)		588	317	271	38	176	802	763	632	1395	11	7	30

(*) Statistics taken over the period 01/12/2014 - 30/11/2015;

(**) The publications with co-authors belonging to different institutes are counted only once;

(***) VAST Scopus: 03 journals with international standards (Advanced in Natural Sciences: Nanoscience and Nanotechnology, Vietnam Journal of Mathematics, Acta Mathematica Vietnamica);

(****) VAST: 09 remaining VAST journals.

Statistics of Science and Technology contracts implemented in 2015 (*)

Unit: million VND

No	Name	Contract with usage of state budget			Contract without usage of state budget			Total		
		Number of contracts	Total value	Value in 2015	Number of contracts	Total value	Value in 2015	Number of contracts	Total value	Value in 2015
1	Institute of Environmental Technology	17	7.085	5.174	319	59.853	59.853	336	66.938	65.027
2	Institute of Energy Science	8	6.927	2.265	60	75.207	16.145	68	82.134	18.409
3	Institute of Geological Sciences	6	6.405	4.195	19	27.523	13.221	25	33.928	17.416
4	Institute of Natural Products Chemistry	6	14.303	4.671	22	9.828	9.828	28	24.131	14.499
5	Institute of Materials Science	9	13.946	3.555	21	10.485	9.886	30	24.431	13.440
6	Centre for High Technology Development	5	2.554	830	2	9.018	9.013	7	11.572	9.843
7	Institute of Chemistry	5	1.453	380	20	16.526	9.262	25	17.979	9.642
8	Institute of Physics	33	32.077	5.642	36	2.119	2.098	69	34.196	7.740
9	Institute of Mechanics	7	4.825	2.312	9	6.825	4.770	16	11.650	7.082
10	Institute of Geography	9	5.766	1.004	6	5.801	5.737	15	11.567	6.741
11	Institute of Information Technology	4	3.360	863	25	7.955	3.007	29	11.315	3.870
12	Institute of Biotechnology	11	3.786	2.809	7	1.972	1.042	18	5.758	3.851
13	Institute of Oceanography	9	6.724	1.691	8	4.402	1.267	17	11.125	2.958
14	Nha Trang Institute of Technology Research & Application	3	1.566	250	5	1.546	1.546	8	3.112	1.796
15	Institute for Marine Geology & Geophysics	2	1.785	1.785				2	1.785	1.785
16	Southern Institute of Ecology	1	94	78	7	5.647	1.593	8	5.741	1.671
17	Institute for Tropical Technology				26	1.743	1.629	26	1.743	1.629
18	Institute of Chemical Technology	2	1.250	530	10	991	990	12	2.241	1.520
19	Institute of Genome Research	4	5.432	1.520				4	5.432	1.520
20	Hochiminh city Institute of Resources Geography	3	3.206		5	6.474	1.487	8	9.679	1.487
21	Institute of Marine Environment & Resources	12	6.877	1.305				12	6.877	1.305
22	Institute of Geophysics				8	6.129	1.059	8	6.129	1.059
23	Institute of Tropical Biology				12	1.075	861	12	1.075	861
24	Institute of Applied Physics & Sci. Instruments				4	794	794	4	794	794
25	Institute of Marine Biochemistry	3	1.460	700	0			3	1.460	700
26	Institute for Scientific Information				1	620	620	1	620	620
27	Tay Nguyen Institute of Scientific Research	3	1.449	346	1	228	228	4	1.677	574
28	Institute of Applied Materials Science				2	759	557	2	759	557
29	Mien Trung Institute of Scientific Research				8	433	433	8	433	433
30	Institute of Ecology & Biological Resources	2	1.064	383				2	1.064	383
31	Vietnam National Satellite Center	1	765	350				1	765	350
32	Institute of Applied Informatics & Mechanics	1	800	300	11	2.150		12	2.950	300
33	Space Technology Institute	1	154	154				1	154	154
34	Vietnam National Museum of Nature	1	35	10	2	602	30	3	637	40
35	Ho Chi Minh City Institute of Physics	1	129					1	129	
Total		170	135.897	43.721	655	266.084	156.337	825	401.981	200.057

(*) Statistical data for the period 30/11/2014-30/11/2015

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Responsible for the edition: Institute for Scientific Information

Add: A11 Building - Vietnam Academy of Science and Technology
18 Hoang Quoc Viet, Cau Giay, Ha Noi

Tel: (+84) (4) 3756.4344.

Fax: (+84) (4) 3756.4344

Email: vanthu@isi.vast.vn

Website: <http://isi.vast.vn>

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VIETNAM ACADEMY OF SCIENCE AND TECHNOLOGY

Vietnam Academy of Science and Technology

Address: 18 Hoang Quoc Viet, Cau Giay, Ha Noi

Tel: (+84) (4) 3756.4333

Fax: (+84) (4) 3836.3122

Website: <http://www.vast.ac.vn>