NATIONAL RESEARCH FOUNDATION

PRESS RELEASE

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10 OUTSTANDING YOUNG SCIENTISTS AWARDED THE SINGAPORE NRF FELLOWSHIP TO CARRY OUT CUTTING-EDGE RESEARCH IN SINGAPORE

1 On the recommendation of its international Fellowship Evaluation Panel (FEP) of distinguished scientists (see **Annex A**), the National Research Foundation (NRF) announced today, the 5th cohort of young scientists to receive the prestigious Singapore NRF Fellowship. These 10 Fellows will join the ranks of 38 others since the award was started in 2007.

2 The aim of the Singapore NRF Fellowship is to build a pool of young, brilliant and passionate researchers in various fields of science and technology to add to Singapore's research talent pool and help advance our scientific and technological edge. The NRF Fellowship will provide each NRF Fellow with up to $3 million in research funding support over five years to perform cutting-edge research in Singapore (see **Annex B** for a write-up on the NRF Fellowship programme).

3 The NRF received a total of 120 applications from researchers of various nationalities from all over the world. These scientists are currently doing research as post-doctoral fellows or junior faculty in top universities such as MIT, Caltech, Berkeley and Yale. After two rounds of stringent evaluation, 17 candidates were shortlisted and invited to Singapore for technical presentations and an interview by the NRF Fellowship Evaluation Panel. 10 were finally selected as recipients of the Singapore NRF Fellowship, Class of 2012 (see **Annex C** for a brief write-up on the awarded NRF Fellows).

4 Dr Francis Yeoh, Chief Executive Officer (National Research Foundation) said: "The NRF Fellowship gives bright, young scientists a wonderful opportunity to prove themselves in research. We welcome the newly awarded NRF Fellows to become part of the vibrant research community here in Singapore, taking up appointments as assistant professors in our universities. We expect many to become international scientific leaders in due course as well as role models to aspiring students who want to pursue careers in research."

5 Professor Sir Roy Anderson, Chair in Infectious Disease Epidemiology, Imperial College London, and FEP member said: "The quality of the candidates applying for the NRF Fellowship improves each year, and it was difficult to choose between them. I am quite sure we're going to see some very excellent scientific research from them in the coming years."

6 Newly awarded NRF Fellow Dr Chong Yidong, a Singaporean who is currently a postdoctoral fellow at Yale University said: “Optics and photonics research in Singapore has become increasingly prominent over the past several years, with many extremely active research groups. I look forward to being a productive and engaged member of this growing research community.”

7 Dr Nathalie Goodkin, who is from the United States and currently an Assistant Professor in the University of Hong Kong sad: “I am thrilled to have been awarded an NRF Fellowship as it will allow me to be part of a great team in earth sciences research in Singapore, whose ground-breaking work I have been following for some time now.”

8 These new Singapore NRF Fellows will begin their research shortly in their respective host institutions in Singapore.

9 The first three groups of NRF Fellows have settled well into the research environment and are already producing promising results. An example is Associate Professor Teo Yik Ying of NUS, whose work in the area of genetics seeks to find the reasons that cause people to suffer from diseases like cancer, diabetes and hypertension. A/Prof Teo will also investigate why people respond differently to modern medicine used to treat the above-mentioned diseases

10 Another NRF Fellow is Associate Professor Hilmi Volkan Demir of NTU. A/Prof Demir and his team have developed white LEDs with the world's highest colour quality. These results have led to collaborations with industrial partners, and to a new scientific program to study high efficiency energy transfer.

11 The Fellowship Evaluation Panel also spent some time assessing the progress of the Fellows awarded two years ago. The FEP found their progress promising. Professor Anthony Leggett, Professor of Physics at the University of Illinois, and a Nobel Laureate in Physics commented: “It is encouraging to see that these young researchers have managed to set up substantial research groups in such a short time.”

The National Research Foundation (NRF)

The National Research Foundation (NRF), set up on 1 January 2006, is a department within the Prime Minister's Office. The NRF sets the national direction for research and development (R&D) by developing national policies, plans and strategies for research, innovation and enterprise in Singapore. In addition, the NRF funds strategic initiatives to build up Singapore's R&D capability, develop research talent and nurture a culture for innovation and entrepreneurship. The NRF also serves as the secretariat for the Research, Innovation and Enterprise Council (RIEC), chaired by the Prime Minister. Deputy Prime Minister Teo Chee Hean serves as the Chairman of the NRF Board.

The NRF aims to:

- Transform Singapore into a vibrant R&D hub that contributes towards a knowledge-intensive, innovative and entrepreneurial economy;
- Make Singapore a talent magnet for scientific and innovation excellence.

For more information, please visit www.nrf.gov.sg.

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Annex A

Fellowship Evaluation Panel

Members	
1.	**Dr Curtis R Carlson* (Chairman)** President and CEO, SRI International
2.	**Prof Ulrich Suter (Acting Chairman)** Emeritus Professor, Swiss Federal Institute of Technology Zurich
3.	**Prof Sir Roy Anderson** Chair in Infectious Disease Epidemiology, School of Public Health, Imperial College, UK
4.	**Prof Aaron Ciechanover** Research Professor, Faculty of Medicine & Research Institute, Technion Nobel Prize in Chemistry (2004)
5.	**Prof Rita Colwell*** Distinguished University Professor, University of Maryland College Park and Johns Hopkins University Bloomberg School of Public Health, USA
6.	**Prof Michael Graetzel** Professor, Ecole Polytechnique de Lausanne (EPFL), Switzerland; 2010 Millennium Technology Prize Winner
7.	**Prof Sir Anthony Leggett** John D. & Catherine T. MacArthur Professor & Centre for Advanced Study Professor of Physics, University of Illinois Nobel Prize in Physics (2003)
8.	**Prof Charles Lieber*** Mark Hyman Professor of Chemistry, Harvard University
9.	**Prof Mark Spearing** Professor & Head, School of Engineering Sciences, Engineering Materials, Southampton University, UK
10.	**Dr Su Guaning** President Emeritus, Nanyang Technological University

* Could not attend this year’s meeting

Annex B

Fact sheet on the Singapore NRF Fellowship

Overview

1. The Singapore National Research Foundation (NRF) Fellowship Scheme is a globally competitive programme aimed at attracting, recruiting and rooting outstanding young scientists and researchers to conduct independent research in Singapore.

2. Singapore NRF Fellowship awardees (subsequently referred to as "NRF Fellows") will be given complete independence and freedom to pursue their own research directions. They will also be free to choose their preferred host organisation in Singapore from any Singapore-based university or research institution.

Eligibility

3. The NRF Fellowship is open to all outstanding scientists and researchers under the age of 40 at the close of the call, of any nationality with a PhD degree in any discipline of science and technology (life sciences, natural/physical sciences, engineering, computer science[1]) from a reputable university. Scientists who are already based in Singapore may still apply.

Grant

4. Each Singapore NRF Fellowship provides a research grant of up to S$3 million (approximately USD2.4 million) over five years and a separate salary component equivalent to that of an Assistant Professor's remuneration package in Singapore's autonomous universities. The NRF Fellowship grant can only be used to fund research conducted in Singapore.

Selection Process

5. All valid applications received by NRF will be sent to the Singapore NRF Fellowship Local Evaluation Panel (LEP) and other local reviewers for a first round of shortlisting. Applicants shortlisted by the Singapore NRF Fellowship LEP will have their applications forwarded to the NRF Fellowship Evaluation Panel (FEP) for a second round of shortlisting to determine the list of final candidates for consideration.

6. Finalists for the Singapore NRF Fellowship will be invited by NRF to visit local research organisations and present their proposals, prior to the final interview. The visit will be followed by an interview conducted by the NRF FEP. The NRF FEP will make the final selection of awardees after all the finalists have been interviewed.

[1] Including infocomm technology and interactive & digital media

Annex C

Shaffique ADAM

Shaffique Adam is a theoretical physicist and a National Research Council Fellow with the Electron Physics Group at the Center for Nanoscale Science and Technology, a division of the National Institute of Standards and Technology in Gaithersburg, MD (USA).

Shaffique was born in Nairobi, Kenya. After completing his A-level studies in Kenya, he went on to *Stanford University* where he completed his bachelors of science, majoring in physics with a minor in mathematics. He graduated with both departmental honors and a University distinction. After spending 4 months as an exchange student at Magdalen college in *Oxford University*, Shaffique went on to pursue his doctorate in theoretical physics at *Cornell University* where he worked with Piet W. Brouwer on the magnetic properties of nanoscale conductors. He then moved to the condensed matter theory center at the *University of Maryland* where he worked with Sankar Das Sarma on the electronic transport properties of graphene.

Shaffique's background is in an area of mesoscopic physics that is concerned with understanding the properties of electrons in nanoscale conductors. In particular, he is interested in the interplay between quantum mechanics, disorder and many-body electronic interactions in these confined geometries. Nanoscale physics presents both fundamental challenges to our understanding of electronic phenomena, as well as the potential to harness these materials for improved technology. Shaffique has published over 30 manuscripts in prominent journals including *Nature*, *Nature Physics*, *the Proceedings of the National Academies of Sciences* and *Physical Review Letters* trying to understand the physical mechanisms at play in a variety of technologically important advanced materials including semiconductor quantum dots, magnetic nanoparticles, and graphene.

In Singapore, Shaffique plans to explore the electronic properties of interacting Dirac fermions. These unusual electrons occur in newly discovered solid state materials including graphene and topological insulators. His research goal is not only to understand the consequences of this unusual electronic behavior, but also to find a pathway to control these novel systems enabling future electronic devices that improve our quality of life. Singapore is already at the forefront of research in novel electronic materials like graphene. This makes it an ideal location to explore new theoretical directions and their application to technology.

CHONG Yidong

I obtained a B.Sc in physics from Stanford University in 2003, and a Ph.D in physics from the Massachusetts Institute of Technology in 2008. From 2008-2011, I worked as a postdoctoral researcher at Yale University.

My research interests lie mostly in the field of theoretical optics, and specifically in scattering theory, microcavity lasers, photonic crystals, quantum noise effects, and electromagnetic realizations of various condensed-matter phenomena such as localization and topological modes. My Ph.D thesis research involved the first experimental demonstration and detailed theoretical analysis of an electromagnetic "topological mode", an entirely novel class of electromagnetic waves occurring in magneto-optic photonic crystals; this work was published in *Nature* in 2009. Another high-profile research topic in which I have recently been involved is "coherent perfect absorption"--a general theoretical framework which describes optical devices that can absorb incident electromagnetic waveforms with perfect efficiency. We published an experimental demonstration of this concept in 2011, in the journal *Science*.

My current research goals include studying the theoretical and practical limits of coherent perfect absorption, and more generally of interferometric control of optical absorption, in various photonic systems such as random and/or strongly scattering media. Optics and photonics research in Singapore has become increasingly prominent over the past several years, with many extremely active research groups in the universities and several of the A*STAR research institutes, and I look forward to being a productive and engaged member of this growing research community.

Slaven GARAJ

Slaven Garaj was born in Zagreb, Croatia, and already in his early age, he was attracted to scientific pursuits through physics and astronomy, which led him to enroll in Physics program at University of Zagreb. During his undergraduate studies, he organized a scientific expedition to Mongolia, which yielded interesting scientific results and attracted international media attention. After receiving Diploma in Physics in 1998, Garaj pursued PhD at the Swiss Federal Institute of Technology in Lausanne (ETH Lausanne) in the field of Condensed-Matter Physics, There, he investigated electronic properties of fullerenes, soccer-ball shaped molecule of carbons, nanotubes and the other carbon-based materials.

After obtaining his PhD, Dr. Garaj was awarded prestigious Swiss National Science Foundation Fellowship for Prospective Researchers and he moved to Harvard University (Boston, USA) where he pursued research in nanoelectronics and nanofluidics. At Harvard Nanopore Group, Dr. Garaj was investigating physics properties of DNA molecules passing through solid-state nanopores, and DNA interaction with nanoelectronic sensors. The research was aimed at developing a new method for rapid DNA sequencing, and as a result, several of his resulting inventions have been licensed and are being further developed by a commercial company. Recently, Dr. Garaj developed a new class of nanopore – graphene nanopores – uniquely suited for single-molecule detection, due to graphene's atomic-layer thickness and its unique electronic properties. Throughout the years, his different projects attracted a wide media attention, and his research has been featured by BBC News, Discovery, New Scientist, Nature, Nature Materials, MRS Bulleting, etc.

In Singapore, Dr. Garaj plans to establish an internationally recognizable group in the emerging field of integrated nanoelectronics/nanofluidics for single-molecule sensing. The central project, to be pursued under the NRF Fellowship, is the development of a new DNA sequencing method that will build upon Dr. Garaj's previous work on graphene nanopores. Within this method, a single DNA molecule is pulled through a nanometre-scaled graphene pore in linear fashion, allowing for the non-destructive interrogation of each of the nucleobases in their native genetic sequence. The main goal is to achieve full-genome DNA sequencing for a price tag below US$1000, which would bring the genomic technology from the realm of research laboratories to the domain of the healthcare. This potentially strategic future technology would instigate a revolution in personalized medicine, and could lead to a cluster effect with the ongoing nano-bioscience and genomic research efforts in Singapore.

Nathalie GOODKIN

Dr. Nathalie Goodkin is an Assistant Professor of Environmental Science at the University of Hong Kong. Prior to joining the University of Hong Kong, Dr. Goodkin worked as a post-doctoral fellow at the Bermuda Institute of Oceanography. In addition, Dr. Goodkin has worked as an investment banker in the Mergers and Acquisitions group of Credit Suisse First Boston. Dr. Goodkin received a Ph. D. in Chemical Oceanography from the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution (WHOI) Joint Program in Oceanography and Applied Ocean Engineering, and an AB, cum laude in Chemistry from Harvard University. While in graduate school she was the recipient of an Ocean and Climate Change Institute Fellowship, a Paul M. Fye Teaching Fellowship, and a Stanley W. Watson Foundation Fellowship. Currently, Dr. Goodkin is a Guest Scientist at WHOI and a Non-Resident Scientist at the Swire Institute for Marine Science.

Dr. Goodkin's research is focused on using coral geochemistry to understand ocean-atmosphere interactions, climate behavior, and pollution histories over the past 500 years. Through the use of coral samples in both the Atlantic Ocean and the South China Sea, Dr. Goodkin has extracted sub-annual data that can provide insights to climate behavior on seasonal to decadal time scales. As a doctoral student, Dr. Goodkin and her collaborators demonstrated that coral skeletal extension rates can influence paleo-environment proxies particularly in slow-growing corals adapting previous techniques to account for biological influences. In addition, Dr. Goodkin's research showed that changes to the variability of the North Atlantic Oscillation, the dominant atmospheric system in the North Atlantic, are occurring concurrent to changes in mean-hemispheric temperature and that these changes mainly impact the periodicity of the oscillation rather than the mean-state. Currently, Dr. Goodkin is undertaking studies similar to this in the Indo-Pacific region as well as investigating dominant controls on coral growth rates in marginal environments. Her work has appeared in journals such as *Nature Geoscience* and *Global Biogeochemical Cycles*.

Dr. Goodkin's planned research in Singapore focuses on understanding how changes to mean sea surface temperature, salinity and circulation interact with the Southeast Asian Monsoon. As warm water from the Pacific Ocean is pushed through the marginal seas of Southeast Asia towards the Indian Ocean, heat is transferred from the ocean to land driving precipitation patterns. Understanding how these systems have changed and interacted in the past will be critical to predicting climate in the future. Dr. Goodkin plans to establish an environmental geochemistry laboratory at the Earth Observatory of Singapore (EOS) and looks forward to collaborating with the cutting edge scientists already established at EOS.

Silvija GRADEČAK

Silvija Gradečak received Diploma in Physics from University of Zagreb, Croatia, in 1999. After graduation, she moved to Switzerland and obtained her PhD in Physics from the Swiss Federal Institute of Technology in Lausanne (EPFL) in 2003. At EPFL, Silvija initiated the research on structural and optical properties of laterally overgrown gallium nitride. After receiving Swiss National Science Foundation Fellowship for Prospective Researchers, she joined the group of Prof. Charles Lieber at Harvard University as a Postdoctoral Research Fellow. Her postdoctoral work focused on nanowire-based photonics and nanoelectronics and development of nanoscale-based light emitters. She joined MIT faculty in September 2006 as a Merton C. Flemings Assistant Professor of Materials Science and Engineering. Her current interdisciplinary research program is based on synthesis of materials with confined dimensions – including two dimensional films, one dimensional nanowires/nanotubes, and zero dimensional nanocrystals – and their assembly into functional devices for applications in nanophotonics, nanoelectronics, and in energy harvesting and conversion.

Except for her research, Silvija has extensive teaching and advising experience. She has taught two core sophomore-level classes and developed a new graduate-level course, which was offered via videoconference to students at the National University of Singapore for two years (in 2009 and 2010). To date, she has advised 12 graduate students (3 of whom have graduated), 7 undergraduate research assistants, and 5 postdoctoral researchers. Silvija has been recognized for her research and teaching accomplishments and she received several prestigious awards, including NSF CAREER Award, 3M Innovation Award, Merton C. Flemings Career Development Chair, Thomas Lord Career Development Chair, and MIT Alumni Fund Award for Teaching and Education Enhancement.

To address some of the key challenges in the field of nanomaterials, Silvija combines a set of unique synthesis and characterization techniques with robust material models and device fabrication. Her research group has demonstrated controlled growth and doping of III-V compound semiconductor nanowires and nanowire heterostructures through fundamental understanding of the nanowire growth mechanisms. She has developed a unique cathodoluminescence system and reported the first optical studies of single nanowire heterostructures with spatial resolution of <20 nm. She also developed a new class of hybrid organic-inorganic photovoltaic devices with improved power conversion efficiency. Her NRF project will focus on development of semiconductor nanowires with new structural, optical, magnetic, and electronic properties, advancement of electron microscopy techniques for direct correlation of structural and physical properties with unprecedented resolution, and development of novel nanowire devices including nanowire-based light emitting diodes, single photon sources, and lasers.

LING Xing Yi

Xing Yi Ling obtained her Bachelor Degree of Chemical Engineering, 1st Class Honors from the University of Adelaide, Australia in year 2000. She received her Master Degree of Chemical Engineering from the National University of Singapore (NUS) and Institute of Materials Research & Engineering (IMRE) in September 2004. She pursued her Ph.D. under the supervision of Prof. David Reinhoudt and Prof. Jurriaan Huskens at the University of Twente, Netherlands. In October 2008, she received her PhD degree, with thesis entitled “From Supramolecular Chemistry to Nanotechnology: Assembly of 3D Nanostructures”. She was awarded the 2009 IUPAC Young Chemist award for her Ph.D. research. In May 2009, she joined Prof. Peidong Yang at the University of California, Berkeley for postdoctoral research under the Rubicon fellowship from the Netherlands Organization for Scientific Research (NWO, NL). At Berkeley, she worked on the shape controlled plasmonic nanocrystals for surface-enhanced Raman spectroscopy sensing applications. In July 2011, Xing Yi Ling joined Chemistry and Biological Chemistry division at Nanyang Technological University as an assistant professor.

Xing Yi Ling’s current research interest combine chemistry, nanotechnology, and materials science approaches to develop functional nanostructures with novel catalysis, plasmonic and sensing applications. She is particularly interested in using self-assembly of plasmonic nanocrystals to make anisotropic nanocrystal structures with emerging optical phenomena, developing nanostructured plasmonic light harvesting devices for optimal solar-to-fuel conversion, and designing ultrasensitive surface-enhanced Raman spectroscopy (SERS) sensing platforms of environmental toxin detection.

The proposed research topic targets at achieving ‘sustainable earth’ and ‘innovation Singapore’. This project promotes Singapore as the innovative hub with creative ideas – two-step strategy towards anisotropic superlattices to create new materials with emerging properties. In addition, the proposed research will be developed into two specific applications that meet the direct needs of Singapore. Solar-to-fuel production using photocatalysis will reduce Singapore’s dependence on non-renewable energy. A quick and efficient SERS environmental sensor system for toxin monitoring ensures the safety and health of Singapore’s residents and to keep a balanced ecosystem in this city-state. Positive outcome of the proposed study will further strengthen Singapore’s position as the international and regional green energy and environmental powerhouse.

Fumio MOTEGI

I am generally interested in spatial control of cell's interior design and how this applies to the events necessary for cellular functions during development. At the level of single cells, segregation of genetic material relies on proper position of RNAs, proteins, and organelles along the body axes. Mistakes in these positioning lead to cell death or diseases such as cancer. As a grad-student in Dr. Issei Mabuchi's lab of University of Tokyo, I studied the mechanism of actomyosin cytoskeleton rearrangement during mitosis in fission yeast. In Dr. Asako Sugimoto's lab in RIKEN CDB and Dr. Geraldine Seydoux's lab in Johns Hopkins University, I used multidisciplinary approach involving cytology, biochemistry, and genetics to elucidate the mechanism by which the developmental cue dictates asymmetric segregation of PAR-type polarity proteins along the anterior-posterior axis in newly fertilized zygotes.

The complex journey from an embryo to adult relies on the establishment of cellular asymmetry, which gives rise to the diversity of cells and tissues. My postdoctoral work has highlighted the key processes to establish cellular asymmetry during oocyte-to-zygote transition. The *C. elegans* oocyte is symmetric and becomes polarized shortly after fertilization by generating two distinct cortical domains: one contains a complex of PAR-3, PAR-6, and atypical protein kinase C, and the other includes PAR-1 kinase and PAR-2. The sperm-donated centrosome acts as a source of the symmetry-breaking cue, but the nature of the cue remained unknown. I demonstrated that symmetry breaking involves two parallel pathways: one relies on cortical flows of actomyosin, which transports the PAR-3 complex away from sperm centrosome. The other depends on centrosomal microtubules, which manipulate self-organizing interactions among the PAR proteins and locally recruit the PAR-1 complex to the cortex. These findings reveal how two redundant mechanisms ensure robust establishment of cellular asymmetry during early embryogenesis.

The project I intend to pursue as an NRF fellow in Singapore involves 1) understanding the identity of the cue that dictates symmetry breaking and 2) the nature of spatial patterning of cellular asymmetry in newly fertilized zygotes. This project will allow us to uncover the comprehensive mechanisms of spatial design for asymmetric cell divisions, which will provide insights into how a developing embryo specifies somatic and germ cells with precision and accuracy. Understanding the process of asymmetric cell divisions is vital to prevent uncontrolled cell growth and for the every-day functioning of polarized cells, including stem cells and neurons. The molecular similarity in *C. elegans* to other systems make it very likely that this project will highlight new principles in stem cell biology, tissue regeneration, and prevention of cancer. The new technology for manipulating cell polarity will be applied for maintenance of stem cells *in vitro*, and will yield insights into development of drugs for cancer prevention.

Katsutomo OKAMURA

I completed my Ph. D training in the Siomi lab at the Tokushima University in Japan in 2000-2004. In the 4 1/2 years of training, I learned many techniques in RNA biochemistry and *Drosophila* genetics, and developed my interest in small RNA biology. Since this time, I have been using *Drosophila* as the primary model for my studies. I moved to the Isshiki lab at National Institute of Genetics, Japan to study roles of microRNAs (miRNAs) in *Drosophila* development, particularly during the formation of neuroblast lineages. For more thorough studies on miRNAs using genome wide analysis, I moved to the United States to work in the Lai lab at the Memorial Sloan-Kettering Cancer Center in 2006. When I joined, the lab was trying to apply the cutting-edge next generation sequencing technologies to miRNA research. I was able to combine these technologies with traditional biochemistry and genetics, and this powerful combination has boosted our ability to analyze molecular mechanisms of small RNA biogenesis. With these studies, I successfully obtained three post-doctoral fellowships and co-authored 18 papers including 8 research articles as first author.

My long term goal is to understand how the complex gene regulation is achieved in higher organisms, particularly at the post-transcriptional level. Small regulatory RNAs including miRNAs are currently recognized as key players in gene regulation. miRNAs usually down-regulate target gene expression by guiding the effectors to specific target mRNAs. Many miRNAs have essential roles in normal development, and dysfunction of miRNAs often leads to diseases, such as cancers. My research has been focused on the mechanisms of small regulatory RNA biogenesis. My previous studies uncovered an unexpected diversity of the small RNA processing mechanisms by revealing novel pathways including the endogenous siRNA and mirtron pathways. These studies demonstrated that animal cells harbor independent yet related small RNA pathways to regulate genes by distinct mechanisms. I followed up these studies to gain further insight into the molecular mechanisms, and showed that these small RNA pathways are connected to complex mechanisms that achieve robust sorting of small RNAs into specific effector complexes, which is of fundamental importance to small RNA-mediated gene regulation.

The proposed studies aim to answer some of the most important questions in the miRNA field: 1) How do the miRNA processing machineries determine specific cleavage sites? 2) What are the ranges of the RNase III substrates? 3) How is miRNA stability regulated? Even though essential protein components of the miRNA processing pathway have been identified, the mechanisms by which the processing machineries select only a few hundred miRNA genes from many random hairpin structures to produce specific mature miRNA products are poorly understood. In addition, recent studies have shown that miRNA stability is regulated in sequence specific and non-specific manners. However, the molecular mechanisms regulating miRNA stability have not been well studied. By answering the key questions, these studies will help us better understand how miRNA mediated gene regulation is integrated in the gene regulatory networks.

The outcomes from these studies have direct impact on medical applications. It has been known that many single nucleotide variations or mutations in miRNA hairpins affect their processing efficiency, and some of these variations are implicated in human diseases. However because of the lack of knowledge on the substrate recognition mechanisms, the effect of variations on miRNA processing cannot be predicted unless experimentally tested. Furthermore, given the importance of miRNAs in diseases, I anticipate that the identification of factors regulating miRNA stability may uncover new links between the miRNA pathway and human diseases. Based on the intense interest in biomedicine in Singapore, I strongly believe that these studies will contribute to the competitiveness of Singaporean research.

Thomas PEYRIN

Thomas PEYRIN received his engineer M.S. in 2004 from CPE Lyon and specialized in theoretical computer science at the Ecole Polytechnique in France. He completed in 2008 a doctorate in cryptography at Orange Labs, formerly known as France Telecom, during which he was awarded the Japan Society for the Promotion of Science (JSPS) grant. He previously worked as a Cryptography Expert at Ingenico (the world leader in payment solutions) and he is now a Research Fellow at the School of Physical and Mathematical Sciences of Nanyang Technological University in Singapore. He was recently awarded the Singapore Lee Kuan Yew Postdoctoral Fellowship.

He published more than 30 papers in top cryptography and information security conferences, one of them received the best paper award from the conference Asiacrypt 2007. He served in many program committees in renowned cryptography conferences such as Crypto, Eurocrypt, Asiacrpyt, etc. His favorite research topic is symmetric-key cryptography, in particular hash functions, block ciphers and cryptanalysis. He also recently got interested in lightweight cryptography, aimed for very constrained environments. Notably, he is one of the designers of LED and PHOTON, currently the smallest known block cipher and hash function. He was involved in the NIST SHA-3 competition as one of the main designers of the candidate ECHO, which has been selected for the second round of the process. He also proposed BPS, a format-preserving encryption scheme, which is currently being standardized by the American National Standards Institute.

Cryptology, the science of hiding information, is located at the edge of mathematics, computer science and electronics and it can be divided into two subfields: cryptography (which defines the techniques that allows to guarantee some security properties) and cryptanalysis (which analyses and tries to invalidate these properties).The first goal of this research proposal is to study the security of current symmetric-key cryptography algorithms such as block ciphers and cryptographic hash functions, two of the most important primitives in cryptography, backbones of the security applications in various industries such as telecommunications, banking, access control, etc. and used in everyday applications such as PC, cellphones, smart-cards, Internet, etc. PC, cellphones, smart-cards, Internet, etc. In particular, we will analyse the well known AES block cipher (the current worldwide standard and by far the most widely deployed algorithm in the industry), and the SHA-1 hash function, currently the most utilized hash function in the world. The second phase will consist in designing new secure cryptographic components and eventually building new block cipher and hash function proposals, bringing both efficiency and security to the industry. Apart from the academy-oriented theoretical research results expected in the very active field of cryptography, this project will also produce intellectual property in its second phase. Moreover, developing a local know-how on symmetric-key cryptography is crucial for companies or institutions in Singapore that have to deal with security, a more and more important factor in many industry and military sectors.

SUN Lei

I received my Bachelor's degree from College of Life Science at Beijing University. I then went to the Biochemistry Department at Case Western Reserve University to pursue my Ph.D career. I worked with my mentor, Dr. Michael Harris, to study a classical RNA-protein functional complex, RNase P, that catalyzes the maturation of tRNA and focused on how this ribonucleorprotein complex recognizes and catalyzes substrates. Since 2008, I have been working in Dr. Harvey Lodish's lab as a postdoc at the Whitehead Institute to study the roles of non-coding RNAs in adipose tissue development.

My first study has established that the miR-193b-365 microRNA cluster is an essential regulator of brown fat development. Brown fat, unlike the energy-storing white fat, is specialized to burn lipids for heat generation and energy expenditure as a defense of cold temperature and obesity. Blocking miR-193b and/or miR-365 in primary brown preadipocytes markedly impairs brown adipocyte adipogenesis by enhancing Runx1t1 expression, whereas myogenic markers are significantly induced. Forced expression of Mir-193b and/or Mir-365 in C2C12 myoblasts blocks the entire program of myogenesis, and, in adipogenic conditions, miR-193b induces myoblasts to differentiate into brown adipocytes. Lastly, mir-193b-365 is up-regulated by Prdm16 partially through Ppara (Nature Cell Biology 2011 Jul 10;13(8):958-65). This is the first study to show that microRNAs play essential roles in brown fat development and lineage determination between brown fat *vs.* muscle. Encouraged by the results of the microRNA project, I expanded my research field to long non-coding RNAs (lincRNAs). Collaborating with Dr. John Rinn from Harvard University, I profiled the transcriptome of adipocytes and pre-adipocytes. We identified several hundreds of lncRNAs that are specifically regulated during adipogenesis. Many lncRNAs are adipose-enriched, strongly induced during adipogenesis and bound at their promoters by key adipogenic transcription factors such as PPARg and CEBPa. RNAi-mediated loss of function screens identified functional lncRNAs with varying impact on white fat adipogenesis. We adapted an information-theoretic metric to score cellular phenotypes by quantifying the global "transcriptome shift" between precursor and adipocyte cell states. (Manuscript has been submitted). These findings represent the first study to explore the functions of long non-coding RNAs in adipocyte development.

In Singapore, I will continue working on the roles of non-coding RNAs (microRNAs and long non-coding RNAs) in brown fat development and determine the underlying mechanisms. Obtained results will shed new light on regulation of brown adipocyte development and expand the functional characterization of non-coding RNA into another exciting biological system. Moreover, my studies may provide direct drug targets or reveal druggable pathways to promote BAT activity and prevalence or confer energy expenditure features to other tissues, which could be developed into anti-obesity therapies. My research, if accomplished, will contribute to the battle against obesity.