

Editorial*

Riddhi Shah and Sudeshna Sinha, Guest Editors

International Women's Day offers us a wonderful opportunity to acknowledge the contributions of women in the field of science. Marking this occasion, we are excited to present this Women's Special Issue of *Resonance*. The first of such a special issue, authored and assembled by women, was launched two years back. In keeping this tradition alive, we hope to reinforce the point that the earlier special issues set out to make. We would like to underscore yet again to young impressionable readers of *all* genders that there are many outstanding women researchers who while excelling in their discipline, are also involved in effectively communicating the thrill of their findings. We believe that these special issues positively impact the confidence of young women scientists, and can significantly affect the nascent attitude of young readers towards women in science.

However, for us, this was not merely an exercise in bringing out a journal issue emblematic of the increasing presence of women in STEM, but primarily an opportunity to gently nudge our wonderful women colleagues to contribute to a journal that has reach and influence, especially among the young readers. It is our hope that the stimulating articles in this issue, authored solely by women, will illustrate the depth and diversity of subjects women have engaged in over the years. They also serve to demonstrate powerfully how our society can tap its resources more comprehensively by focusing more on women scientists.

This issue features Mildred Dresselhaus, one of the most renowned physicists, material scientists and electrical engineers of our time, popularly known in the scientific circles as the "Queen of Carbon". A leading expert on carbon materials, she made path-breaking contributions to research on graphite, carbon fibers, fullerenes,



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carbon nanotubes, and graphene. As captured in the article by Jayeeta Lahiri, her extensive research on carbon materials galvanized the current era of carbon nanoscience and technology.

The issue in hand carries engaging articles in disciplines ranging from astrophysics, mathematical biology, and theoretical computer science to enzyme kinetics, protein structures, and genetics. This span of areas is indicative of the gamut of research fields women scientists are actively engaged in.

In the arena of astrophysics, H K Jassal sheds light on the intriguing nature of dark energy. Her article discusses how the accelerated expansion of the Universe is driven by dark energy and how dark energy parameters are constrained by observational data.

Mechanical forces are known to play vital roles in determining cellular functions and behaviors such as growth, migration, and tissue regeneration. Rumi De addresses the truly interdisciplinary question of how cells sense the mechanical forces and properties of the surrounding matrix and discusses the concept of mechanosensors.

Arti Dua focusses on the fundamental Michaelis–Menten (MM) relation between the rate of enzyme catalysis and substrate concentration, and discusses how recent experiments reveal that the MM equation, though valid for bulk amounts, is not obeyed at the molecular level. She demonstrates how new statistical measures of fluctuations in the catalytic rate identify a regime in which the MM equation is always violated.

The article by Jennifer A Flegg and Neela Nataraj is in the interdisciplinary arena of mathematical biology – a growing research enterprise. It brings to light how mathematics has the potential to mediate the complexity of cancer biology by abstracting the system into a mathematical framework that can be analyzed to gain biological insight. Specifically, it provides an introduction to the mathematical models of one of the important stages of tumor growth, the avascular stage, where there is no blood supply to the tumor.



Lalitha Guruprasad focusses on the myriad aspects of protein structure. This is an exciting area of research, as proteins are essential building blocks of life. The article discusses how the three-dimensional structure of a protein is dictated by its amino acid sequence, and non-bonding, short, medium and long-range interactions mediate the folding of proteins to thermodynamically stable structures. The article describes how the flexibility in protein structures allows the modulation of its functional role and mediates the interactions with other binding partners.

In an expository article, Kaneenika Sinha introduces some fundamental milestones in the study of prime numbers over the ages, such as the prime number theorem, the Riemann zeta function, and recent investigations into the spacings between consecutive primes. Important applications of prime numbers in safe data transmission, namely the RSA public key cryptosystem are also discussed.

Knot theory continues to grow as a vibrant area of research within low dimensional topology with vast applications in areas as diverse as the science of the DNA to neural networks. Swatee Naik gives a flavor of knots, links, and three-dimensional manifolds, introducing the reader to a range of fascinating concepts and ideas in three-dimensional topology.

In the realm of theoretical computer science, Meena Mahajan draws a parallel between the circuits with linear threshold functions as primitives and the natural model for computation in the brain. She discusses how most functions cannot be computed by small threshold circuits of depth-two (circuits where the maximum number of nodes an input value has to flow through before reaching the output wire is two). This analysis fosters a better understanding of the capabilities and limitations of various computation models.

Beena Pillai addresses a set of intriguing questions related to complex and apparently conscious efforts to improve the chances of survival of the next generation, as well as the more deep-seated involuntary transfer of genetic information from the parents to



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offspring. She discusses the basic tenets of genetics while drawing attention to the empirical evidence that indicates the existence of other extrachromosomal modes of inheritance.

The issue also features an interview of an accomplished physicist Maria Cristina Marchetti by Supurna Sinha. The conversation spans interesting insights on non-equilibrium statistical physics, condensed matter theory, and biological physics, and also discusses the difficult balance women researchers have to tread between professional and personal commitments.

Finally a note on all those who helped this special issue fructify: We are grateful to Professor N Sathyamurthy (Chief Editor, Resonance), for giving us an opportunity to guest edit this special edition, and to Professor Ram Ramaswamy (Former President, Indian Academy of Sciences) and Professor Debashis Ghoshal, for being supportive at all stages of our endeavor. Above all, we are grateful to the contributors, most of them young. Almost everyone we invited, contributed enthusiastically and took great care to make even the most technical aspects of their fields of research accessible and exciting, even to the uninitiated. We really look forward to many more such articles from women scientists – and not just in special women's issues!

Hope you enjoy reading the articles in this issue, as much as we enjoyed putting them together.

