PRESS RELEASE

15 JANUARY 2020 | FOR IMMEDIATE RELEASE

World's first ultra-high resolution 3D comprehensive mapping of human brain kicks off

New mapping technique using powerful x-ray technology will provide clear and detailed images of the brain and aid development of more effective treatments for neurodegenerative diseases

Singapore, 15 January 2020 — Scientists from the National University of Singapore (NUS) are working as members of an international team to produce a first-of-its-kind ultra-high resolution 3D comprehensive map of the human brain's neural network. The effort involves teams from Singapore, Japan, South Korea and Taiwan. Australia and China have also expressed interest to be part of the project. Initiated at NUS, the Singapore team, comprising researchers from the local scientific community, will use synchrotrons – extremely powerful x-ray sources – to trace the complex and intricate networks that cover the brain.

Associate Professor Low Chian Ming from the NUS Yong Loo Lin School of Medicine's Department of Pharmacology and Department of Anaesthesia is a co-founding member of this international consortium, and leads the team from Singapore. The team will work to construct the map of the human brain and coordinate the data management for this endeavour.

The work will link the synchrotron facilities in the Asia Pacific region under a collaboration called Synchrotron for Neuroscience – Asia Pacific Strategic Enterprise (SYNAPSE), which is expected to involve more than 1,000 researchers. Launched today at the NUS Shaw Foundation Alumni House Auditorium, the founding members of the initiative signed a Memorandum of Understanding (MOU) committing to work together to complete their brain map project by 2024.

Faster, crystal clear images of the brain

Each participating facility will work on a portion of the same brain. Using synchrotron x-rays, the SYNAPSE partners will image the brain network on a scale of 0.3 micro-metres, with an image being taken at the speed of 1 cubic millimeter per minute. The overall data acquisition and processing speed is more than 10 times faster than any other current method (such as super-resolution microscopy or Magnetic Resonance Imaging (MRI), according to Assoc Prof Low. He estimates that it will take the SYNAPSE collaboration about four years to map a human brain; other methods would take as long as the lifespan of an average person.

SYNAPSE will complement the structural map constructed from x-ray imaging with subcellular and molecular information from other advanced imaging techniques such as infrared spectromicroscopy, super-resolution visible-light three-dimensional microscopy and cryo-

electron tomography. This coordinated approach will provide ultra-small structural details of the entire brain, analogous to the detailed features of Google Earth images. By contrast, other current maps of the human brain only capture certain specific areas.

SYNAPSE will enhance the understanding of the structure of the brain and the composition of its various structures, clarifying the normal functions and helping to identify the causes of brain diseases.

As mapping a human brain will generate a huge amount of data, a second MOU was signed today by the SYNAPSE members to implement a High Performance Computing network to rapidly process, store, mobilise, access, and analyse such data. Singapore, which will leverage the petascale supercomputing resources at the National Supercomputing Centre (NSCC), will be the data hub of SYNAPSE. The data hub will link all the SYNAPSE partners via the established high-speed 100G international network connections of the Singapore Advanced Research and Education Network (SingAREN).

In parallel, the Singapore team will conduct its imaging work at the Singapore Synchrotron Light Source (SSLS) facility located in NUS.

“Globally, brain mapping has gained impetus due to the growing impact of brain diseases. What we are setting out to do is a world-first enterprise. The images captured with unprecedented speed, clarity and granularity by SYNAPSE will form an extensive human brain map. They will show how neurons are connected and how they interact to result in cognition and intelligence. Our findings could potentially contribute to effective treatment for increasingly important neurodegenerative pathologies such as Alzheimer’s disease and other forms of dementia,” Assoc Prof Low explained.

An International Advisory Board (IAB) including experts from neuropathology, electrophysiology, cell biological approaches and imaging has also been established to support SYNAPSE and assure its scientific excellence.

For more information on the members of SYNAPSE and SYNAPSE IAB, please refer to ANNEX.

For media enquiries, please contact:

Gwen KHOO
Senior Executive, Communications
Yong Loo Lin School of Medicine
National University of Singapore
DID: +65 6772 3783
Email: gwen.khoo@nus.edu.sg

TAN Hock Lee
Senior Assistant Director, Communications
Yong Loo Lin School of Medicine
National University of Singapore
DID: +65 6772 3756
Email: hocklee@nus.edu.sg

About the National University of Singapore (NUS)

The National University of Singapore (NUS) is Singapore's flagship university, which offers a global approach to education, research and entrepreneurship, with a focus on Asian perspectives and expertise. We have 17 faculties across three campuses in Singapore, as well as 12 NUS Overseas Colleges across the world. Close to 40,000 students from 100 countries enrich our vibrant and diverse campus community.

Our multidisciplinary and real-world approach to education, research and entrepreneurship enables us to work closely with industry, governments and academia to address crucial and complex issues relevant to Asia and the world. Researchers in our faculties, 29 university-level research institutes, research centres of excellence and corporate labs focus on themes that include energy, environmental and urban sustainability; treatment and prevention of diseases common among Asians; active ageing; advanced materials; as well as risk management and resilience of financial systems. Our latest research focus is on the use of data science, operations research and cybersecurity to support Singapore's Smart Nation initiative.

For more information on NUS, please visit www.nus.edu.sg.

About the NUS Yong Loo Lin School of Medicine (NUS Medicine)

Established in 1905, the NUS Yong Loo Lin School of Medicine is the first institution of higher learning in Singapore and the genesis of the National University of Singapore.

The School offers one of the finest undergraduate medical programmes in the Asia Pacific region and enjoys international recognition and respect. The Times Higher Education World University Rankings 2019 by subject and Quacquarelli Symonds (QS) World University Rankings by Subject 2019 list NUS Medicine as the leading medical school in Asia.

It admits 300 students to the MBBS degree programme annually and its principal missions are to educate and train the next generation of healthcare professionals, and foster research that will help to advance the practice of medicine.

The 18 NUS Medicine departments in the basic sciences and clinical specialties work closely with the Centre for Medical Education, the Centre for Biomedical Ethics, the Centre for Healthcare Simulation as well as the restructured public hospitals to ensure that teaching and research are aligned and relevant to Singapore's healthcare needs. The School is a founding institutional member of the National University Health System.

For more information about NUS Medicine, please visit http://nusmedicine.nus.edu.sg.

ANNEX

SYNAPSE Founding Members

Japan	SPring-8 http://www.spring8.or.jp/en/
Singapore	Singapore Synchrotron Light Source (SSLS) http://ssls.nus.edu.sg/
South Korea	Pohang Accelerator Laboratory (PAL) http://pal.postech.ac.kr/paleng/
Taiwan	National Synchrotron Radiation Research Center (NSRRC)https://www.nsrrc.org.tw/english/index.aspx

SYNAPSE IAB

Chairman **Professor Adriano Aguzzi** Institute of Neuropathology University Hospital Zurich	Adriano Aguzzi is a 2019 NOMIS awardee and has been full professor of neuropathology and director of the Institute of Neuropathology at the University of Zurich (Zurich, Switzerland) since 1997.
Professor Arthur Konnerth Technical University of Munich, Germany	Professor Konnerth's research has focused on exploring the basic processes underlying brain function. By means of electrophysiology, imaging and cell biological approaches, he focuses on synaptic interactions in neuronal circuits in order to achieve a better understanding of the mechanisms underlying learning and memory. A further goal is the elucidation of the neuronal defects associated with Alzheimer's disease.
Dr Shamesh Noam Champalimaud Centre for the Unknown, Portugal	During his PhD, Dr Noam harnessed advanced Magnetic Resonance Imaging (MRI) methodologies to investigate micro-architectures of highly heterogeneous and complex systems, with special emphasis on the elusive–yet equally paramount–characterizations of the brain's gray matter.