In this issue

Quantum signature of classical chaos

Chaos is considered to be one of the major scientific discoveries in recent times. It is concerned with rather complicated behaviour associated with nonlinear dynamical systems and one of the important features of a chaotic system is a sensitive dependence of its evolution on the initial conditions. While chaos has been studied extensively in classical systems, recently, there has been an upsurge of interest in investigating the quantum dynamics of classically chaotic systems. In this issue, Chattaraj *et al.* **(page 1371)** present a study of the quantum domain behaviour of a classical double well oscillator (corresponding to a quartic potential) which exhibits chaos in the presence of an external monochromatic field. The study has been based on the hydrodynamical model of quantum mechanics, the so-called quantum fluid dynamics and quantum theory of motion, pioneered by David Bohm and others, which provide a 'classical-like' prescription for the description of a quantum system. The so-called 'Bohemian' trajectories are obtained by integrating the velocity field defined in terms of the gradient of the phase part of the wavefunction. Through the classical as well as quantal phase space portraits based on these trajectories, the authors have arrived at important conclusions about the quantum–classical correspondence of chaotic systems. They demonstrate that while quantum effects suppress the classical stochasticity, classical chaos generally enhances quantum fluctuations.

Swapan K. Ghosh

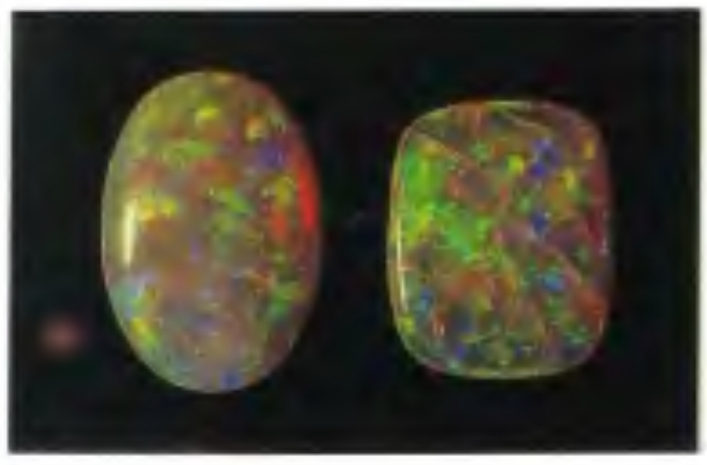
Symptom or sequence?

The article on 'The characterization of tobacco mosaic virus isolated from tomato in India' by Shoba Cherian *et al.* **(page 1384)**, is the first report on the genomic characterization of an Indian isolate of a tobamovirus. The authors have analysed a tobamovirus isolate infecting tomato in Karnataka. This virus was hitherto considered to be tomato mosaic virus (ToMV) and not tobacco mosaic virus (TMV) based on local lesion assay. The virus under study produced local lesions on *Nicotiana sylvestris* like ToMV whereas TMV causes systemic infection on this host. The authors constructed a cDNA library and sequenced a 1 kb fragment from the 3′ terminus of the viral genome. Surprisingly, careful alignment of the nucleotide and amino acid sequences with other tobamoviruses, showed greater homology with TMV than with ToMV. Therefore, they concluded that it is a strain of TMV infecting tomato. The question arises as to how this strain of TMV manages to produce local lesion symptoms like ToMV. This paper clearly demonstrates the power of sequencing and sequence alignments to finetune the classification of a virus.

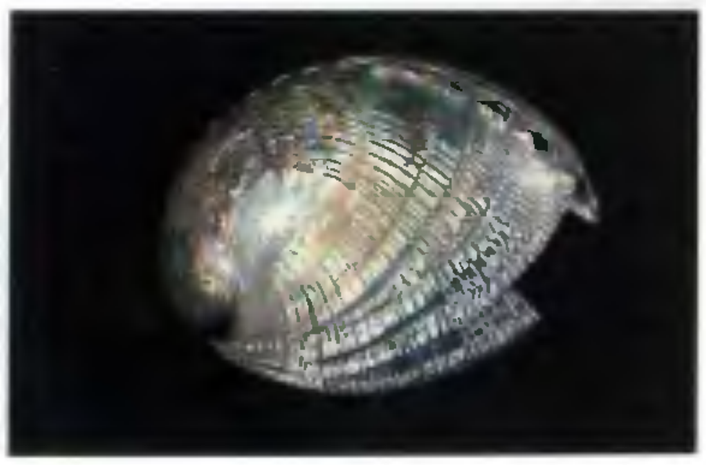
R. Usha

Optics of heterogeneous media

Nature is spectacular when it comes to colours. Her visible beauty has attracted the attention of not just poets but also of scientists. Surprisingly, more often this coloration is due to an optical heterogeneity present in the system exhibiting the colour. In point of fact, opals, moonstones and the wings of butterflies owe their colours to the structural heterogeneity present in them. Naturally the scale of heterogeneity varies considerably from system to system. It could be either on a scale comparable to the wavelength of light or be very different from it. In the latter case we have two sub-classes depending upon whether the scale of heterogeneity is very large or very small compared to the wavelength of light. Each of these cases leads to its own special optical effects. To illustrate this point, we mention here that the beautiful iridescence of an opal or the lustre of a pearl is due to a periodic structure on a scale comparable to the wavelength of light. On the



Opal polished



Iridiscent shell

other hand, the whiteness of marble is due to a random collection of crystallites of calcium carbonate with a heterogeneity on a scale larger compared to the wavelength of light. As an example of greater relevance to human beings we may mention here that the turbidity of a swollen pathologic cornea or that of cataractous eye lens arises from random variations in refractive index on

a scale comparable to or larger than the wavelength of light.

This rich class of naturally existing optically heterogeneous materials has been enriched further by man-made materials. Also, in recent times, more fascinating optical properties of such systems have been unravelled. The articles appearing in this special section present different facets of this fast growing area of research. Each article highlights the present status, in addition to discussing optical effects associated with the heterogeneous medium under consideration. We have articles covering periodic, quasi-periodic and random media, and this presentation includes all possible situations. Pendry's article discusses photonic gap materials *per se*. This is followed by a review on nonlinear optics in a quasi-periodic structure by Dutta Gupta. Next we have a brief review by Suresh *et al.* dealing with diffraction in periodic and random liquid crystals. The paper by Kumar addresses itself to mirror-less lasing in random media. Following this is an article by Ramachandran on transmission in turbid media. To emphasize the medical implications of this subject, we have a paper by Gupta on tissue optics.

These topics do not exhaust all the important and interesting phenomena seen in heterogeneous media. In this hot topic of research every now and then something new is reported in literature. For example, three years ago it was demonstrated[1] that light propagation in a random medium exhibits an optical analogue of the familiar Hall effect. It was shown that the diffusion of light in a random medium in the presence of an external magnetic field leads to the appearance of light diffusion in a direction perpendicular to both the magnetic field and the direction of incidence of light. The direction of this transverse diffusion is decided not only by the nature of the particles constituting the medium but also by the direction of the magnetic field. More recently[2] even an optical analogue of magnetoresistance has been demonstrated. On the materials front, in 1998 alone many new photonic crystals were discovered and many more fabricated thus adding to the ever growing list. Since I felt that these new photonic gap materials would be of interest even to a general reader, I have tried to cover some of them in my article 'Photonic crystals'. All in all an attempt has been made to stimulate the reader's interest in this current area of intense research.

1. Rikken, G. L. J. A. and van Tiggelen, B. A., *Nature*, 1996, **381**, 54–55
2. Sparenberg, A., Rikken, G. L. J. A. and von Tiggelen, *Phys. Rev. Lett.*, 1997, **79**, 757–760.

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