

Foreword

In 1974, the Russian physicist Vitaly Ginzburg wrote a book entitled 'Key Problems of Physics and Astrophysics' in which he presented a selection of important and challenging problems along with speculations on what the future holds. The selection had a broad range, was highly personalized, and was aimed at the general scientist, for whom it made very interesting reading.

Thirty odd years later, in the Platinum Jubilee Year of the Indian Academy of Sciences, the two of us were requested by the Academy to invite articles from fellow physicists, which would constitute part of this special volume on *Current Trends in Science* being brought out on this occasion. We were fortunate that our invitations were accepted readily. Although necessarily different in scope and style from Ginzburg's book, there are some similarities: the choice of topics is subjective and the contributions convey important and challenging problems – both solved and unsolved – to the interested scientist.

Sunil Mukhi and **Probir Roy** trace developments in theoretical high energy physics, which they call the 'cutting edge of the human scientific endeavour', from the Standard Model and its inadequacies, to string theory. The contribution by **G. Baskaran** focusses on variations on the theme of resonating valence bond (RVB) behaviour to explain both high-temperature superconductivity

and anomalous behaviour in the normal phase in a variety of correlated systems. **G. Ravindra Kumar's** article sheds light on light and its interaction with matter. Technical breakthroughs such as chirping, allow ultra-high fields to be created in pulses, resulting in completely new behaviour when they interact with hot, dense matter. **R. Pandit, P. Perlekar** and **S. Sankar Ray** focus on turbulence, 'the last great unsolved problem of classical physics'. An overview of the statistical description of fluid turbulence is presented, including 2-d turbulence, the passive scalar problem and the effect of polymer additives. **R. Nityananda** deals with gravitational dynamics on the galactic scale. Gravity leads to counterintuitive effects, and normal statistical mechanical notions do not apply. Issues addressed include the Antonov instability, and the multiplicity of possible stable solutions in collisionless stellar systems.

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