of the geotechnical properties of the region. The report describes a variety of maps available, and needless to say that these provide the basic information required for future designs. A few other maps, also prepared by GSI and discussed in this report – the geotechnical map of Delhi, soil classification and N-value maps (acquired by conducting standard penetration tests) for depth range of 0 to 20 m, are also available. Studies on depth to bedrock, liquefaction potential, shear wave velocity and microtremors (ambient noise), nature of attenuation of seismic energy, etc. provide input, to assessing the site-specific nature of expected damage. Based on preliminary liquefaction studies, the relative risk in various parts of Delhi has been assessed; this is discussed in detail in this report.

Engineering seismology and strong motion studies have always been the most important components of hazard assessment. A strong motion network of 16 stations maintained and operated by CBRI has been generating high quality data during the last 8 years (Figure 2). A digital, telemetered network of 16 stations with VSAT communication is one of the major features of the weak and strong motion studies in and around Delhi. Installation of accelerographs in multistoried buildings to record the Peak Ground Motion (PGA), with a view to study the soil structure interaction, is another feature of the strong motion studies in Delhi; a third component is the assessment of seismic vulnerability of buildings. The report also contains a set of maps of the geology, geomorphology, and earthquake distribution; it also provides a rich bibliography of related papers. This report is a good starting point for those who wish to work on the studies related to seismic hazard assessment of Delhi. In fact, the report provides a wide range of information that will be useful to the earth scientists, engineers, administrators and planners.

Figure 2. Strong motion accelerographs installed in and around the Delhi region.

Copies of this report can be made available on request from the DST.

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MEETING REPORT

Disorder, complexity and biology*

The intertwined themes of the DISCOMB04 conference – disorder, complexity and biology – are three major points at which physical science meets nature. The vigorous and rapidly expanding activity in these areas, was reflected in the present meeting. What started off as the study of disordered systems, soft matter and structural biology, is not only enriching physics, but is developing into one of the major enterprises of science.

A broad range of topics were covered under the following categories:

- Phase transitions and critical phenomena.
- Soft condensed matter: liquid crystals, polymers, colloids, microemulsions, etc.
- Interfacial phenomena and wetting: surface effects and confined systems.
- Disordered systems: random lattices, glass transition, spin glasses, localizations, etc.
- Biological systems: Protein-folding, DNA unzipping, biological networks, membranes, etc.
- Computer simulation experiments.

P. Ramachandra Rao (Banaras Hindu University, (BHU), Varanasi), in his inaugural address, pointed out to the importance and need for exploring the behaviour and properties of disorder, complex and biological systems. T. V. Ramakrishnan (Chairperson, DISCOMB04) discussed at length the main theme of the academic sessions.

Two plenary lectures and thirty-six invited talks by scientists from India and abroad (14) were delivered and sixty contributed papers were presented in the poster sessions.

When polymers are chemically or physically cross-linked, they form random elastic networks that support shear. Tom Lubensky (Univ. of Pennsylvania, USA) made a lucid presentation of an elastic network and simple theories of their properties. The issues of current interests related with nonlinear elasticity of networks composed of semi-flexible polymers such as actin, the interplay between randomness and non-affine responses and static and dynamic response in liquid crystalline elastomers were addressed by him. Molecules that form liquid crystals are usually rod-like. But V-shaped (boomerang-like) molecules, derived by bending rod-like molecules, should form a biaxial nematic. Satyendra Kumar (Liquid Crystal Institute, Kent, USA) summarized the original experimental results on bent-core mesogens and showed firm evidence, based on X-ray diffraction studies, of the existence of a biaxial nematic phase in rigid

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bent-core mesogens derived from 2,5-bis-(*p*-hydroxyphenyl)-1,3,4-oxadiazole and oxazole. The phase transition behaviour in these materials was discussed in detail.

Molecular biology is concerned with study of the nature of molecules involved in basic life phenomena that are determined by the structure and dynamics of the nucleic acid known as DNA. However, little is known in depth about the biological processes. At present, the subject constitutes one of the most active thrust areas in physics. Fourteen invited talks related with various aspects of these processes were presented during the conference. The problem of temperature-driven or force-induced unzipping of DNA was introduced by Y. Singh (BHU). He discussed results, as obtained from theory, about the dependence of critical force for unzipping on the temperature, base-pair location, defects, etc. S. M. Bhattacharjee (IOP, Bhubaneswar) discussed the phase diagram of the force-induced unzipping of double-stranded DNA, when it is pulled from an anchored end with particular emphasis on the nature of re-entrance and triple point. S. Kumar (BHU) talked on the force-induced transitions in a polymer system and presented the results for three different models. He showed that re-entrance occurs when force is applied at one end of the absorbed chain in a cubic lattice but not in a square lattice. The problem of DNA worming through protein channels and nanopores was addressed by M. Muthukumar (University of Massachusetts, USA). He presented quantitative details of the experimental observations and compared these with Langevin dynamics simulations for alpha-hemolysin channels. DNA is known to wrap around histone proteins, primarily driven by electrostatic interactions, to form a chromatin fibre that is further condensed into a compact higher-order chromosome structure within the cell nucleus. The underlying biophysical rules of the dynamics of individual histone octamers, called the nucleosomes, and many related questions are poorly understood. G. V. Shivashankar (NCBS and RRI, Bangalore) described ongoing experiments in his laboratory related to mapping the dynamics of nucleosome fluidity using state-of-the-art single molecule biophysical methods.

The issue related with gene expression (GE), which is the central activity in a living cell and is primarily regulated at the transcription level, was addressed by Indrani Bose (Bose Institute, Kolkata) and J. Chakrabarti (S. N. Bose National Centre for Basic Sciences, Kolkata). Bose presented results obtained from a stochastic model of GE and showed that graded and binary responses occur naturally in the model depending on the relative stability of activated and deactivated gene states with respect to that of mRNAs/proteins. Chakrabarti discussed the results of their model studies to explain the mechanism of fast kinetics of protein–DNA specific binding. B. K. Chakrabarti (SINP, Kolkata) summarized the recently obtained analytic results for fracture dynamics in fibre bundle models with global load-sharing features and on the denaturant-induced unfolding pattern of a few proteins. G. Pellicane (Messina, Italy) reported their MC simulation work on the phase diagram properties of prototype globular protein solutions, namely lysozyme and gamma-crystallin in water and added salt, within a short-range effective representation of the macroparticle interactions. He showed that the general phase diagram topology of globular protein solutions can be characterized by a metastable protein–protein demixing region just below the solubility line.

K. L. Sebastian (IISc and JNCASR, Bangalore) discussed the mechanism of crossing barriers in one and three dimensions by long-chain polymers. He showed that the results of their numerical simulations are in agreement with the kink mechanism. The hydrodynamic behaviour of membranes is extremely rich in biodiversity. P. B. Sunil Kumar (IIT Madras, Chennai) discussed the factors responsible for this varied behaviour and presented results obtained from dissipative particle dynamics simulations that elucidate the dynamics of shape changes in bilayer membranes. Understanding the role of water in biological system is still an open problem. K. Bhattacharyya (IACS, Kolkata) reviewed the current status of this problem and discussed at length the recent information generated from ultrafast laser spectroscopy and computer simulation studies. Some of the outstanding problems of plasma membrane characterized by high areal-density regions consisting of cholesterol and saturated lipids were summarized by M. Schick (University of Washington, USA). He reviewed the properties of these components, the phases they display and presented the results of a microscopic model exhibiting sufficient conditions for raft formation. The issue of 'rafts' in the field of cell biology was discussed by Madan Rao (RRI and NCBS). Rao described results, as obtained by using a variety of FRET techniques and theoretical analyses, related with the cell surface organization of a specific-raft marker – GPI-anchored proteins.

Nine talks in the area of liquid crystals on a variety of themes such as defects and patterns, molecular engineering, synthesis and properties of bent-core, banana and disc-shaped mesogens, external perturbations-induced phase transitions and liquid crystal devices were presented. A. M. Srivastava (IOP, Bhubaneswar) discussed formation of topological defects near an isotropic–nematic phase transition and showed that the experimental measurement of defect–antidefect correlations can be used to test theories of cosmic defect formation in the early universe. Oleg D. Lavrentovich (Kent State University, USA) described the fluorescence confocal polarizing microscopy technique that is capable of revealing how the orientation of molecules changes not only in the plane of observations, but also along the direction of observation. He discussed the application of this technique to a variety of 3D director structures associated with core structure and dynamics of dislocations, undulation effects and surface anchoring in lamellar mesogens and phase separation in liquid crystals with distorted director. B. K. Sadashiva (RRI) talked about molecular structural requirements for obtaining switchable phases in achiral compounds composed of bent-core molecules and presented results on the structures and electro-optical properties of a number of achiral bent-core mesogens. Sandeep Kumar (RRI) addressed issues related with synthesis of organic-stabilized metal particles and discotic liquid crystals and showed that gold nanoparticles can be inserted in the supramolecular order of discotic liquid crystals without disturbing their mesomorphic properties. C. V. Yelamaggad (CLCR, Bangalore) talked about work on the synthesis and properties of columnar liquid crystal phases. D. S. Shankar Rao (CLCR) reported on the synthesis of biaxial nematic and smectic A phases derived from organic system that is a unique combination of a bent-core molecule linked to a rod-like unit through a flexible aliphatic spacer.

S. Krishna Prasad (CLCR) covered several aspects of the photoinduced phenomena in liquid crystals. He discussed application of random field Ising model to photoinduced nematic–isotropic tran-

sition, the effect of nanophase segregation on photo-driven disorder-to-order transition, time-resolved measurements of the dynamics of the photoinduced $S^{*}_{c\alpha}$ to S_A transition and many other issues.

Mohan Srinivasarao (Georgia Inst. Tech., USA) made an interesting presentation of a number of intriguing issues related to surface phenomena in liquid crystals with particular emphasis on anchoring transitions at polymer interfaces. He showed that the observed broad anchoring transitions provide a way of achieving highly tilted anchoring. S. D. Lee (Seoul National University, Korea) discussed molecular ordering at periodic interfaces for liquid crystal devices. Many related issues were addressed with the conclusion that the use of periodically modulated interfaces is essential for studying continuity of molecular ordering and formation of defects in soft matter.

Discussion on disordered materials and complex fluids and computer simulations was the subject of thirteen invited talks. R. N. Bhatt (Princeton University, USA) talked about disorder and frustration in diluted magnetic semiconductors. He emphasized, using a combination of analytic, numerical mean field and Monte Carlo methods, how the nature of ferromagnetic phase in these materials in the limit of low magnetic ions and carrier densities is rather unusual, resulting in unconventional spin excitations, and corresponding unconventional thermodynamic properties. The limitations and promises of various theories were discussed. The essential ingredients of density functional theory, based on the Ramakrishnan–Yussouff free-energy functional, and its application to study equilibrium properties of the mixed phase of high temperature superconductors in the presence of random pinning, were presented by C. Dasgupta (IISc). Use of a combination of liquid state theory, density functional theory and the replica method, in performing a first principles calculation of the melting line of the vortex lattice in the (magnetic field–temperature) plane (in the presence of random point pinning) was explained and results were shown to be in good agreement with experiments on high temperature superconductors. An overview of various phase transitions in the $Sr_{1-x}Ca_xTiO_3$ system driven by zone centre and zone boundary soft modes was summarized by D. Pandey (BHU). Results of XRD, neutron diffraction, Raman scattering and dielectric studies elucidate their rich variety of phase transitions in this mixed perovskite system.

Sanjay Puri (JNU, New Delhi) discussed recent work on ageing (non-stationarity) of autocorrelation functions in the domain growth of ternary mixtures and described a proposed stochastic model that takes account of both ageing and equilibrium (stationary) contributions to autocorrelation functions. S. Sengupta (S. N. Bose National Centre for Basic Sciences) talked about the predictions of replicated integral equation theories of liquid structure for liquids in a random external field.

P. Shukla (NEHU, Shillong) summarized recent progress in understanding hysteresis in the limit of zero-temperature of the system, and zero frequency of the driving field in the framework of the random field Ising model and presented exact solutions of the model in simple cases and their relevance in understanding nonequilibrium properties of complex systems with quenched disorder. M. C. Mahato (NEHU) presented results of calculation of hysteresis loop in a periodically driven double-well potential system using information of passage field distributions. The important features and inadequacy of the method were pointed out.

D. Dhar (TIFR, Mumbai) discussed salient features and promises of Oslo rice-pile model. He showed that the one-dimensional Oslo rice-pile model is a special case of the Abelian distributed processors model and obtained an exact steady state of the model. Generalization of other Abelian critical height models where critical thresholds are randomly reset after each toppling, was presented. S. S. Manna (S. N. Bose National Centre for Basic Sciences) discussed different networks that are the subject of extensive studies at present. Theoretical modelling of these networks in particular scale-free networks in the Euclidean space and their cross-over behaviour to other types of networks were reported.

L. Harnau (Max Planck Institute, Germany) addressed issues related with colloidal suspensions of nonspherical particles and liquid crystals. Application of microscopic density functional theory to investigate the phase behaviour of colloidal suspensions of rods or platelets subjected to various constraints was discussed and results presented. L. G. MacDowell (Universidad Compulutense, Madrid, Spain) talked about the evaporation/condensation transition of liquid droplets. It was shown that the system size at which the saturated vapour condenses into a droplet is governed by a characteristic length scale depending on the coexistence densities, temperature and surface tension. The role of fluctuations was discussed. The results of both theory and simulations were presented.

Two invited talks dealt with computer simulation studies. G. Cwilich (Yeshiva University, USA) presented results obtained from real space numerical simulation of the propagation of a signal in a nonlinear, excitable two-dimensional, finite random medium. It was shown that simulations not only allow for a study of the transport regime, but also the distribution of scattering intensities in the stationary state inside the sample. The detailed features of diffusive as well as quasi-ballistic propagation were covered. Based on classical and *ab initio* molecular dynamics simulations studies, A. Chandra (IIT, Kanpur) discussed the dynamics of water–water and anion–water hydrogen bonds (HBs) at room temperature. The dynamics of F ion water hydrogen bonds is much slower, while that of I ion water hydrogen bonds is much faster than that of water–water hydrogen bonds. However, the Cl ion water and Br ion water HB dynamics is similar to that of water–water HBs.

This report gives a glimpse of the large variety of topics of recent interest and the science covered at this conference.

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