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GUEST EDITORIAL

Special Issue on Astrochemistry and Astrobiology

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The special issue on Astrochemistry and Astrobiology in the *Journal of the Indian Institute of Science* was planned to highlight the importance of these emerging areas, in a broader context of space explorations, in the World and India. Indian Institute of Science has played a huge role in the space explorations of India, as the founding Chairman of the Indian Space Research Organization (ISRO), Prof. Satish Dhawan, was also the then Director of the Indian Institute of Science. A human–space mission has been announced by ISRO recently and space biology will be important for this endeavor. Historically, all studies on planets and interstellar medium were denoted as astronomy and astrophysics, though the importance of chemistry was always recognized. Studies on interstellar molecules and their origin involve complex physics and chemistry leading to the establishment of astrochemistry as a discipline on its own. Origin of life on our planet earth remains a mystery and search for the molecules of life and astrobiology (search for life or potential habitable environments beyond Earth) began in parallel.

A search for 'astrochemistry' and 'astrobiology' in the ISI Web of Knowledge gives interesting details. The search was repeated with a condition that address contains 'India'. Data for astrochemistry in the world begin in 1971 and astrobiology begin in 1983. When the address included India, the first paper containing 'astrochemistry' was published in 1992 and 'astrobiology' was published in 2000. The growth in both these fields became significant in this millennium. Not surprisingly, astrobiology has overtaken astrochemistry in terms of the number of publications. As of July 2023, Web of Knowledge has about 9900 publications containing astrobiology and about 5100 publications containing 'astrochemistry' throughout the world. When the address included India, this reduced to 150 for astrobiology and 182 for astrochemistry. Clearly, the contributions to these important fields from India are marginal at best. The Editors of this special issue have discussed this at various times and have been trying to highlight the importance of research in this area. This issue is one of the results.

This special edition had been in works since before the COVID-19 pandemic, which not only took about three years away from our precious time, but it also took many colleagues, friends, family members, and many more away from us. Three years later, the whole world is trying its best to get back to "Normal". However, none understands that it is not the "Old Normal", but a post-pandemic "New Normal". People are still physically and psychologically affected by the Pandemic, and it is our duty as Scientists to analyze, understand, and implement corrections to human behavior to minimize the tragedy should another similar pandemic to be faced in the future.

What is the context of COVID-19 to Astrochemistry and Astrobiology? There is a lot. Astrochemistry is an emerging area of Space Sciences research that focuses on understanding how chemical processes occur on other planets, moons, extrasolar planets, and the space between stars (interstellar medium). Astrochemistry provides us a context how prebiotic molecules could have been made and delivered to many potentially habitable planets/moons, including Earth—that we know is inhabited. Similarly, astrobiology is also an emerging area of Space Sciences research that focuses on understanding whether life can exist in space beyond Earth—on planets, exoplanets, moons, or even space. Astrobiology also focuses to understand how life on Earth could evolve in space environment—from bacteria to humans.

While we hoped to have a comprehensive collection of contributed articles covering both astrochemistry and astrobiology, we realized that post-pandemic adjustments made many colleagues to hesitate to commit for another article, while others really put a lot of effort in submitting

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articles to this special issue. We thank both, especially those who submitted articles, revised them to final forms.

It is our aim to bring articles together to give the community an opportunity to appreciate how far we progressed and engage in research activity to take it from now into the future. It is hoped that this issue will inspire more present and future scientists and help in advancing this field in the World and in India.

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Not applicable.

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Elangannan Arunan is currently the Chair and Professor at the Inorganic and Physical Chemistry Department, Indian Institute of Science, Bangalore. His current research interests include microwave spectroscopy, hydrogen bonding and other intermolecular bonding, chemical kinetics and dynamics, astrophysics and astrochemistry. He was a member of the International Editorial Advisory Board of PCCP during 2005-–2016. He is an Editor of the Journal of Molecular Structure and is on the editorial board of the Journal of Molecular Spectroscopy and the Journal of the Indian Institute of Science. He chaired the IUPAC task group that redefined hydrogen bonding in 2011. His group proposed the carbon bond, analogous to the hydrogen bond, with carbon acting as an electron acceptor. He edited the 100th Volume of the Journal of the Indian Institute of Science coinciding with the 100th year of the Latimer and Rodebush paper explicitly discussing the hydrogen bonding in water.

Murthy S. Gudipati born and raised in southern India and went to several schools in rural villages and urban colleges before receiving M.Sc. (1981) at the University of Hyderabad, India, and Ph.D. (1987) at the Indian Institute of Science, Bangalore, India. After a 3-year post-doctoral collaboration with Prof. Josef Michl (at Austin, Texas), he joined University of Cologne, Germany, in 1990, where he was awarded Habilitation in Physical Chemistry (tenure) in late 1998. In 2007, he joined NASA's Jet Propulsion Laboratory where he studies the evolution of ices in the universe. He is actively involved in Europa Clipper Mission as a Co-I and Investigation Scientist. Most recently, he was involved in Rosetta mission to comet 67P/Churyumov- Gerasimenko. He has been working on putting a cryogenic comet sample return mission concept to bring deeper parts of a comet's nucleus, which could hold the secrets of our early solar system. In- situ instrumentation for solar system missions is another area of work that he enjoys, maturing the technology readiness level (RTL) of laboratory instrumentation to space instrumentation.

Kasthuri J. Venkateswaran Kasthuri J. Venkateswaran's extensive 47+ years of research experience in marine, food, and environmental microbiology holds immense significance in our understanding of microbial life across diverse habitats. As the leader of the ISS Microbial Observatory projects, he has pioneered efforts to characterize microorganisms within U.S. nodes and the Kibo Japanese Experiment Modules. This has provided vital insights into the microbial dynamics in space environments—a frontier not widely studied before. By employing molecular microbial analysis, he has deepened our grasp of the ecological roles and behaviors of microbes. Moreover, his field studies in extreme environments, ranging from the enigmatic deep sea to the challenging confines of the International Space Station, highlight his dedication to unraveling the mysteries of life in some of Earth and space's harshest settings. His work plays a critical role in advancing our understanding of microbial adaptability and resilience, with potential applications for future space missions and Earth's own extreme habitats. In the realm of space sciences, his leadership extends to directing vital research and developmental initiatives for the Mars Program Office. His pivotal role ensures the meticulous cleaning, sterilization, and certification of spacecraft components, safeguarding mission objectives and minimizing the risk of contaminating other celestial bodies. Furthermore, his keen observations of the microbial interplay within ISS modules and spacecraft assembly hubs provide essential data that can influence human space exploration's future trajectory and the quality of space-based scientific investigations. Through these diverse endeavors, he exemplifies the seamless integration of space science with terrestrial research, emphasizing the broad-reaching implications of his work, both in space exploration and innovations here on Earth.