



Aug 16, 2019

Association of Asia-Pacific Physical Societies (AAPPS)  
Division of Plasma Physics (AAPPS-DPP)

## Subramanyan Chandrasekhar Prize of Plasma Physics

– Professors Liu Chen and Kazunari Shibata are selected as 6th (2019) Laureates –

The Division of Plasma Physics (Chair: Mitsuru Kikuchi) under the Association of Asia Pacific Physical Societies (President: Gui-Lu Long) has selected Professor Liu Chen of the Zhejiang University/University of California, Irvine and Professor Kazunari Shibata of Kyoto University as the 6<sup>th</sup> (2019) Laureates of S. Chandrasekhar Prize of Plasma Physics, which is awarded to scientists who have made seminal / pioneering contributions in the field of plasma physics.

### Citations

**Liu Chen** : *For his pioneering and seminal theoretical contributions to physics of both magnetic fusion and space plasmas; including, notably, geomagnetic pulsation theory, nonlinear gyrokinetic theory, Alfvén wave heating and kinetic Alfvén waves, toroidal Alfvén eigenmodes, "fishbone" and energetic particle modes, and excitation of zonal flow in toroidal plasmas.*

**Kazunari Shibata**: *For his pioneering and seminal contributions in solar and astrophysical magnetohydrodynamics (MHD), including the first non-steady MHD numerical simulations of astrophysical jets from magnetic accretion disks, the discovery of coronal X-ray jets and chromospheric anemone jets in the solar atmosphere and theories and numerical simulations for solar jets and mass ejections based on the MHD reconnection mechanism, his pioneering proposal of plasmoid-induced-reconnection and fractal reconnection, and his suggestion that superflares, observed on Sun-like stars, may also occur on the Sun.*

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## On the achievements of Professor Liu Chen



Professor Liu Chen

Prof. Liu Chen was born in 1946 at Hangzhou, received his Bachelor’s degree from National Taiwan University in 1966, and took his Ph. D thesis at University of California, Berkeley in 1972. After working at Bell Laboratory with A. Hasegawa, he worked in Princeton Plasma Physics Laboratory (PPPL) (1974-1993). Then, he moved to UC Irvine as Professor (1993-2012) and since 2012 he is above-scale professor of physics (Emeritus). He founded the Institute of Fusion Theory and Simulation at Department of Physics, Zhejiang University in 2006 and, since 2016, he has been the Director Emeritus.

He published a celebrated paper (JGR1974) with A. Hasegawa at Bell laboratory on the theory of experimentally observed Long-Period Magnetic Pulsation in the magnetosphere as a coupling between the solar wind perturbations at the magnetopause and the shear *Alfvén* waves. This paper has received 940 WoS citations and 1145 Google citations.

He developed a nonlinear gyrokinetic equation with E. Frieman in PPPL (Phys. Fluids1982); which averages out fast gyro motion to arrive at a kinetic equation for low frequency electromagnetic waves. Nowadays, the nonlinear gyrokinetic equation is one of the most powerful equations in plasma physics. This paper has received 523 WoS citations and 770 Google citations.

He also discovered key physics of *Alfvén* waves such as *Alfvén* waves heating through spatial resonance (PRL1974, Phys.Fluids1974) and kinetic *Alfvén* wave (PRL1975, Phys. Fluids1976) with A. Hasegawa; as well as *Alfvén* wave – energetic particle interactions such as “Fishbone” oscillation as energetic particle-driven internal kink mode (PRL1984), prediction of EPM (Energetic particle mode) in the *Alfvén* continuum (Phys. Plasmas1994), and *Alfvén* eigenmode as the discrete gap mode (Ann. Phys. 1985).

He also successfully developed a theory of zonal flow driven by drift-wave turbulence in toroidal plasma using ballooning representation as a key mechanism of self-regulation of plasma turbulence (Phys. Plasmas2000).

His total citation is 10, 868 in Web of Science with H-index=54 and is 14,082 in Google Scholar citation with H-index=61. Due to his outstanding research accomplishments illustrated above, he is the recipient of a number of prestigious awards; notably, *J.C. Maxwell Prize* from American Physical Society in 2012 and *Hannes Alfvén Prize* from European Physical Society in 2008.

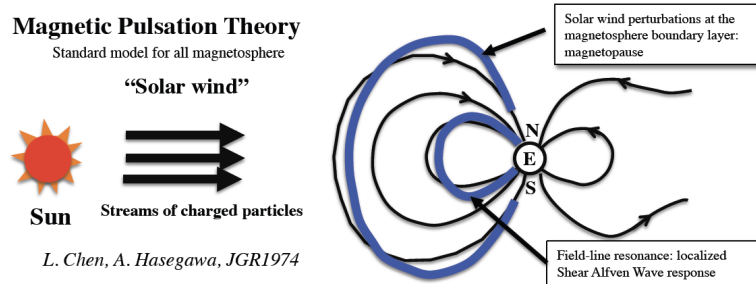


Fig. 1 Liu Chen’s Magnetic Pulsation Theory

### Magnetic Fusion “Fishbone Mode” Theory

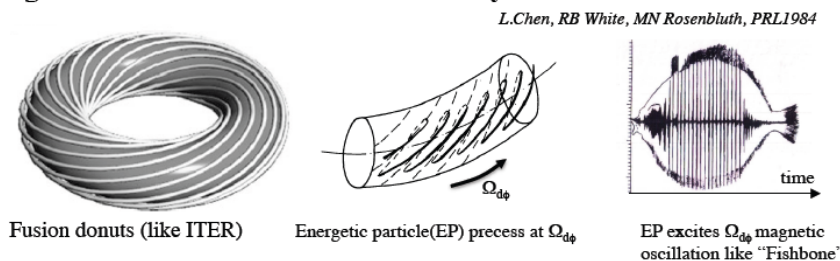


Fig. 2 Liu Chen’s “Fishbone Mode” Theory

## On the achievements of Professor Kazunari Shibata



Professor Kazunari  
Shibata

Prof. Kazunari Shibata was born in 1954 at Osaka and got his PhD degree at Kyoto University in 1983. After working at Aichi University of Education and National Astronomical Observatory of Japan for 16 years, he has been a professor at Kwasan and Hida Observatory of Kyoto University since 1999. From 2004, he has been Director of Kwasan and Hida Observatory until this March (2019). He served for community as President of Astronomical Society of Japan during 2017-2019.

He discovered the physical origin of astrophysical jets in collaboration with Prof. Uchida (PASJ1985, PASJ1986), i.e., the astrophysical jets are accelerated by the strong Lorentz force associated with the twisted magnetic field in the accretion disk. He also demonstrated the same mechanism working for the relativistic jets from

black holes (Science 2002).

He discovered X-ray jets in the solar corona (as seen in the left panel of Figure 1) and X-ray plasmoid ejections from solar flares using the soft X-ray data observed by the Yohkoh satellite (PASJ1992, ApJL1995). He then developed a magnetic reconnection model of coronal X-ray jets (Nature1995) (as seen in the right panel of Figure 1). More recently, he discovered smaller anemone-shape jets in the solar chromosphere using the Hinode satellite data (Science2007). He proposed a unified model, i.e., plasmoid-induced magnetic reconnection model, to explain all kinds of jets, solar flares, and even corona mass ejections (CMEs). The model has been recognized world-widely. His unified reconnection model of solar flares, especially of jets, has revolutionized our understanding of solar eruptions.

In recent years, he has been focusing on superflares on solar-type stars (as seen in Figure 2), and found that superflares of 1000 times more energetic than the currently-largest solar flares may occur once in 5000 years on the Sun! The result has a strong impact on the public.

Prof. Kazunari Shibata has published more than 290 papers in refereed journals. According to Google scholar, these papers have been cited more than 21,000 times, and his H-index is 78. His total citation in Web of Science is ~14,000 and his H-index is 64. He has also trained tens of PhD students and many postdocs from Japan and other Asian-Pacific countries, e.g., China and India. He is the recipient of FY2001 Chushiro Hayashi Prize of Astronomical Society of Japan.

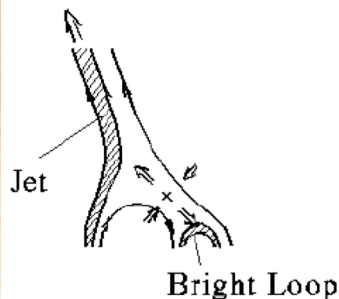
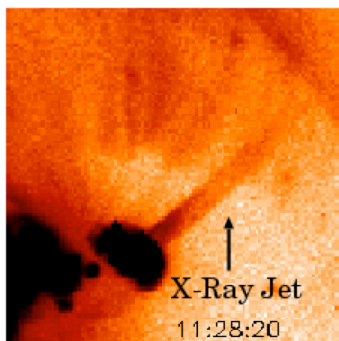


Fig. 1. Left: A soft X-ray jet in the solar corona; Right: Theoretical model

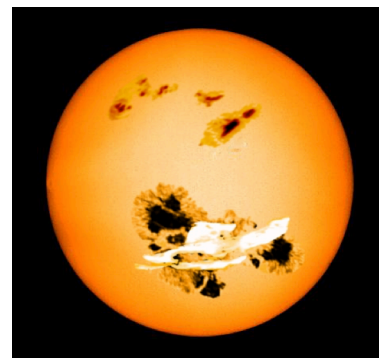


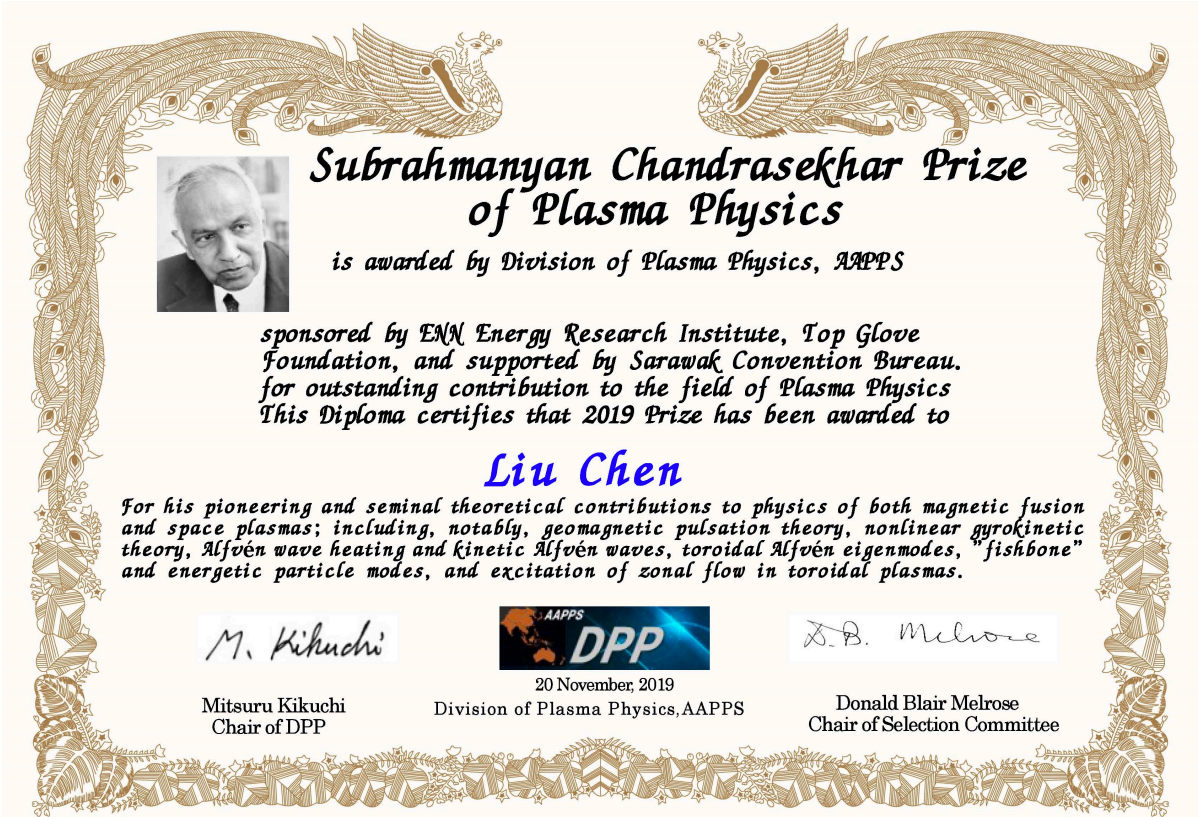
Fig. 2. An imaginary superflare occurring on a solar-type star





**Appendix-1: Certificates of 2019 S. Chandrasekhar Prize of Plasma Physics**

Certificate and medal will be given at the 14th Asia-Pacific Physics Conference in November 20 at Kuching, Malaysia.




**Subrahmanyan Chandrasekhar Prize of Plasma Physics**  
is awarded by Division of Plasma Physics, AAPPS

*sponsored by ENN Energy Research Institute, Top Glove Foundation, and supported by Sarawak Convention Bureau. for outstanding contribution to the field of Plasma Physics This Diploma certifies that 2019 Prize has been awarded to*

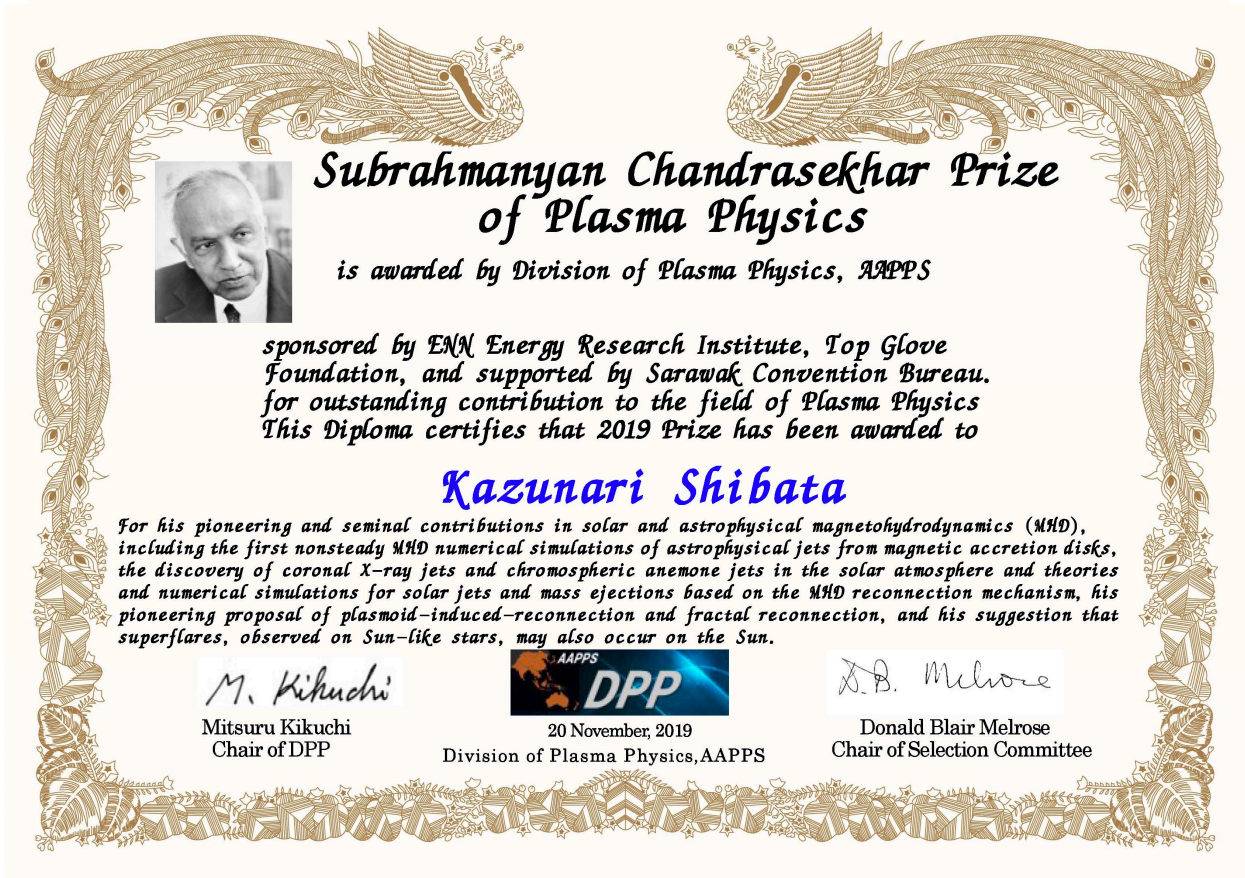
**Liu Chen**

*For his pioneering and seminal theoretical contributions to physics of both magnetic fusion and space plasmas; including, notably, geomagnetic pulsation theory, nonlinear gyrokinetic theory, Alfvén wave heating and kinetic Alfvén waves, toroidal Alfvén eigenmodes, "fishbone" and energetic particle modes, and excitation of zonal flow in toroidal plasmas.*

*M. Kikuchi*  
Mitsuru Kikuchi  
Chair of DPP

  
20 November, 2019  
Division of Plasma Physics, AAPPS

*D. B. Melrose*  
Donald Blair Melrose  
Chair of Selection Committee




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**Kazunari Shibata**

*For his pioneering and seminal contributions in solar and astrophysical magnetohydrodynamics (MHD), including the first nonsteady MHD numerical simulations of astrophysical jets from magnetic accretion disks, the discovery of coronal X-ray jets and chromospheric anemone jets in the solar atmosphere and theories and numerical simulations for solar jets and mass ejections based on the MHD reconnection mechanism, his pioneering proposal of plasmoid-induced-reconnection and fractal reconnection, and his suggestion that superflares, observed on Sun-like stars, may also occur on the Sun.*

*M. Kikuchi*  
Mitsuru Kikuchi  
Chair of DPP

  
20 November, 2019  
Division of Plasma Physics, AAPPS

*D. B. Melrose*  
Donald Blair Melrose  
Chair of Selection Committee

## Appendix-2: Glossary

### 1. Subrahmanyan Chandrasekhar

Astrophysicist born in India. He received the Nobel Prize in Physics in 1983 *for his theoretical studies of the physical processes of importance to the structure and evolution of stars*, including the Chandrasekhar limit on the mass of white dwarf stars. His research covered several broad areas, as seen from his texts, which included *Principles of Stellar Dynamics* (1942), *Hydrodynamics and Hydromagnetic Stability* (1981), and an influential book based on his lecture notes in *Plasma Physics* (1960).

### 2. AAPPS: Association of Asia-Pacific Physical Societies

(HP: <http://www.aapps.org/main/index.php>)

The Association of physical societies in the Asia Pacific region founded by the Nobel Laureate in Physics C.N. Yang, and Professor Akito Arima in 1983. The AAPPS held the 12<sup>th</sup> Asia Pacific Physics Conference under the president (at that time) Shoji Nagamiya in Makuhari, Japan. The current president is Professor Gui-Lu Long, Tsinghua University, China.

### 3. AAPPS-DPP: Division of Plasma Physics, AAPPS

(HP : <http://aappsdp.org/AAPPSDPPF/index.html> )

The first division under the AAPPS based on the success of the plasma physics program in the APPC-12. This division was formed in January 2014 based on the recommendation of Professor Nagamiya at the AAPPS council. From Nov 28, 2018, AAPPS-DPP becomes legal entity.

### 4. Subrahmanyan Chandrasekhar Prize of Plasma Physics

Subrahmanyan Chandrasekhar Prize of Plasma Physics is a top plasma physics prize founded by the AAPPS-DPP in July 2014 and is endorsed by AAPPS. This prize is given to a plasma physicist annually for pioneering and/or seminal contribution to plasma physics. The prize recipients were Professor S. Ichimaru (2014), Professor P. Kaw (2015), Professor D. Melrose (2016), Professors C.Z. Cheng and Lou C. Lee (2017) and Toshiki Tajima (2018) (<http://aappsdp.org/AAPPSDPPF/prizetable.html>). The 2019 prize is sponsored by ENN Energy Research Institute, Top Globe Foundation, and supported by Sarawak Convention Bureau.

The 2019 Selection Committee composed of leading plasma physicists in Asia-Pacific region.

Chairman : Professor Donald Melrose (University of Sydney)

Members : Professor Sanae I. Itoh (Kyusho University),

Professor Yasushi Ono (The University of Tokyo),

Professor Ding Li (Institute of Physics, Chinese Academy of Science),

Professor Guosheng Xu (Institute of Plasma Physics, Chinese Academy of Science),

Professor Yong-Seok Hwang (Seoul National University)

Professor Jungyeon Cho (Chungnam National University)

Professor Robert Dewar (Australian National University)

Professor Ravindra Kumar (Tata Institute of Fundamental Research)

Professor G.C. Anupama (Indian Institute of Astrophysics)

Professor Lin Ni Hau (National Central University)

Professor Kerchung Shaing (National Cheng Kung University)

### 5. H-index:

The definition of the index is that a scholar with an index of  $H$  has published  $H$  papers each of which has been cited in other papers at least  $H$  times