Potentiality of Sustainable Humanosphere in Contemporary India

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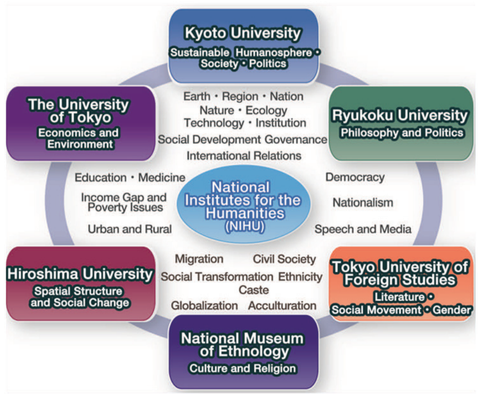
The Contemporary India Area Studies (INDAS) project aims to develop a comprehensive understanding of the present dynamism of India from a holistic and long-term perspective. The Center for the Study of Contemporary India at Kyoto University (KINDAS) serves, in collaboration with the National Institutes for the Humanities (NIHU), as the hub research center of the whole project, coordinating and organizing the cooperative research activities of the network of six INDAS Centers.



Research activities at KINDAS seek to investigate the changing process of people's lives under globalization and examine its links with the current socio-political dynamism from the perspective of sustainable humanosphere (socio-ecological environment for human life). The center aims to capture the potentiality of South Asian forms of development and democracy where the negotiation, management, and governance of socio-ecological diversity have played vital roles. It is hoped that understanding India will shed light upon a path towards a diversity-enhancing globalization. INDAS is keen to establish international collaboration in its research activities, and is about to launch a series of books titled New Horizons in South Asian Studies, which will be published by Routledge, London.

www.indas.asafas.kyoto-u.ac.jp/kindas/?lang=en

The Center for Islamic Area Studies at Kyoto University

Professor Yasushi Tonaga, Graduate School of Asian and African Area Studies
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The Islamic Area Studies Project was inaugurated in 2006 under the auspices of the National Institutes for the Humanities (NIHU) with a network of five core centers: Waseda University, The University of Tokyo, Sophia University, Kyoto University, and Toyo Bunko (The Oriental Library). The Center for Islamic Area Studies, currently in its second year, is affiliated with the Graduate School of Asian and African Area Studies of Kyoto University.

Its research is generally focused on international organizations and institutions. The center is composed of three groups. The first group focuses on international relationships in and around the Islamic world. The second researches international Sufi orders, which have been observed in most areas of the Islamic world. The third undertakes research on Islamic law and economics, including the recently developed Islamic economy.

The center has robust cooperation with several international institutions, such as the National Centre for Scientific Research (CNRS) (France), Durham University (UK), the National University of Malaysia (Malaysia) and Busan University of Foreign Studies (Korea). The center holds annual workshops and seminars with its partner institutions.

The achievements of the center's researchers and doctoral students are introduced in an annual magazine titled *Kyoto Bulletin of Islamic Area Studies* and an independent series of works titled *Kyoto Series of Islamic Area Studies*. The center aims to cultivate young researchers who will lead the next generation of Islamic studies.

www.islam.waseda.ac.jp/en/centers/kias/

Significant Enhancement in Speed of Magnetic Domain Wall by Voltage Application

Associate Professor Daichi Chiba, Institute for Chemical Research

Associate Prof. Daichi Chiba and his colleagues reported a new electrical way to control the switching speed of local magnetic bits. In magnetic recording devices, the information is saved in a huge amount of small magnetic bits as a direction of magnetic polarity (N or S pole). The magnetic domain wall (DW) is a nano-scaled twisted magnetization structure between two magnetic domains with opposite magnetic polarities. Controlling the position of a DW corresponds to a switching of the local direction of magnetic polarity, and thus, is potentially useful for the information writing process in future magnetic non-volatile memories and logic devices. A DW can be moved by applying an external magnetic field and/or electric current, and its speed depends on their magnitudes. They found that applying an electric field could change the velocity of a magnetic domain wall significantly. A field-effect device, consisting of a top-gate electrode, a dielectric insulator layer, and a wire-shaped ferromagnetic cobalt layer was used to observe the effect. A gate-voltage was applied between gate electrode and the cobalt layer through the insulator layer. They moved the DW in the cobalt wire by applying an external magnetic field, and showed that the voltage application can change the speed of the DW by more than one order of magnitude. This significant change is due to electrical modulation of the energy barrier for the DW motion. The concept presented here will be useful in reducing the energy consumption of magnetic recording media and logic devices.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120606_1.htm

New method to examine the unoccupied states of solid materials: Near-ultraviolet inverse photoemission spectroscopy

Assistant Professor Hiroyuki Yoshida, Institute for Chemical Research

Both holes and electrons play a role in organic semiconductor devices such as organic light-emitting diodes and organic photovoltaic cells. While the valence states, in which holes move, have been extensively examined by photoemission spectroscopy (PES), the unoccupied states, in which electrons travel, have been almost unexplored due to the lack of suitable experimental methods.

The unoccupied states should be examined for solid samples by injecting electrons. In this regard, inverse photoemission spectroscopy (IPES), which is a complimentary of PES, is an ideal experimental tool. The previous IPES methods, however, introduce electron radiation damage to the organic samples and have a low energy resolution of about 0.5 eV. The applicability to the study of organic semiconductors has therefore been limited. Surprisingly, such instruments have been widely used without any fundamental improvement since the late 1970s.

This research has demonstrated IPES in the near-ultraviolet (NUV) range for the first time. By lowering the kinetic energy of incident electrons below the damage threshold (typically 5 eV for most of organic materials), the sample degradation has been significantly reduced. Electrons in this energy range emit photons in the near ultraviolet range (NUV), allowing us to use high resolution optical bandpass filters. The overall energy resolution has been improved to 0.27 eV which is about two times better than in the previous instruments. The experimental scheme simultaneously solves the two critical problems of the previous IPES. This new method is expected to be widely used as a standard technique for examining the unoccupied states and determining the electron affinities of organic materials.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120511_1.htm

Separation of Supercritical Slab-Fluids to Form Aqueous Fluid and Melt Components in Subduction Zone Magmatism

Assistant Professor Tatsuhiko Kawamoto, Graduate School of Science

Subduction zone magmatism is triggered when H_2O-rich subducting plate (slab)-derived components are added, such as aqueous fluid, hydrous partial melts or supercritical fluids from a subducting slab. Chemical analyses of subduction-zone magmas suggest two slab-derived signatures of a melt and a fluid. These two liquids unite to a supercritical fluid under high-pressure and high-temperature conditions beyond a critical end point.

Dr. Tatsuhiko. Kawamoto and his colleagues showed the critical end points between H_2O and sediment (a rock at the top of a slab) or high-Mg andesite (HMA, a magma equilibrated with H_2O-rich mantle) located at 80 and 90 km depth, respectively, by using an x-ray radiography technique under high-pressure and high-temperature conditions at the SPring-8 synchrotron facility in Japan. Those depths are within the mantle wedge underneath volcanoes, which form 90–200 km above subducting slabs. The obtained data suggest that sedimental supercritical fluids are fed to the mantle wedge from the subducting slab, and then they react with mantle peridotite to form HMA supercritical fluids. Such HMA supercritical fluids separate into aqueous fluids and HMA melts at a 90 km depth during ascent. The aqueous fluids are fluxed into the asthenospheric mantle to form arc basalts, which are locally associated with HMAs in hot subduction zones. The separation of slab-derived supercritical fluids into aqueous fluids and melts elucidates such double magmatism of mantle-derived andesites and basalts, and two slab-derived signatures observed in island arc basalts.

www.pnas.org/content/109/46/18695
www.vgs.kyoto-u.ac.jp/InetHome/kawamoto/default-E.htm

Constituents of a Galaxy at 12.4 Billion Light-Years Away Revealed by ALMA

Associate Professor Tohru Nagao, the Hakubi Center for Advanced Research

How and when did galaxies with hundreds of billions of stars form and evolve? Associate Prof. Tohru Nagao and his colleagues are focusing on the chemical composition of galaxies to tackle this question. Galaxies in their evolving phase are generally covered by large amounts of dust, which blocks visible light. Furthermore, to measure their chemical composition, it is necessary to observe extremely distant and very faint galaxies. It has therefore been difficult to investigate the chemical composition of actively evolving galaxies at a great distance through visible-light observations.

To overcome this difficult situation, Nagao's team focused on millimeter-wavelength (high-frequency radio wave) observations instead of visible-light observations, since radio waves penetrate thick dust. Last year, Nagao's team observed an extremely active star-forming galaxy, LESS J0332, which is about 12.4 billion light-years away. Using the Atacama Pathfinder Experiment (APEX) telescope operated by the European Southern Observatory, they detected an emission line of carbon. However, due to the insufficient sensitivity of the telescope, they were unable to detect any other metal-ionic lines and therefore they could not explore the constituents of that galaxy.

The Atacama Large Millimeter/submillimeter Array (ALMA) international observatory, under construction in the Chilean Andes, recently solved this sensitivity problem. Using this new equipment, Nagao's team observed LESS JO332 and detected an emission line of nitrogen. By comparing the observed emission-line strength ratio with theoretical models, they revealed that its chemical composition is similar to the Sun, even though this galaxy existed when the age of the universe was only 1.3 billion years after the Big Bang. That result suggests that the chemical evolution of massive galaxies was already complete at a very early epoch in the history of the universe.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120612_1.htm
www.aanda.org/articles/aa/full_html/2012/06/aa19518-12/aa19518-12.html

Fetal Brain Development in Chimpanzees: Human Encephalization Starts in *Utero*


Associate Professor Satoshi Hirata [left] and Dr. Tomoko Sakai [right],
Primate Research Institute

The brains of humans increased dramatically in size after the emergence of the genus *Homo*. Elucidating the differences in the developmental patterns of brain structure between humans and great apes will provide important clues to understanding the remarkable enlargement of the modern human brain. Earlier studies have argued that, compared with other primates, the extraordinary brain enlargement observed in humans is due to not only the human specific pattern of postnatal brain development, but also to that of prenatal brain development. However, the prenatal trajectory of brain development has not been explored in our closest living relatives, the chimpanzees (*Pan troglodytes*). To address this lack of information, a research team led by Drs. Tomoko Sakai, Satoshi Hirata, and Hideko Takeshita (The university of Shiga Prefecture) tracked the fetal growth of the chimpanzee brain from approximately fourteen to thirty-four weeks of gestation (just before birth) using 3D ultrasound imaging for the first time. The results were compared with those obtained for the human brain during approximately the same period. They found that human and chimpanzee brains begin to show remarkable differences very early in life. In both primate species, the brain initially grows increasingly fast in the womb. After twenty-two weeks of gestation, brain growth in chimpanzees starts to level off, while that of humans continues to accelerate for another two months or more. These results suggest that maintenance of fast development of the human brain during intrauterine life appears to have emerged after the split of the two species following their evolution from a common ancestor and has contributed to the remarkable brain enlargement observed in humans.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120925_1.htm

Immunotoxin-Mediated Tract Targeting in the Primate Brain


Professor Masahiko Takada [left] and Dr. Ken-ichi Inoue [right],
Primate Research Institute

Using a neuron-specific retrograde gene-transfer vector (NeuRet vector), the research team led by Prof. Takada and Dr. Inoue established immunotoxin (IT)-mediated tract targeting in the primate brain that allows ablation of a neuronal population constituting a particular pathway. They attempted selective removal of the cortico-subthalamic “hyperdirect” pathway. In conjunction with the direct and indirect pathways, the hyperdirect pathway plays a crucial role in motor information processing in the basal ganglia. This pathway links the motor-related areas of the frontal lobe directly to the subthalamic nucleus (STN) without relay at the striatum. After electrical stimulation in the motor-related areas such as the supplementary motor area (SMA), triphasic responses consisting of an early excitation, an inhibition, and a late excitation are usually detected in the internal segment of the globus pallidus (GPi). Several lines of pharmacophysiological evidence suggest that the early excitation may be derived from the hyperdirect pathway. In the present study, the NeuRet vector expressing human interleukin-2 receptor α-subunit was injected into the STN of macaque monkeys. IT injections were then made into the SMA. In these monkeys, single neuron activity in the GPi was recorded in response to the SMA stimulation. They found that the early excitation was largely reduced with neither the inhibition nor the late excitation affected. The spontaneous firing rate and pattern of GPi neurons remained unchanged. This indicates that IT-mediated tract targeting successfully eliminated the hyperdirect pathway selectively from the basal ganglia circuitry without affecting the spontaneous activity of STN neurons. The electrophysiological finding was confirmed with anatomical data obtained from retrograde and anterograde neural tracings. The present results define that the cortically-driven early excitation in GPi neurons is mediated by the hyperdirect pathway. The IT-mediated tract targeting technique will provide us with novel strategies for elucidating various neural network functions.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2012/120626_1.htm