

CV (Tetsuya SATO)

Born in Kobe, Japan on December 14, 1939

Graduated from Kyoto University (Department of Electronics, Faculty of Engineering) (1963)

Received Master of Electronics from Department of Electronics, Faculty of Engineering, Kyoto University (1965)

Received Doctor of Engineering from Kyoto University (1969)

Presently,

Emeritus Professor of National Institute of Fusion Science (NIFS)

Emeritus Professor of Graduate University of Advanced Studies (GUAS)

Emeritus Professor of University of Hyogo

Associate member of Science Council of Japan

Member of Education and Research Council of National Institute of Natural Sciences (NINS)

Member of Steering Committee of Research Institute for Humanosphere, Kyoto University

Member of Council of ITO International Education Exchange Foundation

Professional Career:

Assistant Professor of Kyoto University (Physics), 1967-1973

Associate Professor of University of Tokyo (Institute of Geophysical Research), 1974-1980

Professor of Hiroshima University (Institute for Fusion Theory), 1980-1989, and also Professor of Nagoya University, 1984-1986 and Professor of Institute for Space and Aeronautical Sciences (1983-1986)

Founded the Theory and Computer Simulation Center at National Institute for Fusion Science (NIFS), became Director of the Center and Professor (1989-2003), and also held the position of Vice-President of NIFS (1995-1999)

Played the role of establishing the Fusion Science Course at GUAS, and also held Professor of GUAS ((1991-2003))

Director General of the Earth Simulator Center at JAMSTEC (2002-2009)

Professor and Chair of Establishment Committee of the Graduate School for Simulation Studies, Hyogo University (2009) which was established in 2011

Dean of the Graduate School for Simulation Studies, University of Hyogo (2011-2013)

Councilor of Hyogo University (2013-2014)

Oversea Career:

NRC-NAS Resident Research Associate at NOAA, Boulder (1971-1972)

Alexander Von Humboldt Stipendiat at MPI, Garching (1972-1973)

Visiting Scientist of PPPL, Princeton University (1979-1980)

Research Associate of Bell Telephone Laboratory, Murray Hill (1980)

Consultant of Institute of Geophysics and Planetary Physics, UCLA (1981-1985)

Awards received

Tanakadate Award (Geophysics) (1975):

Nishina Memorial Award (Physics) (1986)

Computational-World Honors 21st Century Achievement Awards, International (Earth Simulator)) (2003)

Tokyo Creation Grand Award (Earth Simulator) (2004)

Dawson Award on Simulation Science of Plasmas, International (Plasma Simulation) (2005)

Honorary Member of Society of Geomagnetism and Earth, Planetary and Space Sciences (SGEPSS) 2014

Academic Activities (National and International)

Since there are too many, pick up only some of them in the following;

International;

Established the ISSS (International School for Space Simulation) in 1980 which is still actively functioning)

Editor-in-Asia of Geophysical Research Letter (GRL), American Geophysical Union (AGU) 1982-1986

Associate Editor of Journal of Geophysical Research (JGR), AGU 1985-1987

Executive Secretary of UA-Japan Inter-Governmental Science Cooperation Program on Nuclear Fusion Research from 1989 till 2001

International Advisory Committee of ICPP (International Conference on Plasma Physics) 1994-2001

Policy Board Member of NERSC (National Energy Research Scientific Computing Center), USA, 2003-2006

Member of International Review of Research Using HPC in UK, 2005

HPC Acquisition Panel Member, USA, 2006

Member of Science Review Toward 2020, Microsoft, 2007

Member of the Scientific Advisory Board (SAB) for the IHPC, Singapore 2007-2011

National;

Editor of Computational Science Discovery (CSD) 2007-2011

Editor of Environmental Research Letters (ERL) 2008-2012

Chair of the External Review Committee of Research Institute for Humanosphere, Kyoto University, 2012

Chair (2007) and member (2009 and 2013) of the Selection Committee of Director-General of NINS-NIFS

Member of the Selection Committee of Director General of NINS-Institute of Molecular Sciences, 2009 and 2013

Member of the Selection Committee of the President of NINS (National Institute of Natural Sciences) 2013

Member of the Selection Committee of Director-General of NINS-NIFS 2014

Research Highlights of Prof. Tetsuya Sato

Prof. Sato published over 300 refereed papers in scientific journals, including Science and Nature, numerous articles, over 20 books including co-authored and over 40 Review papers. His activities were reported numerous by domestic and international news media, TV and specialized journals.

With the encounter with the first-generation hand-made semiconductor computer at Kyoto University in 1962, prof. Sato's entire academic and research career was destined to devote himself to the development and promotion of the simulation science.

His Master course and Doctor course researches (1963-1968) were the first real simulation work which clarified the whole lifetime of nonlinear development of the ionospheric irregularities caused by the cross-field (gradient-drift) plasma instability (Ref.1). This work was the first success of a fully-nonlinear study by using an electronic computer and in fact stimulated the Cornell University group in US and other groups

in the world over the half-century thereafter. At that time, in plasma physics, as well as, other physics fields, the analytical (linear and quasi-linear) approach was in full flourish. However, prof. Sato has early realized that any phenomena occurring in the real world are ever nonlinear and complex. Such realization that any real phenomena occurring in Nature are highly complex, never simple, has pushed him to challenge the field of complex phenomena; in particular, “self-organization” and directed him to use an electronic computer as an fundamental tool in further entire scientific activities. While keeping the academic position at the universities and national research organization (1967-2002), prof. Sato’s principal theme was ever the elucidation of fascinating self-organization phenomena.

Some of epoch-making scientific works are shown in the following:

(1) Discovery of Externally Driven Magnetic Reconnection as a powerful energy conversion mechanism in a magnetized plasma in 1978 (Ref.2). This reconnection process has been keeping interests of numerous simulation researchers and is now widely believed to be the cause of sudden energy explosion phenomena in astrophysical and space events, such as, magnetospheric substorms, solar flares and jet streams in galaxies. That research on externally driven magnetic reconnection is now widely recognized as a seminal work on magnetic reconnection.

(2) Theory of auroral arc formation in polar light in 1978 (Ref.3). This is the self-consistent 3D theoretical work that elucidates the generation of auroral arcs as a result of a three-dimensional feedback interaction between the magnetosphere and the ionosphere by solving the MHD magnetosphere and the ionospheric dynamics in a self-consistent way.

(3) In 2005, prof. Sato devised an innovated simulation algorithm that is named the Macro-Micro Interlocked (MMI) methodology (Ref.4). A real complex phenomenon, which is observed both in laboratory and in nature, always arises as a result of a macroscopic (fluid-like) process and a microscopic (particle-like) process. No matter how powerful computer one can develop, however, one can never solve directly exact evolution of a system because of the astronomically large number of freedom, e.g. greater than order 10 to the 40^{th} . The MMI methodology provides a really smart way of attacking such a macro-micro coupled complex phenomenon. Applying this MMI algorithm to the auroral arc formation predicted by the Sato theory (Ref.3), a grand 3D simulation study was performed and succeeded in demonstrating that globally colorful auroral arcs are generated as a result of a global magnetosphere-ionosphere feedback MHD instability and developed by bombarding energetic electrons with broad spectra concurrently generated locally along magnetic field lines by ion-acoustic double layers.

(4) The existence of Ion Acoustic Double Layers causing auroral electron acceleration was already discovered by earlier particle simulation work in 1978 (Ref.5). Above work was notable in that a puzzling mechanism of accelerating magnetospheric low energy electrons, say less than 100 eV, to high energy auroral electrons greater than 1keV, was found. Observationally the existence of such double layers was confirmed much later.

(5) Generation of Dipole Geomagnetic Field and its Intermittent Reversals in 1997 and 2002 (Ref.6). The century-long puzzle of the existence of the dipole geomagnetic field was disclosed by Sato and his coworkers, along with and the sudden and repeated irregular reversals of the magnetic field polarity by simulations on large supercomputers.

Since 2002 prof. Sato was appointed as Director General of the Earth Simulator Center (ESC) in Yokohama; which was the fastest supercomputer in the World from 2002 to 2004, for the first time ever taking over the US leadership. He devoted himself

in opening up a new frontier area of Simulation Science as the world leader, rather than deepening the conventional simulation research consisting of the elucidation of individual nonlinear processes in science and engineering. The most outstanding outcome was to really open the door to Future Science. The essential point of opening up of Future Science is to enable to perform all-in-one (Holistic) simulations, namely, simulation of the whole system at once using such as the MMI algorithm. This is because only by doing simulation for the complete system self-consistently without imposing any artificial boundary conditions one can have a scientifically credible prediction of the future evolution of a real system. During prof. Sato's leadership of the Earth Simulator (2002-2008), the predictive science of the global warming, the earthquake and other global phenomena has been dramatically developed and the age of the Holistic (all-in-one) simulation has dawned.

After the shutdown of the Earth Simulator in 2008, Prof. Sato moved to opening up a brand new science at the University of Hyogo. He believed that by the dawning of the holistic simulation based on the Earth Simulator the conventional simulation science would ever keep producing fruitful results in natural science such as, e.g. the bio-science. Therefore, he turned his attention to opening up a new simulation field where the human's existence is the main target rather than elucidating mechanisms of natural phenomena and man-made products.

While, the dramatic Lehman Brothers bankruptcy shock happened on September 15 of 2008; prof. Sato thought that this would be nothing but the warning from the Nature that the modern Western paradigm based on the principle of competition and capitalism has already matured and approaching the end. He thus appeals strongly for urgency and significance of the paradigm shift from the competition paradigm to the new paradigm based on the Japanese spirit of "Wa"- harmony and equality, namely, his honest appeal of the paradigm shift from "Reductionism" to "Holism". In 2011 he succeeded in establishing a new graduate school at University Hyogo with a basic goal to gradually spread the new paradigm "Wa" in a bottom-up fashion with the help of supercomputers in the modern society where the paradigm of competition and capitalism are prevailing. He named this approach "Socio-simulationics".

In educational achievements, prof. Sato's long and fruitful academic career was devoted to the development and cultivation of young scientists, also by supervising more than twenty PhD candidates, including Chinese, Korean, Brazilian and Serbian graduate students, and by promoting to elite academic ranks over ten full professors. In addition, during a career he served in many international activities, such as review panel expert and committee member.

References (selected)

- Ref.1: Radio Science 1, 212-225, 1967; Phys. Fluids 10, 1262-1268, 1967;
J. Geophys. Res.(JGR) 74 1969,2923-2932
- Ref.2: JGR 83, 217-220, 1978; Phys. Fluids 22, 1189-1202, 1979
- Ref.3: JGR 83, 1042-1047, 1978
- Ref.4: J. Phys.(Conference Series 16), 310-316, 2005; Computational Science and
Discovery(CSD) 2, 1-9, 2009
- Ref.5: Phys. Rev. Lett. (PRL) 44, 740-743, 1980; JGR 86, 3357-3368, 1981
- Ref.6: Phys. Fluids B 5, 2793-2805, 1993; Phys. Plasmas 2, 1421-1431, 1995
- Phys.Rev.E 55, 4617-4626, 1997
- Science 295, 1887-1890, 2002
- Nature 454, 1106-1109,2008
- Nature 463, 793-796, 2010