The 2022 Subrahmanyan Chandrasekhar Prize of Plasma Physics awarded to Arnab Rai Choudhuri

The Division of Plasma Physics (DPP) under the Association of Asia Pacific Physical Societies (AAPPS) has selected Arnab Rai Choudhuri (Indian Institute of Science, Bengaluru) as the 2022 Laureate of the Subrahmanyan Chandrasekhar Prize of Plasma Physics. The 2022 Selection Committee consisted of leading plasma physicists, including Rajaraman Ganesh (Institute for Plasma Research, Gandhinagar) and Ravindra Kumar (Tata Institute of Fundamental Research, Mumbai). The certificate and medal were awarded virtually at the Sixth Asia-Pacific Conference on Plasma Physics on-line e-Conference (AAPPS–DPP2022, http://aappsdpp.org/DPP2022/index.html) during 9–14 October 2022. The Prize named in honour of Nobel laureate Subrahmanyan Chandrasekhar was founded in 2014 by AAPPS–DPP, and is awarded annually for seminal contributions in the field of plasma physics[1]. The previous laureates are Setsuo Ichimaru (2014), Predhiman Krishan Kaw (2015), Donald Blair Melrose (2016), Chio Zong Cheng and Lou-Chuang Lee (2017), Toshiki Tajima (2018), Liu Chen and Kazunari Shibata (2019), Hyeon Keo Park (2020) and Taik Soo Hahm (2021). Choudhuri and Kaw are the only Indians among the 11 laureates of this prize over nine years[2,3].

The diverse contributions of Choudhuri are recognized by the following citation: 'For the key role in developing the flux transport solar dynamo model of the 11-year sunspot cycle, and for using this model to provide theoretical explanations of many solar phenomena, as well as the first successful dynamo-based prediction of a sunspot cycle.'

Choudhuri is recognized for his fundamental contributions to the theoretical study of magnetohydrodynamic processes in astrophysics, particularly those related to the Sun. Using computer simulations, he showed how the bipolar sunspots form by the buoyant rise of magnetic flux tubes from the solar interior to the surface[4]. Based on the magnetic classification, a bipolar sunspot group has a positive and negative polarity (or bipolar) with a simple division between the polarities. These simulations demonstrated that the magnetic field in the solar interior must be significantly stronger than that predicted by other models. This gave birth to the 'flux transport dynamo model'[5,6]. This model provides an excellent explanation of a variety of solar phenomena, including the 11-year sunspot cycle and accurately predicts the strengths of the sunspot cycles. The model also clarifies the variations in the sunspot cycle. Choudhuri and collaborators were the first to make a valid prediction (in 2007) of the sunspot cycle before its onset[7]. This was for cycle 24, which reached its peak around 2014. Their prediction included a comprehensive model of grand minima like the Maunder minimum (time intervals during which sunspots became exceedingly infrequent) during 1645–1715, when sunspots were rarely seen. Choudhuri has also worked on active galaxies, extragalactic jets, neutron stars and pulsars.

In 2005, Choudhuri generously released the simulation code named Surya (developed by him and his collaborators) for solving the basic equations of solar dynamo theory. The freely available code is widely used in the plasma community worldwide. He served as the Convener (2000–07) of the Joint Astronomy and Astrophysics Programme at the Indian Institute of Science (IISc), Bengaluru. He has authored two advanced textbooks used worldwide[8,9] and a popular science book[10].

Choudhuri is an alumnus of Presidency College, Kolkata, and the Indian Institute of Technology (IIT), Kanpur. He completed his Ph.D. in 1985 from the University of Chicago, USA under the supervision of the renowned plasma physicist, Eugene Newman Parker. Since 1987, Choudhuri has been based at IISc. He is an elected Fellow of the Indian National Science Academy, Indian Academy of Sciences and The World Academy of Sciences.

In addition to the Subrahmanyan Chandrasekhar Prize of Plasma Physics, there are other awards instituted by AAPPS–DPP, including the Plasma Innovation Prize (in recognition for seminal/pioneering contributions in the field of plasma applications, focusing on impacts on industry, established in 2019). The previous winners are Roderick William Boswell (in 2019), Masaru Hori (2020) and Anthony (Tony) Bruce Murphy (2021). The 2022 prize has been withheld.

The other awards instituted by AAPPS–DPP are the Young Researcher Award (established in 2016 for the age group: 30–40 years), U30 Doctoral Scientist/Student Award (established in 2018 for the age group under 30 years) and the Poster Prize (established in 2018 and selected from the Annual Asia-Pacific Conferences on Plasma Physics). Indians have been faring well in the aforementioned prizes. Dhanya Mahalingam Balaram was among the four recipients of the inaugural Young Researcher Award (2016). Swarniv Chandra (Kushmandi Government College, Kushmandi) was one of the eight recipients of the 2022 Young Researcher Award. Gopal Hazra and Laishram Modhuchandra Singh were two of the six recipients of the inaugural U30 Award (2018). Among the six 2019 U30 award recipients, there were two Indians – Sudip Mandal and Rupak Mukherjee. Recipients of the inaugural Poster Prizes (2018) were Punit Kumar, Teena Jangid and Ram Prasad Prajapati. In the following years, the recipients were Deepika Behmani, Sushanta Barman and Swati Swagatika Mishra (2020), and Swati Dahiya, Kalyani Barman and Shrish Raj (2021). Among the 66 posters in 2022, 12 were selected for prizes, which included three from India. They were by Swati Swagatika Mishra, Sushanta Barman and Kalyani Barman (all from IIT Kanpur). The nominations close in April of each year[1].

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Sameen Ahmed Khan, Dhofar University, Department of Mathematics and Sciences, College of Arts and Applied Sciences, Salalah, Sultanate of Oman.
e-mail: rohelakhan@yahoo.com